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Dynamic poverty heat map

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Santa Clara University

DEPARTMENT of COMPUTER ENGINEERING

Date: May 15, 2013

I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

Jonathan Ahumada, Kurt Jurgens, and Jasmine Farias

ENTITLED

Dynamic Poverty Heat Map

BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

BACHELOR OF SCIENCE IN COMPUTER SCIENCE AND ENGINEERING
BACHELOR OF SCIENCE IN WEB DESIGN AND ENGINEERING

_____

THESIS ADVISOR

_____

DEPARTMENT CHAIR

DYNAMIC POVERTY HEAT MAP

by

Jonathan Ahumada, Kurt Jurgens, and Jasmine Farias

SENIOR DESIGN PROJECT REPORT

Submitted in partial fulfillment of the requirements
for the degree of

Bachelor of Science in Computer Science and Engineering
Bachelor of Science in Web Design and Engineering

School of Engineering
Santa Clara University
Santa Clara, California

May 15, 2013

Dynamic Poverty Heat Map

Jonathan Ahumada, Kurt Jurgens, Jasmine Farias

Department of Computer Engineering

Santa Clara University

2013

ABSTRACT

Data management and analysis can become an overwhelming task when having to deal with large amounts of data. Fundación Paraguaya (FP), an organization that aims at reducing poverty in Paraguay, currently has been facing this data readability issue. The data from electronic surveys conducted by FP to measure poverty levels in different areas of Paraguay are currently presented in a complex and overwhelming manner via Excel spreadsheet. This method of data representation increases the risk of committing errors, as well as slows down the process of efficiently locating the areas of greatest needs and allocating the resources to these areas.

Our Dynamic Poverty Heat Map web application proposes to eliminate that issue for Fundación Paraguaya by visually representing same amount of data gathered with a heat map. Through this senior thesis describes the methodology for the development of a heat map as our solution for better data representation and readability, as well as all the implementation that it underwent. We will also discuss our test plan and collaboration with Fundación Paraguaya and HP in Ireland in working to develop a product specific for a client. Our web application helped facilitate the process of narrowing down the data to certain departments and survey questions for the means of easy analysis and comparison. Ultimately, the Dynamic Poverty Heat Map increases the speed with which Fundación Paraguaya can locate and distribute resources of greatest need.

ACKNOWLEDGEMENTS

We would like to dedicate this thesis to each of our supporting and loving families. Thank you for believing in our higher education and for being more than a support system throughout these four years. You have all been the best role models possible in what responsible and professionalism is. We appreciate everything you have done for us and continue doing, no matter what stage of our life we are in.

The development of this Dynamic Poverty Heat Map web application would not have been possible if it were not for the involvement of several individuals. We would like to acknowledge first of all, Dr. Silvia Figueira, our Senior Design Project advisor for being with us since step one and helping us overcome minor obstacles we encountered. She is currently an Associate Professor of Computer Engineering at Santa Clara University as well as a member of SCU's Frugal Innovation Lab. Also, we would like to give a special thanks to Keith Douglass Warner, an Associate Adjunct Lecturer in the Theology Department at Santa Clara University for introducing us to Fundación Paraguaya and presenting us with the proposal to solving the data analysis issue the organization was currently facing.

To Fundación Paraguaya, we greatly appreciate your time and cooperation in the development of this project. Thank you for dedicating a moment of your time from your busy schedules to be able to meet with us via Skype in order to answer any question or concern we had. In addition, we would like to acknowledge the presence and involvement of a sector of HP located in Ireland. They facilitated the process of obtaining the data from their database, as well as provided us with professional suggestions as to what technology to use to complete certain tasks. All of your help is greatly appreciated.

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Chapter 1
Introduction

1.1 Background

Fundación Paraguaya is an organization that aims to decrease the level of poverty in Paraguay. The problem is that Fundación Paraguaya has difficulty identifying where the best places to expend their resources are. The company HP (Hewlett-Packard) has teamed up with Fundación Paraguaya to create an electronic survey that would help them find the areas that need the most help. Fundación Paraguaya employees were given HP Netbooks to go out into the field and conduct the survey on Paraguayan citizens. In total, over 50,000 citizens were surveyed with over two-thirds of that number being females.

1.2 Current Solution

The data that has been recorded from all of these surveys is being stored on an HP server in Ireland. However, this large amount of data currently serves no real purpose. Fundación Paraguaya needs a way to easily and quickly retrieve, view, and manage this large amount of data. Their idea is to create a website that displays data while keeping in mind that many of their users are illiterate. Therefore, the website needs to be designed so that it can be read and understood visually. Currently, their software can only display the data in the survey format making it hard to analyze.

