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Applied Technology Group Project Documentation for NLS-Project

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Project Documentation

for

NLS-Project

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1. Abstract

Loyalty systems are commonly used to build and improve relationships between business and customers. Throughout history they evolved and became almost essential for small businesses such as coffee shops or small local stores. In this paper we will analyze existing loyalty systems that are presented in the world and Irish market, how they are used in the coffee shop industry and how new technologies can change and shape this industry. We examined multiple coffee shops brands present in Ireland and their rewards systems. We compared their loyalty systems using alternative methodologies and theoretical lenses in order to find new ways to approach the subject of customer retention and loyalty.

Our main goal was to make a brand new system which will offer a turnkey solution for the industry. Another goal was to simplify interaction with loyalty systems in such a way that customers will participate in it without even noticing any discomfort. This process can be achieved by using Near Field Communication chips that can be found in any smart-devices such as phones and watches, or bank cards that have the contactless payment option. We also considered ethical and data storing risks that the new system might bring.

The product that was built during this research project represents only a Minimal Viable Candidate, and still needs to pass a long way before it can be implemented in the real market. On the other hand we hope it can start a movement in the right direction and impact the industry in the near future.

2. Acknowledgements

The @TODO team would like to thank Graham Glanville, who supervised this project. He provided great support throughout the making of the project, and his insights proved to be a great help specially on the research phase of this document. His knowledge about documentation and project management also helped shape this document and helped us to conduct ourselves in a more efficient way.

We would also like to thank other faculty members. Although not directly part of the project, Amilcar Aponte, Greg South, Ken Healy and Mikhail Timofeev always extended a helping hand when we had questions related to their expertise. John Snel and Amilcar Aponte also helped keep the Raspberry Pi inside CCT, which was very handy and provided easy access to the board to any of the project members.

Finally, we would like to thank CCT College Dublin for doing what was possible to help us continue working in our projects despite the current events happening worldwide. Knowing that communication between students and college were minimally affected and that we could still use most of college resources was very reassuring and kept us focused on the project.

3. Introduction

Coffee is one of the most consumed beverages around the world, having an impact not only on the breakfast table, but also in the world's economy. The global coffee consumption is estimated to have risen by 2.1% in 2018/2019 when compared to the same period of the previous year, while global coffee production increased by 3.7% (International Coffee Organization, 2019). Coffee represents a market that is worth 130.4 billion Euros in 2018 and is expected to grow even more (Mondo Research, 2018).

With that in mind, it comes as no surprise that coffee shops are the fastest growing restaurant category. In the 2014-2015 period, the global sales of coffee shops increased by 9.1% (Friend, 2016), which represents a thriving market that offers a large number of different coffee shops to the public.

When choosing a coffee shop many factors come into consideration. Familiarity and past experience with a shop/brand, convenient location and friends and family incentive are, in that order, the four leading reasons behind picking a specific coffee shop (Burge, 2013). Considering that, coffee shops may deploy different marketing tools focused on customer retention.

One of such tools is the use of loyalty programs. Loyalty programs involve the practice of rewarding customers in some way for using the services or purchasing the goods offered by a business (Sharp and Sharp, 1997). Those rewards come in many forms, such as "a reduction on the total price, a cash value, a free product, a reduction on a specific product, a lottery game ticket (of a lottery game organised by the store or company), a reduction in another store or even a reduction in the customers parking ticket price" (Smets et al. 2011). Loyalty programs are also beneficial to retailers, increasing customer engagement. According to NXP, engaged customers that can spend up to 60% more per transaction and buy 90% more frequently. It was also stated that 37% of customers prefer card-based programs, 33% digital programs, while 30% are not sure (NXP, 2017). That creates an interesting scenario in conjunction with the fact that half of

Irish card owners use contactless payments as a way to pay for goods and services (McMahon, 2016).

Taking all of this into consideration, our group is proposing an approach to loyalty programs using Near Field Communication (NFC) technology used in contactless payment. We believe that it will create an easier and more robust experience for customers when using loyalty programs while reducing costs that business owners have with the usual physical card based approach. This will be a part of our research.

3.1 About this document

Like any software development document, the main purpose of this paper is to explain product functionality, unify project-related information, record the process of product creation, as well as ensure that developers are headed to accomplish the objectives of the project.

One of the best practices to create such documentation is to write a requirement document using a single, consistent template that all team members adhere to. During the research for another subject that we did last year, our team discovered an IEEE template for a project requirements documentation, that is recognisable and very often used in the industry. After walking through the Student handbook for this project it was very clear that there are many similarities between the IEEE template and recommendations in the handbook. This was one of the reasons why we, as a team, chose to use IEEE template for this paper. The second reason was to get familiar with this template due to its broad use in the industry, as it definitely will be helpful in the future. Last but not least: IEEE template has a defined structure with description of each section of the documentation that must be produced in order to draw a full picture of the future product.

Obviously, the template structure is meant for professionals, and isn't 100% suitable for a college student project. For this reason the structure was changed correspondingly to the goals and objectives that were set by the CCT but it also aligns to the vision of the team too. This adaptation allows us to have the best of both worlds: to

work according to one of the best practices existing in the industry while in the safe environment of the college.

3.2 Intended Audience

This document is intended for the investor/entrepreneur audience who encountered this new opportunity to serve, more efficiently and promptly, a possible demand surge in the market for the next few years. As people's mindset is changing in favour of technology and environment, combined with the popularity of coffee retailing, this might turn into an interesting approach for entrepreneurs to get involved and profit from.

This report is also directed to the coffee retailing companies/business, which have been searching for means of improving customer satisfaction aligned with customer loyalty/rewards programs by the use of breakthrough technology, concerned with the environment. To businesses that are willing to set up and, possibly, adapt their model entirely to embrace this new paradigm .

This tome is also dedicated to every single person that considers themselves to be a coffee lover, a customer of this market, enthusiasts of getting involved with rewarding systems for doing what they like.

Last but not least, to all potential computing students in the future that could use this work as an inspiration to develop their own project or product.

Audience details

- Business wise:
    - Shops around Dublin, Ireland, that serve as their core product, coffee or hot beverages in general;
    - Business that utilizes a basic information system to process at least the cashing/till operations;
    - Whether in terms of gross income or physical site size, this system can be applied to all business sizes;

- A slight preference for businesses that have their own loyalty system, but want to improve by automation means.

3.3 Team Roles & Responsibilities

Cauê Duarte (2017228)

Conducted research about coffee shops and loyalty systems that were used to justify the project. Research on technologies that are going to be used for the project (NFC and Raspberry Pi). Responsible for helping the construction phase of the project, programming and testing the NFC Reader and the Raspberry Pi. Finally, responsible for proof-reading, text structuring and video-editing for the team's screencast.

Felipe Mantovani (2017192)

Contribution on the NFC research technology for the viability of implementing this to the project. Planning of the use case scenarios in the product function section. Writing and specification of the intended audience of the technology we are proposing.

Responsible for "containerizing" the application through the use of Docker tool, development of the RESTful API type. Backend coding, among others. Also, responsible for supporting the other peers with the device testing and cloud deployment of the app.

Olga Kiseleva (2017136)

She took the role of team Project and Product manager, and her main responsibilities will be to support the team with planning, organizing and coordinating all project work. As well as working on documentation, User and Hardware Interface and providing all technical help to other members of the team to overcome any obstacles. Last, but not least she was responsible for some section of this documentation and keeping the team updated in terms of what particular help she needs with it.

Taras Boreyko (2017284)

Researcher on the problem statement and alternative loyalty systems that are in use. Contributing to the NFC research and helping to implement this technology. Involved in connection of the components in the physical device. As the work on the project in the last few weeks was just online my responsibility was to create an access for the group to

the Raspberry Pi and all physical components. Furthermore, programming of the backend with other group members.

