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The Virtual Armory Survey and Portal

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The Virtual Armory Survey and Portal

Interactive Qualifying Project Proposal

Submitted to the Faculty

of the

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for graduation

by

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April 13, 2011

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Abstract

This project created an interactive, online survey to generate a personalized museum map for visitors to the Higgins Armory Museum; it also created a web portal to display past and future online interactives generated for the museum by WPI student teams. Research was done in the fields of arms and armor, museum tours and demographics, and profiling in order to create an educational product that would appeal to younger generations.

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Introduction

Museums have become an important part of preserving culture in a modern society. It is true that direct education outside of mandatory school systems has become unpopular among younger generations. For example, if one were to visit a local library, very few children are there by their own will. This has presented museums, as alternative education environments, with the challenge of attracting families and instilling them with a desire to learn. This project attempts to draw in these potential visitors with an appealing survey, and then present them with a personalized tour map. Furthermore, a website portal and survey are provided a permanent home on the internet to be viewed by both these visitors and future IQP groups alike to view past projects that were completed at the Higgins Armory Museum.

Clearly, this is not the first project that was performed between WPI and the HigginsArmoryMuseum. Several IQP groups have completed projects at the museum, some of which have even won awards. Unfortunately, these students turn in their reports and data regarding the project to the professor, and the final report remains archived as their legacy, possibly with scattered individual websites that were eventually removed over time. A major goal of this project was to rescue these lost treasures from obscurity, and present them to the public in a collected and approachable manner. In years past, the professor could distribute the files of previous groups individually, but these were cluttered and unorganized. From this chaos, the idea of the Web Portal was born, where both IQP groups and museum visitors alike could have common access to past projects in a non-alienating way. In addition, future IQP

groups can quickly look at past IQPs at a glance to understand what prior art is available before searching through the detailed digital archive from the professor. The modular construction of the portal allows for straightforward expansion by these IQP groups, providing a growing community of projects that are visible to the public.

One of the main purposes of designing the Web Portal was to provide a place where past, present, and future IQPs could be posted in a manner that was appealing to both IQP teams working on projects as well as the casual website visitor, who may have an interest in the museum. On one side, an IQP team is viewing each project from a technical aspect, whereas a visitor is viewing it from the “wow factor” perspective. A visitor typically desires some educational information regarding the subject of interest, but he or she will want an exciting, interactive experience instead of simply being told how something works. To satisfy both views, the Web Portal was designed in an aesthetically pleasing manner, built around a medieval theme, and modularly designed. The overall design incorporates numerous features found to be common through researching museum based websites. Although the Web Portal is a rather unique concept in comparison to what is currently available, there is no steep learning curve for the common computer user. A new visitor may easily navigate to the desired project through a navigational bar and hyperlinks, located in similar positions as those found in other websites. This navigational bar expands downwards (to allow new projects to be seamlessly added), and each project has a nearly identical page, so a new IQP group could copy one of these pages, add a link to their own, and create a short description of their project for others to view.

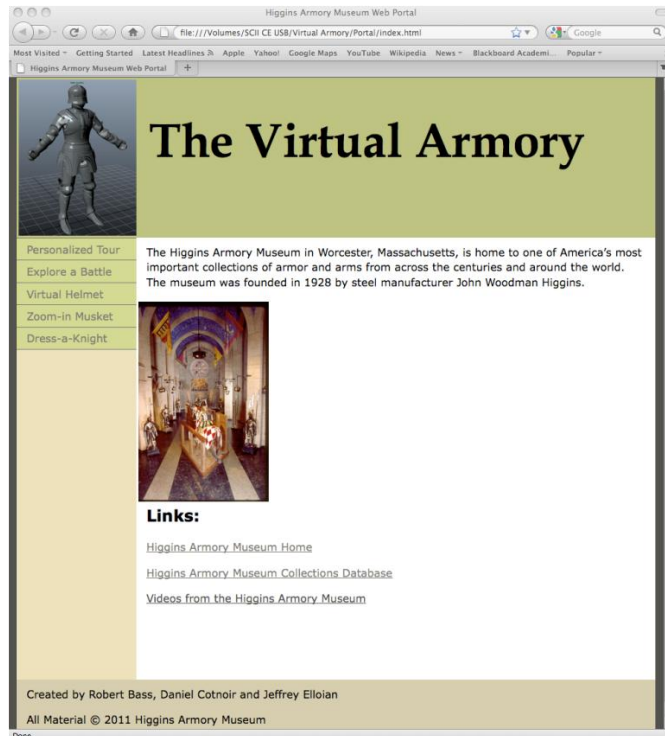


Figure 1-A screenshot of the Portal main page

The second major objective of this project was to create a personalized online survey for potential museum visitors, and provide each user with a museum tour map. This new interactive experience compliments the Web Portal, not only from an educational standpoint, but in terms of attracting new visitors, visitors from the computer age, to visit the museum. Many people spend several hours per day browsing the internet for various reasons, representing a large proportion of the population that could potentially visit the museum to learn. Almost every museum in existence current has a website, but in the Digital Era, a website requires something to stand out in order to attract visitors. At the time of writing, research has found no other online, personalized museum survey, which would make this project, the one belonging to the Higgins Armory Museum, the first of its kind. Of course, the idea of web-personalization is not a novel concept. In fact, techniques such as the

customization of personal accounts or the advertisement of particular products based on a users individual history have been very successful in commercial websites. This portal helps tap into the market of a generation of computer users to help educate them in a fun and enjoyable manner.

Being such a novel idea, the survey had to not only be functional, but garner the attention of museum visitors . If the survey was too dry, it would not hold the interest of the younger generations the technology is marketed towards. This was approached in two ways: Using imaginative questions with a sense of humor, and giving the results a personalized feel. The first was simply a matter of writing something that would appeal to the targeted audience; the survey questions often put the visitor in fantasy-like setting that is consistent with the museum's image. The questions ask the visitor to imagine themselves back during the Medieval times of many of the museum's artifacts, giving some insight into the social workings of the time while asking what interests them the most, as opposed to bluntly telling the visitor to pick what they want to see out of a list.

This interactivity leads into the personalized aspect of the project. Questions are randomly selected from a pool of choices, so that there is a very low chance a visitor who takes the survey multiple times will receive the same survey twice. The survey addresses the visitor by the name they input, and the results are given as a "quest" for the visitor to complete. From the answers given, the survey will give a map of the museum marked with artifacts and events of interest in the museum. A large number of artifacts and events means that even if a visitor were to answer the same questions the same way twice, the artifacts presented would not

likely be the same. This way, the results feel more unique and not a generic or random assortment unrelated to the questions. In the light-hearted spirit of the questionnaire, the final map would even examine the categories to select an appropriate fun fact in a topic of the user's interests.

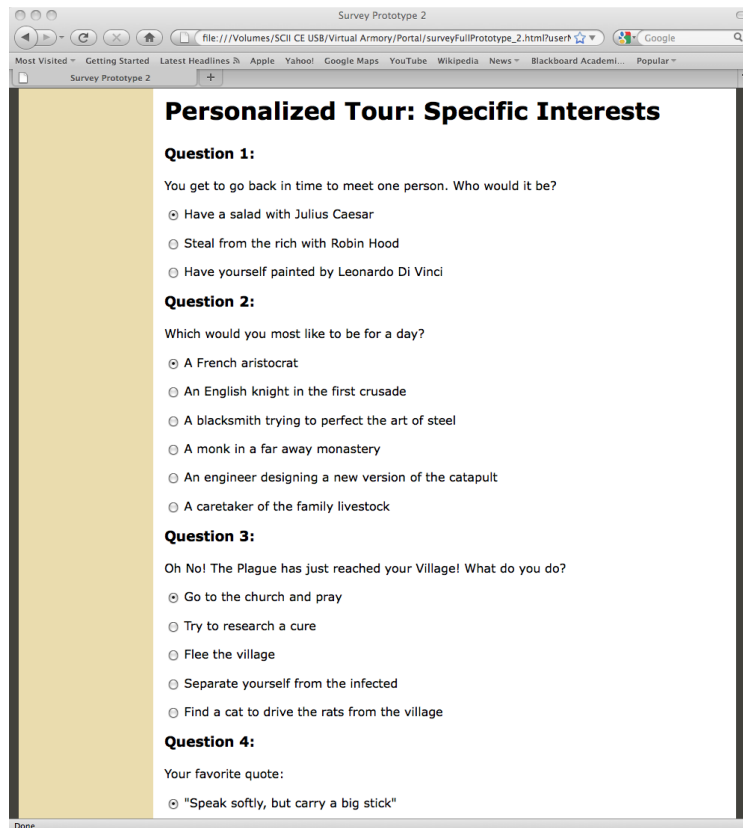


Figure 2-A screenshot of the survey questions

Much like the Web Portal, the personalized survey is also very modular, such that the museum can update and change the questions, artifacts, and events as new acquisitions are made or new events are held. This ensures that the survey will not become redundant or outdated in a short period of time, and the framework could even be adapted for use by other museums. By far, the largest legacy of this project will be the concepts that it provides to the

outside world. It is hoped that other museums and educational institutions encourage and sponsor projects that are similar to the WPI Interactive Qualify Project. The portal is not simply an archive of projects of the past, locked away in some library, but rather it is an interactive showcasing of what students have done in the past for the museum. If other institutions are impressed with this feature, they may emulate it and create independent projects, with the ultimate goal of building a stronger community and providing a foundation for education.

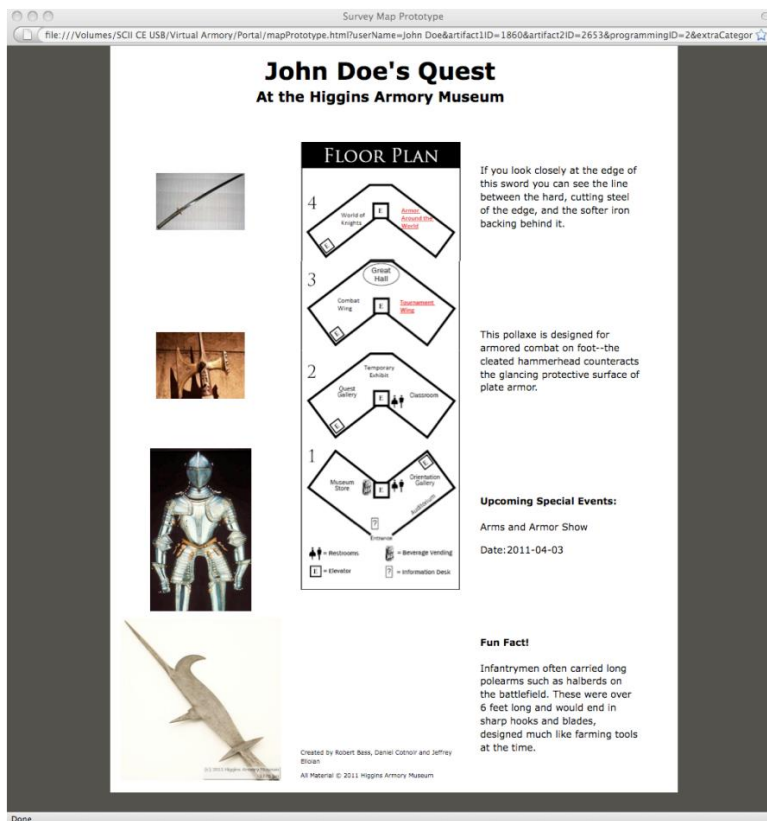


Figure 3-A screenshot of a sample of the results page of the survey

This idea can be further expanded with the concept of the survey. In an age where the majority of young people spend several hours per day on the internet, placing a fun and interactive link between the past and present could attract visitors. This colloquial format and

"fun" style can best attract this diverse, technology based market. To find evidence of the success of such a style, one would need not to look further than the billboards of Higgins Armory Museum. By attracting a younger audience to become engaged in learning about the past, it is hoped that other museums will take this model and create their own independent, professional designs, based on this dynamic survey.

Arms and Armor Research

By Daniel Cotnoir

Evolution of European arms and armor from the Middle Ages to c. 1700 (3rd floor West)

Throughout Europe, arms and armor went through major changes from the 9th century up to the 18th century. The weapons and defenses used differed from one geographical location to another, though each distinct piece of equipment evolved with the warfare itself throughout Europe.

In Western Europe, there were two main groups of fighters on the battlefield; the infantry, composed of serfs and peasants who did not have formal military training, and the cavalry, consisting of nobles and fief owners. The peasants were expendable foot soldiers who were not given any arms or armor from the country, but were exempt from taxes. These infantrymen had to provide themselves with whatever weapons they could afford, and wore leather and cloth into battle, along with any scraps of armor that had or could find on the battlefield. They would commonly use bows and slings as weapons, but by the 14th century, the infantry was using more sophisticated close-combat weapons. Slender swords would be used as thrusting weapons, as well as pikes, vogues (long, pointed spears), and guisarmes, which were lances with axe blades or spikes on the foot of the blades. (Boutell et al., Ch. 7). In the 15th century, the infantrymen began using crossbows more regularly, despite being inferior to longbows in terms of distance and speed. (Bull, Ch. 3, pg. 60-62) Crossbows

The infantrymen, however, fell easily in battle to the mighty cavalry, as the foot soldiers could not stand up to the charging line of heavily armored men on horseback. Once the feudal

armies had been done away with in the 15th century, these men were recruited by the kingdom, paid from the royal treasury or from taxes. In the early Middle Ages, the cavalry would wear mail shirts, often metal rings sewn onto a cloth tunic. They wore large iron helmets covering their heads, necks, and shoulders, and carried very large shields that were generally kite-shaped. These shields had two straps on the back, such that they were adjustable on the wearer's arm, and were also able to be strapped to a soldier's back for easier carrying. For weaponry, these early cavalry wielded slender lances of medium length, often barbed. These were used as both thrusting weapons, like spears, and as throwing weapons, like javelins. In addition to the lances, these cavalry would carry long, double-edged swords that tapered down from the hilt, or massive maces made from wood or iron. Also common were single-bladed axes with long shafts, and rarely seen were short, sharp daggers. (Boutell et al., Ch. 7)

By the 12th century, the cavalry's equipment became more focused on protecting the body. In addition to the chain mail shirts, hooded tunics were worn to protect the shoulders and neck, with large, cylindrical helmets over the hood. Leather gauntlets with metal pieces protected the hands, while champons protected the feet. Metal plates were added to the armor to protect the otherwise exposed joints such as elbows, knees, and shoulders. The legs were covered by two plates of armor with hinges on the outside; however, all of this protection wasn't without its downsides. The cavalry had little mobility in these suits of armor, especially if one was knocked from his horse and onto the ground. If the soldier fell over in a suit like this, he was at the mercy of the other soldiers on the battlefield. In addition to the changing armor, the lances were no longer used as javelins, and were not barbed. Swords used by these soldiers

also became much shorter than before. (Nicholson, Ch. 4, pg 103-104). The richer, more powerful knights would display flags from their lances as they rode into battle, and were known as Knight Bannerets. (Boutell et al., Ch. 7)

As the 15th century approached, the armor had changed again, this time more in favor of mobility. There were still innovations for protection, such as camail covering the neck and shoulders of the wearer beneath smaller, conical helmets called basinets. These basinets had visors that could be moved up or down, and could even be taken off of the helmet. The camail, however, was quickly replaced by strong steel plates that surrounded the throat. Armor on the feet became long and pointed, though this was mostly for appearance. More practical was the use of iron corselts called demi-cuirasses, that covered the entire midsection of the cavalry. Below this hung plates of armor like a kilt to protect the hips and thighs, resulting in the full plate armor of the 15th century. (Bull, Ch. 3, pg. 66-67). In terms of weaponry, the typical lances had become longer and heavier, tapering down to a point. Small shields were located at the held end, protecting the user's hands while offered enhanced stability. The swords were replaced by rapiers that excelled in thrusting, as they were sharp, thin, and long, as opposed to the older, broader swords. (Boutell et al., Ch. 8)

Knights (4th floor West)

Knights were the strongest force on the battlefield up to the 16th century. Knights were not just well-trained, well-equipped soldiers, but were higher in social standing than the typical infantry of the Middle Ages. These knights fought to maintain their society, regarding warfare

as natural state of mankind. It was their duty to defend their way of life, eventually becoming a patriotism for their country and ruler. (Barber, Ch. 10)

By the 11th century, knights were fief owners in Europe who owed a debt to fight for their Duke or overlord. This was a full-time profession as a higher class, as only nobles could afford the time, weapons, armor and horses for the lengthy apprenticeship as a squire. Not all knights owned land, however; there were knights in service of others, who were considered lower in rank to those who did own land. Knights were the cavalry of the armies, riding on horseback with more sophisticated arms and armor than the common infantry. They wore knee-length mail shirts called hauberks, with mail hoods (coifs). Atop the hoods were segmented helmets with large nasal pieces, and sometimes mail covered the front of the legs. Knights held circular shields that were 3 feet in diameter, made of wood planks covered in leather, sometimes reinforced by metal rim; later, kite-shaped shields would be more common. (Edge et al., Ch. 1)

Swords were the knights' weapons of choice, based on old Viking weapons. The swords were broad and double-edged, with blades about 2.5 feet long. The points were slightly rounded, intended for cutting and slashing as well as thrusting. Knights wore the swords hung at the left hip in a scabbard, or, less commonly, they could be held in a slit in the mail shirt above the hip. Of course, swords were not the only weapons wielded by the knights. Knights would charge into battle with lances that were also used as spears, with battle flags usually tied to the end. These weapons were about 6 feet long, but were replaced by longer lances at around 10 feet long by the end of the century. Not as essential were weapons such as maces

and the Scandinavian battle-axes, which were 4-5 foot long broad-axes with 10 inch heads.
(Edge et al., Ch. 1)

Into the 12th century, knights were becoming more defined, especially due to the Crusades. Knights were now fully associated with the Church, with knights defending the Holy Land and the pilgrims that visited. (Gies, Ch. 6) At this time, knights were not seen on the battlefield as often, since France and England were generally at peace, leaving the majority of knights to fight in the Crusades. (Barber, Ch. 10) The arms and armor used by knights were continuously being reworked to fit the knights' fighting style, as well as to take advantage of new manufacturing techniques. In terms of armor, helmets went from very conical in shape to much more rounded through the century. The end of the century showed face guards with holes for vision and ventilation, as well as a front piece on the coif to cover the lower face and throat. Mail shirts were mostly the same as 11th century, with longer sleeves sometimes ending in mitten-like gloves (mufflers). Surcoats, which were long, sleeveless gowns, were sometimes worn over the armor, particularly when fighting in the hot climate of the Middle East. Leg guards were more commonly worn, as well as mail to cover the feet. Shields remained mostly the same, but gradually became shorter, as to be more useful on horseback.
(Edge et al., Ch. 2)

For weaponry, knights continued to primarily use swords and lances. The lances grew to 10-12 feet, with slightly smaller and sharper points, and were relatively thin and did not taper. Sword blades were now around 25-30 inches or longer, and were used as both cut and thrust weapons. Reflecting the now more prominent religious aspects of knighthood, the pommels of

swords often depicted or contained holy relics, while blades were inscribed with religious text. Battle-axes became more widely used across Europe, and maces were used more frequently as well. (Edge et al., Ch. 2)

By the 13th century, knights' armor had gone through a few major changes, enhancing their defenses at the expense of some mobility. Helmets were given a narrow neck guard, forming a cylindrical helmet with a flat top, known as the great helm, or heaume. The front was eventually extended down to protect the wearer's neck. The helm was eventually tapered to deflect blows from swords. Helms had crests for identification in the thick of battle, where the sides were not always well-defined. The end of the century saw the use of the kettle hat, consisting of a large bowl with a wide brim, which was usually made of a series of metal plates. (Edge et al., Ch. 3)

Mail was no longer the only protection for the body—knights began to wear cuirasses, originally made of leather, as a rigid defense against thrust weapons. Quilted garments were also worn under the mail shirts to absorb shock. (Barber, Ch. 10) Surcoats became more common, especially those that were sleeveless and calf-length. Infrequently, couters, which were disc-shaped plates that covered the elbows, were worn over the mail. Whalebone (made from the baleen of whales) and leather gauntlets were sometimes worn for hand protection. For the lower body, gamboised cuisses were quilted cloth tubes worn around the legs, with iron cups covering the knee-caps and steel shin guards. Shields flattened out at the top, becoming less kite-shaped and more triangular. These became smaller about half-way through the

century. Mail for horses was rare; usually leather or cloth defended the horses, but sometimes iron shaffrons defended the horses' heads. (Edge et al., Ch. 3)

Swords and lances were still the weapons of choice of the 13th century knight. Swords became heavier and longer (40-42 inches) to deal with heavier, solid armor, and had longer grips to allow two hands. Falchions were also used, which were widened at the end of the blade for cutting. Knights began to use daggers as stabbing weapons, which were previously only used by the infantry. Axes became bigger, with 4-5 foot shafts, and maces became more popular for smashing the new armor. Maces were typically either iron or bronze and about 3 long; two-handed maces were also used. (Edge et al., Ch. 3)

The 14th Century saw the fall of the feudal system in Europe; instead of nobles defending their kingdoms, countries were simply hiring armies. Even so, the heroics of knights, such as Bertrand Du Guesclin of Brittany inspired an early patriotism in the Middle Ages. (Gies, Ch. 7) The arms and armor of the knights went through a number of changes as well, particularly in the development of the coat of plates. First, great helms remained mostly the same, though they were more tapered at the top, and were seen more often in tournaments than in battle. The helmets went down to the shoulders and chest, and guard chains attached the helmet to the body armor, so as not to lose the helmet in battle. Basinets, or small, conical helmets that covered the cheeks and back of the neck, were worn as well. Aventails were curtains of mail hanging from the basinets to the shoulders, though not covering the face.