1.3 Our Solution

Our solution to the problem is to create a web application that will show all of the data utilizing heat maps and graphs (pie chart and bar graph). We will provide visual heat maps to show which areas of Paraguay have the most severe conditions for each of the questions in the survey. The web application will be designed to have a more efficient survey process and accurate data analysis.Fundación Paraguaya will also have the ability to view, print, edit, and/or remove data.With this development, Fundación Paraguaya will be able to better track and respond to regions where certain necessities are unavailable.

Chapter 2
Dynamic Poverty Heat Map

2.1 Introduction to Fundación Paraguaya

What is Fundación Paraguaya and what is its goal?

Fundación Paraguaya is a non-profit organization located in Paraguay whose aim is to fight and eliminate poverty. According to the World Bank, 32.4% of the population is at poverty line in Paraguay [1]. Families in Paraguay are facing severe poverty in terms of lack of basic and essential resources such as clean water, housing, clothing, food, etc. According to Unicef, "The Cateura Dump… is the final dumping site for more than 1,500 tons of solid waste. Poor waste management has caused the country's most essential water supply to become dangerously polluted and the environment contaminated" [2]. Therefore, Fundación Paraguaya's mission is "to develop and implement practical, innovative and sustainable solutions which eliminate poverty and create decent living conditions for every family" [3].

How SCU Became Involved in the Project

We came about this organization through our Senior Design Project Advisor, Dr. Silvia Figuiera. She told us about four Santa Clara University students who had traveled to Paraguay one summer and volunteered at Fundación Paraguaya to conduct these electronic surveys on Paraguayan families. When viewing the data gathered from the conducted surveys, they experienced difficulty in reading the data in an efficient manner. Therefore, the idea of developing a new and more effective way of displaying the data was suggested. Keith Warner, a professor in the Theology Department at Santa Clara University, presented the idea of solving this data analysis and representation problem as a Senior Design Project that senior engineering students could take on. Our advisor took on Warner's suggestion and offered it to us a design project idea. We were amazed with the work that Fundación Paraguaya was doing in helping fight poverty in Paraguay, so

we were privileged to be collaborating with them in this project that would benefit their cause.

2.2 Microsoft's Survey Tool

Fundación Paraguaya's Process for Conducting Surveys

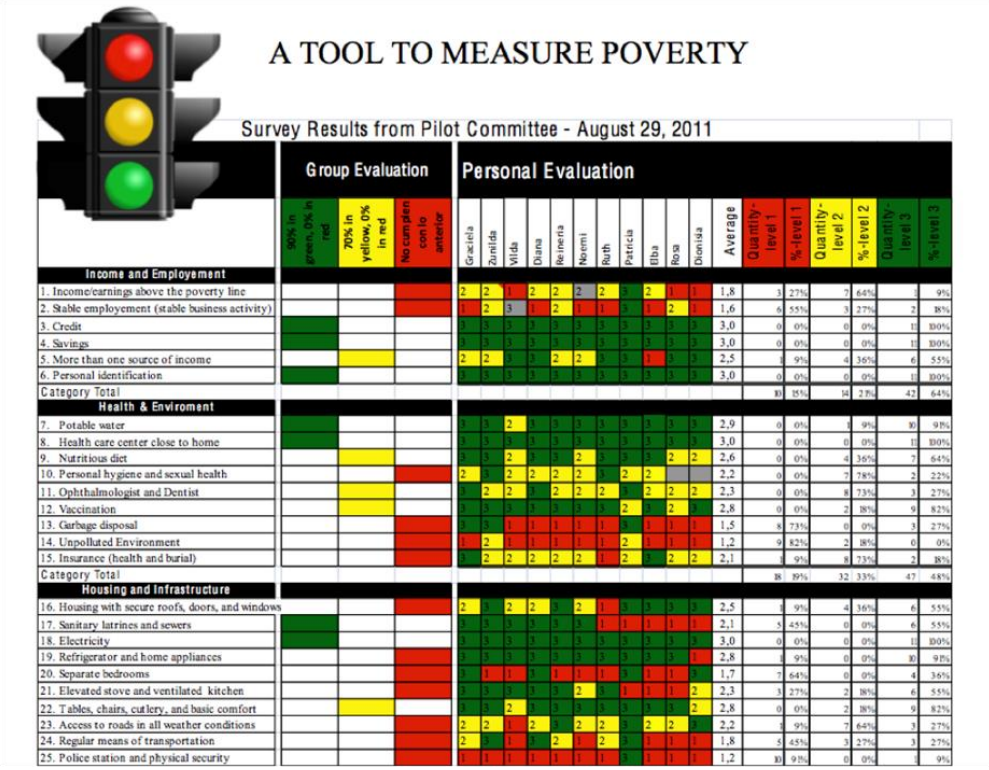
Fundación Paraguaya fulfills their mission of helping allocate resources effectively to families in Paraguay through conducting surveys personally. The surveys are conducted electronically and not in print. Therefore, FP members go out into the field with HP netbooks (donated by HP) and have the female head-of-household represent their family in answering the questions. The survey is 50 questions (indicators) in length and is split in 6 different categories (dimensions): Income and Employment, Health and Environment, Housing and Infrastructure, Education and Culture, Organization and Participation, and Personal and Motivation. Each question comes with images that help depict and create a sense of familiarity in the surveyed, as well as descriptive titles to reaffirm what the image is representing. (See Figure 2.2.1)