3.4 Problem statement

The first problem we could identify was that the common loyalty system has been gradually getting replaced by the so-called “smart devices” as their popularity has increased in the past few years. Contactless payments, smartphones, computerised tills have become even more common in every coffee shop as part of their evolution. There is no doubt that the same is likely to happen to the loyalty cards system. Some companies have already been using laser cards, QR-code systems, applications with special passwords to add stamps on the account and so fourth. However, many coffee shops are not risking to change from a paper-based system as it requires additional training for staff, not to mention that it might be expensive to implement and maintain it.

The second issue is related to the customer involvement. Paper loyalty cards systems have proven themselves to be working over the years. However without finding hard facts, the team has assumed that there are a number of customers who avoid any interaction with this type of systems. As Coffeebi, 2017 states, the engagement comes with communication and involvement, where it is about taking and receiving, questioning and answering. Companies want to keep track of all the data raised from its customers and benefit them by offering some perks, such as a free item they provide or sell.

One other problem this research indicates is that the system has no easy-to-use approach. Paper cards take extra space to be kept in people’s pockets and there is the risk of forgetting your loyalty card or losing it.

The last situation spotted is linked to an environmental concern. The paper industry is responsible for 9% of the total emissions of carbon dioxide from manufacturing industries and deforestation is the source of 25% of human-caused greenhouse gas emissions (EPN, 2014). With the emerging fast-growing retail business, such as coffee shops, and the increase of popularity of loyalty programs, the replacement of the paper-based to a paperless, or even digital system, could be seen as a good opportunity since it could diminish the negative impacts on the environment.

3.5 Goals and Objectives

Research and market analysis of existing paperless loyalty systems.

One of the main goals of this document is to gather information about existing systems, how each of them works and the pros and cons. This information will help us to define the technologies that will be used for prototypes, as well as it will help to outline the features of the future product.

Objectives:

- Find and analyse loyalty systems that are present in the Coffee Shop market in Dublin in September-November 2019;
- Find and analyse loyalty systems that are present on the international market in September-November 2019;
- Outline pros and cons for each of the existing systems;
- Gather and document all information in the research section.

Research and planning of the prototype NLS-Project: technologies that will be used, their architecture, main features and other components.

Based on information and understanding of the newly presented paperless systems, our team will be able to make a decision and outline the scope of the technologies that can be used to build a prototype, as well as define other components of the future system. In this part we will look into details of what is the best existing practice, what are the statistics of usage and whether it would be possible for the average Coffee Shop to implement the proposed solution.

Objectives:

- Research best practices and technologies that can be used, e.g. QR codes, magnetic cards, proximity NFC, voucher code generation, among others;
- Define features that prototype must have;
- Draft the project scope based on the researched best practices;
- Propose a solution based on the gathered information and criteria described above.

Build and implementation.

After all the preparation steps the goal will be to develop the prototype that uses technological components to easily simulate the “carrying” of the “virtual” card and be able to update its state by accumulating or taking points.

For the building platform, the components involved in this step will be a device responsible for storing a full set of rewarding terms the business will hold, as well as its customers data. Each coffee shop will have their own rules of points reclaim and customer data stored in one place. This device will also be ”listening” to any customer device just to begin the interaction and exchange information.

For the customer side, the system app will simulate the “virtual card” and store any points accumulated for following the set of rewarding terms. The main idea is to make the app interactable with the business device.

For testing this idea, the group will acquire one of these devices, either Raspberry Pi or Arduino, develop a fake data platform and attempt to reproduce the steps to check if the interaction between these devices can happen. If the devices are able to exchange information it is a good sign for the development of the prototype.

Building and implementation objectives:

- Setup the main device that will host all the program information such as rewarding terms and participant customer data;
- Reproduce the steps and allow devices to exchange messages;
- Analyze the expected behaviour and correct the mistakes and errors;
- Improve efficiency in the inter-device communication tasks;
- Create a temporary platform for test-driven development purposes;
- Launch the application:
    - First release: checking if everything is working as expected and still fixing bugs that may occur;
    - Final release.

3.6 Product Scope

This project consists in the development of a web-based system where the coffee shop company can build its own rules for the loyalty program and make available to the customers, from the access to the reward granting system, which is based on how many points have been accumulated.

Because this system already exists utilising paper based approach, this is a great opportunity for businesses to incorporate a software based approach for this same concept. This could cause a cost reduction for the business, since it would eliminate the need to produce paper cards. The customers would also benefit from this because it would no longer have to carry the physical paper cards in their pockets, reducing the chances of damaging, losing, etc.

The goal of this project is to increase customer satisfaction, reduce costs for the business side and diminish the negative environment impact that paper usage causes.

The extra goal would be a support of the mobile application to the addition to the main web-based system which can create better accessibility.

4. Research and Proposed Solution

4.1 Loyalty Systems and how they are different from each other

For this section of this research, the goal is to make an analysis and a comparison of the most frequently used loyalty systems, how they work, what their features are and the pros and cons of each one of them. To accomplish it, we selected popular coffee shops, with two of them being based in Dublin. Using the rule of at least two cafes we tried to narrow our list down as well as not to exclude local Coffee Shops from it. The final list of candidates for research: Caffe Nero, The Art of Coffee, Costa Cafe, Insomnia and StarBucks*.

In the table below we outlined the most common features, the pros and cons of each system you can find after the table.

Table 4.1: An analysis of coffee shop loyalty systems

Coffee Shop/Loyalty program feature	The Art of Coffee	Costa	Insomnia	Nero	SB*
How many cups to buy to get a free coffee	**10**	**28**	**9**	**9**	**15**
Points that can be discarded to get discounts	**-**	**+**	**+**	**-**	**+**
Discounts for reusable cups	**+**	**-**	**+**	**+**	**+**
Buy n-items get a discount/free item	**-**	**+**	**+**	**-**	**+**
Mobile application	**-**	**+**	**+**	**+**	**+**
Unique features	**+**	**+**	**+**	**-**	**+**

The Art of Coffee

Due to a small number of cafes in this network, this coffee shop has a very standard paper-based loyalty system. For customers, it takes just 10 stamps to get a free coffee, tea or hot chocolate. One stamp can be acquired for every drink that customers buy.

Some of The Art of Coffee branches that are located beside colleges give one extra stamp for the students, in order to encourage them to be more active loyalty system users.

Costa Coffee

This cafe has the highest number of beverages to buy out of all cafes that we researched due to their non-standard practice. We need to outline that 28 is an average number, as Costa gives you 5 points for each 1€ spent. The points are stored on the magnetic card, that can be scanned in the coffee shop and points can be spent to pay for any item at any time. These coffee shops also allow their customers to buy 1 or 2 items such as pastry, and get another one either half price or free. **The Unique feature** of this loyalty system is free unlimited access to Wi-Fi in the cafe areas.

Overall, this loyalty system looks transparent and easy for customers to understand, however the bonuses do not look very competitive in comparison to the other analyzed cafes.

Insomnia

This Coffee network has by far the fullest and most complicated loyalty program. It appears to be well thought and has the most number of **Unique features** such as: “Your very own Birthday Treat”, 20 additional points (“Beans”) for reusable cups, free seasonal items and special offers for customers. As you can see from the table above all the boxes are ticked, it has the 2nd lowest amount of coffee to buy in order to get a free item. Points are being stored in the customer profile, which can be accessed by scanning a QR-code in the shop.

Overall, the loyalty system in Insomnia cafe appears to be the most complex, innovative and thought through. It might be very confusing for the customers. However, it will be a great point of reference for our team to outline some special product functions and features that are used today in the market.

Caffe Nero

One of the simplest loyalty systems that were found during the research. Caffe Nero has its own mobile application which stores points using QR-code in the mobile app, as well as paper cards with stamps that can be found in the shops around Dublin. Nevertheless both mobile and paper based loyalty systems are coexisting together. It looks like a very unique approach nowadays, as normally mobile applications or magnetic cards tend to replace paper cards. We can just assume that it was done that way not to exclude customers who, for any reason, do not want to use their mobile device for this purpose.

However, this approach is not transparent, as there is no way to track how many paper cards went out and how many stamps were put in there. It will not concern customers, but on the other side it may be a consistent issue for a business.