Visors were worn, becoming snout-like with breaths and pivots. Kettle hats were now typically only made from one or two plates of steel when used. (Edge et al., Ch. 4)

A coat of plates was a new type of surcoat consisting of steel plates wrapped around the body. This was worn over the hauberk and under the surcoat. Breastplates took the form of a single large plate worn on the chest along with shoulder plates at the beginning of the century. The plates of armor eventually reached down to the hips, where plates then formed a skirt for the upper thighs. This was not common until the end of the century, however. Brigandines were developed, being much like coat of plates, except with smaller, more flexible plates to allow more movement for the knight. Plate arm harnesses defended the entire arm, ending with gauntlets with either steel or whalebone plates. Leg harnesses varied throughout the century, with innovations such as greaves made of two pieces of steel and cuisses made of a single plate. Single plates protected the thighs beneath the skirted coat of plates. Spurs were essential to knights to both control their horses and to show their rank. The rowel type of spurs would remain in use for over 500 years. (Edge et al., Ch. 4)

At this point, knights' swords were divided into either cutting or thrusting. For cutting, there were long, broad, double-edged blades. Thrusting swords tapered very quickly, with diamond-shaped cross-sections, and often had longer grips to allow a second hand to thrust with even more force. There were intermediate swords as well, that began wide but quickly tapered to a point, being used for both cutting and thrusting. Falchions were also still used by knights. Daggers were now common on knights, with different variations having different types of hilts. Lances were now 12 feet long, with steel tips designed to pierce armor. Knights would

often have maces with heavy steel heads, as well as warhammers to bash in the new plates defending their opponents. Knights had to beware the commoners' weapons, too; the infantry had new weaponry as well, such as 7 foot spears with diamond-shaped tips and halberds with blades and spikes. The 6 foot English longbow could fire over 400 yards, and crossbows could not fire as far, but could penetrate further. (Edge et al., Ch. 4)

The 15th Century saw a dramatic rise in the size of armies. The judicial systems around Europe were often corrupt, so common men would offer military service to their local nobles in exchange for protection in the courts. This made it rather easy to assemble large numbers of infantry for battle. At this time, armor design fell into two main categories: German and Italian. For helmets, German armor used basinets and kettle hats (made of one piece of steel now), with brims turned down and slits for vision. Sallets were common, often with visors and long tails. These became more shallow over the century. "Black"sallets were rough and deep, with long tails and small visors. Bevors were worn with sallets to cover the chin. A Kastenbrust was the German breastplate, sloping down and out from the chest. Back plates were made of a single piece to accompany the breastplate. The breastplates became flatter over time, and ended at the waist. Later in the century, the breastplates were made in two pieces with a thin waist, along with a two piece back plate and a sort of tail piece. Plates for arms were strapped around the shoulders, elbows, and upper and lower arms with leather. Shoulder armor became larger, wrapping entirely around the body. Mitten gauntlets were used to protect the back of the hands as well as the front, with a wrist plate and sometimes finger protection. More plates were added to the legs, hinged on the sides to fit around the legs, and extended further up to

the hips. Pointed toes were highly exaggerated on the armor protecting the feet. (Edge et al., Ch. 5)

Italian armor was generally more popular than German armor. Sallets and armets were used instead of basinetts or kettle hats. Armets were derived from basinetts, being made from one skull piece, with a tail down the back of the neck. Hinged visors were in front, with wrappers, or plates for extra defense of the chin, strapped around the rear of the helmet. The sallet, or celata, had a rounded skull fitted to the neck, with an edge sticking out of the back, nearly reaching the shoulders. These were eventually given visors as well. Breastplates were made of multiple pieces, such as side tassets and wide back plates across the whole breastplates. Italian armor protected the arms more than the German armor, using large, reinforced pauldrons for the shoulders. Leg armor gained little other than a few more plates, however. Full suits of mail were not regularly worn under these suits of armor; pieces of mail were attached at exposed points such as joints. (Edge et al., Ch. 5)

Cut and thrust swords from 28-40 inches were still widely used, and were lightened by hollowing. Hand-and-a-half thrusting swords were common, and were blunted about 6 inches from the hilt, for gripping closer to the blade. Short swords replaced long knives in the knights' inventory, and falchions were no longer widely used. Hip belts were replaced by diagonal sword belts, with triangular daggers across the knights' other side. Lances were now even larger, being wider in the center and tapering in both directions. A steel plate guarded the knights' hands as they held the weapon. Pollaxes and ravensbills were a deadly combination of axes and halberds, at 4-6 feet long and capable of piercing and shattering armor. The knights'

maces and warhammers (about 2 feet long now) were made of steel and were lighter, with pointed edges. (Edge et al., Ch. 5)

By the 16th Century, knighthood was already well into a decline. Gunpowder could pierce all but the heaviest of armors, which simply was not practical to wear. Armored knights were no longer the powerful forces on the battlefield that they were in previous centuries. Since new weaponry could easily defeat a fully armored knight, there was a shift towards lighter armor, which allowed for more mobility. Armor was now produced in large quantities, but not as much for knights as for the general armies. Usually half-armors were used, which were light, with no plates on the legs for greater mobility. Their corslets had no lance rests, and had full armor for the arms, along with open helmets called morions. Gauntlets were not often worn at this point. (Edge et al., Ch. 6)

Lancers and javelins were the lighter-equipped cavalry, wearing three-quarter-length armor without lance rests, visors, or much armor on the limbs. Full armor was used much more often in tournaments than on the battlefield. These had close-helmets with pivoting visors, and "wasp" waists on the breastplates, with larger tassets. Mitten gauntlets were still worn to protect the hands, and wide-toed armor was worn on the feet. These armors became even more flamboyant and decorated than before; even though knights were no longer the most powerful force of the battlefield, they were still of high social status and showed it. (Edge et al., Ch. 6)

The weaponry had not changed much into the 16th century, with swords and lances being the standard arms of the knights. Lances and swords had little evolution, as they were already nearly perfected for the knights' style of warfare in the last century. The weapons were more extravagantly decorated, but not very different in function. Rapiers gained popularity at this time, and not just in combat, but also off of the battlefield in fencing. Long bows and cross bows, while still useful, were soon replaced by the unmatched power of guns. This was a problem for the knights, as their armor could not stand up to close-range gunfire, and they became less and less a staple of European warfare. (Edge et al., Ch. 6)

Tournaments; Manufacture of armor (3rd floor East)

Tournaments

Tournaments were essentially great displays of medieval pageantry, with heroes competing in combat and sports for fine armors and weapons, while upholding all of the ideals of chivalry. What began as a rough, dangerous imitation of war became more elaborate and less about fighting than about putting on a fantastic show.

Medieval tournaments are speculated to have begun in the 10th or 11th century, though there certainly were less organized mock battles before this time. These early competitions consisted of melees, with two sides fighting as though they were at war. Knights who performed best received a prize, such as a horse, arms, or armor of those who lost. Not just knights on horseback fought; foot soldiers would join in fights, and knights would wield swords if knocked from their horses. (Gies, Ch. 5) These tournaments featured nearly no rules, and

often lead to severe injuries and death. (Edge et al., Ch. 7) Weapons were not blunted, so the fights could lead to fatalities; riots would occasionally break out over acts of violence. It was not uncommon to see multiple knights take on a single enemy or to take the wounded as prisoner. (Gies, Ch. 5)

The Church was a rather influential part of medieval life, and it did not look kindly on these mock battles. In 1130, Pope Innocent II actually banned tournaments, since they were considered violent and sinful sports. Though the sport was now illegal, it only became more popular through the 12th century. Judges and heralds began keeping score and order in the sports, and the joust became a tournament staple. The joust was unique in that it focused on individual knights and their honor. In 1194, Richard I of England legalized his own tournaments in spite of the ban. (Edge et al., Ch. 7) By 1250, jousts were separated into those of peace and war, using different equipment for safety. Weapons for tournaments were distinguished from weapons for war; these were essentially normal war-time weapons with dull blades for safety. Lances only needed to have the blade at the end replaced with a dull one, as they were already brightly painted for war. The blades on the lances were also commonly replaced by a design much like a small plough-share, with three dull points to spread the force of the impact. (Barber et al., Ch. 7) With new focuses on safety, the ban was eventually lifted by Pope John XXII in 1316, though the Church still did not fully approve of the events. (Edge et al., Ch. 7)

The 14th century led to more refined rules in the games, leading to a much more organized, safe experience. The battles now took place on a single field rather than just the countryside, and each cavalier was given a set number of charges, or “lists.” (Gies, Ch.7)

Around the 1330s, armor specific to tournaments was being developed, focusing on two main things: protection against the weaponry used in the tournaments (like lances for jousting), and the appearance of the knight. Jousts in particular needed specific armor; the arret (a hook to hold jousting lances in place) for breastplates was a major innovation for the sport in 1340. Unlike the triangular war shields used at the time, jousts used ébranché shields by the end of the 14th century. They were generally oval-shaped, with a section missing on the right side to allow the lance to be aimed properly. These shields were hung over the shoulder, so they would not be lost after impact. (Barber et al., Ch. 7)

In the 15th century, the tournaments were nowhere near as vicious as the tournaments of the 10th and 11th centuries. Any hand-to-hand combat was well-regulated, with normal war armor and weapons in a simple enclosure, or sometimes with a barrier in between the combatants. Jousts were fought "at the barriers," meaning the knights approached each other from across a wooden fence. The combatants would charge along the tilt barrier, with lances raised until the last moment, where it was angled 20-30 degrees to exert the least amount of force on the opponent. They were commonly hollowed or jointed for easier shattering, adding to the pageantry of the event. The tournament had become immensely popular as a spectator sport, with pageantry, music, dancing, parades, costumes, and so on. Knights would carry women's "favours" into the games, with their victory being dedicated to the woman chosen, prominently displaying the chivalry of the times. (Edge et al., Ch. 7)

Jousts were very popular in Germany in the 15th century; the most common form was the "Gestech," where the goal was to either shatter the lance or dismount the opponent.

The "Hohenzeuggestech" variation had the knight in a nearly standing position on the horse, while the "Rennen" or "Scharfrennen" used pointed lances for dismounting the opponent and light armor. Armor was specialized for all types of jousts at this time, of course, weighing almost double that of war armor at around 100 pounds. Breastplates were made thicker on the left side, where the opponents' lances would strike. Cuirasses with lance rests were worn, with large helms, large gauntlets covering the entire left lower arm and hand, and pauldrons for the shoulders. Polder-mittens were worn on the right arm, with a large shell-like plate over the elbow. Small wooden shields were hung over the left side of the breastplate. (Edge et al., Ch. 7)

One of the most significant innovations in armor for the joust was the frog-mouthed helm; this helmet closely followed the shape of the head, with a rounded top and an outward-curving front. This was a smaller target for the opponent in the joust, and provided the wearer with great protection. The helm was also attached to the breastplate with metal clasps in case of a hit to the head. (Barber et al., Ch. 7)

Jousts weren't the only form of mock battles in the tournaments in the 15th century, though. There was still the traditional foot combat, called the tourney, which employed regular field armor. Originally consisting of many knights fighting each other, it became one-on-one by the 16th century. Clubs and maces, as well as swords, were the primary weapons used, as it was less dangerous than a sharper weapons. Armor completely encased the knights' bodies, with large skirts of metal called tonlets. In France, there were variations without tonlets that still covered the entire body, with articulations at each joint to allow movement, resulting in a very rigid yet flexible suit of armor. (Edge et al., Ch. 7) The 16th century tournaments moved

more towards pageantry and horsemanship and away from jousting, since knights had become more of a governing class than a military one. (Gies, Ch. 9) However, there were still shows for the many spectators, employing new technologies to entertain. In the 16th and 17th centuries, mechanical devices were sometimes incorporated into armor for the sake of this pageantry. For example, some shields were designed, through a series of springs, to fall apart into many pieces when struck with a lance.(Barber et al., 7).

Manufacture of Armor

Mail

Mail was some of the earliest metal armor developed in Europe, and was widely in use until the very end of the 17th century. Mail was easy to make, very flexible, and it provided great protection from cutting, though it was rather time-consuming.Apprentices would make the rings of the mail, while the most skilled crasftsmen would link them into the final mail.Closed rings were punched from plates of metals, while open rings were made from iron wire.It is speculated that a thin strip (3-5 mm) was cut from a sheet of metal, which was then drawn through successively smaller holes to get the wire to the correct diameter. This wire was then wrapped around a rod, leaving the wire in a long coil. By cutting one side of this coil, many open rings of the same diameter were produced. (Pfaffenbichler, Ch. 5)

Working the metal would cause it to harden, so it was often annealed, or brought to red hear and then cooled, leaving it softened.Softened rings were threaded on wire, with the ends flattened and overlapping. These ends were either bored with holes for iron rivets or punched.Each ring was interlinked with four other rings.If closed rings were used, open rings

would link the closed rings, with each row alternating between the two types. Open rings were then closed with riveting pincers or hammer welding. (Pfaffenbichler, Ch. 5)

Plate Armor

Plate armor production required a number of specialists: an armourer to forge the plates (a hammerman), a polisher (a millman), and a finisher. Locksmiths sometimes made the hinges and fastenings for more expensive suits, and artists, etchers, gilders, and painters would decorate the suits. Steel or wrought iron was hammered into flat pieces, though water-driven tilthammers would replace hammering by hand by the middle of the 16th century for wealthy craftsmen. The armourersthemselves did not hammer the iron; iron arrived for the craftsmen in plate form, hammered flat. These plates were cut into the shapes needed for different pieces of armor. Then they were shaped by hammering the plates over different shaped anvils (called stakes) that fit into a workbench. (Pfaffenbichler, Ch. 5)

Like mail, plates were worked cold, but were frequently annealed. Heat was also needed for specific details of the plates, such as turned-over edges. The edges were trimmed with large shears to their correct sizes. Attention had to be paid to the thickness of the plates; some plates were thicker than others to protect vital areas, and some plates were thicker in different places of the same plate (like the center of the breastplate). Most plate armor was case-hardened, meaning the outside was very hard, while the inside was softer. This was done by coating the surface of the plate with hog's lard or a similar fatty substance, covering it in goatskin and clay, and heating it. The carbon would diffuse into the iron, turning the iron into

steel. Another method involved packing the iron with charcoal into an iron box and placing the box in a forge for a length of time. (Pfaffenbichler, Ch. 5)

To further harden steel, it could be quenched by placing it, red-hot, in cold water or oil. Water makes the steel harder but more brittle, while oil is much less extreme. In the 16th century, it was found that reheating quenched steel will temper it, leaving it hard but not brittle. This took great skill, since the steel must not get too hot for too long, which would reverse the quenching. Slack-quenching was used more often than quenching, which used a less extreme liquid than water. (Pfaffenbichler, Ch. 5)

Armor of proof was developed by the middle of the 14th century. This was specifically guaranteed to resist the common weapons of the time, tested against crossbows and by the 16th century, gunshots. However, in order for the iron armor to withstand gunshots, it had to be very thick and heavy, which was not very practical at the time. (Pfaffenbichler, Ch. 5)

The final step for the armourer was fitting together the pieces. Every plate had to fit exactly, as any plates that did not fit snugly over and under each other were not correctly defending the wearer. Polishers would then smooth and shine the outside of the armor with grindstones and polishing wheels. Armourers took the polished plates and assembled them by riveting the lames, or plates joining other plates, to leather straps. Hinges and buckles or staples were added to the plates, and the insides were lined with padding. With a fitted harness, this completed the suit of armor. (Pfaffenbichler, Ch. 5)

Decoration

Engraving was done by hand, carving the armor with a sharp tool. This was rare, as it was difficult and time-consuming. Gilding was done by heating gold on mercury on the plate armor, though this was highly toxic. A safer method consisted of painting the armor with varnish, applying a fine gold leaf, and heating to dry the varnish, securing the gold. Different temperatures caused the steel to change colors, so armourers could make armors bluer by heating and quenching them correctly. (Pfaffenbichler, Ch. 5)

Etching was the most common decoration technique. Once protected by varnish or wax, a design was scratched into the coating with a needle. The plate was then dipped into acid, which would only penetrate the armor where there was no protective coating. After being washed, the design was blackened with oil and heated, leaving the armor with a finely detailed etching. (Pfaffenbichler, Ch. 5)

Non-European Arms and Armor

The Near East

In the Near East, armor never changed drastically from European designs of around 1400. The armor of Turkey, Persia, and India were all very similar at this time, aside from decoration. The early mail from before 1400 was composed of large, riveted links. These links were often stamped with texts or designs as ornamentation. Later mail had smaller links with no rivets, but was not particularly strong. Much like in Europe, body armor would cover the entire body, being a combination of mail and plate armor. (Bull, Ch. 6) Unlike Europe, however, this

armor would integrate mail and plates into a single piece of armor. Over the mail, plates would be used as splints across jazerans, which were rows of chains. Large plates were set over or sometimes into the mail, and soldiers were equipped with small, steel helmets called casques, with guards reaching down to the wearer's nose and a sharp spike on top. Thin camails for guarding the neck, and decorated arm guards were also worn. (Dean, Ch. 11)

Much like the armor of these regions, weapons were fairly similar throughout the Near East. Sabres were used often, only differing through the regions in decoration and slightly in shape. The majority of the straight swords used were nearly identical. Short daggers with wavy blades and heavy handles were common throughout the regions, as were polearms. Most polearms of these regions were very light and balanced, as they were generally made to be thrown rather than used as thrust weapons. Bows were popular in the East as well, though the longbow was replaced by the short composite or recurve bows made of wood, sinew, and horn. These bows had a much farther effective range than the European longbow; instead of about 200 yards, these had a range of around 400 yards. Most of the regions decorated the weapons with insets of precious stones. (Dean, Ch. 11)

Of these regions, India had perhaps the most unique set of weaponry, though much of it was influenced by Persian designs. The typical sword, called a shamshir (of Persian origin), was very curved, while another common type, the kilij (of Turkish origin), had a blade that grew very wide at the tips. The dhal was a round shield, though it ranged from metal with inlaid jewels to leather with brass bosses. Occasionally, even turtle shells were used as the body of shields. Thrust daggers (known as a katar) had an H-shaped handle and pointed blades. The

bagh-nakh, or "Tiger's Claw," fit inside the user's hand, with multiple curved blades that looked and acted much like the claws of a tiger. Axes with crescent-shaped blades, called a tabar were very common, and sometimes the ax handles concealed small daggers. Popular types of daggers were the choora, with a straight blade, and the khanjar, with a curved blade and pistol hilt. (Bull, Ch. 6)

The Far East

The Far East had a lot less in common with Europe than the Near East during the Middle Ages. Some of the technologies were similar across the continents, though many were developed completely independently of one another. Of course, the Far East had a number of major differences in arms and armor compared to Europe, as seen in examples like China and Japan.