Figure 2.2.1 – Electronic Survey Tool

The "Stoplight Method"

Along with the images there is a poverty measurement tool called the stoplight method that utilizes three very distinct and opposing colors: red, yellow and green as a way to represent the three most generic severity levels. A red color indicates level 3 of severity meaning there is a severe need and lack of that specific resource. A yellow color is level 2 severity, representing that there exists a need and lack of that resource on an average level. Lastly, a green color indicates that the level of severity is a 1 which can mean one of two things: there is or never was a need to begin with or the lack of resources was resolved.

Once the surveys are conducted and each family has given their input, FP members return to their respective offices and connect to the internet in order to upload their survey results to a database in Ireland observed by HP. FP receive an Excel spreadsheet form of the outcome of all the surveys utilizing the same stoplight method to represent the severity and need/lack of resources. (See figure 2.2.2)



A TOOL TO MEASURE POVERTY

Survey Results from Pilot Committee - August 29, 2011

	Group Evaluation			Personal Evaluation																
	90% in green, 0% in red	70% in yellow, 0% in red	No cumplen con lo anterior	Graciela	Zunilda	Vilda	Diana	Reinerio	Noemi	Ruth	Patricia	Elba	Rosa	Dionisia	Average	Quantity-level 1	%-level 1	Quantity-level 2	%-level 2	Quantity-level 3	%-level 3
Income and Employement																					
1. Income/earnings above the poverty line				2	2	1	2	2	2	2	1	2	1	1	1,8	3	27%	7	64%	1	9%
2. Stable employement (stable business activity)				1	2	3	1	2	1	1	1	1	2	1	1,6	6	55%	3	27%	2	18%
3. Credit				3	3	3	3	3	3	3	3	3	3	3	3,0	0	0%	0	0%	11	100%
4. Savings				3	3	3	3	3	3	3	3	3	3	3	3,0	0	0%	0	0%	11	100%
5. More than one source of income				2	2	3	3	2	2	3	3	1	3	3	2,5	1	9%	4	36%	6	55%
6. Personal identification				3	3	3	3	3	3	3	3	3	3	3	3,0	0	0%	0	0%	11	100%
Category Total																10	15%	18	27%	42	64%
Health & Enviroment																					
7. Potable water				3	3	2	3	3	3	3	3	3	2	3	2,9	0	0%	1	9%	10	91%
8. Health care center close to home				3	3	3	3	3	3	3	3	3	3	3	3,0	0	0%	0	0%	11	100%
9. Nutritious diet				3	3	2	3	3	2	3	3	3	2	2	2,6	0	0%	4	36%	7	64%
10. Personal hygiene and sexual health				2	3	2	2	2	2	3	2	2			2,2	0	0%	7	78%	2	22%
11. Ophthalmologist and Dentist				3	2	2	3	2	2	2	3	2	2	2	2,3	0	0%	8	73%	3	27%
12. Vaccination				3	3	3	3	3	3	3	2	3	2	3	2,8	0	0%	2	18%	9	82%
13. Garbage disposal				3	3	1	1	1	1	1	3	1	1	1	1,5	8	73%	0	0%	3	27%
14. Unpolluted Environment				1	2	1	1	1	1	1	2	1	1	1	1,2	9	82%	2	18%	0	0%
15. Insurance (health and burial)				3	2	2	2	2	2	1	2	3	2	2	2,1	1	9%	8	73%	2	18%
Category Total																18	19%	32	33%	47	48%
Housing and Infrastructure																					
16. Housing with secure roofs, doors, and windows				2	3	2	2	3	2	1	3	3	3	3	2,5	1	9%	4	36%	6	55%
17. Sanitary latrines and sewers				3	3	3	3	3	3	1	1	1	1	1	2,1	5	45%	0	0%	6	55%
18. Electricity				3	3	3	3	3	3	3	3	3	3	3	3,0	0	0%	0	0%	11	100%
19. Refrigerator and home appliances				3	3	3	3	3	3	3	3	3	3	1	2,8	1	9%	0	0%	10	91%
20. Separate bedrooms				3	1	1	3	1	1	1	3	1	1	1	1,7	7	64%	0	0%	4	36%
21. Elevated stove and ventilated kitchen				3	3	3	3	3	2	1	1	1	1	2	2,3	3	27%	2	18%	6	55%
22. Tables, chairs, cutlery, and basic comfort				3	3	2	3	3	3	3	3	3	3	2	2,8	0	0%	2	18%	9	82%
23. Access to roads in all weather conditions				2	2	1	2	3	2	2	3	2	2	2	2,2	1	9%	7	64%	3	27%
24. Regular means of transportation				2	3	1	3	2	1	2	3	1	1	1	1,8	5	45%	3	27%	3	27%
25. Police station and physical security				1	1	1	1	1	1	1	3	1	1	1	1,2	10	91%	0	0%	1	9%