StarBucks

The loyalty system in this coffee shop is quite similar to Costa Coffee, in the way that customers can aquire points (“Stars”). To earn a Star you must pay with a registered Starbucks Card. The points are stored in a magnetic card that can be used as a credit card in any coffee shop across the globe. This card can also be linked with the mobile application which allows top up without going to the physical shop. After acquiring 50 points, a customer card can change its status to “Gold”, which will unlock some additional bonuses, such as free coffee shots and so on.

The possibility of using the same loyalty card anywhere is a unique approach that our team hasn't seen in other researched coffee shops. It means that their loyalty system is well standardized on the technical and infrastructural level. Doing research on StarBucks gave us some insights on the technical approach for the system we are building.

Research Conclusion

Although there are many different loyalty systems out there, all of them work based on identical principals. The pros and cons of each loyalty system are coming from the marketing side and how well it was thought through. We can also see a trend: large coffee-shop networks have more complex and more digitized systems. On the other hand, small coffee shops and small networks are still using the old approach. We can certainly see the need for the market to bring new technologies to the industry. Adopt these technologies in such a way that it will improve customer experience and satisfy coffee shops' needs.

With that in mind, our team would like to propose a solution which in our opinion would improve and provide a better user experience and allow coffee shops to improve user engagement. That would be achieved by seamlessly joining the payment action to the loyalty system interaction. It will be done by creating the loyalty system in a small device that would identify customers that use contactless payment and award each purchase.

4.2 Proposed solution

This group proposes a contactless approach to loyalty systems, where customers would use their own NFC chips inbuilt into contactless payment medium (being it a card, a smartphone, a smartwatch or others) to interact with the program. At the point of sale, when requested to process a payment, the shop clerk would also have a small device that when approached by a contactless card, would award the customer with a loyalty point.

After analyzing different approaches on how to deliver the solution, two scenarios were designed: one with the minimal requirements, where the system would only have features that are absolutely required for it to work, and a more robust solution where besides the core functionalities, the system would also have some ideal features to improve user experience.

The main functionality of the system would be achieved by reading the NFC (Near Field Communication) chip that is used in contactless payment. After reading the card, the device would connect to a database and increase the number of points that a specific card has. After a certain amount of points, the customer would be eligible to receive some sort of reward defined by the business. It is important to clarify that the NFC reader device would only read the physical identifier of the NFC chip and is not going to have access to any banking information.

For the database, this group believes that MySQL would be the best solution. It is open-source, reliable, compatible with all major hosting providers, cost-effective, and easy to manage (Drake and *ostezer*, 2017). The fact that the database would keep a relatively small size considering that we are dealing mostly with small coffee shops means that the scalability problems the MySQL can present won't be an issue.

Ideally the customer would have a way of checking how many points they have whenever needed. It is this group's intentions to build a website where the customer would be able to visualize the points earned so far. This would require some sort of linking the loyalty points not only to the contactless card, but also to something else the customer could use as an identifier (like an email), to check the loyalty points online. This makes registering an email necessary when first using the loyalty program, which means

the NFC reader would also need a keyboard or some other I/O functionality. Taking into consideration the time constraints, further discussion will be made to come up with ways to implement this and whether this will be a part of the final project or not.

The group believes that this loyalty system might be beneficial for a number of reasons. Andrew Gazdecki (2018), when studying the behaviour of people born between 1977 and 1995, concluded that people are attracted to different, easy to access loyalty programs. Accessibility is one factor that it is important to expand. By having loyalty programs linked to the customer's method of payment, there would be no need for any extra punch/stamp cards. This also means that the customer does not have the risk of forgetting their loyalty card, thus possibly failing to rack up benefits from the loyalty program.

The team is aiming to develop a turnkey product that could be installed and customized in any coffee shop. As it raises multiple challenges, these challenges are highlighted in Section 3.4 Minimal and maximum project configuration.

4.3 Near Field Communication

Near Field Communication (NFC, for short), is a wireless, low-power set of communication protocols, a system of rules that allows data transfer between devices. NFC is based on the magnetic induction of NFC chips, that can transfer data between each other when held together a few centimeters from each other (Faulkner, 2017).

NFC devices are standardized by ISO/IEC 14443 and ISO/IEC 18000-3, meaning all devices that use NFC can communicate with each other. NFC uses an interrogator device and the NFC chip. When the two devices approach each other, the interrogator sends a magnetic signal that powers the chip (which doesn't need a battery of its own). This makes NFC chips small and cheap. After that connection is made, the two devices can then send information to each other (NFC.org, 2017).

The technology is widely used in the form of Samsung Pay, Apple Pay, Google Pay, Fitbit Pay, or any bank mobile application that supports contactless. Another use case of NFC technology is to make pairing easy between smartphone and bluetooth

devices, like speakers and headsets, that now can be paired by just putting the two devices together (Sony, 2018).

4.4 NFC Reader (Raspberry Pi/Arduino)

The solution to loyalty programs that this group is proposing needs an NFC Reader to uniquely identify the NFC chip (being represented by a contactless card, a smartphone or a smartwatch). There are many different types of NFC readers available in the market and even mobile applications developed for that specific reason. The system would also need a database to keep a record of all loyalty points, and possibly internet connection in case the group pursues the idea of hosting the databases of all client coffee shops in the cloud.

With that in mind, the group decided that using an open-source project solution in the form of either a Raspberry Pi or an Arduino would be ideal. Both of them have low cost and are modular, which means they can be adapted to better fit a particular situation.

The Raspberry Pi can be defined as a very small computer. The Raspberry-Pi-4, latest model as of November 2019, is 85mm by 56mm. The same model has 2.4 GHz and 5.0 GHz IEEE 802.11ac wireless capabilities, the connection standards used for conventional Wi-Fi, and an ethernet port. It also has 4 USB ports to connect with other devices, 2 × micro-HDMI ports allowing dual-display up to 4k definition. Its 64-bit quad-core processor, paired with up to 4GB of memory (RAM) and a micro SD card slot for both data storage for loading the operating system. There are older, smaller versions available with different specifications (Raspberry Pi Organization, 2019).

The other option is the Arduino. Arduino is a microcontroller-based board. As such, they excel at generating an output for a specific input. They are used for Internet of Things applications, can be powered by AAA batteries and are generally very small. The Arduino MKR WAN 1300, for example, is only 67.64mm by 25mm.

Both of them have their advantages and disadvantages when applied to the proposed project. Being a microcontroller, the Arduino would be ideal to read NFC chips, provided it is paired with the appropriate board (called “shields”). Unfortunately they are not built for data processing and Internet connection in mind, and although both can be

achieved, the process can be rather arduous (Parrish, 2017). With that in mind, using a Raspberry Pi solution would better suit the project. We can read NFC chips with the help of an extra board, update the database containing the loyalty points and when necessary use different displays to interact with it. If instead of locally hosted the database is hosted in the cloud, the Raspberry Pi can then use its Internet connection capabilities to easily do the same, and the devices can also be accessed and updated using remote access.

4.5 Project requirements and technical specification

As mentioned earlier, there are two main scenarios for the project. The minimal requirements for the system would involve a Raspberry Pi, that would be used to host a MySQL database that will store all customers cards' NFC chip identifiers and the number of points they have. After a customer gets a certain amount of points, the board would indicate the customer has a free coffee and would then reset the points of that specific customer. The Raspberry Pi would also handle the data outputted by the NFC Reader. The system would also need an NFC Reader, that would read the NFC chip of the device being used as a means of payment (contactless card, smartphone or smartwatch) and pass its identifier to the Raspberry Pi.

With this setup, all data would be stored locally, meaning that there would be no external backup being made, so any damage to the board might cause permanent data loss, possibly hurting the relationship with customers. The customer would also have no way of checking his or her loyalty points, since the system would only show when they are eligible for a free coffee.