China developed suits of armor rather early, as evidenced in the Terracotta Army. These life-size statues of Chinese soldiers date back to at least 210 BCE, with the soldiers molded fully equipped in traditional armor. This armor consists of riveted metal scales covering the upper body and shoulders, though there is no armor protecting the arms, legs, and head. From the Middle Ages up to the 18th century, armor was made from many copper scales attached by brass wire. This was worn over a hessian coat, shoulder pieces made from leather. From around 1736 to 1795, soldiers had quilted armor with plates on the shoulders and head. As for weapons, the typical military swords were usually large, two-handed, and a bit curved. Bronze crossbows were used as early as 200 CE. (Bull, Ch. 6)

Japanese armor was quite different from European armor, focusing more on lighter and more flexible armor. The armor fit loosely, with broad defenses for the neck and shoulders and large skirts. The armor was also highly colorful and decorated, covered in many coats of lacquer. (Bull, Ch. 6) Japan followed ancient customs in its armor-making; armor was modeled after centuries-old designs, and major changes were highly discouraged. Around 1000, Japanese armor consisted of jazerans laced together in rows, called a do. These rows were hung atop each other on cords, and a leather breast defense was hung over the scales. Shoulders were covered by wide, square scales, called a sode. Square thigh guards known as a kusazuri hung from the corselet and were very similar to those on the shoulders. Armor worn by lesser ranks sometimes had more than 4 sheets protecting the thighs, sometimes as many as 12. A large neck guard reached up and around the face, protecting the sides of the head. A heavy bowl-shaped helmet, or kabuto, protected the head, made of 8 plates, with 2 plates attached to the front like horns (horns could be quite large). Arm defenses consisted of cloth sleeves covered by large plates held in place by mail. Loose leg coverings were protected with rows of scales, with large greaves at the shins.

This design stayed in use for the next few centuries, up until the mid-1300s. Around 1338, rows of scales could be replaced by bands of iron. Corselets became single plates covering the front and back of the soldier, with ridges that resembled the older rows of scales. Helmets were made in a number of irregular shapes instead of simply small domes. Neck defenses became smaller, and masks (called a menpo) were more common, depicting the faces of people, animals, and mythical creatures. Precious metals such as gold inlaid in the metals

became a more common form of decoration for the region. 1600 to 1868 was a time of peace, though there were many kinds of ceremonial armor still used. Typically, the helmets did not cover the ears as much as they used to, and the neck defense fit very close to the body. Thigh and shoulder guards were still large and hanging, with light mail covering the arms and legs.

Japan had a number of unique weapons that reflected the strict culture the warriors lived by. There were three main types of swords: the katana (long sword), the wakizashi (short sword), and the tanto (dagger). Until 1877, all military carried a long sword and a short sword. The long sword was the primary weapon, the short sword was a secondary weapon, and the dagger was more ceremonial. Most of the swords used were single-edged and curved. In particular, the long sword was usually over 2 feet long and curved slightly. It had a long grip for one of two hands, and was hatchet-tipped. (Bull, Ch. 6) In addition to swords, there were four main types of spears, or yari: typical spears had wide, long heads with four sides, and were fairly blunt. There were halberd-like spears with cross-shaped heads, as well as the naginata, with sword-shaped blades. The last type was very large, and had a very wide blade. (Dean, Ch. 12) The Japanese soldiers were also proficient in the use of the longbow, made of curved wood and bamboo. (Bull, Ch. 6)

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Research on Profiling, Demographics, and Culture

By Robert Bass

Profiling: State of the Art, Basics

Profiling is a technique in which data about people is collected and stored in profiles, which can then be used to infer later behavior. Profiles can be constructed in many different ways, depending on what they're used for. (Gauch et al., Sec. 2.1, ¶12)

When creating such a profiling system, there are several main things that need to be kept in mind. First, one must consider the *content* of the system: “*what* has to be represented, that is which information pertaining to the user has to be represented...” and “...*how* this information is effectively represented.” (Amato & Straccia, pg. 185, ¶12) In addition, one must consider the *structure* of the system. This has several additional components to it: it can use explicit or implicit information gathering, be dynamic or static, be short-term or long-term, or have some hybrid of these choices. (Gauch et al., Sec. 2.1, ¶6-7) The exact definitions of these terms will be presented later, along with the implications of each choice.

Different profiling systems keep track of different things, and thus the first decision that must be made when creating a profiling system is what kind of information must be stored. This could include things like demographic information about the user, information about things that the user wants or desires, meta-information that helps the system adapt, etc. (Garuch et al., Sec. 2.2) Again, this depends on the system in question: a system that simply retrieves articles of interest for the viewer from a database need only keep track of user interests (Middleton et al., Sec 1.6, ¶13), while a system that actively searches the entire

internet for specific data might include a number of additional data points, such as privacy information and preferences as to how and when to deliver the data (Garuch et al., Sec. 2.2).

Structure is also important when creating a user profile, since the structure you choose will alter both how profiles are compared to other things, and how new information is added to a profile after its creation. The simplest form of profile structure is the keyword vector. In this structure, user profiles are created using specific keywords paired with values representing how much that keyword represents that user. For example, someone who really likes basketball but only sort-of likes soccer might get a value of .9 for basketball and a value of .4 for soccer. When making a comparison, a system would try to find things with similar weights for the given keywords (Gauch et al., Sec. 2.3.1, ¶1).

Other, more complex structures exist as well. One example of such a structure is the ontology, which uses a system of nested keywords that allow computers to make generalizations and inferences. When a specific keyword is applied to a profile, for example, “apple,” the system can traverse the tree and assume that previous, containing keywords, such as “fruit” or “food” in this example, also apply. It can then infer that nearby keywords in the hierarchy, like “orange” or “pear,” might also be appropriate. (Middleton et al., Sec 2.2.1 & 2.2.5, ¶1). Another example of a complex structure is the semantic network, in which concepts are represented as nodes and relationships between concepts are represented as connections between nodes. Semantic networks are useful because you don’t have to use keywords to represent concepts. As an example, one system uses a semantic network based on sets of synonyms. (Gauch et al., Sec 2.3.2, ¶1).

As mentioned above, there are several additional parameters that must be decided with regards to the system's structure. The first parameter deals with how to gather information: explicitly or implicitly? First, some definitions: an explicit system is one that "...[relies] on personal information input by the user..." (Gauch et al., Sec 2.2.2, ¶12). On the other hand, an implicit system gathers information directly from the user's actions, without specifically asking the user to input data. (Gauch et al., Sec 2.2.2, ¶16) There are advantages and disadvantages to each technique. An explicit system is direct and (for some users) enjoyable, but takes up the user's time and can be inaccurate. On the other hand, implicit systems don't take up any user time and can gather tons of different information, but may require users to install new software, and may require a large time investment to develop the software. (Gauch et al., Sec 2.2.2, ¶15 & 10)

Another parameter to take into account is the system's flexibility. People change over time, and so should a profiling system. A profiling system that can adapt to user actions is said to be dynamic, as opposed to unchanging, static systems. (Gauch et al., Sec. 2.1, ¶7) Having at least part of your system be dynamic is usually a good thing; "in general, a system must be able to detect or must allow the user to indicate [changing preferences], and should respond by adapting to these changes." (Amato & Straccia, Sec 2.2.4, ¶1)

Depending on the system, it may also keep track of whether a profile is short-term or long-term, i.e. whether the traits represented are characteristic of that person in general, or just that person right now. For example, noting that someone is a computer programmer is probably long-term data, whereas noting that someone had fish for dinner or is looking for a

new watch is likely short-term data. Flexibility becomes very important here; a short-term system must be very flexibly and constantly changing, whereas a long-term system can be a little more static. (Amato & Straccia, Sec 2.1, ¶6)

One very important application of user profiling is the recommender system, a system which trawls through a database or set of websites and, based on a profile, brings up a series of entries / website that it thinks the user will enjoy. In this case, the data collected is about the kind of things a user finds enjoyable or interesting. The system can then compare this information to the content of, say, a website. The closer the match, the more likely the user will be interested. (Middleton et al., Sec 1.6, ¶3)

Recommender systems do have one glaring flaw, however: the cold-start problem. This problem occurs when a system gives poor results near the beginning of its life, due to the fact that no data has been collected yet. This can cause potential users to give up on the software, which prevents it from getting the data it needs to provide good results. This problem can occur both when a system is completely new and when a new user joins. (Middleton et al., Sec. 3.1, ¶2 & 3) One possible solution to this problem could involve extracting data from an external source, such as a company's customer database. Information about new users could then be inferred from the "seed" data, reducing the impact of the problem. (Middleton et al., Sec. 3.2)

This is only the tip of the iceberg with regards to user profiling. For example, many systems include complicated learning algorithms. However, such algorithms are most likely beyond the scope of this project. (Middleton et al., Sec. 1.2, ¶12)

Profiling: State of the Art, Advanced

This section will begin by looking at some of the basics given in the previous section in more detail. That section mentioned implicit data gathering methods, in which the profiling system gathers information about the user based on the things the user does. However, one important point was not covered there: *how* does the system do this? It depends on the system, but as an example, let's consider an online recommendation system, a common use for this sort of data gathering technique. First, the system usually adds a "cookie" to the user's browser that allows the profiler to recognize that user, and allows the system to gather data regarding that user's actions (Bilchev and Marston, Sec 6, ¶12). After that, the system can gather information stored in several different locations, each of which gives some information about the user. First, the system can check the user's browser history, which keeps track of past website requests, as well as when the website was last visited and how often it was visited. Second, the system can check the user's bookmarks, which are a very clear indicator of the user's preferences in websites. Third, the system can check to see if the user clicks any links on a particular page; if the user clicks a lot of links on a page, it's likely the user likes it. Finally, the system can check an access log to see how long the user spent on a particular page (Chan, Sec 2.1, ¶12-6)

Note that implicit data gathering and profiling brings up an important and controversial issue: that of consumer privacy. Profiling systems are useless without information about the users, and as such some information gathering must be done. However, the more data you gather about a user, the closer and closer you get to finding that user's true identity. In other words, the user's anonymity on the Internet becomes jeopardized. This becomes particularly problematic if profiler in question gathers data without the user's knowledge, an act much easier than it might seem (Bilchev and Marston, Sec. 6, ¶12).

There are several different ways that profiling systems can make inferences about the preferences of the user. One such way is called the collaborative approach. In this method, profiling systems make assumptions about the properties of a user based on other profiles that are similar. For example, if two profiles are similar, and profile 1 liked a specific website, then chances are profile 2 would like it as well. This approach runs on the basis that "...users with comparable interests [are likely to behave] similarly."(Chan, Sec. 4.2, ¶1)

Another, similar approach involves using demographic data. Using a number of different sources, it is possible to gather massive amounts of raw data about a large population. Using this data, one can break up this population into a number of categories, each of which has its own unique characteristics and likely behaviors. By determining which category, or demographic cluster, a particular user is in, one can use the demographic characteristics as a baseline, which can then be altered through machine learning algorithms. (Krulwich, pg. 38-39)

Now, let's consider a couple of different ways profiling systems can be used. One alternative to the methods previously discussed involves a system that constructs two profiles: a factual profile and a behavioral profile. The factual profile is similar to the ones described above, and contains information about the user, the user's likes, etc. The behavioral profile consists of "...conjunctive rules, such as association or classification rules." (Adomavicius and Tuzhilin, Sec. 2, ¶4) These rules describe cause-effect relationships that might apply to the user. (Adomavicius and Tuzhilin, Sec 2 ¶3-4)

A core problem with this system is that the algorithms used to mine through the data and create these rules usually find many relations that are not important, even if they are statistically relevant. Therefore, a system like this needs an additional component: a validator (Adomavicius and Tuzhilin, Sec 2 ¶7). Validators are usually human as opposed to computers, and must accept or reject rules manually, although there are systems in place to make that job easier (Adomavicius and Tuzhilin, Sec 3 ¶ 1-3).

Profiles can also be merged by creating a new profile with properties such that the differences between it and all its component profiles are minimized. First normalizing and then averaging the "weights" in each of the components determine the weight of the new properties. (Yu et al., Sec. 4.3) This can be used in situations where a system must profile a group of people, but must also be flexible. As an example, consider a program that searches for TV shows that someone might like. Television watching is, in general, a social activity, and as such it would be prudent to create a system that could make "group profiles," which looked for shows that an entire group of people would like. However, creating a single group profile

would not be sufficient in this case; what if one of the people in this group was too busy to watch TV, for example? This is where profile merging comes into play. By having each member of the group create an individual profile and then merging them, you can create a system that can adapt to people not being there, simply by leaving that particular profile out of the merged profile (Yu et al., Sec 3, ¶15).

Finally, let's take a look at a couple of common uses for profiling systems. One of the best known uses for these systems is targeted advertising. The idea is simple: by gathering information about a customer's likes, dislikes, demographics, and prior purchasing habits, one can determine what that customer would be willing to buy, and advertise those things. Unlike most profiling systems, targeted advertisements usually don't gather the information for the profiles themselves, rather relying on already constructed profiles, or use a pre-gathered set of data to construct a profile. (Bilchev and Marston, Sec. 2)

Advertising systems like these can work in one of three different ways. In one model, the provider of the profiling system hosts its advertisements on several, separately owned websites (the "publishers") and sells its services to a number of clients, who specify their target demographic. The buyers then pay the provider, who passes some of the profit on to the publishers. Alternately, one could have a model like Facebook, where the provider and publisher is the same company. Facebook sells its advertising space to other companies, and then displays the ads on its site based on the profiles already generated by its users. Finally, one could have a model similar to Amazon, where the provider is also the advertiser. In this system, the provider would get space on other websites, tailor the content of that space to that

website's viewers, and give a percentage of the take from that website's link to that specific publisher (Bilchev and Marston, Sec. 3.1 – 3.3).

Another use for profiling systems is search personalization. Due to the nature of many languages, the same set of keywords can be interpreted to mean multiple different things. Using a profiling system, a search engine can try to guess the correct "context" for the search, thus limiting the search to entries relevant to the user (Sieg et al., Sec. 1, ¶1-3). Alternately one could use a profile to "fill in" information that was left out. For example, if someone was searching for, say, a grocery store, the system could use the address stored in the profile to limit the search to grocery stores within a certain distance of the user (Storey et al., Sec. 3)

Museum Demographics

This section shall begin looking at museum demographics by examining a number of visitor interviews and surveys taken by the Higgins Armory Museum itself. Although the questions asked in these surveys were very open-ended, it is possible to gather a good deal of information from the answers the visitors gave. In addition, it makes an excellent source of pure demographic information, such as gender, age, group size, and whether or not the visitor has come to the museum before. Each of these demographic categories will be looked at in turn.

One of the first things that jumps out when looking at this data is that almost every person interviewed came to the museum in a group. In fact, 63% of the people interviewed came in a group of 3 or more people, and out of the 148 interviews, only two were of people who came to the museum alone. This data demonstrates a key motivation for going

to museums: as a social or family experience (Leinhardt and Knutson, p. 52, ¶3). Indeed, a good portion of the people who come in groups of 3 or more are there with their families.

The age range of people who were interviewed varied drastically from 6 to around 78. From the data gathered, the average visitor to the museum is about 36 years old, with a median age of 37.5, a mode of 36, and a standard deviation of 15.532. When broken up into age groups (children and teenagers 17-, young adults 18 – 30, adults 31 – 42, middle-age adults 43 – 56, older adults 57+), the data corroborates the median age; the largest age group is adults at approximately 30%, with a close second going to middle-age adults at 26%. This is significant compared to children and older adults in particular (14% and 9%, respectively), although not quite as significant compared to young adults (21%). The difference between men and women is fairly small (about three years), with a similar difference between those in groups of 3 or more and those who came alone or with a single person. In general, this simply shows that the museum tends to cater more towards adults who likely have young children.

The gender divide for this data is fairly small, with approximately 47% of the interviewees being male and 53% female. This seems to make sense, since although women tend to visit museums more than men, the subject matter (arms and armor) would seem to me to be something men would be more likely to be interested in (Chung et al. 1, ¶3). Interestingly enough, however, men appear to be more likely to come to the museum in a smaller group. 45% of the men interviewed came to the museum with at most one other person, as opposed to 34% of the women.

Finally, 60% of the interviewees were attending the museum for the first time. This is to be expected; after all, museums tend to update relatively slowly, and many people wouldn't want to come back to see the exact same content. In addition, a lot of the children under 10 who were interviewed had been to the museum before. This could be because the armory museum is partially catered to children, and they find the museum enjoyable. However, it may also simply be a quirk in the data, or perhaps children who had visited the museum before were more comfortable there, and thus were more likely to talk with the interviewers, as there are a good number of young children who, although they weren't interviewed, were part of a group that was visiting the museum for the first time. Additionally, it could be due to the lack of sensitivity children tend to have towards repetition; many children don't seem to mind seeing the same things over and over again, and many actually enjoy it.

All of this data applies only to the Higgins Armory Museum, and is thus very specific. However, larger studies have been done to give us more information about the average museumgoer. According to these studies, those who patronize museums are "likely to be in the upper education, occupation and income groups, younger than the population in general and active in other community and leisure activities."(Anderson, p. 150, ¶3) This gives a very rough picture of the kinds of people who visit museums, and seems to mesh with the data from the Higgins Armory interviews.

In addition to this basic profile, we can get some information about specific types of museums as well. For example, art museums tend to have older, highly educated patrons, and few have young children. History museums also have older patrons, but are less likely

to be highly educated. They also have a very small gender gap. In contrast, science museums have younger audiences, and also have the highest cultural diversity amongst museums. Finally, children's museums also have young patrons, and their patrons also tend to have high incomes (Chung et al. 2, ¶5 – 8).

As a final, somewhat tangential note, there are several different reasons to consider when gauging a person's *reaction* to a museum. In general, one can break a museum patron's motivation into four variables: intentionality, habits, topical familiarity, and persistence/effort. Intentionality refers to the planning and forethought the visitor goes through before coming to the museum. Someone who has been planning a trip for a while is more likely to enjoy the museum. Habits refers to how often people visit museums. Someone who visits museums often is more likely to grasp the pacing and style of a museum, and thus will retain interest longer. Topical familiarity refers to the patron's interest and familiarity in the topic the museum is exhibiting. Someone who specifically seeks out a museum for an exhibit of interest is likely to enjoy it more. Finally, persistence/effort refers to the amount of time a patron is likely to spend on a single topic, and thus determines the likelihood of the patron getting bored (Leinhardt and Knutson, p. 53-54).