Figure 2.2.2 – Survey Results Spreadsheet

Disadvantages and Problems with Current Survey Tool

The problem found with this method of representing survey results is it becomes too overwhelming and complex to analyze. Each survey result contains the responses to each of the 50 questions (indicators) and then the answers are highlighted with its respective level of severity color representation. The result of the data being represented this way causes a time delay in indicating where the urgency for resources is. As well as it becomes an ineffective method for comparing various surveys to one another.

2.3 Dynamic Poverty Heat Map Logic

Our Approach As A Solution

As you previously saw, the current method used to represent the data gather from the conducted surveys was too inefficient to serve the purpose of managing and representing large amounts of data. Therefore, an approach we found to be a possible solution to this problem was displaying visual data representations. Visual data representations such as heat maps and graphs are a more simplistic, visually interesting way of presenting the same large amounts of data in a more concise manner. Also, a web application instead of a website would contribute to the idea of presenting a product which is simplistic, but at the same time interactive and interesting to use.

What is a Heat Map?

A heat map is a visual and graphical data representation method that utilizes numerical values from data gathered and presents them as colors on a map. Depending on the occurrence and proximity between numerical values, one will be able to see a circle of a specific color (heat spot) marking a location on the map or a cluster of the same color (red, yellow and/or green) to indicate quantity or occurrence depending on the situation (See figure 2.3.1).

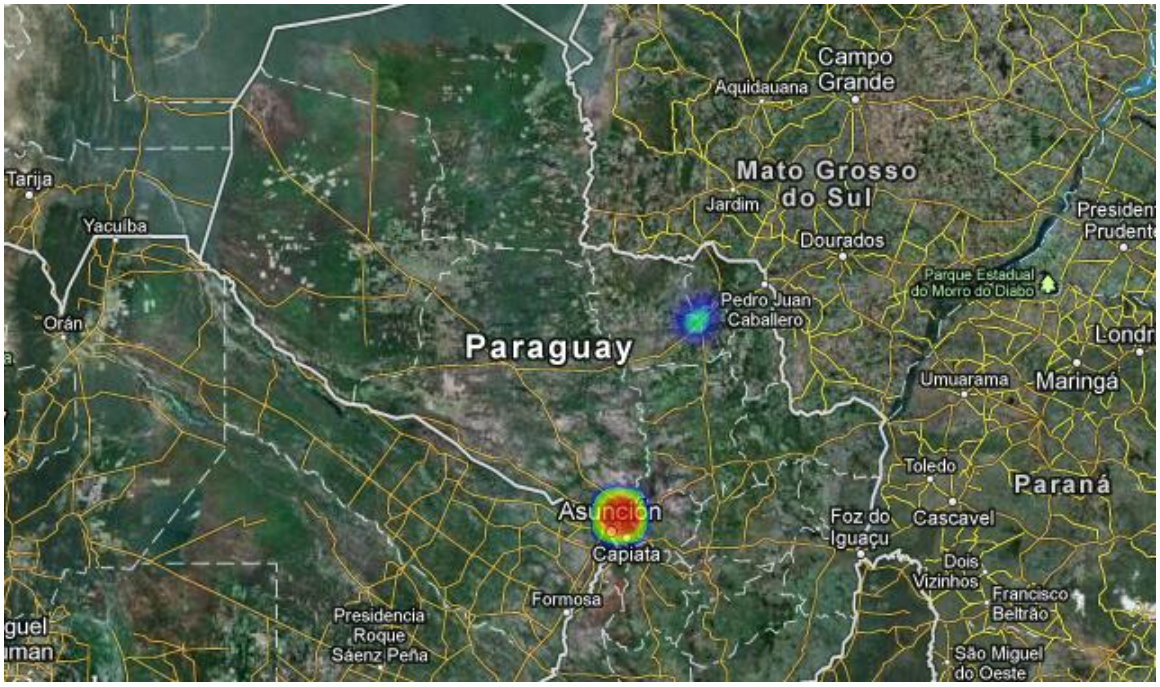


Figure 2.3.1 – Heat Map of Paraguay (Screenshot)

Benefits of Visual Data Representation

A **heat map** would best suit what we wanted to accomplish. There will not be a change in the way data is visually represented in a heat map as aside from the survey tool. The same stoplight method will be displayed on the map to indicate poverty levels and locations. This will save time and effort in FP members learning a new method of measuring poverty levels. Also, two additional data representation tools: a bar graph and a pie chart will also be included to serve the same purpose of visually displaying data.