As for the ideal scenario, we would have the MySQL database hosted on a cloud provider. That would make remote configuration of the database easier, and would also provide more availability since the database backup does not rely on the Raspberry Pi anymore. Another feature is user registration. The Raspberry Pi would not only be connected to the NFC Reader, but it would also be connected to a keyboard and a screen (alternatively a tablet can be used to fulfill both functions). With the extra input and output functionalities, a login system can be set in place, where the customer could create a simple profile using some sort of identifier (like an email and password). That profile would

be then mapped to the chip in the customer's NFC device (contactless card, smartphone or smartwatch). The system would also have a web page being hosted in the cloud, where the customer could enter its details and check a lot of different information about their shopping behaviour and, more importantly, the number of loyalty points the customer currently has. The communication to the database would be performed via REST API.

It is important to point out that the second scenario described in this section is more robust in its components, leading to an increase in expenses. That would be caused by the addition of one input and one output device (or a tablet). There is also a price attached to using cloud services, even if they are as simple as hosting one website and one small database.

4.6 Minimal and maximum project configuration

As it is mentioned above, the team is aiming to build a turnkey product, which in fact could be extremely difficult. One of the reasons why it can be more challenging is hiding behind the definition of "turnkey product" term.

In Information Technologies the concept of ***Turnkey product*** normally refers to a product or service designed in such a way that it can be built or installed and with small configuration ready to operate. In other words we need to build an off-the-shelf product that can be used in any coffee shop with minimal amount of configuration from the end user. By and large, the varieties of loyalty program features described in *Section 2.1* must be presented in the NLS-Project.

In order to visualise the future features and functions of the NLS-Project its minimum viable product will be compared to its maximum configuration. MVP-prototype will include core features that all coffee-shops have in common. Another factor that was helpful to outline the scope of the prototype was the time limitations, as the team needs to deliver a ready to use candidate by May 2020.

It is important to say here that many features can be opted out by the coffee shops, so the turnkey version of it must include the full varieties that are present in the market at the moment. To simplify the description of features, the term ***Point*** is used,

nevertheless each coffee shop will decide how to call it, the value of it when discarded and the cost of it in real money when it gets acquired.

Table 4.6: Comparison of features between the Maximum and Minimum viable product

Function or feature	MVP	Turnkey config.
Set Point name	-	+
Set Point cost, when its get acquired	+	+
Set Point value, when discarded	+	+
When discarding: get a free drink	+	+
When discarding: get a discount for the whole order	+	+
When discarding: get a gift, e.g. pack of coffee, cup	+	+
Top up point after purchasing each drink e.g. 1 - drink	+	+
Top up point after each transaction regardless amount spent or drinks purchased	+	+
Free birthday drink or discount	+	+
Extra Points for students	-	+
Auto-generated monthly report for management that either available in the account or sent by email	-	+
Integration with Cafe Till or bank system, to process points automatically when transaction happened	-	+
Integration with accounting software (Automatically add all the discounts/free drinks into the monthly	-	+

report/bill)		
Web-interface to set up physical NLS-Project device for coffee shops	-	+
Web-interface to set up customer account	-	+
Share Points with friends	-	+
A constructor to build a mobile app that will be compatible with the system	-	+
Integration with social networks: “get n-Points for each friend, who downloaded the app and bought a coffee”	-	+

4.7 Planning and estimated timeline

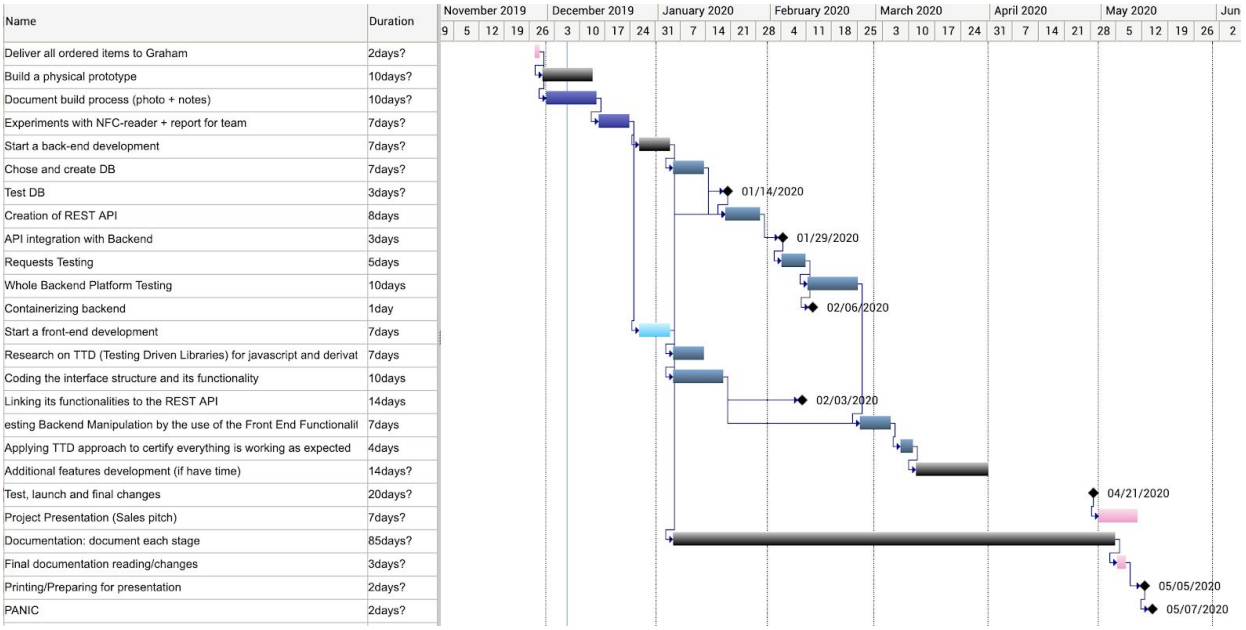
The planning phase is one of the most important parts of any project. There are millions of different tools that can help build a project plan, draw a road map and manage the tasks and resources. Unfortunately, many of them can not be accessed or used for free. Nevertheless our team decided to use the inbuilt task management function in Basecamp. We also used Gantter to set a Project RoadMap and Gantt chart. Finally, Trello was used as a message board and our Product backlog in the early stages of the project.

Gantter

Gantter is widely used in the industry. It allows drawing of project road maps by setting the tasks in the SpreadSheet format. It has many useful features such as: each task can be linked with a specific resource, tasks can be changed to milestones, each stage can be assigned to the specific person and it is interconnectable with Google SpreadSheets. We chose it from many others because of its reputation. It provides the first 30 days of usage for free and all team members can be connected without paying additional fees.

Below you can find the original plan and timeline that were planned for this project. As none of the team members worked with most of the technologies that we are planning to use in this project, the time spent in some tasks might be inaccurate. Nevertheless it contains all the important stages that we, as a team, consider important.

Figure 4.7.1: Screenshot of estimate timeline and tasks dependencies from Gantter



All of the tasks below are set for MVP candidate configuration, the timing for each task was calculated in a way where we are also including a learning/discovering time and also 3 to 5 hours for local tests. In the worst case scenario, we should not go over the limit, on the other hand, there is a high chance that we spare more time for additional features development.