This is an important point to mention because it helps to explain the demographics provided above. For example, people with more education are more likely to find interest in a topic a museum might exhibit (variable 3), and those already active in other leisure activities might have a schedule for seeing museums (variable 2). In fact, even the demographics of specific museum types can be explained by this. For instance, science

museums tend to have a lot of hands-on or interactive exhibits, and thus might appeal to younger audiences, who have less patience (variable 4).

Connections to American Culture and Interest Groups

Before this section begins considering which cultural groups have the most potential interest in the Armory Museum, there are a few points that should be mentioned. First of all, no interest group is homogeneous, and there will always be some members of a group that do not agree with the standard norm. Secondly, there are relatively few groups that have a strong, direct connection to the Armory Museum itself, and as such this section will be considering some groups with a much weaker connection. Finally, note that this section will feature a lot more speculation than the other two; as such, most of the references will be to information about that interest group, rather than the more direct references given in previous sections.

As the Higgins Armory Museum is primarily a history museum, it would be natural to assume that it would appeal to groups interested in history; specifically, the historical periods during which the armor was used. However, it's important to note that the museum would probably appeal more to people who were interested in history, but were not experts. An ideal example of this kind of group is historical reenactment societies, which attempt to simulate the society and lifestyle of certain, mostly medieval, time periods. Such groups would likely have members who are interested in the time period, but are not as knowledgeable as professional historians. As such, they would find the museum interesting, and still be able to acquire new knowledge during their visit. The Society for Creative Anachronism is an excellent, almost

archetypical example of this kind of organization. It has over thirty thousand members worldwide, and many of their events include sword fighting. (Society for Creative Anachronism)

Starting at this point, it is possible to extrapolate additional interest groups by removing some of the properties that tie the aforementioned “ideal” interest groups to the museum. For example, if one removes the focus on historical realism, one can easily come to the conclusion that fans of the fantasy genre would be interested in the museum. This is corroborated by one of the interviews mentioned in the previous section, in which an interviewee was motivated to come to the museum by the video game *Elder Scrolls IV: Oblivion*, which one of the children in the family was playing.

Speaking of which, people who play video games in particular are a powerful interest group. Many video games, including the world-famous massively multiplayer online game *World of Warcraft*, are of the fantasy genre, and thus have a connection to arms and armor. It’s also a very large interest group, and has been growing rapidly. As an example, as of this year *World of Warcraft* has over eleven million subscribers from around the world, and has remained at that level despite the economic situation (Burnes, ¶8-12). As an additional note, the average *World of Warcraft* player is about 30 years old, which is very close to the average visitor age for the museum (Yee, ¶4).

Removing different properties can derive additional examples. If one removes the focus on arms and armor, you could consider people who enjoy making historically accurate models of things like ships as a potential interest group. Such people are clearly interested in history,

and would most likely enjoy the fine craftsmanship. Again, evidence can be drawn from the interviews, as many of the interviewees from the previous section mentioned the fine details as one of the things they enjoyed at the museum. Unfortunately, there seems to be very little information about the modeling demographic as a whole. However, there are a large number of modeling clubs and organizations devoted to various kinds of modeling, so one can assume that the demographic is at least somewhat large. A couple of examples: the Marine Modelers Club of New England is an organization of around fifty, based in the Boston area. They specialize in making model ships. Although they may not be very large, they seem constrained to a small area, so they could be representative of larger groups (Marine Modeler's Club). As an additional example, the Armor Modeling and Preservation Society has around six hundred members worldwide. Although they are not locally based, they do specialize in modeling armor, so they might be able to appreciate the museum's collection more (Bell).

In addition to modelers, other kinds of artists might also be interested in the museum. Theater might be a good interest group to try to get, especially people like prop and set designers. Such people would want to make the performance as accurate as possible, and as such might want to look at real arms and armor for reference. Actors might find the information about culture helpful to make their performances more accurate. One example of such an organization is the American Repertory Theater (ART), a thirty-year-old theater group based in Harvard Square. They've done performances around the world, and was rated "one of the top three theaters in the country by Time magazine" (Paulus). Other kinds of artists might also be interested, especially people who work with metal.

Finally, if one removes the focus on the time period and/or location (medieval Europe), one could attract people who were interested in the arms and armor of other time periods or locations. This could include general weapon enthusiasts who might be interested in historical aspects, or people who are just interested in a different time or place. The museum already covers this to a small extent with the exhibits on non-European / ancient arms and armor, plus the demonstrations about roman gladiators or Vikings. As an example, fans of the History Channel might fall into this group. There is a great deal of overlap between both content and demographics in this case. The channel has an audience of about five hundred thousand, and although the average viewer age is higher than the average visitor age for the museum, the primary age range appears to be similar. In addition, the channel features many different programs with regard to many different subjects, including arms and armor (Downey).

As a final closing note, there are a few interest groups that were not mentioned above, due to the fact that the museum probably already caters to them. Obviously, people who are directly interested in the subject (medieval arms and armor) would be interested. This includes arms and armor collectors. Historians and people in the museum business would be interested in the museum as a whole, although perhaps from a different perspective than the average visitor. Finally, people who actually make arms and armor to sell online (for costumes, etc.) would enjoy the museum, although that is a bit of a niche group.

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Research on Virtual Museums and Their Relationship with Visitors

By Jeffrey Elloian

Introduction

Museums have seen great advances since the first collectors began to present their exhibits publically. Curators now find themselves trying to rapidly adapt to a dynamic society. Being an informal educational institution, a museum losing the interest of its visitors, and therefore their attendance, it becomes little more than a forgotten archive. This could ultimately lead to funding problems and overall failure of the museum, but more importantly, society would lose a reservoir of education and culture. Clearly, it is universally beneficial to find a compromise between the educated elitist view of the museum as a pillar of culture, and the common person setting aside time to learn about a subject in which he or she is interested.

In creating a survey to design personalized museum tours for individuals, it is important to build a knowledge base as to what currently exists. The first logical place one would research are modern "virtual museums," a very loose definition to be discussed later in this report. Most virtual museums are tied to a physical establishment, from which it is important to understand how physical layouts affects the view of the visitor. We then examine the face of the museum: how docents provide the human element of interaction between this establishment and the visitors. Replicating this interface in the final product will help bolster Museum-Visitor Relations. Of specific interest to our project are how museums and other businesses approach personalization and profiling, as these techniques will need to be used to their full potential to best captivate the busy 21st century visitor and educate him or her with the material that they enjoy.

Examples of Modern Virtual Museums

An important area in modern technology is the presentation of museums to the new generation of visitors. In the modern era, consumers are introduced to advanced technology at a young age, raising their expectations from all services. Not only does this apply to any modern business attempting to better communicate with its customers, but it has a profound importance to any educational institution as well. In addition to studying other modern museums, we will compare and contrast (where applicable) these features with those already in place at the Higgins Armory. By analyzing the current techniques of modern museums, we can generate efficient methods to remain competitive with other forms of media, and thus remain attractive to new generations. This allows one to preserve culture and history, while simultaneously keeping pace with modern technology to deliver information in an efficient and interesting manner. In order to produce comparable results, it is vital to examine preexisting examples of state of the art virtual museums first.

The majority of "virtual museums" consist entirely of websites. This would clearly appear to be the most economical solution considering the vast majority of youth in the Western world have internet access. Furthermore, a website is significantly easier to maintain in comparison to a physically establishment that one must heat, clean, protect, etc. Logically, an institution would wish to expand to the internet, as it is a very inexpensive method of expanding one's influence to a much wider audience. Different museums use several different techniques to accomplish this goal, all fitting individual themes and goals, personalized for the particular establishment.

In regards to our project in particular, it is vital we closely observe the overall design of these websites to capture the interest of the user. To begin this analysis, let us examine the Japanese Art virtual museum of the Asia Society Collection. As can be seen in Figure 1, this website uses a standard navigation technique: placing a navigation bar on the left tab. Although this is a conservative approach, it is easy to implement, and, more importantly, very intuitive for a visitor to use. This parchment colored navigation bar clearly contrasts with black background of the content section in a manner that separates the two without being distracting (Asia Society). In comparison, the Higgins Armory Museum website, as shown in Figure 5 on the following page, uses a similar mechanism of contrasting colors, but with a top horizontal navigation bar. An interesting mouse-over drop down menu is used to provide easy navigation to specific pages without a long horizontal list (Higgins Armory Website). The top navigation bar is also a common feature of most websites, but becomes more difficult to add more tabs without increasing page width. It is for this reason we intend to implement a vertical navigation bar for the Higgins Armory IQP Website, so it may be easily updated as new projects are added over time.

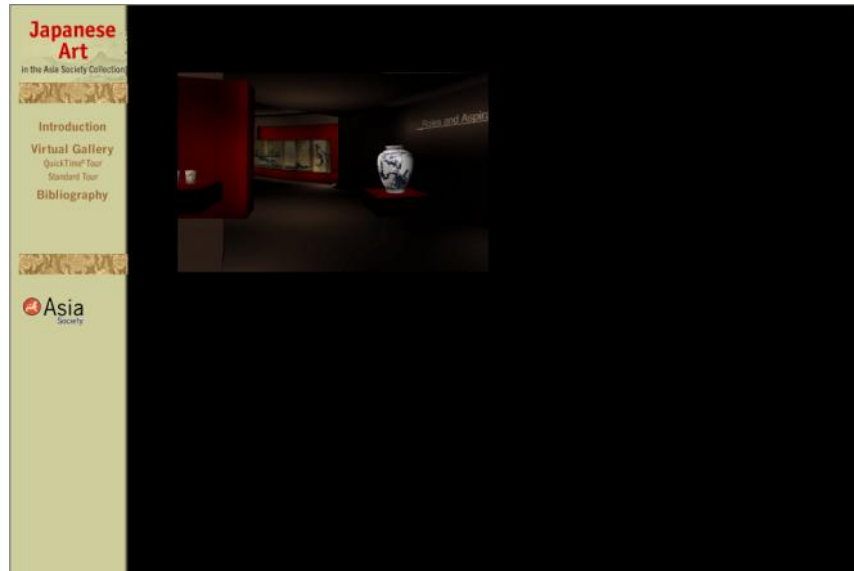


Figure 4-A screenshot taken from the QuickTime Tour of the Japanese Art website of the Asia Society.



Figure 5-A screenshot of the Higgins Armory Museum main page, displaying the navigational bar features.

By presenting content in a unique and captivating manner, a designer is more likely to be able to "sell" their product (or educate the user). The major unique feature of the Japanese Art website is the QuickTime tour (an enlarged image is provided in Figure 6). As a user searches through the "Virtual Gallery," he or she is presented with the option to take a

standard tour (Figure 7) or a QuickTime tour. The latter of these two options requires an additional plug-in, but provides the user with an enhanced experience. This provides the standard tour (consisting of a simple gallery with a brief description of each piece), but with an interactive 3D interface, allowing the user to navigate a virtual museum. One of the most notable features about this "Virtual Museum" is that it is a museum in itself and is not accompanied by an actual physical museum, yet it provides a similar education experience from the convenience of one's computer (Asia Society).



Figure 6-A close-up of the QuickTime Tour from the Japanese Art webpage.

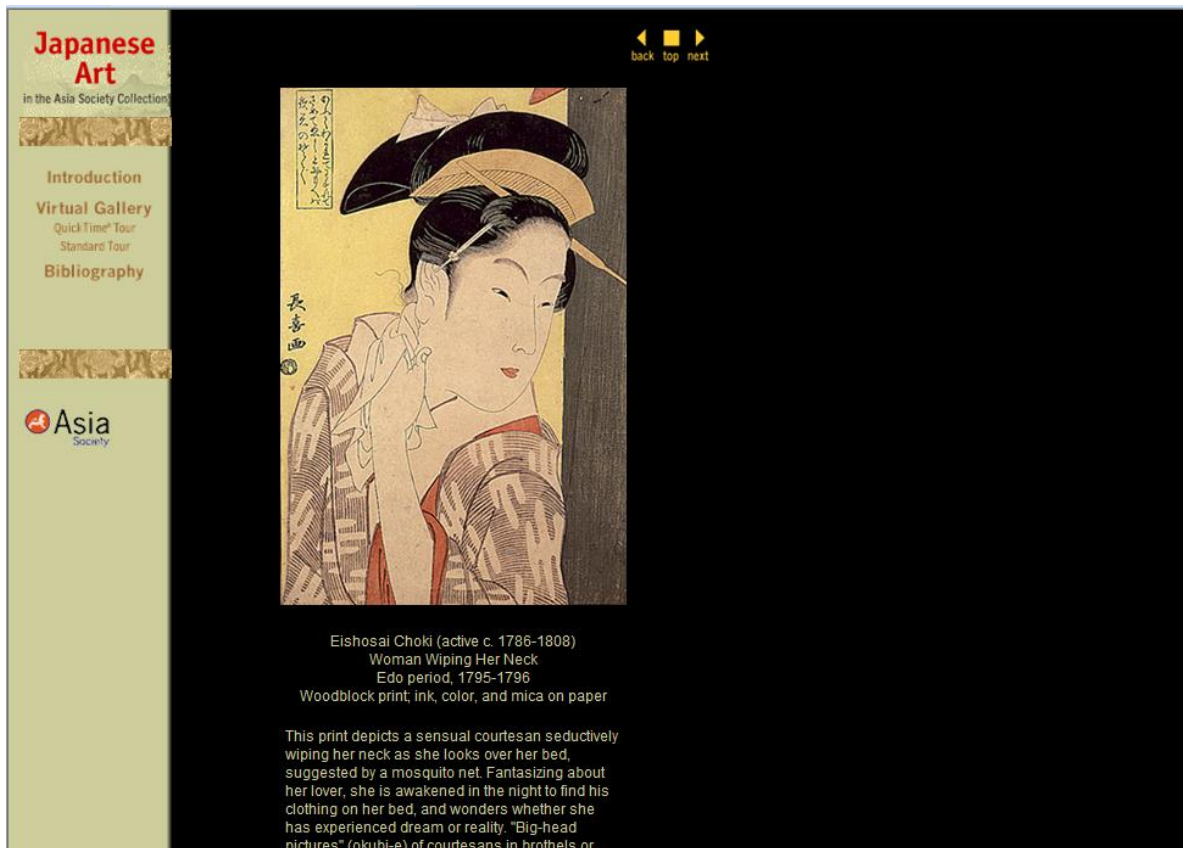


Figure 7-A screenshot of a specific exhibit in the standard tour on the Japanese Art Website.

Another unique approach to the concept of the virtual museum is provided by the Virtual Hampson Museum. The most unique feature of this virtual museum in comparison to others, is the detailed presentation of the pieces. Although only a small subject area is examined by this website (The Nodena tribes of the Mississippi), the collection consists entirely in the form of highly detailed 3D renderings of each of the exhibits. This allows one to easily view individual exhibits, such as a piece of pottery, then rotate the view as if one were holding it in their hands. Moreover, a search feature is introduced to provide the user the ability to quickly find a specific piece of artwork, a trait many researchers would desire in an actual museum to save time. The impressive 3D images were generated through a complex laser

scanning process using the Konica-Minolta VIVID 9i system to capture the surface texture mapped to the respective 3D coordinates, along with a corresponding RGB values. After digitally combining these through processing software, the final viewable form of each object is precise from 0.2 mm at most to approximately 5 μ m (University of Arkansas, 2009, para 2-6). An example can be seen on the following page (Figure 8 showing the menu, and Figure 9 showing an example of a specific artifact). All of these artifacts exist in storage, but the highly detailed renderings seen in Figure 9 allow visitors to examine an exhibit safely up close. The shelving style provides the user with sense of realism, whereas the search bar provides a utility to find an artifact quickly from a practical standpoint. When one clicks on an object, the so-called "3D Viewer" appears as seen in Figure 9. Two windows are opened: the rightmost window displays a description and brief movie file rotating the object. By clicking the "3D Viewer" button, the rightmost window is opened and the user may rotate the artifact manually, zooming anywhere up to a few millimeters from the surface with excellent resolution.

The advantages of using such a method are clear. While cost estimates are not directly mentioned, by providing material that is as realistic as possible on the internet, one can avoid material costs associated with the full upkeep of a physical establishment. Although it is true that these websites may operate in conjunction with a traditional museum, holding an online exhibit alone allows one to safely store very fragile objects (such as those displayed on the aforementioned website) in a better preserved environment, while simultaneously providing viewers an extremely detailed view. This allows the viewer to observe an object from angles that an actual display case would not permit or objects that the museum would not have room to

display. Often it is unrealistic to be able to view an artifact extremely closely in a museum, but 3D renderings permit a professional researcher or an average visitor the ability to quickly zoom in closely to any artifact in the collection without any risk to the real object.



Figure 8-A screenshot taking from the Virtual Hampson Museum displaying a sample of the gallery of artifacts on display



Figure 9-A screenshot taking from the Virtual Hampson Museum detailing the 3D representation of the artifact.

There are many online galleries that claim to be museums, and the definition of a museum is often very vague, thus one could consider any educational establishment with the mission of preserving past culture or art for display to the public to effectively be a museum. Most of these so-called museums online are tied to a very narrow area of study, with varying degrees of accuracy and detail. A couple specific examples are examined in this report, but there are countless others throughout the internet that one can find with a search engine.

The Aviation History Museum attempts to accomplish this with articles concerning various historic military and commercial aircraft. The navigational features on this website appear basic, but the content provides a user with a deep insight into any different facet of these aircraft. As opposed to a single paragraph description as seen in other websites, there

are multi-paragraph descriptions for each individual airplane, with equally detailed articles explaining specific models, engines, short biographies of famous airmen, and description of the aerodynamic characteristics of these aircraft. This presents a crossover between science, technology, and history of flight to appeal to multiple audiences. An example of a small section of an article may be viewed in Figure 10 on the following page (The Aviation History Online Museum, 2010).



Figure 10-This screenshot of the main page of the Aviation History Online Museum

The synthesis of many years' intimate experience of fighter biplane design, translated into the modern formula; a compromise between tradition, and requirements born of a new era in air warfare--such was the Hawker Hurricane. The Hurricane shouldered the lion's share of Britain's defense during the "Battle of Britain," and was largely responsible for the successful outcome of this conflict. The Hurricane equipped more than three-fifths of RAF's Fighter Command squadrons. The Hurricane also proved to possess an astounding propensity for adaptation, and the multifarious roles that it undertook earned for it the distinction of being the most versatile of single seat warplanes to emerge from the Second World War.

The Hurricane was the work of Sydney Camm, who began its design in 1934. The prototype first took to the air on November 6, 1935, at Brooklands, and the initial production Hurricane I entered RAF service in December 1937, with No 111 Squadron. Powered by the famous **Rolls-Royce Merlin** engine, it became the first RAF monoplane fighter with an enclosed cockpit and retractable undercarriage and was the first RAF fighter monoplane capable of exceeding 300 mph in level flight.



Figure 11- A small article from the Aviation History Online Museum

This can be taken in comparison of other websites that fall closer to the border between a website and a virtual museum, such as the Online Titanic Museum shown in Figure 12. Due in part to the focused subject area, the amount of available material on display is significantly lower. This website may have several images and very short accompanying descriptions; however, has little else to separate itself from an online gallery. The exhibits correspond to various images of artifacts, but, similar to the aviation museum, the online titanic museum does not have a physical establishment, and it is unclear if the authors are in possession of any of the listed artifacts (Online Titanic Museum, 2008). Due to these appearances, this presentation could cause the user to doubt the validity of the information presented on the page, thus

reducing its educational value. If a museum loses its credibility as an educator, the only function it serves is as an archive, which researchers may feel reluctant to trust as a viable source of information.