A **bar graph** offers the opportunity for comparison of data through the use of bars of height equal to the data's numerical value. This will allow for easier distinction between which resources based on the color and height of the bar for each indicator (See Figure 2.3.2). This figure demonstrates the difference in values in poverty levels within one dimension such as Housing/Infrastructure. This bar graphical representation of the data also allows for further comparison among the different six dimensions of where the greatest need is at or where improvement is evident.

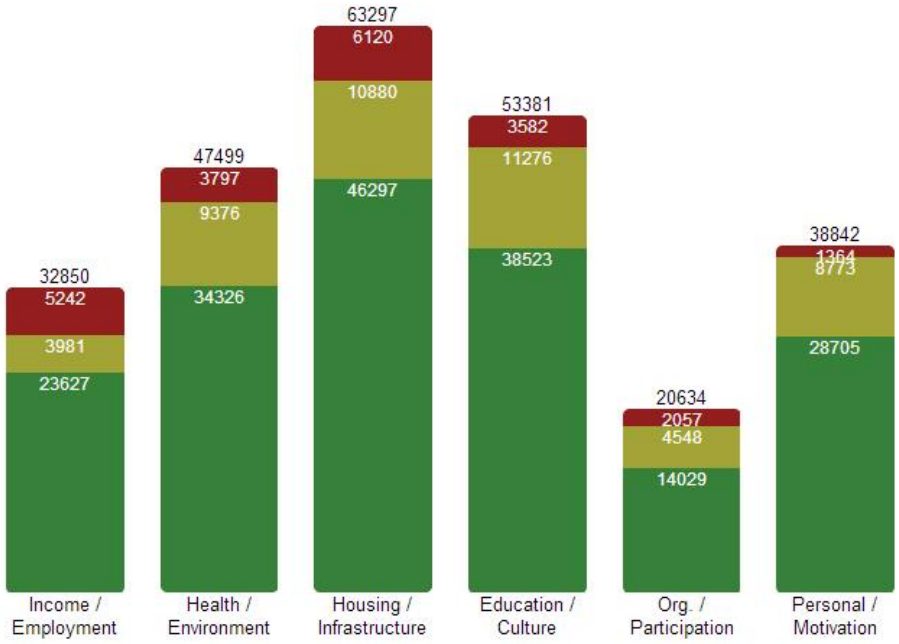


Figure 2.3.2 – Bar Graph Representation of Data (Screenshot)

A **pie chart** serves the purpose of representing percentages. By providing information such as the percentages, it can benefit the organization well in being determinant factors for improvement or the downfall of allocation of resources or lack off (See Figure 2.3.3).

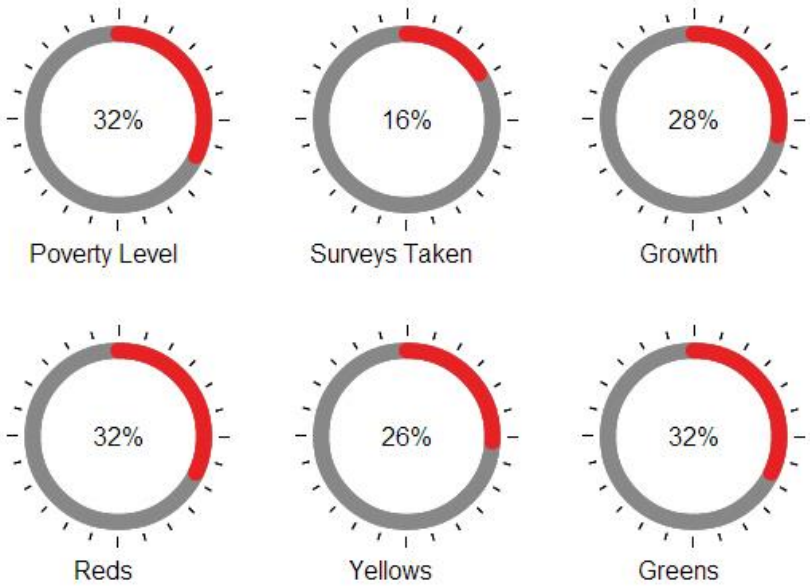


Figure 2.3.3 – Pie Chart Representation of Data (Screenshot)

Chapter 3

Design Process

3.1 Requirements: Functional

The following section describes the functional requirements for the web application.
The web application will:

1. Allow user to register for access to the web application.
2. Allow user to request administrative or limited-access accounts upon registration.
3. Allow user to Login/Logout in order to obtain administrative rights and permissions or user profile and preferences.
4. Grant user, with administrative accounts permission, permission to edit and/or delete data.
5. Allow user, with an administrator account, to export data from server.
6. Allow both administrator and limited-account users the ability to view data using heat maps.
7. Allow user select specific regions of the heat map for more detail.
8. Allow user to filter data by department, dimension, and question.
9. Provide multiple graphics in order to display certain data most efficiently.
10. Provide an auto-sync between web application and server in order to ensure most up-to-date data.
11. Always store data on the server and never locally.
12. Only accesses and retrieved data from the server if it's requested by the web application.