Figure 4.7.2: Screenshot of estimate timeline and tasks dependencies from Gantter

	Name	Duration	Start	Finish	Predeces
1	Deliver all ordered items to Graham	2days?	11/25/2019	11/26/2019	
2	Build a physical prototype	10days?	11/27/2019	12/10/2019	1
3	Document build process (photo + notes)	10days?	11/28/2019	12/11/2019	1
4	Experiments with NFC-reader + report for team	7days?	12/12/2019	12/20/2019	3
5	Start a back-end development	7days?	12/23/2019	12/31/2019	4
6	Chose and create DB	7days?	01/01/2020	01/09/2020	5
7	Test DB	3days?	01/10/2020	01/14/2020	6
8	Creation of REST API	8days	01/15/2020	01/24/2020	5,6,7
9	API integration with Backend	3days	01/27/2020	01/29/2020	8
10	Requests Testing	5days	01/30/2020	02/05/2020	9
11	Whole Backend Platform Testing	10days	02/06/2020	02/19/2020	10
12	Containerizing backend	1day	02/06/2020	02/06/2020	10
13	Start a front-end development	7days	12/23/2019	12/31/2019	4
14	Research on TTD (Testing Driven Libraries) for javascript and derivat	7days	01/01/2020	01/09/2020	13
15	Coding the interface structure and its functionality	10days	01/01/2020	01/14/2020	13
16	Linking its functionalities to the REST API	14days	01/15/2020	02/03/2020	15
17	esting Backend Manipulation by the use of the Front End Functionalit	7days	02/20/2020	02/28/2020	15,11
18	Applying TTD approach to certify everything is working as expected	4days	03/02/2020	03/05/2020	17
19	Additional features development (if have time)	14days?	03/06/2020	03/25/2020	18
20	Test, launch and final changes	20days?	03/25/2020	04/21/2020	
21	Project Presentation (Sales pitch)	7days?	04/24/2020	05/04/2020	20
22	Documentation: document each stage	85days?	01/01/2020	04/28/2020	5
23	Final documentation reading/changes	3days?	04/29/2020	05/01/2020	22
24	Printing/Preparing for presentation	2days?	05/04/2020	05/05/2020	23
25	PANIC	2days?	05/06/2020	05/07/2020	24

Basecamp

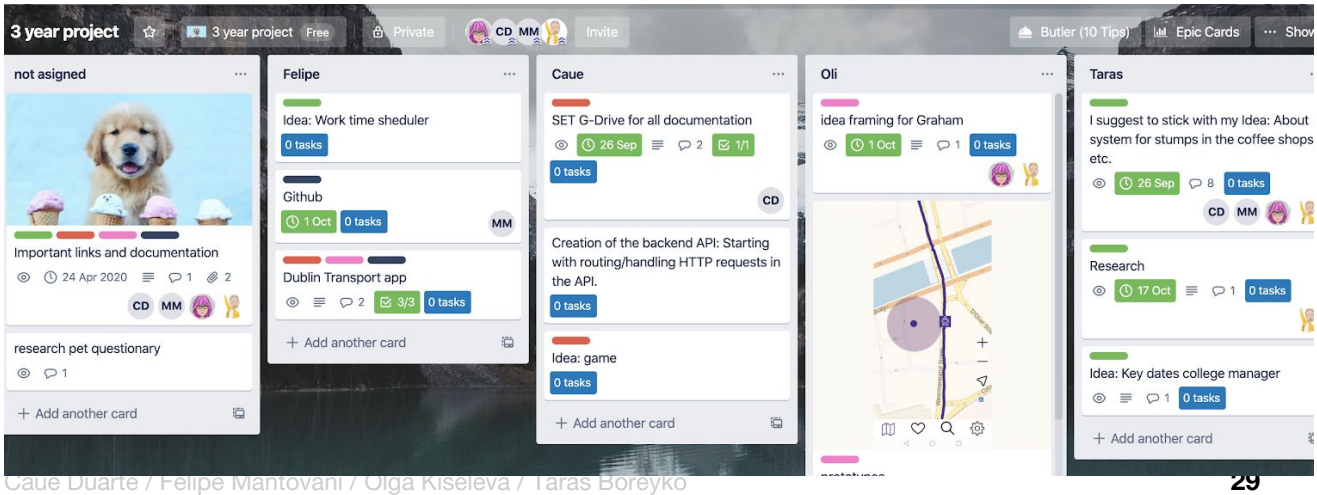
Basecamp is used on a daily basis by all members of the team. It provides great functionality to manage and set tasks for the team, as well as overlook the team's progress.

Figure 4.7.3: Screenshot of day-to-day team tasks from Basecamp

Trello

Trello is also highly recognisable and it currently has a high usage in the industry. It is customizable and can fully fit functions of Task Manager, Resource Manager, Product Backlog and even project RoadMap. It was chosen for the same reasons as Gantter: the team wanted to get exposed to as many products as possible and employ best practices that exist in the IT-market. It was used pretty heavily during the exploration and search for the idea in the beginning of the semester. All information and thoughts were stored there. We are planning to keep using it to store Product features, when we will get to the phase of the active development.

Figure 4.7.4: Screenshot of Product Backlog/Task Manager from Trello



4.8 Targeted audience

- People aged 18 and older.
- People that find in coffee a way to complement their everyday activities. Usually students in college or workers in companies close by the coffee shop during their break time.
- People currently residing in Dublin, Ireland.
- People that have a slight knowledge of operating the basic functions of a smartphone.

4.9 Ethics and data storage

General Data Protection Regulation

For this team, one of our main priorities is the privacy of our visitors. This Privacy Policy document contains types of information that is collected and recorded by NLS-Project and how we use it.

If the visitor has additional questions or requires more information about our Privacy Policy, they should not hesitate to contact us.

General Data Protection Regulation (GDPR)

We are a Data Controller of visitors' information. NLS-Project legal basis for collecting and using the personal information described in this Privacy Policy depends on the Personal Information we collect and the specific context in which we collect the information:

- NLS-Project needs to perform a contract with the visitor;
- The visitor needs to give NLS-Project permission to do so;
- Processing visitor’s personal information is in NLS-Project legitimate interests;
- NLS-Project needs to comply with the law;
- NLS-Project will retain visitor’s personal information only for as long as is necessary for the purposes set out in this Privacy Policy. We will retain and use

their information to the extent necessary to comply with our legal obligations, resolve disputes, and enforce our policies. Our Privacy Policy was generated with the help of GDPR Privacy Policy Generator and the Privacy Policy Generator.

- If a visitor is a resident of the European Economic Area (EEA), they have certain data protection rights. If you wish to be informed what personal information we hold about you and if visitors want it to be removed from our systems, they will need to contact us.

In certain circumstances, visitor has the following data protection rights:

- The right to access, update or delete the information we have on them.
- The right of rectification.
- The right to object.
- The right of restriction.
- The right to data portability
- The right to withdraw consent

Log Files

NLS-Project follows a standard procedure of using log files. These files log visitors when they visit websites. All hosting companies do this and a part of hosting services' analytics. The information collected by log files include internet protocol (IP) addresses, browser type, Internet Service Provider (ISP), date and time stamp, referring/exit pages, and possibly the number of clicks. These are not linked to any information that is personally identifiable. The purpose of the information is for analyzing trends, administering the site, tracking users' movement on the website, and gathering demographic information.

Cookies and Web Beacons

Like any other website, NLS-Project uses 'cookies'. These cookies are used to store information including visitors' preferences, and the pages on the website that the visitor accessed or visited. The information is used to optimize the users' experience by customizing our web page content based on visitors' browser type and/or other information.

Privacy Policies

Visitors may consult this list to find the Privacy Policy for each of the advertising partners of NLS-Project.

Third-party ad servers or ad networks use technologies like cookies, JavaScript, or Web Beacons that are used in their respective advertisements and links that appear on NLS-Project, which are sent directly to users' browsers. They automatically receive the visitor's IP address when this occurs. These technologies are used to measure the effectiveness of their advertising campaigns and/or to personalize the advertising content that you see on websites that you visit.

NLS-Project has no access to or control over these cookies that are used by third-party advertisers.

Third Party Privacy Policies

NLS-Project' Privacy Policy does not apply to other advertisers or websites. Thus, we are advising visitors to consult the respective Privacy Policies of these third-party ad servers for more detailed information. It may include their practices and instructions about how to opt-out of certain options. Visitors may find a complete list of these Privacy Policies and their links here: Insert links herePrivacy Policy Links.

Visitors can choose to disable cookies through their individual browser options. To know more detailed information about cookie management with specific web browsers, it can be found at the browsers' respective websites. What Are Cookies?

Online Privacy Policy Only

Our Privacy Policy applies only to our online activities and is valid for visitors to our website with regards to the information that they shared and/or collected in NLS-Project. This policy is not applicable to any information collected offline or via channels other than this website.