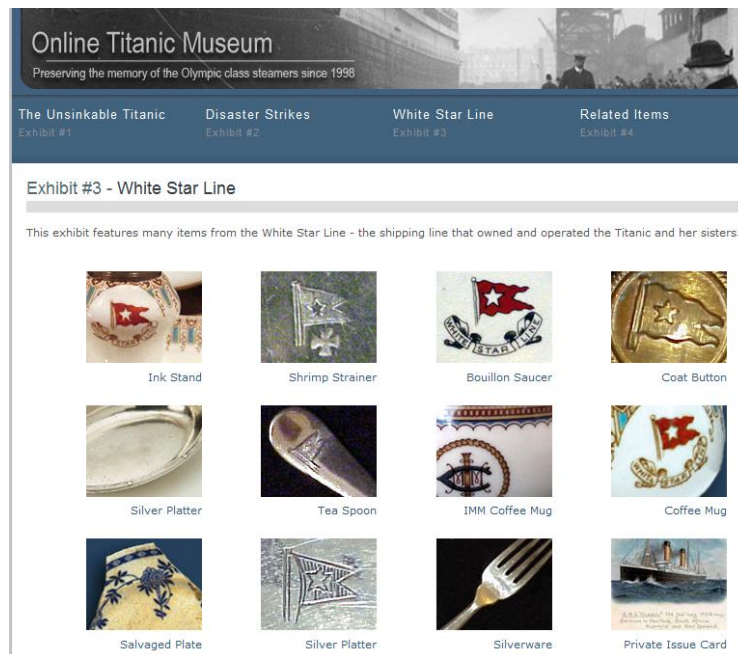


Figure 12- A screenshot of the main page of the Online Titanic Museum

Physical Layout of Museum and Tours

The concept of a museum is vague and loosely defined. For the purposes of this study, we will consider a museum to be any institution of learning (either physical or digital), whose main purpose is to preserve culture to display in an informal environment. This definition will be refined in a later section, but is adequate in grouping together the clusters of establishments that were discussed in the previous section. Historically, there is a competition between these two ideals of museums: providing an educational environment for visitors, and preserving a

historical collection of pieces. Modern museums have been experimenting in reaching out to younger visitors (contrary to stereotype of conservative museums being reluctant to accept change), a sharp contrast to the elitist origins of museums in Britain during the 19th century. As society has moved from a focus on individualism and classification to diversity and relativity, it is vital that museums keep up with society if they wish to convey their messages (Lord 2000, pg 22-23).

To gain a better understanding of the Higgins Armory, our IQP group decided to take a self-guided tour of the museum, observing both the exhibits and the tour guides. (Higgins Armory). The staff members were of particular interest to us, as we seek to emulate the friendly "human element" within our survey methods to form a close relation with the users over the internet. Several staff members were not directly giving tours, but staying near particular exhibits, occasionally stopping visitors to engage in conversation about a particular exhibit. All members of the staff proved to be very knowledgeable about all of the exhibits when we asked any questions. The actual tour guides actively led groups around the museum, stopping in front of major exhibits to provide a basic analysis and explanation. They explained safety concerns, but balanced this serious tone with an upbeat, excited personality in describing exhibits in an interactive manner (ie. asking the audience questions). These tour guides, some of which were dressed in armor, tried to connect closely with the children, referencing pop culture views of the medieval knight and contrasting these images with historic facts (choosing "buzzwords" to build vocabulary in an understandable context) (Higgins Armory).

In touring the Higgins Armory, our group also took note of the physical layout of the structure. The overall superstructure is in the shape of overlapping "V"s as seen in the Figure 13 (the rightmost "V" is a balcony above the Great Hall). The first two floors house fewer exhibits and are dedicated mostly to group activities or temporary exhibits. As we arrived to the third floor, we found that the Great Hall contained the majority of the exhibits on display, structured in a general chronological pattern (the 4th floor being a continuation of the Great Hall on a balcony with non-European and ancient artifacts). Each piece on display had a descriptive placard containing up to a paragraph of information about the item. These exhibits were supplemented with modern technology, as there four possible audio tours that one could listen to (the main tour, the Kid's Tour, Women's History, and Visual Description). In addition, there was a touch screen interactive exhibit on knights on the fourth floor, allowing one to view modern renditions of jousting matches (Higgins Armory).

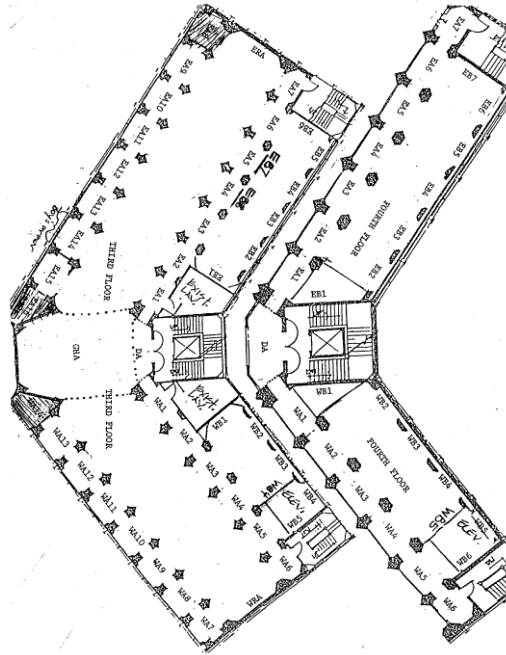


Figure 13-A floor plan of the (Great Hall)3rd and 4th floors at the Higgins Armory

A final concept worthy of note in relation to the creation of museums and tours is the ability to cope with handicapped visitors. Although these responsibilities are more closely tied with the docent, as discussed in the following section, it is vital to avoid any discrimination against handicapped visitors. One must remember that these visitors came to the establishment of their own free will, and it is only fair to foster their love for learning with the appropriate accommodations. Simultaneously, a designer must accept that all of the other visitors are at the museum for similar reasons, and their ability to enjoy themselves should not need to be compromised for the comfort of another visitor. For example, many visitors have reported that audible "speech reading" (where a user can push a button to have a pre-recorded voice read the description aloud) is disruptive to their own experiences (Lord,2000, pg 72).

Visual impairment is one of the most common disabilities that a museum visitor could have. Blind visitors require the most attention of any type of visitor because of the associated safety precautions that are necessary to prevent accidents. Signs must be placed in close proximity to path, preferably with a Braille translation. In addition, exhibits should have a sufficient quantity of space surrounding them so the visually impaired, who may be accompanied by a seeing-eye dog (for whom the museum should prepare by using durable floors and keeping food and other distractions away from exhibits). Those without an assistant typically use other senses or canes, thus it is desirable to have large doors (such that the visitor can feel the pressure difference of entering a new room) and to avoid uneven terrain for the sake of safety (Lord,2000, pg 71). If visitors have minor visual impairment, there is less of a safety concern, but it is the responsibility of the tour guide to make him or her feel less isolated from the group so that they may best enjoy their experience at the museum. Most of these limitations on the physical environment have little direct application on designing an online interface, but they are important to consider in presenting the user with an appropriate tour.

Docents

The behavior and presentations of the docents (from the Latin *docens*), educated tour guides, act as the face of the museum to the visitors. Ideally, curators aspire to obtain friendly, outgoing, and knowledgeable people to give these tours, regardless if they are being paid or volunteering. Due to their vital role to the success of a museum, docents often receive highly focused training, not only in the specifics of the presentation material, but also in the art of presentation and communication with the visitors. In addition, it is of utmost importance for

them to receive hands-on training in the museum environment (as opposed to pure research) to become a comfortable and knowledgeable representative of the establishment (Johnson et al, 2009, pg 29-30). It is important to study docents and their interactions with visitors because they constitute the majority of the previously mentioned "human element" that we wish to emulate in the final product. Through either audio or visual representation, we seek to promote user comfort through a sense of individual importance (Bowen et al, 2004, Web Personalization, para 4).

An important part of a visitor's experience that is rarely considered is the expectations that the tour guide is highly knowledgeable, not only about the subject area, but the overall layout of the museum. It is vital that docents receive more than simple documentation about individual exhibits, but rather form a close connection with everything on display, and its layout within the museum to deliver the best experience and best carry out the mission of the museum. In addition, a visitor expects any representative of the museum to display him or herself professionally as one, and to be able to direct this visitor to any appropriate staff member or location of the museum, especially in the rare event of an emergency (Johnson et al, 2009, pg 33). Therefore, familiarity with layout of the establishment and its people are essential to achieving an impressive presentation to visitors.

A docent or any educator must take great care in their manner of presentation to convey their information to the intended audience. The technique of doing so effectively has become an art form. Unfortunately, the physical body language that an instructor displays, even though it has large effect on expressing ideas, often is ignored. The importance of this

subject is undeniable in the real world; however, there is little consensus on the best physical display outside of general guidelines. A common recommended technique is to keep ones hands in front of oneself to avoid temptation to jingle keys in one's pocket or providing other unrelated distractions that show either nervousness, uncertainty, or apathy about the exhibit being explained. Furthermore, one should avoid folding or clasping one's hands together while presenting to prevent visitors from feeling unwelcome to ask questions. A visitor could easily feel subconsciously intimidated by a docent crossing their arms while speaking, thus creating a barrier between the educator and the guest. In general, a gentle clasp or resting one's hands by one's side are generally acceptable practices, but do not display the enthusiasm as a tour guide speaking with his or her hands as he or she passionately describes the subject matter. If the speaker does this in a clear voice, with understandable vocabulary, while constantly making eye contact with at least one member of the audience, he or she should easily captivate the attention of the tour group (Johnson et al, 2009, pg 33).

It is important to consider that a docent's primary function within the museum environment is supposed to appear as the face of the museum, and to educate visitors in a friendly and approachable manner. Unfortunately, situations often arise where these tasks become more complicated than they appear in a job description, and a guide finds himself or herself having to make decisions for the overall benefit of the group. A common example occasionally manifests itself with larger groups of children, such as those participating in school trip visits. In general, most consider it to darken the image of the museum for a museum official to act as the authoritarian figure in terms of crowd control, as this is not a docent's

primary role. Due to the fragile nature of a museum, a reasonable amount of control and order are required for the sake of safety. There are often several techniques employed by these guides to best provide an informative and interesting learning environment, while still encouraging safe and non-disruptive practices. Some instructors accomplish this by staring only at the students to encourage children to focus and answer questions, as opposed to the adults becoming engaged in a conversation with the docent, while the children become bored and distracted (Johnson et al, 2009, pg 33). Overall, teaching children is one of the hardest challenges a museum guide will ever come across, and many skills and techniques have been developed to help docents better handle these encounters.

As commonly imagined, one of the main types of visitors that will tour a museum are children, primarily students. Children are universally stressed as one of the most important types of guests, as they are still trying to learn about the world around them and are therefore very impressionable. Unfortunately, this curiosity about the universe around them, and the natural state of their nervous systems at younger ages, results in a constant demand for stimuli, regardless of direction. This leads to children with short attention spans, that can be disruptive or distracting from the main learning objectives of the exhibits. When dealing with very young children, it is suggested to control them from touching sensitive objects by asking them to form a large semi-circle, thus providing all of the children with an equal line of sight as well as providing a protective distance. Additionally, one may also ask children to sit cross-legged on the ground for the presentation of an exhibit to prevent them from moving around. Arguably, one of the most effective techniques in controlling the children is to actively use education as

the distraction itself and involve them in activities. Many docents take this a step further by redirecting this physical restlessness into an interactive compare and contrast exercise, which allows multiple students to participate, form independent observations, and perform an analysis. This can further be enhanced through some form of physical stimulation or related exercise, an activity that that promotes individual thought, or, for older children, the responsibility of a presentation at the end (Johnson et al, 2009, pg 33). Docents are required to find their own techniques to be successful in dealing with children, but any combination of these strategies may be employed effectively.

In order for people to learn efficiently, most educators believe that a proper learning environment must be provided to those that which to learn. There is a significant difference between formal and informal education and their corresponding environments. A formal environment appears strict to the participant and is often the material covered is part of a mandatory curriculum, thus forcing the student to learn. On the other hand, a museum falls under the category of an informal educational institution, where its participants come to learn out of their own free will. It is therefore important for both the curator and the docent to foster a guest's desire to learn and provide a less stressful learning environment, to reward their decision to learn by choice. To successfully accomplish this, the curator should be sure to acknowledge how the placement of additional photographs and exhibits that are not included in the main tour may distract the user from their learning experience. Other, non-visual distractions may also provide difficulties that should be considered, such as loud groups occupying central areas that all visitors must access. It is widely accepted that people learn

through different media at different speeds, generally associating Kinesthetic learning (through tactile objects) with younger age levels, followed by auditory learning and vocal instruction, and with visual learning (through text and images) to be appeal to higher tiers of education (Johnson et al, 2009, pg 32).

When examining objects through the senses, it is important to take into consideration disabled visitors, such that they feel neither discriminated against nor singled out from the tour group. It may be difficult to identify handicapped guests, but once a tour guide has recognized them as such, there are several common practices to help them enjoy their visit. In larger groups, where there may be multiple rows, a visitor in wheel chair should be politely invited to the front of the audience so that he or she can see the exhibit clearly. Those that are hearing impaired are more difficult to identify, and may wish to avoid embarrassing themselves by asking the docent directly for help. It is often recommended for the guide to ask in the introduction if anyone would prefer any accommodations and permit them to move closer to the speaker with minimal social awkwardness. The tour guide should then remember to keep in mind the special needs of the visitor and to speak clearly to allow all of the visitors to focus on the material and not their personal discomfort. In working with blind visitors, safety is an important goal, and these visitors should receive the most attention. Often adults can be convinced to participate with the introduction interesting trivia facts, followed by independent visual observations by the views. This allows any visually impaired members to obtain detailed information about an object as a side effect of a group activity, as opposed to feeling as though they are not part of the tour group (Johnson et al, 2009, pg 35).

The Museum-Visitor Relationship

The objective of every museum is different, but the public conception of a museum is typically that of an educational based archive of artifacts that is open to the public. Like any other major institution or organization, a museum will typically govern itself through a mission statement. By definition, this statement will clearly present the permanent, overall goals and objectives of the establishment in a manner intended to be inspiring to employees. Distinctive vocabulary such as "preserve, protect, display, interpret., etc." provide a sense of duty, obligation, and importance to all of the staff members. After viewing such statements, visitors are more likely to feel that the establishment is a trustworthy source of knowledge, and therefore focus more on their surroundings than checking what they are willing to believe. This is to contrast from specialized mandate claims and vision statements. The mandate claim of a museum is a refined mission statement that describes the subject matter in study, and how the museum is different from its "competitors." On the other hand, the vision statement is typically much shorter and can be regarded as the policy the museum has towards visitor relations and obligations to them (Lord, 2000, pg 45-46). The Higgins Armory mission statement may be viewed as a combination as fitting the definition of all three statements above, but it primarily qualifies as a mission statement. This statement tells us not only what is being studied("arms and armor"), but why it is preserved and protected ("for the benefit of the general public and specialized audiences").

"The Higgins Armory Museum is a non-profit educational institution that presents the history of arms and armor, in a broad cultural context, as shaped by the Museum's Guiding Principles. The Museum achieves its mission by preserving, researching, exhibiting and interpreting its

collections for the benefit of the general public and specialized audiences." (Higgins Armory Mission Statement)

With the user group roughly defined from the mission statement, we can gain a better idea of specific museum-visitor relations by analyzing surveys completed by past visitors. A few of the surveys that were distributed to children would contain a few short paragraphs about material at the museum, followed by questions to see what was retained. As discussed further in the following section, older children typically have preset views and interests, and they will remember information that best corresponds to their own personal views (Higgins Armory Files). By analyzing these surveys over time, it is possible to find trends in the opinions of the visitors. This often reflects pop culture at the time of the survey. For example, if a major, Hollywood movie was released about the crusades, many viewers would have a peaked interest in that area. Often they can be disappointed by the differences between reality and action films; however, we observed several of the tour guides effectively comparing and contrasting the views of society to actual history in a diplomatic fashion. In doing so, they deter the possibility of disbelief and open the visitors' minds to historic information.

Personalization

In the digital age, personalization has taken a new role in everyday life. In sharp contrast to the mass production and replaceable parts of the previous century, people of Western cultures have to come to expect and appreciate individualized attention to meet their personal desires. Naturally, museums have attempted to keep up with the pace of society and adapt their presentations accordingly. Personalization is not limited to the scope of adapting to a user's tastes, but improving efficiency of navigation and providing the user with what he or

she desires to find quickly. This has been accomplished through both modernized in-museum exhibits to interactive, online experiences.

Prior to rise of the internet in the 1990s, personalization was not a very common feature of businesses. How could one single out customers from thousands of people, and remember certain traits of each individually? The internet has an extremely large scope, and it became nearly impossible to for one to provide users with their desired information, in the correct timeframe, and to the desired amount of detail (Bowen et al, 2004, Origins and Evolutions, para 2). With every user having a unique internet protocol address (IP), or another form of user account, it becomes possible to distinguish users apart. The personalization of websites generally has three ultimate goals: to provide better service by predicting customer needs, to improve the efficiency and experience of the interaction between user and provider, and encourage the user to reuse the process to repeat business (Bonett, 2001, What is Personalization, para 2). Considering their comparable interactions with the public, it is clear why one can draw several parallels between these goals of commercial websites and those of a museum.

"Museums and galleries that are becoming available on the World Wide Web could personalize tours and suggest to you additional collections to browse, after observing your reaction to what you have already seen. The idea is to move computers toward more personal service, tailored to your ever-changing interests, without increasing the demands on you to explicitly state your preferences"-Rosalind Picard, Director of Affective Computing Research department at MIT (Bowen et al, 2004, Web personalization in Museums, para 2)

We share the same vision for our project as Rosalind Picard comments on in the statement above. Of course, we understand the realistic limitations of our project in the

grander scheme of personalization in museums, but we seek to continue down the path of modernization to allow the user to feel like an individual with as little input as possible. In addition to general attendance records to determine capacity requirements, many museums run separate surveys to gather personalization information. These can range from general exit surveys to find common areas of interest for users to subject specific surveys to find the effectiveness of a particular exhibit (Lord, 2000, pg 62). Unfortunately, conducting a survey through the internet limits our potential to generalize about visitors, as we cannot ask their opinion of exhibits they have yet to see. We may wish to incorporate previews of artifacts that our survey evaluates the user to possibly enjoy, to receive direct feedback.

Categorizing Visitors and Potential Visitors

The process of discovering the boundaries and definitions of a group is the most important question to ask when tailoring information to a specific group. Unfortunately, for researchers, classifying likes and dislikes is a very ill defined area. Both educational institutions and commercial website use a filtering technique known as "Collaborative Filtering," which uses various algorithms to profile people with similar tastes into clusters. Many businesses use this to create a "recommended for you "or" others who liked X also enjoyed Y," as a method to sell the users items that they did not originally explicitly realize that they wanted (Bowen et al, 2004, Types of Adaption, para 11). It would greatly assist the effectiveness of our product if we could create information primarily tailored for groups as opposed to individualized information, as we do not have weeks to gather information on a single user (often only a few questions from a single visit).