3.2 Requirements: Non-Functional

We have determined the following non-functional requirements for the web application.
The web application will:

1. Be user-friendly.
2. Be reliable.

3. Create a sense of familiarity between the user and the web application.
4. Ensure security.

3.3 Design Constraints

We have identified the following design constraints for the web application:

1. Access to the data must be limited only to users with administrator accounts.
2. The web application must be able run on networks with low bandwidth.
3. The web application must not rely on browser plug-ins to display data.
4. The web application must be compatible with the latest version of Firefox and Chrome at the time of the web application's deployment.
5. The web application must protect data from unauthorized intruders.
6. The material on the web application must be available in Spanish and English.
7. Design aesthetics must cater to the Paraguayan culture.

3.4 Project Risks

Risks	Consequences	Probability 0-10	Severity 0-10	PREDICTED Impact 0-10	ACTUAL Impact 0-10	Mitigation Strategy
Running Out of Time	Project doesn't get finished	0.25	10	2.5	3.5	Gantt Chart keeping each other on track.
Lack or no communication with Fundación Paraguaya	No access to their servers, no client input	0.2	10	2	5	Attempt multiple forms of communication
Miscommunic-ation between our team and Fundación Paraguaya	Wrong or missing requirements	0.8	2	1.6	1	Keep constant contact with Fundación Paraguaya
The website is not understandable for all users	Lowers the amount of possible users	0.3	5	1.5	1	Beta test with both English and Spanish native speakers.

Table 1 – Project Risks

3.5 Design Overview

The entire surveying tool has three components: server, native application, and web application.

The **server** is responsible for storing all of the data that will be used by web application. Also, all of the data collected by the native application is uploaded to this server. All of the data is stored in a SQL database.

The **native application** was created by Hewlett-Packard with the sole purpose of collecting data. Since the application runs on netbooks, they collect surveys throughout the day storing everything locally. However, at the end of the day all the netbooks are connected to network and begin uploading data.

The **web application** will be used to display all of the data stored on the server. The server-side components of the web application are written in PHP and the client-side is written in HTML, CSS, JavaScript, and jQuery libraries.

The general architecture for the entire system is shown in Figure 3.1.

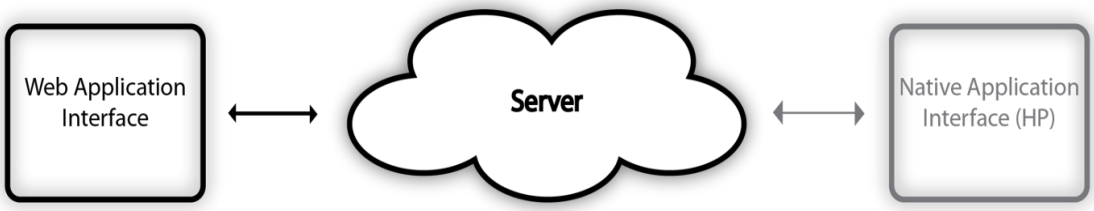


Figure 3.5.1 General System Architecture

3.6 Technologies Used

The web application was developed using the following technologies:

Table 2. Web Application

HTML	Frequently used markup language on the Web.
PHP	General-purpose server-side scripting language.
SQL	Used to manage data in relational database management systems.
JavaScript	Client-side scripting language used to make websites more dynamic.
jQuery	JavaScript library designed to simplify client-side JavaScript tasks.
CSS	Stylesheet language used to adjust the look and formatting of a web page.

3.7 Use Cases

Based on the purpose of the web application we have developed the following use cases:

3.7.1 Registration

Actor: User

Goal: Create an account

Precondition: None

Postcondition: Has an account that can now be logged in.

Scenario:

a. Navigate to the website

b. Click “register account”

c. Fill in the required fields

d. Hit “register account”

Exception: All fields not filled, account with that name already created.

3.7.2 Login

Actor: User

Goal: Log in to the system

Precondition: User has a registered account

Postcondition: User is logged in.

Scenario

a. Navigate to the website

b. Input Username

c. Input Password

d. Click “submit”

3.7.3 Viewing the data

Actor: User

Goal: View the data

Precondition: Logged in

Postcondition: View the data wanted

Scenario:

a. Default page will display heat map.

b. Navigate to the desired data location (if not heat map).

b. Click on graphs/heat maps that you want to take a closer look at.