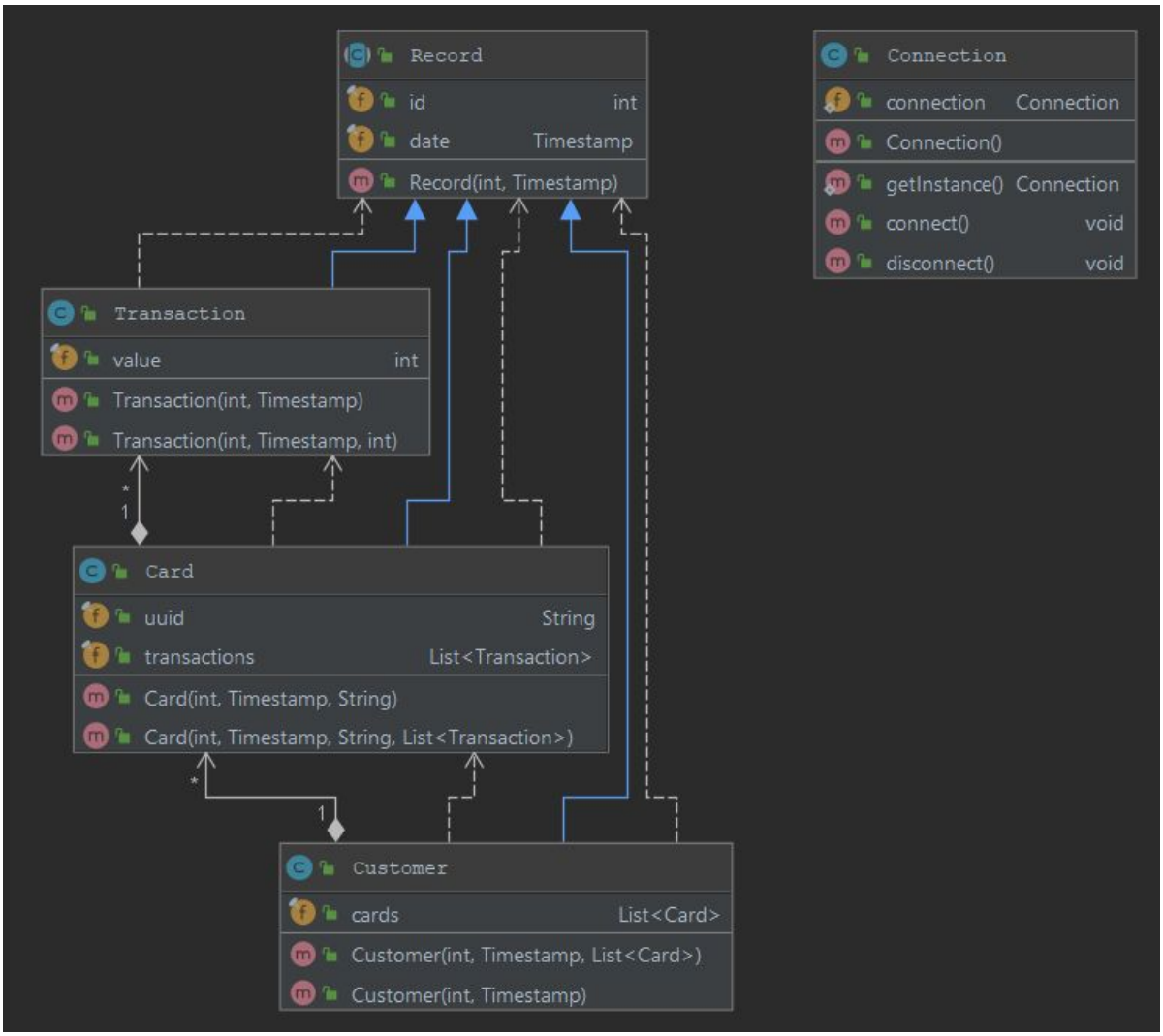
5. Overall Description

In this chapter we will provide more details on the process and product functions, how different parts of MVP-candidate interact between each other and how users will interact with it.

5.1 Class Diagram and Product Perspective

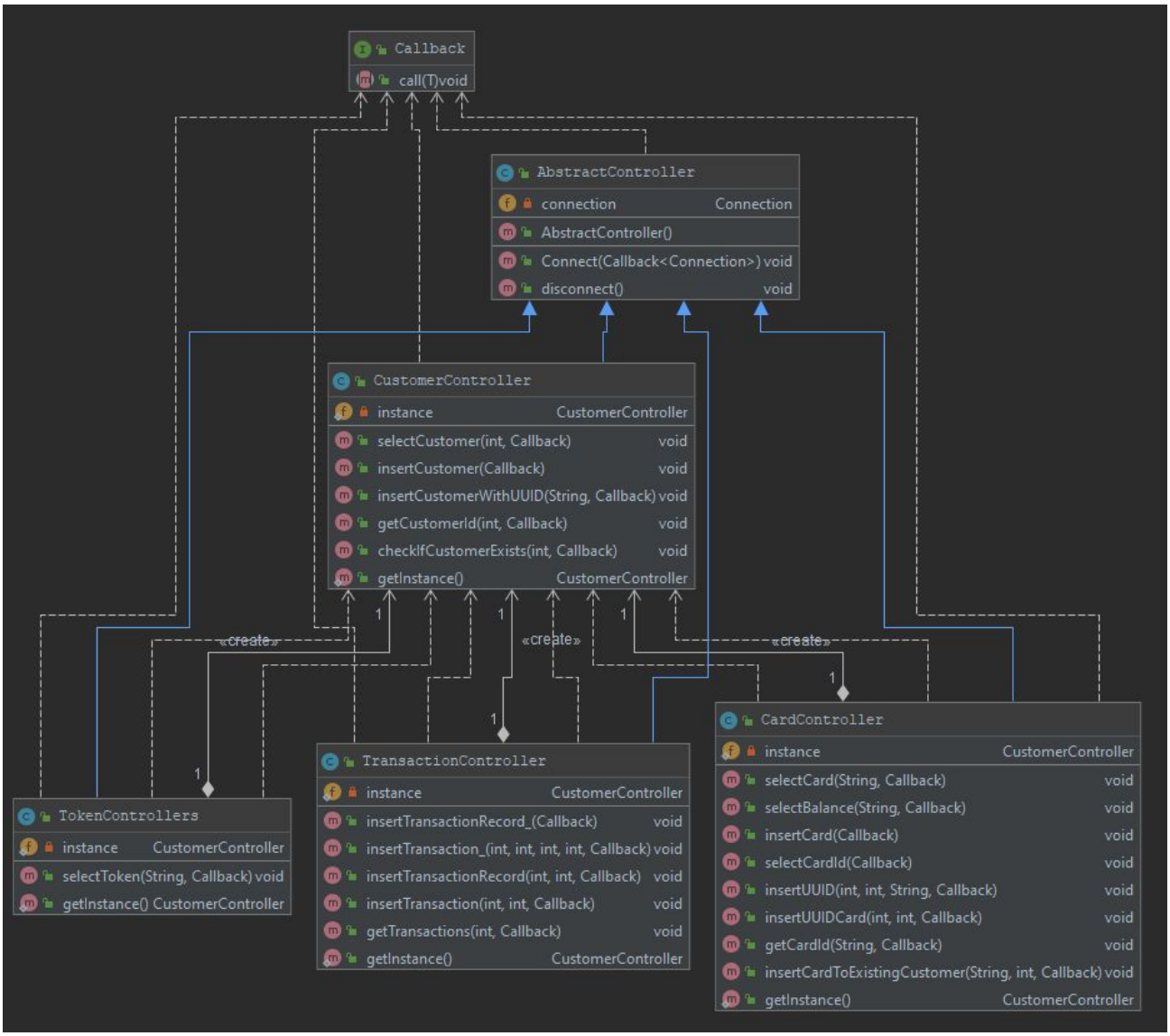
From the product perspective these classes represent the structure of the system components.