One of the easiest areas to delineate groups is through age differences. Due to the varying maturity levels of humans and their unique qualities, it is difficult to create clear dividing lines. For our project, we would like to consider three general age groups: children, adults, and the elderly. Children (minors under age 18) are the most unique and impressionable group, which will be expanded into further subcategories. They are widely considered the most important target audience, as many parents bring children to museums under the impression that it is a safe learning environment for their child to develop and absorb information (Lord, 2000, pg 25). For our purposes, we consider anyone between the ages of 18 to 60 to be classified as an adult, with those above this limit being elders. In 2007, Pew Internet and the American Life Project conducted a survey showing that 71% of Americans use the internet and this number is rising at such a rate that those who do not have internet access are considered a minority and deprived an American expectation of life. For our purposes, the elderly are least likely to use our webpage. The survey reports that only 32% of those above the age 65 use the internet at all, compared to 87% of users 18-29 who incorporate into their lifestyle. As of 2007, the government offers internet access to all public schools in the United States, but teachers still have difficulty bridging the curriculum and reliable internet sources. This further emphasizes the importance of children to museums, and provides a niche for our project (Johnson et al, 2009, pg 110).

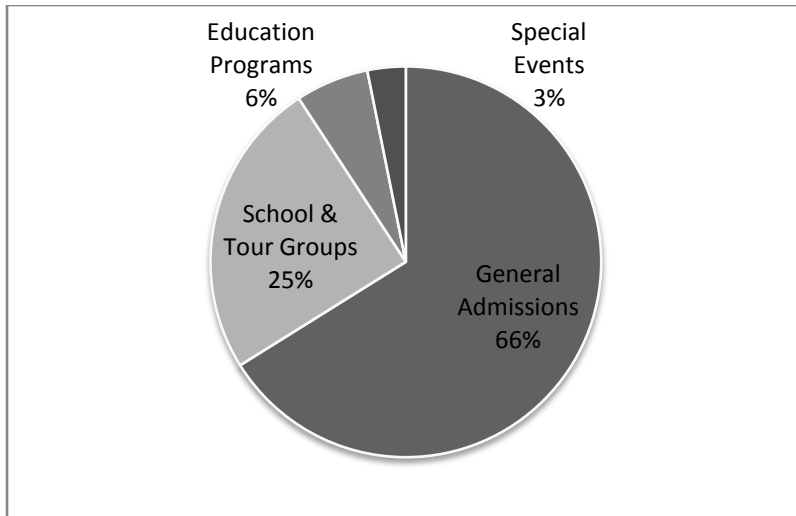


Figure 14-A Pie chart of Higgins Armory attendance records in 2009

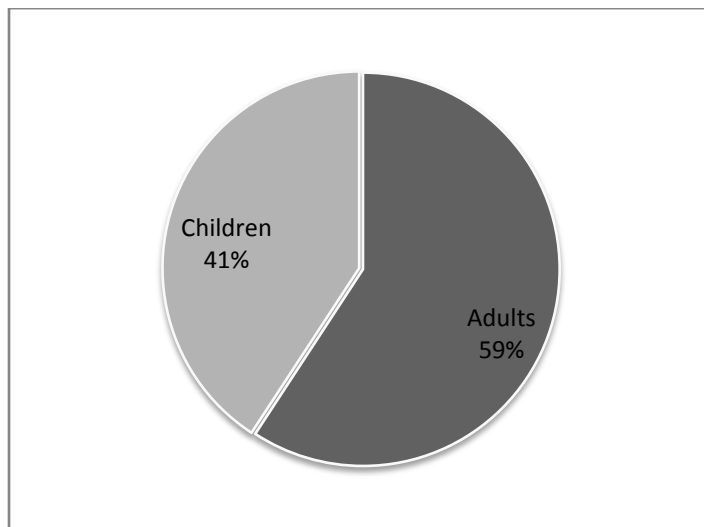


Figure 15-Pie Chart of Higgins Armory General Admittance by Age in 2009

Children are still learning about the world around them, and we must foster this desire to learn to successfully carry out the educational portion of the mission. However, this age group changes far more rapidly than the other two, and it would benefit our project to try creating multiple subdivisions of the "children category." Parents typically bring in very young

children to museums from the younger stretch of the age span of 3-7, but very few of these members would be using the internet (and our survey at this age). Long-term memory typically does not begin to develop until the upper end of this span, resulting in short attention spans and a limited understanding of past events. This youngest age group is arguably the most self-centered and individual group, yet those of the ages 6-7 typically start to seek attention and approval from adults (Johnson et al, 2009, pg 78). It is highly likely we receive many visitors from the ages 8-11, as these are both avid internet users and frequent visitors to the Higgins Armory, as seen in the following graph (Higgins Armory Files). This age group is more creative, yet open minded to the opinions of others. Most important to our project, they typically have a higher attention span and can focus on filling out a survey. On the other hand, Pre-Teens and Teenagers are much more socially centered and easily distracted by one another. They feel they have an image that they wish to uphold and are naturally afraid of embarrassment. While this age group is the youngest capable of complicated abstract thought, they develop these thoughts in an opinionated manner (Johnson et al, 2009, pg 78). In order to reach this age group, we must be able to provide information and views that coincide with their personal interests and beliefs.

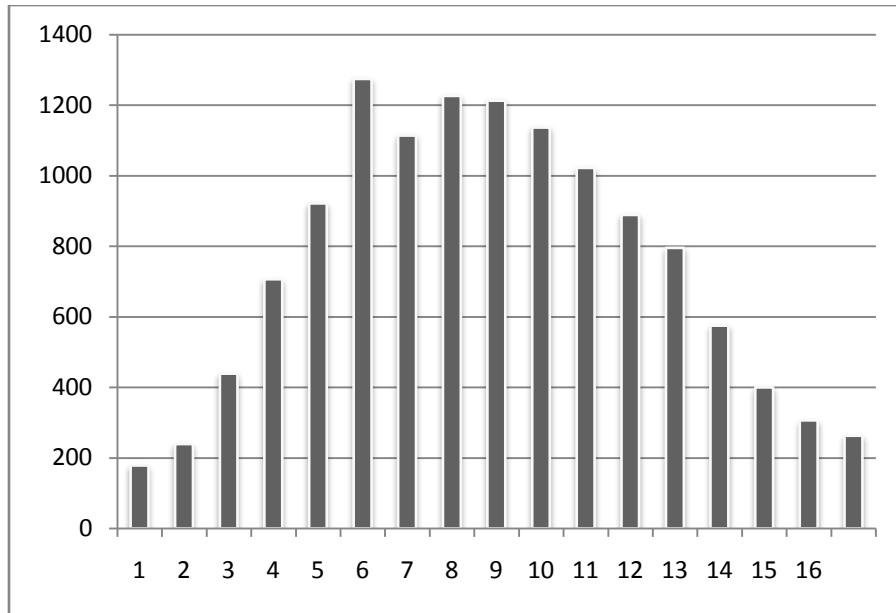


Figure 16- Age Distribution of Higgins Armory Attendance in 2009

Conclusion

As can be seen, the museum has greatly advanced its role in modern society since its beginnings as an archive. Today we view these institutions of art and culture not only as places to preserve the past, but to prepare for the future. Museums have become bastions of informal education: places of relaxed learning for those who wish to study something for pure enjoyment in the subject matter as opposed to the strict confines of a curriculum. This being said, there is no reason that an informal education cannot supplement a formal education found within the school system. After all, the most important visitors to museums are the most impressionable: children.

Although children are not our only potential users, the statistics suggest that there is a significantly higher probability of children using an online survey to design a tour compared to other age groups. It is therefore important to find methods of classification and profiling to

best group these individuals and discover related likes and dislikes within a limited number of questions. This profile will be then used to generate a personalized tour to suggest locations to a visitor in which he or she would be most interested. By using the knowledge base within this report, we intend to implement this design, while adhering to the mission statement, to help carry the Higgins armory further into the digital age.

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Web Portal and Personalized Tour Maintenance Manual

Introduction:

This manual is designed to help future developers maintain, revise, and improve both the personalized tour and the general web portal. It's designed to be accessible to the layman, although anyone reading this should at least have a basic understanding of what HTML looks like. A basic understanding of computer programming languages would help, but is not necessary.

Note that this manual is designed specifically for those making updates or revisions to this project, and as such many aspects of the system are glossed over. There are many aspects of the code that are not important for those making minor revisions, so don't expect a line-by-line analysis of the code.

Web Portal

The web portal is set up as a series of websites that all link to each other. They use one of the default templates that comes with Adobe Dreamweaver, and each one is split up into a number of different sections:

- The header bar, which contains a link back to the home page and the title banner
- The link bar, which contains links to every other project in the portal
- The footer, which contains copyright information and the names of the page authors
- The main section, which contains the content of the page

This section will detail instructions on how to add a new project page to the main section, as well as some suggestions for future improvements to the page.

Adding a New Project

Adding a new project to the portal is a 3 step process: you have to make the page, add links from all the other projects, and add it to the home page.

Creating a Project Page

To create a project page, look through the portal website folder to find the HTML file called `v_armory_template.html`. This is a website template created for use with new projects. Open this up with whatever editor program you prefer, from Notepad to Dreamweaver. Before you do anything else, you should first re-save this file as something else so that you don't write over the template.

Of the four sections mentioned above, there's only three you need to worry about when creating a project page. To start, scroll down to the very bottom of the page to find the `<div class="footer">` tag. Below that, you should see a section that says `<p>Created by Author Name Here</p>`. Put the names of the people in your project where it says "Author Name Here"; you want to get credit for your work, right?

Next, scroll back up a bit to find the section that says `<div class="sidebar1">`. You should notice that this section has a list of links. Choose where in the list you want to put your new project (probably at the top or bottom), and add the following line of code:

```
<li><strong><p>Short Project Name</p></strong></li>
```

With the name of your project substituted for “Short Project Name,” of course. Note that it doesn’t matter where in the list you put this, as long as it goes between the `<ul class=“nav”>` and `` tags. Changing which line it goes on will just change its position in the list.

Finally, look right below this to the `<div class=“content”>` tag. This is where you’ll put all your content for your page. Put your title where it says “Title of your project,” and add whatever content you feel is necessary below that. Adding text is as simple as just writing text between `<p>` and `</p>` tags. Images can be added using `` tags. Links use the `Link text here` tag. There’s a lot more you can do with HTML, but that is beyond the scope of this tutorial. For more tips and tricks, try going to www.w3schools.com, which is a great site for learning HTML and web-based coding.

Adding Links from the Other Projects

Now that you have your project page all set up, your next step is to add a link from each of the other project pages to your page. This is fairly simple, and is similar to how you added the project name to the link bar on your page. On each of the other project pages, add the following line of code in the same place you put your project name in the link bar on your page:

```
<li><a href=“YourProjectPage.html”>Short Project  
Name</a></li>
```

You should remember to use the same name you used on your page, so that clicking it looks like you've made a selection. `YourProjectPage.html` should be replaced with the file name you gave your project page.

Adding Link from the Home Page

Adding a link from the home page is a little more complicated, because the home page has a feature where putting your mouse over one of the links makes a short description of your project appear, along with an image that represents your project. This means that the code to add a link to the side bar is a little more complicated. Open up `index.html`, scroll to the `<div class="sidebar1">` tag, and find the correct place in the list as normal. However, instead of adding the simple line of code above, add this line:

```
<li><a href="YourProjectPage.html"
onmouseout="RestoreImageText('textTable', GetDefaultText())"
onmouseover="ChangeImageText('rollImage', 'textTable',
'imagepath', 'Short description of your project')">Short Project
Name</a></li>
```

Okay, get all that? As before, `YourProjectPage.html` refers to the name you gave your project page, and `Short Project Name` refers to the project name. There are two other things you need to worry about here, though. First, you should get an image that you believe represents your project, and put the file path for that image where it says "imagepath." For example, it could be "knight.jpg" or "project/new_sword.png." Make sure you keep the single quotes there, as those are important. Finally, come up with a short description of your project and put that where it says "Short description of your project." Again, make sure to keep the single quotes.

Example Code

What follows is a complete example of how to add a page. Each step will include one code snippet, with default code appearing black and added code appearing red. Each snippet will include the name of the file it was taken from, as well as a starting line number.

Part 1: Creating a new project page

Filename: v_armory_template.html (renamed MyProject.html)

Starting line: 153

```
<div class="sidebar1">
<ul class="nav">
    <li><strong><p>My Armory Project</p></strong></li>
<li><a href="personalizedTour_Home.html">Personalized
Tour</a></li>
<li><a href="pikes.html">Explore a Battle</a></li>
<li><a href="helmet.html">Virtual Helmet</a></li>
<li><a href="musket.html">Zoom-in Musket</a></li>
<li><a href="knight.html">Dress-a-Knight</a></li>
</ul>
<!-- end .sidebar1 --></div>
<div class="content">
<h1>My Project</h1>
<p> This is a description of my project. Here's a picture of
it:</p>
    
    <p> If you want to go to another part of the project, you
can click <a href="nextPage.html">here</a>. Etc, etc, etc.</p>

<!-- end .content -->
</div>
<div class="footer">
<p>Created by Fred Bar</p>
    <p>All Material © 2011 Higgins Armory Museum</p>
<!-- end .footer --></div>
<!-- end .container --></div>
</body>
```

Part 2: Adding links from other project pages

Filename: knight.html (although something similar would be in every other project page)

Starting line: 153

```
<div class="sidebar1">
<ul class="nav">
    <li><a href="MyProject.html">My Armory Project</a></li>
<li><a href="personalizedTour_Home.html">Personalized
Tour</a></li>
<li><a href="pikes.html">Explore a Battle</a></li>
<li><a href="helmet.html">Virtual Helmet</a></li>
<li><a href="musket.html">Zoom-in Musket</a></li>
<li><strong>
<p>Dress-a-Knight</p></strong></li>
</ul>
<!-- end .sidebar1 --></div>
```

Part 3: Adding link from home page

Filename: index.html

Starting line: 211

```
<div class="sidebar1">
<ul class="nav">
<!-- This list contains the nav-bar information.  To add a new
element to the bar,
    use <li> and <a href> tags to create a link.  To make the
link change the rollover
    image and text, use
onMouseOver="ChangeImageText('rollImage', 'textTable',
    '[corrisponding image file name]', '[text to display
next to image]')" and onmouseout="RestoreImageText('textTable',
GetDefaultText())" -->
    <li><a href="MyProject.html
onmouseout="RestoreImageText('textTable', GetDefaultText())"
onmouseover="ChangeImageText('rollImage', 'textTable',
```

```

`projectPicture.jpg', `This is an example project. It doesn't
actually have anything in it.')">My Armory Project</a></li>
  <li><a href="personalizedTour_Home.html"
onmouseout="RestoreImageText('textTable', GetDefaultText())"
onmouseover="ChangeImageText('rollImage', 'textTable',
'Personalized_Tour/knight_closeup.png', 'Take a short quiz to
generate your own personalized museum map')">Personalized
Tour</a></li>
<li><a href="pikes.html"
onmouseout="RestoreImageText('textTable', GetDefaultText())"
onmouseover="ChangeImageText('rollImage', 'textTable',
'Pikes_Interactive/images/Pikemen.jpg', 'Explore an interactive
image of a medieval battle')">Explore a Battle</a></li>
<li><a href="helmet.html"
onmouseout="RestoreImageText('textTable', GetDefaultText())"
onmouseover="ChangeImageText('rollImage', 'textTable',
'Rotating_Helmet/702.a.jpg', 'View a French helmet from the
1600s in 3d rotating perspective')">Virtual Helmet</a></li>
<li><a href="musket.html"
onmouseout="RestoreImageText('textTable', GetDefaultText())"
onmouseover="ChangeImageText('rollImage', 'textTable',
'Kabyle_lock_musket_closeup/kabyle-lock.jpg', 'Zoom in on a
Moroccan musket to discover its outstandingly detailed
craftsmanship')">Zoom-in Musket</a></li>
<li><a href="knight.html"
onmouseout="RestoreImageText('textTable', GetDefaultText())"
onmouseover="ChangeImageText('rollImage', 'textTable', 'Dress-A-
Knight/pictures/completeKnight.gif', 'Play a short game to learn
how a knight put on his armor')">Dress-a-Knight</a></li>
</ul>
<!-- end .sidebar1 --></div>

```

A Couple Suggested Improvements

- Currently, every time you want to add a new project, you have to add a link from every other project. Sure, that's fine when you only have four or five projects, but it's going to get more and more cumbersome as the number of projects increases. I'd suggest

adding something so that you only have to add the link once. Maybe do something with frames, for those who are skilled with HTML?

- The site's layout is fine, but aesthetically it doesn't really match the theme of the Higgins Armory Museum. Perhaps someone in the future could make it look a little more medieval?

Personalized Tour

The major technical part of this project is the personalized tour, a system that quizzes the user to gather information about his/her preferences in arms and armor, and creates a printable museum map, customized with images and descriptions of artifacts, upcoming special events, and a fun, extra tidbit, all tailored to the answers the user gave to the survey. The user can bookmark this map and print it out again later, or take the tour again to get a different, randomized map.

The design of the personalized tour was focused around updatability. The entire system is built around the idea that no one should have to go into the actual website code to make changes to the quiz questions or map items. This was done with liberal use of XML files, the details of which will be discussed later.

This section will cover three central topics. First, it will examine how the system works, in both a simplistic overview and a page-by-page detailed look. Second, this section will give

detailed instructions on how to make updates to the tour. Finally, it will quickly go into a couple of improvements that could be made to the system.

How it Works: An Overview

The personalized tour system has two basic functions: information gathering, via the quiz, and information interpretation, via its profiling system. First, the system presents the user with a short quiz, and stores the user's answers. Second, using the answers it recorded earlier as a guide, it chooses various map elements it thinks is appropriate, and creates the custom map.

The quiz is divided up into four sections. In the first section, the tour asks two questions, each of which has three answers corresponding to the three "major" categories: military, art, and history. Once these are determined, the user is brought to a second page with five new questions. The first question is always designed to determine the user's time period preference. The last four depend on what the user answered on the first page. If the user chose two different major categories, say art and history, the user would be given two questions linked to that specific category. These questions are designed to go into more detail about what exactly the user likes about that subject. If the user chose the same major category for both questions, the user is given four questions from that category.

The six categories are, in order of their listing in the file:

- Major category questions, which ascertain which of the three major categories (military, history, and art) the user likes.

- Time category questions, which ascertain which time period the user likes.
- Minor category questions, which are sub-divided up into three sections: one for each major category.
- General minor category questions, which are asked regardless of which major categories are chosen.

After all the questions are answered, the user is sent to a tabulation page that quantifies the user's answers and puts them into a profile that the system uses as a guide to determine which artifacts, future programming, and "fun fact" it should add to the map. It picks these semi-randomly from their respective lists, and sends the data to the printable map, which pulls the correct images, text, etc. and prints it in the correct locations.

This is a very general overview. More detail about the process will be given in the next section.

How it Works: A Detailed Look

The personalized tour comprises six web pages in all: the home page, the three question pages, the results tabulation page, and the map page. Each page does some information gathering or computation, and passes that information to the next page using a query string stored in the URL. How query strings work will be explained shortly. For now, each page in turn will be examined in more thorough detail.

The Home Page

The personalized tour home page is, computationally, very simple. All it does is get the user's name and browser information, and passes that information to the first question page. This is the page that interfaces with the rest of the portal, so any links to additional projects (as mentioned in the previous section) should be put here.

As mentioned above, the home page has to "pass" the user's browser information and name to the next page. One important distinction between standard programming and web programming is that any information stored on one web page is lost when the user goes to another page. In order to "store" information, you have to pass it from page to page as the user progresses. There are multiple ways to do this, but in this case it was decided to use a query string. Query strings are variables that are stored in the URL, but don't affect the web page they link to. Instead, they provide additional information that the website can use to alter its content. A query string starts with a "?" placed at the end of the normal URL, then adds a number of variable names and assignments, like "name=George&id=12345". You may recognize this format from websites like Google, which use query strings to make it possible for users to bookmark particular searches. All the information the site needs to do a search is stored in the query string, so by saving this string one can immediately return to a particular search.