Exception: Data doesn't exist

3.7.4 Filtering the data

Actor: User

Goal: Filter Data

Precondition: User logged in

Postcondition: Data has been filtered

Scenario

a. Navigate to the desired data location

b. Click on drop down menu with desired filter option

c. Data will be represented and specific to filter selected

3.7.5 Logout

Actor: User

Goal: Log out of the system

Precondition: User is logged in

Postcondition: User is logged out

Scenario

a. Click "log out"

b. User is logged out of the system and redirected to the Home page

3.8 System Flow Chart

The Flow Chart below is a conceptual model of the way our web application works. Administrator access is part of our future development work and is shown here to show the progress once completed.

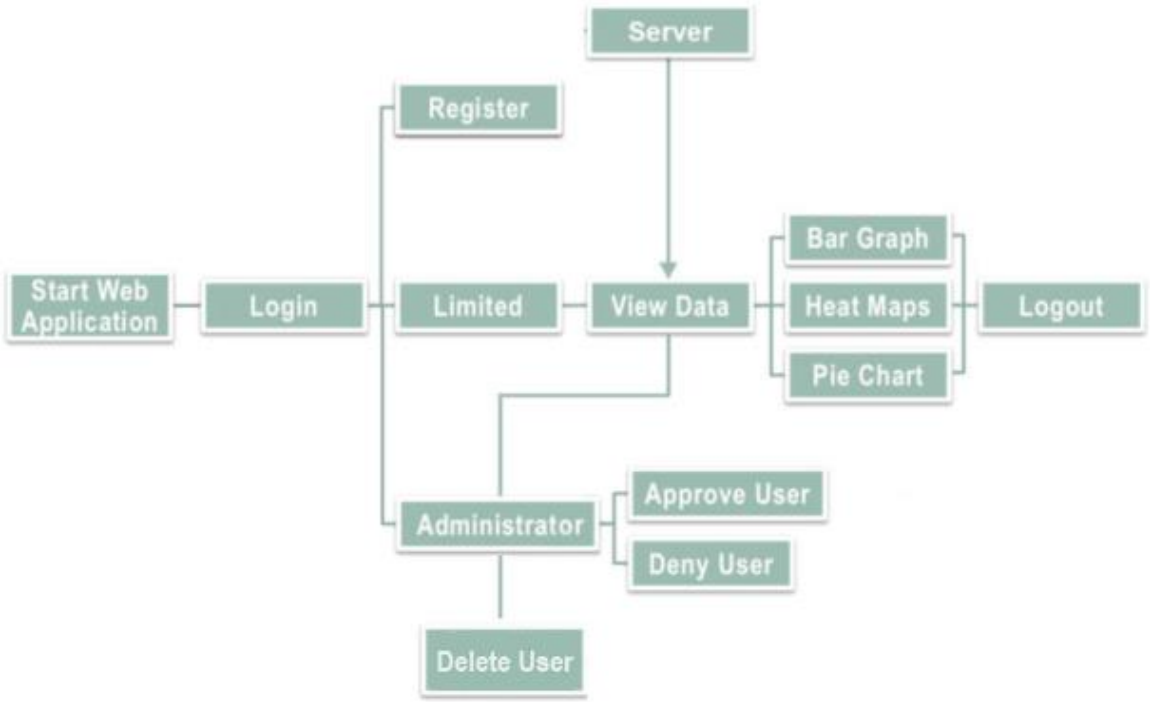


Figure 3.8.1 - System Flow Chart

3.9 Implementation of Heat Map

Use of Google Maps API and heatmap.js

The heat maps used in the website use the two tools, Google maps API and heatmap.js JavaScript library and the data from Fundación Paraguayas' surveys to create dynamic heat maps which represent the data from the surveys. The Google maps API allows for the use of particular sections of Google maps. For example we used Google maps to generate zoomed in maps for each department (region) of Paraguay. Once we had these particular regions generated we used the heat map JavaScript library in order to generate heat maps for each region based on the data from the surveys. The heat map layers will generate based on the results of the survey for particular dimensions(categories) and indicators(questions).

How does Google Maps work?

We specialized the Google maps to receive the desired effect. For example we removed functionality such as moving the map and being able to manually zoom in and out. We also manipulated the JavaScript library to fit our needs. We implemented the heat maps with the database from the survey and used each survey to plot a point on the heat map. The library places a circle on the HTML5 canvas for each result from the survey, with varying intensities based on the severity of the result.

For example, a red result from the survey will result in a circle with a bigger radius on the heat map. Circles with big radiuses next to each other will create the desired red area as represented by the heat map. The severity of the radius in perspective to circles of other radiuses determines how influential each circle should be. We created our own custom severities which we feel represented the data accurately. The combination of all of these functionalities allowed us to create accurate and visually appealing dynamic heat maps that will re-render based off of the desired data from the database.

Chapter 4
Societal Issues

4.1 Ethical

Our web application does not raise any ethical issues. It solely reflects the data gathered from the surveys taken, but presents them in a different way than the traditional form of the Excel spreadsheet. We do not alter any of the information or data to reflect values that could either benefit or negatively affect the organization, or the families surveyed. Therefore, all the data presented is the exact data provided as a result of all conducted surveys.