Figure 5.1.1: System components diagram



Customer uses the card or device that supports NFC technology to make a transaction that creates a record. Database stores 3 key values about the user: Universal Unique Identifier of the card, amount of points and the id of the customer in the system.

Figure 5.1.2: Controller components



Controller diagrams don't represent any template but they are crucial for the system functionality and takes care of the logic in the system.

5.2 Product Functions

Process of becoming eligible to get a reward. In this hypothetical example, the coffee shop business system that rewards its consumer with a free coffee after having accumulated 10 points. 1 coffee would correspond to 1 point.

- Customer initializes a coffee purchase.
- The business checks customer eligibility for getting a free coffee.
- If not eligible, a point shall be added to customer ledger.
- If eligible, 10 points are subtracted from their ledger balance.

The state diagrams below represents the use case above demonstrated:

Figure 5.2.1: State Diagram 1. Overview.

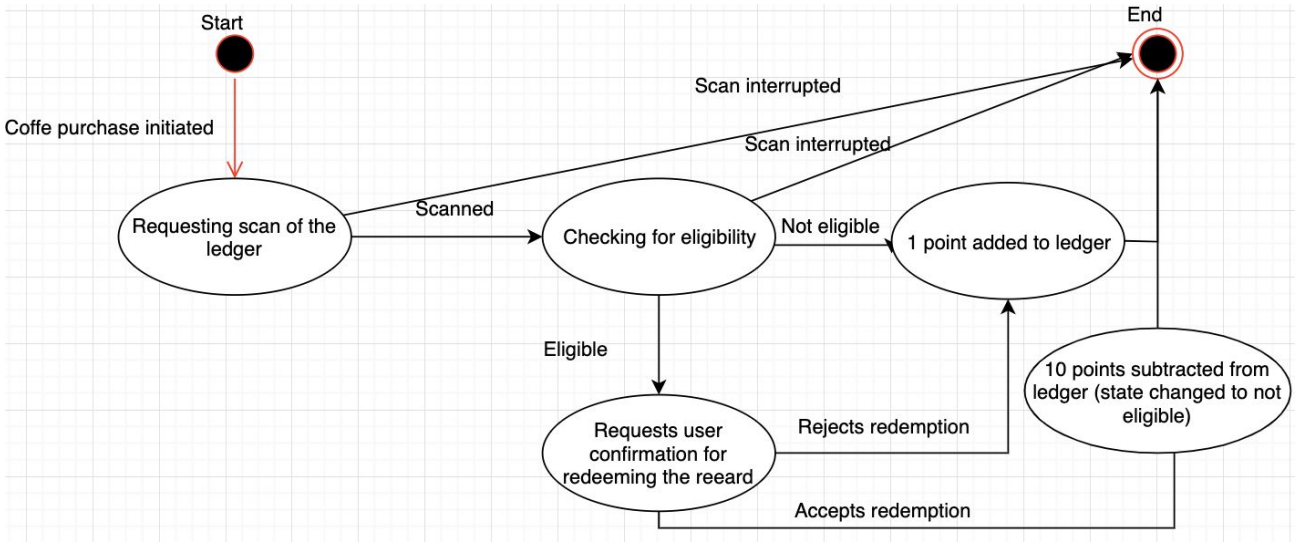


Figure 5.2.2: State Diagram 2. Checking for availability process.

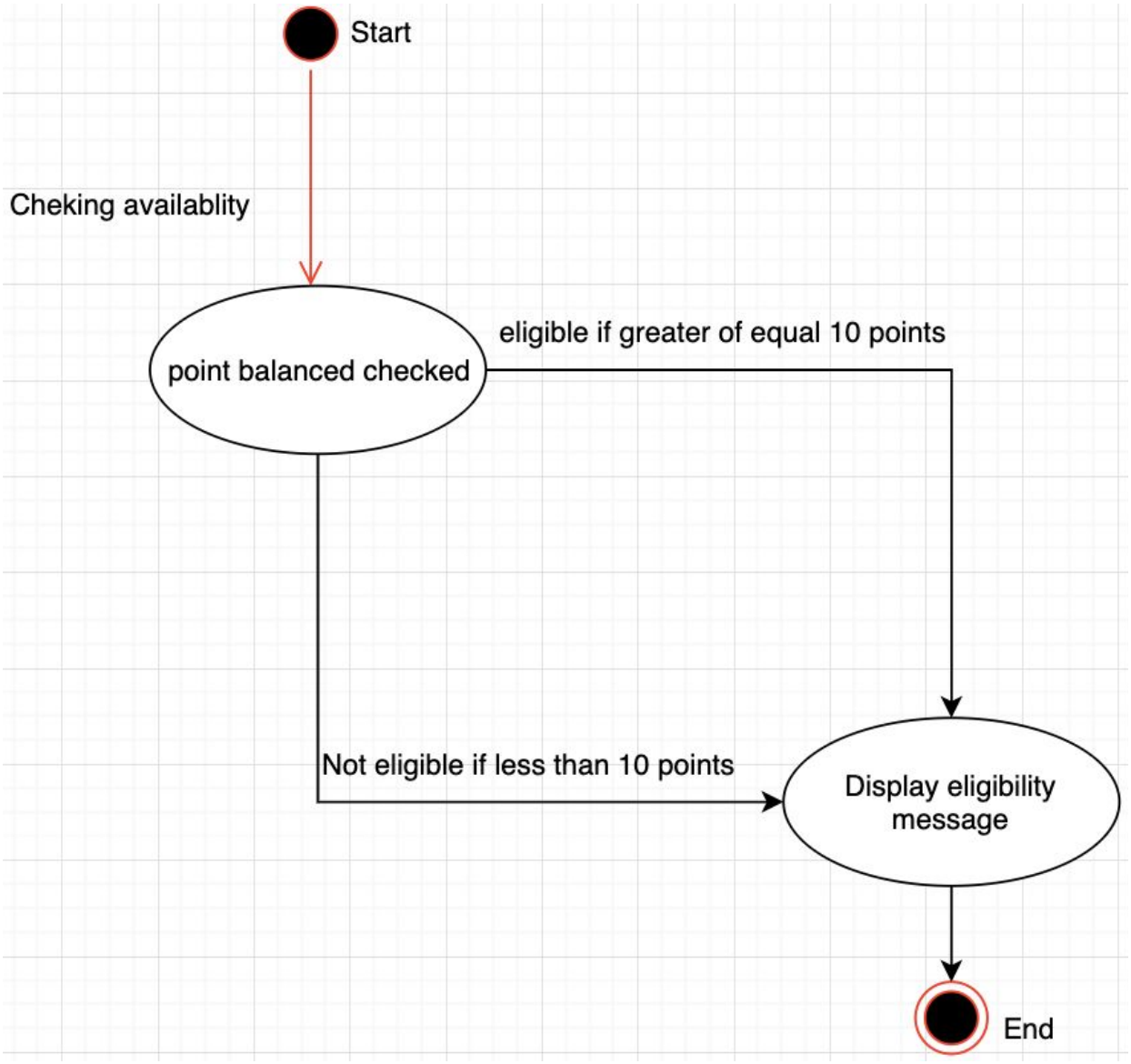


Figure 5.2.3: Sequence Diagram 1. Registration of a new customer/card.