The Question Pages

Once the user's name and browser information are determined, the site picks two major category questions randomly and displays them on the screen. When the user clicks the "next

page” button, the site checks which answers are currently selected, and adds that information to the query string. Since all major category questions contain exactly three answers (one for each major category), it simply gets which category the user chose for each question. This makes it easier for the next page to pick questions relating to the major categories (see below).

The questions themselves are not actually written in the HTML file. In programming, it’s usually ideal to keep most of the important, hard coded data in separate files, so that they can be easily changed. As such, the project required a simple to use file type that is easily read by both humans and computers. Fortunately, such a file type exists: the XML file.

XML files, for those that don’t already know, are a data storage format designed to be easily read and traversed by computers. They store information using a series of nested fields, represented in the document as tags. These fields are organized into a tree structure within the computer, with a single “root” node with several branches. Each branch can itself have sub-branches, and so on and so forth. This makes it very easy for a computer to go through each node in turn, gather information, and move on to the next one.

As an example, in order to find the text to print for a particular major category question, the system starts at the root node of the file, then travels to the “major category” node. This node contains a number of question nodes, which the system picks randomly from. It then opens each question node and travels to the “text” node, which contains the text it should print on the screen.

The other two question pages work in a similar fashion: upload question base, choose and display questions, and record results in query string. There are a couple of specific differences between them, but nothing substantial. For example, the minor category questions on the second page are chosen based on the major categories chosen from the first page.

The Results Page

This is where the results are tabulated. Using the results stored in the query string, the system starts by loading in the major and time categories, then starts going through the minor category questions. Each of these questions assigns a weight to one of the minor categories, and these weights are added together and stored in a profile on this page. The system then uses the profile to match artifacts, special programming, and extra tidbits to the user.

Currently, the profiling system works fairly simplistically. First, it finds the three highest weighted minor categories, picking randomly amongst ties. It passes this data, along with the major and time categories chosen, to the `GetRelevantArtifactsFromXML` function. This function works through the artifact list and picks an artifact weighted towards the user's preferences.

More specifically, the system sorts all the artifacts/special programming into three "tiers," which determine how likely an artifact is to be picked. Tier one artifacts match the user's profile exactly; both major categories, the time category, and all three minor categories are the same. Note that this is independent of the order in which they are listed (the artifact might list its minor categories as "animals, blades, strange_weapons," and a query of "strange_weapons, animals, blades" would find it). Tier two artifacts are a little more lenient;

the two major categories need to be the same, and at least one minor category has to match, but that's it. Tier three artifacts consist of all the artifacts that match the profile in any way, however small.

Once the system has built these tiers, it checks how many artifacts are in each one. If there are any artifacts in the first tier, the system has a 5/8 chance of choosing an artifact from the first tier, and a 3/8 chance of choosing from the second tier. These choices are made completely randomly. If there are no artifacts in the first tier, but there are artifacts in the second tier, it chooses between tiers two and three, with a 5/6 chance of choosing from tier two. If there aren't any artifacts in either tiers one or two, it just picks from tier three.

The extra tidbits work a little differently. Like the artifacts and special programming, they are chosen randomly from a list. However, instead of making the choice based on the top three minor categories, the choice is based solely on the highest rated minor category (more details later).

The Map

Once all the randomization is done, the system puts all the relevant information into a new query string and sends it to the map page, which uses the data stored in the XML files to assemble the printable map. Since the map itself doesn't do any randomization, the user can bookmark the map page or copy the URL to return to that map at any time. Due to formatting differences between Internet Explorer and other browsers, there are actually two different map

pages, formatted differently. This is done to ensure that the map will always fit on one page when printed out.

Updating the Tour

In most cases, adding updates to the tour is simply a matter of editing the XML files that store a majority of the data that the tour uses. Each of the different changes that can be made uses a different XML file and has different qualities. This section will outline all of the different changes that can be made to the system using these files, and how to make these changes.

Adding/Removing/Changing Questions

Believe it or not, none of the questions in the tour are hard-coded, except for the beginning, where the system asks you for your name. Apart from that *every* aspect of *every* question is stored within the questions.xml file. This makes it the longest and most complex of all the XML files used by this project.

Questions.xml is divided up into six sections, one for each kind of question. The format for each question is the same, so just make sure that when you add your question to the XML file, you put it in the right section. These sections are marked with tags that surround them, using the keywords <major>, <time>, <military>, <history>, <art>, and <general>.

Questions are represented using <question> tags. Each question tag contains a number of additional fields, which contain the information about that question, such as its text, input type, and whether or not it contains media. The following is a run-down of each of the fields in a question, and what it does:

- <number>: This field is simply an identifier that can be used to uniquely address a question. Add a new number for each question you add.
- <age>: This field was going to be used for a feature that would differentiate the questions into two age groups: “A” for adults, “C” for children, or “AC” for both. However, that feature is currently unsupported. Put this field in anyway, though, as removing it will throw off the website when it tries to import the XML.
- <media>: This field can be used to add an image or video to a question. It comprises two additional fields:
 - <type>: The type of media that should be displayed. This can be one of several options: “image”, “wmv”, “mov” and “swf” are supported.
 - <filename>: The file path for the image you want to display, relative to Portal/Personalized_Tour/images.
- <inputType>: This field determines what type of input choice the user is given. Currently, two input modes are supported: “radio”, which allows the user to make one and only one selection, and “checkbox”, which allows the user to choose as many options as he/she wants (including 0).
- <text>: This is the text that is displayed on the screen when the question is loaded.

In addition to these fields, a question also has one or more <answer> field, which outline the choices the user can make. Answer fields also have several additional fields inside them:

- `<id>`: Like the question's number field, this field is used to uniquely identify each question. Make sure each one is different for a given question.
- `<text>`: Same as the text field for the question, in that it contains the text that is displayed on the website
- `<value>`: Value fields determine what this answer represents, i.e. which category it adds points to. An answer field can have more than one value field, and each value field contains two additional fields:
 - `<category>`: The category that this answer adds points to. This can be a major category, a time category, or a minor category. A list of categories can be found in a later section.
 - `<weight>`: If the category field represents a minor category, it should also have a weight, which determines how much it adds to the minor category when the profiler checks them. In this case, weight should be a number. If the category field represents a major or time category, the category is unweighted, and this field should be "NA".

Modifying the question list is then simply a matter of adding, removing, or changing the values in question fields. When adding a question, make sure you don't accidentally put one question inside another. In addition, here is a template (complete with three answers) that you can use for adding questions:

```

<question>
  <number></number>
  <age></age>

```

```

<media>
  <type>none</type>
  <fileName>none</fileName>
</media>
<inputType>radio</inputType>
<text></text>
<answer>
  <id>a</id>
  <text></text>
  <value>
    <category></category>
    <weight></weight>
  </value>
</answer>
<answer>
  <id>b</id>
  <text></text>
  <value>
    <category></category>
    <weight></weight>
  </value>
</answer>
<answer>
  <id>c</id>
  <text></text>
  <value>
    <category></category>
    <weight></weight>
  </value>
</answer>
</question>

```

Removing a question is as simple as deleting one of the question tags, from <question> to </question>. Be aware that in order for the system to work correctly in all circumstances, the <major>, and <general> sections need at least two questions, the <military>, <art>, and <history> sections need at least four questions, and the <time> section needs at least one.

There is no upper limit to the number of questions you can add, nor is there a limit to the number of answers a question can have (as long as it has at least one).

Adding/Removing/Changing Artifacts and Special Programming

The artifacts that are displayed on the map are also stored in XML files, in this case `dataFourthFloor.xml` and `dataThirdFloor.xml`. These files contain data for artifacts stored on the fourth and third floors, respectively. Their format is very similar to the question format, albeit somewhat simpler. In fact, you can open and edit the artifact XML files in Microsoft Excell.

As with questions, each artifact is represented by an `<artifact>` tag that contains several fields. Here's a run-down of these fields and what they represent:

- `<anum>`: This field is an identifier, and can be any string you like. Generally, it's used to store the artifact's database ID.
- `<description>`: This field gives a short description of the artifact that is then displayed on the map.
- `<publicloc>`: This field was taken from the database, and represents where the artifact is stored. For the current implementation, the only thing that matters is whether it's stored in the east or west wing. Just make sure that the first two characters of this field are "4W" or "3W" for the west wing, or "4E" or "3E" for the east wing. If the object is on the first floor, you can put "Lobby" or "Orientation gallery", but make sure to store it in `dataThirdFloor.xml`.

- <image>: The filename for the artifact image. Artifact images are currently stored in Portal/Personalized_Tour/images.
- <...Category>: Following the image field are six category fields: two major categories, one time category, and three minor categories. Each artifact must have two major categories and one time category associated with it. They must also have at least one minor category, although you don't need to fill out all three of these. To have fewer than three, just put in "null" for the ones you don't use. See below for a list of categories.
- <museumTreasure>: This tag can be "true" or "false", depending on whether or not you want to consider this artifact a "museum treasure." Currently, being a museum treasure doesn't do anything.

As a short additional note, be aware that you should probably put all your text on one line.

If you need to, use "\n" to add forced line breaks. For example, "This is a\nctest" would look like this:

This is a

ctest

Here's a template you can use to add artifacts:

```
<artifact>
  <anum></anum>
  <description></description>
  <publicloc></publicloc>
  <image></image>
```

```

    <majorCategory1></majorCategory1>
    <majorCategory2></majorCategory2>
    <timeCategory></timeCategory>
    <minorCategory1></minorCategory1>
    <minorCategory2></minorCategory2>
    <minorCategory3></minorCategory3>
    <museumTreasure>>false</museumTreasure>
</artifact>

```

Special events are structured almost identically to artifacts. The XML that contains event data is dataProgramming.xml, and has the following differences:

- Instead of a <publicloc> field, special events have <date> fields which store the date or dates the event will take place.
- The images for special events are stored inPortal/Personalized_Tour/images/programming.
- Special events have no <museumTreasure> field.

Other than that, the two are identical. They're even still called "artifacts," to make the code easier. Here's a template you can use for special programming:

```

<artifact>
    <anum></anum>
    <description></description>
    <date></date>
    <image></image>
    <majorCategory1></majorCategory1>
    <majorCategory2></majorCategory2>
    <timeCategory></timeCategory>
    <minorCategory1></minorCategory1>
    <minorCategory2></minorCategory2>
    <minorCategory3></minorCategory3>
</artifact>

```

Adding/Removing/Changing “Fun Facts”

The “fun facts,” or extra tidbits that are displayed at the bottom of the map, work a little differently than the artifacts and special programming. Instead of choosing randomly based on the profile, the system chooses a tidbit based on the minor category that the user scored the highest on. Extra tidbits are stored in dataExtra.xml, and have the following properties:

- `<category>`: The category that this extra tidbit is associated with. You can have more than one per category, but you can only associate them with minor categories.
- `<description>`: Same as with artifacts and special programming.
- `<image>`: Images for extra tidbits are stored in Portal/Personalized_Tour/images/extra.
- `<header>`: This is the text used for the header. This is so that you can customize the type of extra tidbit you want to use. Currently, two are implemented: “Fun fact!” and “Medieval Career:”.
- `<id>`: This was added in last-minute to support multiple extra tidbits for each category. If you have a category with more than one extra tidbit, you *must* make each one have a different ID.

Finally, here’s a template to use for extra tidbits:

```
<artifact>
  <category></category>
  <description></description>
  <image></image>
  <header>header>
  <id></id>
</artifact>
```

List of Categories

Here's a list of all the categories, for reference. Note that these are case sensitive; make sure to use all lowercase letters, or the system could break.

- MAJOR CATEGORIES
 - military
 - art
 - history
- TIME CATEGORIES
 - ancient
 - middle
 - late
- MILITARY MINOR CATEGORIES
 - cqc
 - ranged
 - polearms
 - blades
 - armor
 - strange_weapons
- HISTORY MINOR CATEGORIES
 - social
 - technology
 - political
 - religion
 - sports
 - animals
- ART MINOR CATEGORIES
 - fantasy
 - design
 - symbols
 - representational

Suggested Improvements

- Currently, the code that detects the user's browser type is a bit of a hack. It could certainly use some improvement.
- Due to the fact that I didn't learn how to import code from an external file until the end of the project, there is a lot of repeated code in the pages, especially between the question pages. This could certainly be exported into a separate file, for maintainability's sake.
- The profiling system works okay for a prototype, but it could certainly be more sophisticated. In addition, the weights for each of the questions could be altered to better fit the questions.
- Our sample size for questions, artifacts, programming, and "fun facts" is fairly small, and doesn't represent each of the categories equally. Adding more of these would help balance things out a bit more.
- As a last minute change, the results screen was augmented using an open source Flash chart program (<http://teethgrinder.co.uk/open-flash-chart-2/>). Unfortunately, since the change was last minute, there wasn't enough time to put the parameters in a separate file. Storing things like chart type, title, colors, etc. in a separate XML file would make the chart much easier to update.

Conclusion

A-Term (PQP)

The first term of the IQP was essentially a planning stage. The primary goals were to design the project and begin researching what would be necessary to complete the project. The term began with brainstorming sessions to decide on an interactive, technology-based project for use as an educational tool at the Higgins Armory Museum. From these sessions arose three major ideas: An online strategy game, an interactive world map/timeline, and a virtual tour of the museum.

The online game was a web-based turn-based fighting game where players would learn about the use of arms and armor. The player would be able to choose a time period and location, which would determine what options they were given for weapons and armor. The game would teach players what strategies were effective for different types of arms and armor, as well as why they were effective. While there was much interest in creating this game, there were some issues with the idea that could not be ignored. The idea was over-ambitious and complicated, requiring a large amount of research into the use of arms and armor from multiple time periods and geographical locations. This project would also have required artistic direction, particularly in the combatants' animation, resources the group did not actively have at its disposal.

The second idea, the interactive world map/timeline, was a much simpler design. The project would consist of a web-based map of the Eastern Hemisphere, where moving the cursor over certain regions would show basic information of the region. Clicking on the region would

zoom the map in, presenting more detailed information about the technology of the region. Along the side of the map would be a scroll-bar or clickable buttons that would change the time period, to compare and contrast technology in these regions over time. This project would have been more feasible to complete given the time constraints of the IQP when compared to the strategy game, but there was less interest in the group due to a lack of interactivity in the project. The group wanted a project that stimulated the user's interest in the subject at hand.

The final idea was a web-based virtual armory tour, complete with an interactive three-dimensional view of the armory. The museum could be navigated in a style similar to the Google Maps "Street View," where a viewer can look at pictures of a location from many angles. Through the armory, exhibits would have clickable points that would provide information on the nearby artifacts. The project would also contain a two-dimensional floor plan of the museum allowing quicker navigation. The code used in the project would have to allow the museum staff to easily update pictures and text to reflect new additions to the museum. This project was ultimately chosen by the group, though the project was changed dramatically shortly after research was done on the topic of museum tours. The three-dimensional view was discarded in favor of a more personalized, guided experience. A user would answer light-hearted and humorous questions, and based on the answers, a floor plan highlighting objects of interest would be presented.

The remaining weeks of the first term was spent doing preliminary research, finding reliable sources in three major categories: Arms and armor, profiling, and museum tours.

These sources would become the basis of the work done in the second term, the research required to complete the project.

B-Term

The second term of the IQP was the researching stage. As in the term before it, there were three main categories of focus, with each member responsible for gathering information relevant to the project. General information on arms and armor was necessary, as the project is most importantly an educational tool. The virtual tour was designed specifically to teach visitors about objects to their specific liking, so research was done on the manufacture, design, and use of arms and armor displayed in the museum, as well as the social impact these items had when they were used.

Equally as important was the second topic of research: museum tours in relation to technology. This project is essentially a gateway between the current digital age of information everywhere and the somewhat antiquated concept of a brick-and-mortar museum. The current generations of youth are more accustomed to gathering information on the Internet as opposed to visiting a museum first-hand; this is a way to capture the interest of a young audience. The research covered existing virtual tours used by other museums, more traditional tours of museums, as well as ideas on personalization to spur visitor interest. With this in mind, the project was designed to offer a unique experience to each user based on their interests, bringing new technology into the museum set of educational tools.

To successfully create individualized tours, research was done in the field of profiling and demographics. The tour would require programming a website that would collect data

from the user, then choose artifacts and exhibits in the museum that the user would be interested in learning about. The group used this information to create a survey where the user is asked a series of multiple-choice questions, which categorized the results and selected items that were pertinent to the user's responses. The research was also used in determining the core audience for the tour; demographic studies showed correlations between a museum's core audience and its types of exhibits. This project is technology driven and caters to an audience of teenagers and young adults, attempting to bring a more contemporary audience to the museum. With this research complete, the group would move on to designing and coding the survey, as well as the web portal for Higgins Armory IQPs.

C-Term

The third term of the IQP was the implementation phase. The main goal of this phase was to complete the web portal and get the survey to a functionally complete "beta" level. The work in this term was divided up into three parts. First, the questions themselves would have to be designed, and resources would have to be gathered to use as survey results. Second, the web portal would have to be tested and updated, to get it to a finalized version. Finally, the web site for the survey itself would have to be built, and the scripts that allow it to run would have to be written.

The primary goal for designing the questions was deciding how the survey would actually work. There are many different ways to get information out of the answers chosen from a survey, and a decision needed to be made as to which one was to be used. The eventual choice ended up being a weighted profile system, where each answer would have a number of

different categories and weights associated with it. These weights would be added up at the end, and the top three would be picked to use as a basis for the user's preference. In addition, a decision had to be made as to the layout of the resulting map, and what was actually going to be displayed. Taking examples from the Higgins Armory exhibit database, a list of artifacts from the third and fourth floor was compiled to use for this purpose. In addition, the user would be provided with an upcoming special event, and an extra tidbit such as an interesting fact.

The portal was in its final stages when C term began. Most of the work in this part involved layout issues and finalizing the content of the pages. This included changing and adding various images, making small changes to the text in various places, and adding a header to the top of the page.

The web portal itself required six different web pages: an introduction page, three question pages, a results compilation page, and a printable map page. It was decided that the question and artifact data would be stored in external XML files, and their content loaded into the web pages when necessary. As such, most of the actual work in this part was in the scripts that loaded in the data, picked random questions and artifacts, and added that data to the screen. Using Javascript, most of the required behaviors were implemented by the end of C term, with only one major problem involving browser compatibility remaining.

D-Term

The fourth term of the IQP was the finalization and testing phase. The primary goals for this phase involved fixing any outstanding bugs, testing the product with other users, writing the documentation, and generally adding any polish where it was needed.

The most important task for the beginning of D-term involved fixing a major bug involving browser compatibility. The system worked fine when it was loaded in Mozilla Firefox, but crashed when it was loaded in Internet Explorer 8. Initial Internet searches suggested that the problem was security related, but it was later discovered that these issues were due to loading the program from a flash drive instead of from a server. Even so, the system still didn't work, and as such a second bug was discovered: an indexing issue due to differences between how the two browsers handle importing XML files. Finally, a third issue cropped up involving the formatting of the map itself. In response to this issue, the map was reformatted using CSS, and separate versions were created for IE and Firefox, due to problems with printing size.

Future Extensions

This project started with great ambition as early as the first meeting at the beginning of A-Term. The majority of the start of the term was dedicated to developing a project idea, and generating a springboard off which to build the remainder of the project. As mentioned previously, many good ideas, such as creating an interactive game or an interactive timeline needed to be turned aside so the project could move forward. These projects were highly feasible, but they either required resources that were not readily available or did not focus on a topic that the group found interesting. The selection of the survey and portal was one of utility

and interest, not on the project specifications themselves. For example, a future IQP team that is highly artistic may find the flash game to be an appealing project and pursue it with great success.