4.2 Societal

The development of this product will affect society in a positive way. Our product is meant to expedite the process of locating the areas in Paraguay with greatest need which will result in a positive impact. Allowing FP members to determine where and what resources need to be allocated will transform communities and cause an improvement in their daily lifestyle. Families will be able to live a healthier and better life due to the efficiency of our web application in providing fast and accurate data.

4.3 Political

Fundación Paraguaya's long-term goal is to minimize or reduce the poverty level in Paraguay. Our web application, if used correctly, should help work towards that goal. We recognize that the goal, if achieved, will be due not only to the organization but also to the governments and other external sources that have provided funding to allow such poverty elimination project to exist.

4.4 Economic

There are no economic issues arising from the development of this product. The only financial issue we had to resolve ourselves was paying for web hosting and a domain name. We paid for a year subscription and the cost was affordable. Fundación Paraguaya

already has their own official website for the organization so they should have no problem in hosting our web application on their own domain. Maintenance of the web application should not be required unless the organization requests any alteration or addition to the functions of the application.

4.5 Health and Safety

There are no health risks in interacting and using our product; it is not a physical product, therefore the only risk users run in terms of operating technological devices is completely unrelated to our web application.

4.6 Manufacturability

The only part of our project that is physical is the server which holds all of the survey data. We do not operate the server, only the web application that imports the data from the server. The product is built the most efficient and effective given the time frame we were given of six months. In addition, we developed this product with our understanding of the technologies available to us during these four years at the university.

4.7 Sustainability

Technological advances are a constant factor for improvement and further development of society. Our web application uses the most up-to-date technologies and scripting languages that have survived throughout the years. In case there needs to be a modification anytime in the future, our product is very adaptable to any advances in technology.

4.8 Environmental Impact

Due to the nature of our product being a website there are no environmental impacts that our product will have.

4.9 Usability

One of the requirements for our project was to create a product that was useful. In implementing our solution we focused on making sure that our product would be fully

understood by all users. We focused on making sure there weren't any barriers our users would have to overcome. Everything would be simple from the moment they started using our product.

4.10 Lifelong Learning

This project definitely taught us many things such as what it takes to be able to work with a client. We had never dealt with a real client, so having to interact with them on a weekly basis via Skype for business meetings was an eye opener and an introduction to what the industry is like. In terms of implementation and use of technologies, the project encouraged exploring multiple ways to go about the development process. It gave us the opportunity to be developing our own ideas and create our own sense of direction in the creation of the project.

4.11 Compassion

The work that Fundación Paraguaya is doing demonstrates compassion in every aspect of the word. Poverty takes many forms such as malnutrition, no access to clean water, etc. Even though our project does not directly alleviate those problems for people, it does play a role in solving those problems by detecting the areas of most need.

Chapter 5
Conclusion

5.1 Lessons Learned

Working on the development of this project shed light on the reality of working in industry and dealing with a client. Time is of the essence when it comes to creating such a product and for a particular client. Therefore, there needs to be:

1. Better Planning - To create the best product possible, better planning is needed. Something always happens and not being prepared for it in giving you time to resolve the issue, can be detrimental when dealing with such a big project like this.

2. Communication – This is a factor that should be taken into critical consideration because it is essential for the development of the product. The client may have a different vision of the way the product will function and have a complete different outcome than what the developers may have, so it is crucial to have constant communication all throughout the developing process.

3. Location makes a difference - Working with an organization that is not local and is out of the country like Paraguay, can raises issues that may delay the process of product development. Among those issues, we learned that finding the appropriate medium to communicate, as well as coordinating each and everyone's time schedules to fit in time for meetings can be stressful and overwhelming.

4. Continuous Trial and Error Testing - In order to provide a client with a product that is useful and will cater to their needs, a lot of research and testing needs to be done prior, during, and even after the creation of the product.

5.2 Advantages of System

The Dynamic Poverty Heat Map presents another method tool for data analysis. The advantage it has over the survey result spreadsheet that Fundación Paraguaya has been utilizing currently includes:

1. More simplistic in design, therefore less overwhelming.
2. Presents all the data, but allows for data filtering.
3. Design minimizes errors, therefore more accurate data analysis.
4. Faster detection and tracking of areas of greatest need.
5. Expedites the process for allocating resources to multiple areas in Paraguay.
6. Visually interesting user interface.
7. Design aesthetics create familiarity between users and the web application.

5.3 Future Work

As a team, we have decided to collaborate with Fundación Paraguaya six months after graduation to further maintain the web application and adding additional features that will best fit their needs. Among those additional features will include:

1. Android Mobile Application Development
    a. Using GPS Functionality
2. Bilingual Preferences
    a. Spanish and English
3. Pie Chart Functionality
4. Administrator Access
    a. Approve/Deny New User Requests
    b. Delete Existing User Accounts

Chapter 6

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