Outside of these initial ideas, several features were discussed throughout the remaining three terms of the project. Unfortunately, there were time constraints and restrictions on resources (especially server access and expertise) resulting in the decrease of overall scope. These ideas, however, were archived in notebooks in the hopes of passing the torch to future groups. Limitations in technology and resources of the current time may not necessarily be applicable to successive years. This is applicable to both the Portal and the Survey.

The most straightforward area to expand is the Portal, as it was created with intention of future expansion. It is hoped that future IQP groups will turn to the Portal for inspiration, and they will in turn pass on their legacy by incorporating their own projects within the Portal. Cosmetically, the Portal has passed the approval of the Higgins Armory Museum, but it will take several months to get feedback from users. Without feedback, it is very difficult to anticipate what people would want changed. The functional aspect of the portal was fully tested, and added features to navigation may make it appear cluttered and forbidding to outside users. In the interest of appealing to visitors outside of the IQP program, it would be beneficial to add more interact features to independent projects on their respective pages, provided this can be completed without unbalancing the current structure of the website.

Among the most impressive ideas within the survey was taken from the brainstorming process in A-term. Originally, a three-dimensional map was envisioned to be able to explore discrete points at the Higgins Armory Museum. The most relevant example of prior art would be the Google Maps Street View system, where a user can have an interactive, panoramic view of the world around him or her. Provided that one could divide the museum into discrete points at which one could view exhibits, this would be an impressive accomplishment. This, however, was considered to be a major difficulty, considering the frequency at which exhibits can be moved (necessitating constant updates on both exhibits and effective points of interest), and the navigational requirements of having four separate floors, whereas Google Maps Street View only looks at one level. Another major complication would arise from the actual imaging techniques, which would require a platform on which a camera could move and take several independent pictures, then splice these pictures into one three-dimensional view. Although this would be a time consuming process, the final result of a three-dimensional virtual tour, would be an inspiring addition to the survey map or even as a standalone project.

There were several smaller ideas for expansions on the survey itself. Although the group is satisfied with the result page of the survey, there is always room for improvement and expansion. The addition of questions and artifacts would result in a greater verity of responses and a more unique experience for the user. There is a significant amount of room for creativity in this field, especially in generating questions, as quality far outweighs quantity, when attracting the attention of a user. The survey is fully equipped to support video based questions, where one could provide a short clip to the user, then ask a question about when he

or she first noticed or enjoyed most. This would be a further extension of the picture based questions, which are one of the most attractive features of the survey. Fortunately, the modular form of the XML files used to store the data are very simple and easy to modify, resulting in an updatable survey rather than a static project. In the middle of C-term, it was originally hoped that a GUI could be added to make editing the questions for the museum more user-friendly, but this grew to be too complex, and become a lower priority to establishing the overall functionality. With this now complete, a future IQP team may find it worthwhile to looking into creating an easier method of adding questions and artifacts.

Cosmetic improvements to provide a more engaging map for the user would assist in reaching out to the population. The map page currently is capable of correctly placing images of artifacts; however, the provided artifacts are of varying shapes and sizes. These, of course, would then be resized to fit in their individually allocated spaces on the page, but such variances appear unprofessional. Unfortunately, the only straightforward method of fixing this would be to crop image to a uniform size for the display, a time-consuming process that was never completed in this project. Furthermore, the initial idea of having a "medieval career" was lost in favor of the a simple "fun fact." To minimize the amount of blank space on the map, and in the spirit of keeping the project fun and user-friendly, it may be worthwhile for future users to consider this option. These careers could be easily derived (with some creativity) from the minor categories in which the user has a preference. These combinations could then be associated with the traits of medieval society. For example, if a person particularly liked ranged weapons, the results page would present him or her with a statement explaining how he or she

would have enjoyed being an archer, and provided the user either a short paragraph containing a description of archers or a fictional scenario.

Overall, the IQP was an enjoyable experience and provided useful skills that could be applied in later projects. Although it is highly unlikely that engineering students will need to do extensive research on medieval history, the most important learning aspect of this project was learning how to complete a project. The mistakes made and lessons learned in this project proved to be vital in learning how to schedule time and resources of several group members, concurrently. These skills have become vital in completing engineering projects, so that the most efficient documentation methods are used to keep track of progress and to schedule work in a fair and intuitive manner.

Upon reexamination, most problems experienced with this project were encountered at the very start and at the conclusion. Although all of the members have participated in team projects on multiple occasions, there was no introductory, "team dynamics" meeting at the start of the term. It would have greatly improved the efficiency of the early stages to establish each member's specialties and the benefit that he brought to the group. Roles within the team are established naturally over the course of several weeks, but the confusion caused during that time period limits productivity.

Furthermore, one of the most important skills derived from the project was organization, and productivity increased drastically once all information was saved onto a single flash drive for future reference. This allows one to save multiple version of software and back-

up the last working version in case of a failure. In retrospect, this was one of the largest problems at the beginning of the term, as all of the previous IQP information was scattered and disorganized, which made research difficult and confusing. The same is true regarding specifics of the project flow in A-Term, where there was confusion regarding exact deliverables, and more direct guidance would help the team meeting deadlines with a quality product. Although the advisor did assist in this area, future groups may benefit from a more rigid structure to increase productivity and eliminate any confusion regarding expectations.

Biographical Information

Robert Bass is currently a junior at Worcester Polytechnic Institute, double majoring in computer science and interactive media and game development. As the software expert of the team, he did most of the website coding and scripting, and assisted with research as well. In addition to games and computer programming, Robert is fascinated by almost every branch of science and mathematics, and loves learning little tidbits about different fields from his own specialty. He also enjoys cooking and singing, and is a 3-year member of the WPI Men's Glee Club.

Daniel Cotnoir is a junior at WPI majoring in Biochemistry. He was charged with the bulk of the historical research in this project, as well as some technical tasks involving getting the project online. He plans on doing graduate research in biochemistry in order to achieve a PhD in the field. In addition to his studies, he is a member of the co-ed service fraternity Alpha Phi Omega, vice-president of the WPI Symphonic Association, and plays French horn in the school's brass ensemble, orchestra, and concert band.

Jeffrey Elloian is a student at the Worcester Polytechnic Institute studying Electrical and Computer Engineering (ECE). In this project, the most help he provided was in the form of organization of group materials, but he also assisted in both coding and research. His primary interests within his major include embedded systems, logic design, radio frequency, and antennas. Over the past year, he has participated as both a tutor and a lab manager of the ECE 2010 introductory ECE course, assisting Professor Makarov with any updates associated with class material. Outside of Academics, Jeffrey is a First Degree Black Belt in Shaolin Kempo Karate, after being an assistant instructor for nearly 2 years.



Figure 17-Group Members from left to right: Daniel Cotnoir, Jeffrey Elloian, and Robert Bass

Appendices

Appendix A- Project Idea Brainstorm List

Timelines

- **Mouse over timeline**-*We feel this is a good idea to incorporate into a larger project, but find it difficult to include as a project in its own.*
- **Evolution of Weapons & Armor from Conception to Modern Day**-*Jeff thought this was a good idea, but this is a dangerous topic as it is very large and diverse and one could easily become bogged down in the details.*

Timeline of changes and upgrades in armor, both stylistic and functional.

- **Parallel Evolution of Arms and Armor in Cultures around World**-*We like the idea of the multicultural theme as we had come up with beforehand; however, we feel the feel a time-line simply does not adequately make an interactive element for something of this nature.*

Comparison of different armor styles in major regions of world, as defined by needs of culture and geographical requirements.

- **Evolution of Armor Making Over Time**-*Overall the group did not particularly care for this idea, as it becomes difficult to illustrate and make interactive.*

A Discussion of how the technology of armorsmithing has changed and improved over time.

Online/Computer

- **Interactive flash about arms and armor shapes**-*We had considered something written in Flash for mousing over arms and armor to learn about strengths and weaknesses and other miscellaneous information, and we would like to incorporate this into a larger project.*
- **Integrate a Forum component?**-*We felt this was a poor decision simply because one would have to constantly moderate this forum, and we cannot be responsible for what people say. (It is nearly impossible to create an automatic filter to filter out all inappropriate or irrelevant posts)*
- **Virtual castle**-*The group thought this could be taken in multiple ways. The simplest would be a 2D floor-map with clickable rooms in which one could zoom to an individual location, perhaps with photographs of a real castle. On the other hand, the more difficult route would require 3D rendering of a castle one could explore, but this would be extremely difficult to construct and tie pertinent information to castle to the objects inside.*
- **Interactive interview with a knight (and others?)**-*We interpreted this as having an "interactive text adventure" in which the user is given so many questions that they can ask the knight, in which it will have pre-programmed responses.*
- **Virtual exhibition**- *We were not entirely sure where to go with this idea or how it could involved with other ideas. How would this be any different from making a webpage on medieval history?*

- **Virtual "Google Street View" Tours**-*This idea was one of our favorite ideas thus far. It is technologically feasible (there are a lot of problems and minor obstacles, but nothing that cannot be overcome), and it allows the user to feel as though they are actually in a real exhibit. We would also like to leave the museum an easy method/device for updating the tour whenever exhibits change.*

Panoramic tour of entire armory with each item in armory tagged and linked to information in database

- **Classic Side-View "Fighting Game" incorporating Combat Manual**-*This is also one of the ideas we had liked. We wish to do so with Flash, which could become a 2D, turn-based fighting game, allowing us to slow down the pace and show what each weapon does against different types of armor. We would like to keep both qualities aspects (physics equations of force) and qualitative aspects (effectiveness of armor) involved, but simplified to a reasonable degree.*

Players each take control of a knight and fight against each other. The knights use techniques presented in Combat Manual, and show the weaknesses and strengths of each move, ie what technique is effective or ineffective against, and how the moves look in combat.

- **Wii Combat Game**- *At Mass Academy, Jeff had some previous experience engineering with gyroscopic devices within the Wii-mote, and discovered that the connection between the hardware and software is very unreliable when used in any amateur fashion (ie. using a Python script to remap commands). Both Dan and Robert believe these devices have come a long way, and could be feasible, but this could become very complex with having to render graphics, considering no one in our group has much digital art experience.*

With a wii-remote embedded in a replica weapon, teach users the combat techniques by having them actually do them out, as per the techniques in the Combat Manual. Potential for expansion: first-person fighting game where player uses sword to fight off enemies

Miscellaneous

- **Audio clips about regions explaining the different arms and armor-***We liked the multicultural aspect of this idea, comparing regions around the world (perhaps through a few different time periods as well), but audio clips are not very interactive.*
- **Behind the scenes look at the museum-***There are limited places where this can be "interactive"*
- **Matching game => which item belongs to which region***Overall, none of us felt that a matching game could keep the target audience entertained long enough to deliver all of the information.*
- **Explore a suit of armor-***We believe that one of the other groups (dress a knight) already has explored this road, and it would be difficult to distinguish our project from theirs (it would be too simple to only look at a different suit of armor)*
- **"Equip yourself for various situations" game-***This is very similar to what we were planning for the Flash game idea.*
- **How to Use Combat Techniques-***This is also an idea that could be incorporated into the game, but then we must consider the force from attacking at different angles, and how different cultures would have approached this.*

Training Session with instructors and students using replica tools as per the techniques in the Combat Manual

- **Effectiveness of Armor, and Different Types against Different Weapons-***Again, this would be the main feature of the flash game if that road would be explored, where the main purpose is explore the effectiveness of different weapons and armor against one another. We feel it is too dangerous to have people try any "hands on" demonstrations.*

Have people wear small portions of different types of armor to give hands-on demonstration of how different types of armor had different uses depending on the weapons

- **Medieval Siege and War Strategies Training-** *This would also be an interesting idea to*

explore, as one could examine different siege weapons, and life during a siege for both the attacker and the defender., but it is difficult to tie into an interactive exhibit.

Students are put into groups and are taught different medieval battle strategies, and are "set upon" each other to demonstrate strengths and weaknesses of each strategy.

- **How to Make Armor with Modern Tools**-*Most of the group did not care for this idea, as it would not be difficult to research and describe the process, but it would be difficult to have some product that the audience could interact with.*

Similar to modern cooking shows, this would be a step-by-step practical guide to forging armor in the modern day.

- **Armory Atlas** -*A previous group had already developed a similar project involving searching for artifacts by answer questions. Although educational, we feel this was already completed successfully by another group, although we would like to keep the map idea simply for the presentation for whichever final project is selected (just as we would with the timeline if possible.)*

Map of World with tags showing where and when artifacts were made as well as when they were found and added to collection. Could be linked to database for further information.

Interactive video—"talk" to a curator, conservator, historical character- *This is the same as conversation with the knight, but with a different subject. Audio recognition is very difficult, and nearly impossible to program a limitless number of responses for.*

Controllable knight to demonstrate armor in motion-*This could involve a lot of 3D rendering and animations that our group does not have much experience with such things.*

Biomechanics theme-*We were unsure where to go with this idea or what was originally intended. If the flash game is pursued, we could mathematically analyze the breaking points of limbs, but this does not tie in very well with the other projects.*

Bluescreen visitor photo -*This would not be very difficult provided we had given backgrounds that would be desirable (ie. a castle).*

Creating a story

Creating a self-image

Virtual castle

“Karaoke” video

Photographic scavenger hunt

Helmet cam

What kind of sword should you have? interactive

Appendix B- Three Selected Project Plans

Interactive World Map and Timeline

Features

- World map spanning Eastern Hemisphere; pertinent regions would give basic information on mouse-over; this would allow a quick comparison of regions during certain time periods.
- Click on region to zoom, presenting detailed information on technology such as weapons, armor, etc.
- A "scroll-bar" or clickable buttons that would move forward or backward in time in specific increments, altering the information presented and showing the progression of the technology.

Work Required

- Probably Flash-based map of the world, with scripting for mouse-over regions and clickable links. This would include what art assets are used, whether they be photographs, 3D models, or drawn representations of the technology.
- Research of technology of many regions over long periods of time. This is entirely dependent on how much information we decide to present. General weapons and armor used would be ideal for technology, and the more populated, most well-known regions would provide the most information. Time spans would depend on what information we can gather; there are obviously facts we do not know about certain places at certain periods of time.
- Implementation of data collected; specifics on the layout of the project, what information is presented where, etc.

Online Strategy Game

Basic concept:

This project is a strategic, turn-based fighting game that teaches players about how and why different arms and armor were used. Players choose a fighter from different time periods and locations, equip them with weapons and armor, and fight either against each other using the strategies that their particular fighter might have employed with the chosen weapons and armor. After the fight, players can learn why those particular strategies were effective.

Details:

The current idea involves a qualitative approach to realism. On a player's turn, he or she is given a number of different choices: how to wield the weapon (stab with it, slice with it, etc.), where to strike, etc. The damage dealt is increased if the player uses the weapon in the "correct" way, or if the opponent's armor is weak at that location or to that specific weapon. The damage dealt is decreased if the player uses the weapon in the "wrong" way, the opponent's armor is good at protecting against that kind of attack, or if the player's armor makes it hard to strike at that location. This can also depend on the situation: if you attack your opponent's legs and he or she falls over, it might make different kinds of attacks deal more damage.

What we will need to do:

- Research:
 - Why certain weapons were constructed the way they were, and how they were used. Katanas and longswords are both swords, but they have different shapes and were used in different ways. Why? What would a longsword do for you (as a knight) that a katana wouldn't? Why is that important? Etc.
 - Why certain armor was constructed the way it was, what it specialized in protecting against, and what parts of the body were most protected. If someone came up to you with a mace, what kind of armor would give you the greatest chance of survival? Why?
 - What kinds of circumstances lead to the construction of said arms and armor? Was it simply technology? A change in fighting style? A reaction to a new kind of weapon/armor?
 - Information about the physical properties of the weapons and armor, such as size, weight, materials, etc. Some physics research may also be done concerning things like impact force and PSI values.
- Determine exact game mechanics. We need to pin down the details of exactly how the game is going to work. How are the fighters going to differ? How much damage does a

longsword do when it strikes the arm? We will need to at least come up with some preliminary values so that they can be coded.

- Code the game mechanics. This includes pretty much everything from making menus and the user interface to the actual fighting system.
- Obtain some art assets. This includes background images, pictures of the fighters/weapons, simple animations for the battle mode itself, sound effects and music (maybe), and other miscellaneous things like button images.
- Write all the text for the info screens and such.
- Playtest. This step can take more or less time depending on how nice we want the final product to be, but we should at least show the game to a few people and see if they can actually figure out how to play it.
- Refine game mechanics. Again, this step can be longer or shorter depending on how nice we want the final product to be. It involves taking the results of playtesting and using them to change certain aspects of the mechanics that didn't work the first time around.
- Repeat the playtesting and refining steps as many times as needed.

What we aim to achieve:

In the time allowed, I expect us to be able to finish a rough game prototype with all mechanics and gameplay features complete to the point where all aspects of the game are playable. In particular, we should be able to create:

- At least two to four playable fighters from different locations or time periods, each with their own set of weapons and armor to choose from.
- A working battle system (see Details, above)
- A user interface that allows players to easily access any part of the game
- Low to medium quality art assets that, while not presentable as a finished product, are good enough that an experienced artist could see what was needed and create higher quality art
- A series of info screens that give more detailed information about the weapons, and armor featured

Street-View Virtual Armory Tour

Overview

This general project intends to create an entirely function full representation of the Armory, but viewable on some form of digital medium. One would be able to either go to a

website, use a mobile phone, or make use of some other device (or this task could also become a cross-platform project) to be able to actively view the museum as if one were actually there in person. This representation should bring the full experience and realism of being at the Armory, and provide clickable links for extra information about specific exhibits.

Suggested Features

- Full 3D representation of the Museum viewable from all sides, preferably with actual photographs, as 3D rendering is less realistic, as well more difficult to create and keep up to date
 - Suggested using a hemispherical representation, where one can pan a full 360° in the θ direction (left to right), and approximately 90° in the ϕ direction (up from ground).
- Extremely difficult to make a continuous map, thus it may be best to follow the example seen in Google Street-View: Have discrete number of points of interest (ie. in front of certain exhibits) at which each "3D picture" is taken
 - These points should then be connected with interactive arrows or some method of easily traversing the museum
- Clickable links for information. Simply provide a few paragraphs of background information that can be easily seen by the user so they do not need to strain themselves to read the placard
- Some device and method that is simple enough to leave behind such that one could update this as necessary with minimal maintenance
- A 2D overview of the entire museum (a floor plan), where one could find specific areas, click them to jump to an exhibit and immediately view the selected area

Required Work

- Overall, this is a very feasible design for a project. The technology to create these "panoramic 3D images already exists, but some improvements and customizations are needed (cost could become a problem)
- There will need to be some historic research to provide useful information, as well as engineering resource to see what the most cost efficient method of taking the photographs would be
- Actual "man-hours " required to physically take these photographs (this is unlikely to work the first attempt and will become a trial and error process)

- Devising an efficient means of allowing one to easily reproduce these images for new exhibits and have the media easily updated without the original IQP group (make this project sustainable with minimal maintenance)

Resources Needed

- We currently have an ECE major, a CS/IMGD major, and a Biochemistry major on this team, which would allow us the ability to program to a reasonable extent. We presumably have access to the museum.
- We may need funds for the construction of a device to take images (ie. a stand for a camera, where we would have fixed notches at measured angles) or anything else
- Mechanical expertise for engineering the stand
- Server space in which to store all of this information
- Historical research