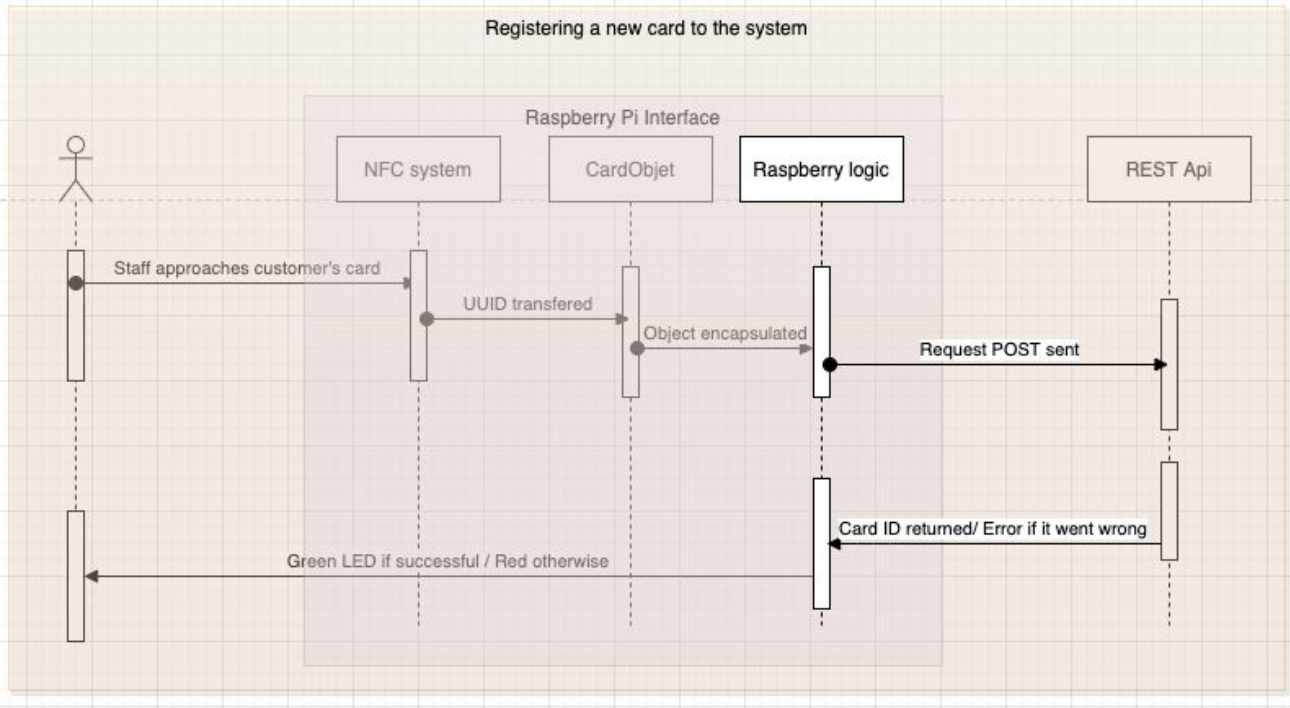
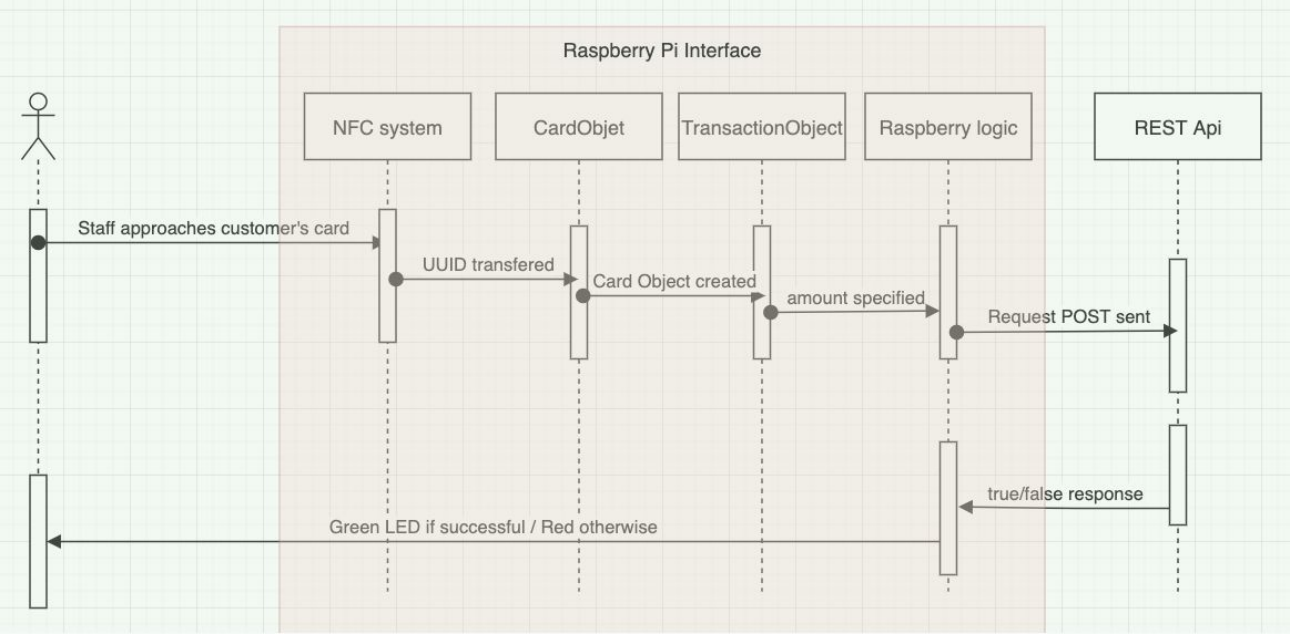


Figure 5.2.4: Sequence Diagram 2. Adding points to an existing card.



5.3 User Classes and Characteristics

The expected operators of the system are the shop clerks. Even though the customer has not been included in the diagrams above, they have a crucial part of delivering the card to the clerk, so that the staff can interact with the system to operate over creating or giving points.

The system internally creates a customer whenever a new card is inserted in the database. The customer in this context is a component of the system, not the actor that interacts with the program.

Staff

The only requirement for the staff is to be knowledgeable on operating the till, handling card and the system functionalities (adding card, adding transactions). The frequency of utilization will vary on how many customers are signed up to the loyalty system and how many of them will be buying coffee.

Customers (as actors)

So far, there is not an interface for customers to interact with the system, but the idea for the future is to implement a platform for the user to check the balance themselves as well as signing up themselves through a login/signup interface.

The customer needs to understand how to operate apps in a smartphone, and needs to understand how the process of subscribing to a service works. The frequency of utilization of the interface will vary on the frequency the customer purchases coffee at the shop. The user might check the accumulated points whenever they finish a purchase to check how long left to redeem the promotion.

6. System Features

In this chapter we will talk in more details about the MVP technical features and components, as well as design solutions for them. Many of the system features were predetermined during stages described above, e.g. Raspberry Pi as a base of NFC reader. By and large, in this chapter we will take a closer look on the technical and design solutions that were chosen and how they were implemented.

6.1 Database

A key factor to a point-based loyalty system is the ability to track the amount of points customers have, so they can redeem their prize after a certain number of points is reached. To achieve that, our system will be using a database to store the data.

Before deciding on what kind of database system will be used, it is important to first define the data that will need to be recorded so that the system can provide it's whole functionality. When looking at the NFC chip approach presented in this project, the only data needed is the unique identifier that NFC chips have and how many times each specific chip was used, which would represent the amount of points the customer has.

On top of that, although not strictly necessary for regular system operation, the database will also record the date the chip was last used and the amount of prizes that was redeemed by the customers, assuming that if there's more than one prize being offered, all of them require the same amount of loyalty points to be redeemed. Those two pieces of data might provide some insight about customer behavior, which can be interesting to the coffee shop managers.

One other design choice was using an identifier as the private key for the table where the customers' points and NFC chip are kept. This was made with scalability in mind. Considering that one customer might have more than one device that performs contactless payment (a smartwatch and a smartphone, for example), all those devices can be mapped to a single customer identifier. With that, the customer's loyalty points will be device independent, meaning that no matter the device used, the loyalty points would

be counted together. It is important to point out that, as of the writing of this document, this functionality has not been implemented since that would mean redesigning how the Raspberry Pi would be used by the shop clerk and customers, possibly including the addition of new input devices (buttons).

For the choice of database management system, a relational database system would suit the project better, specifically MySQL as it was stated in chapter 2.2. The system would only be dealing with high structure data (only integers and strings of characters) and some internal processes can be automated, like the counting of how many prizes were given (Farias, 2018).

Concept Assumption

For the database design, we first need to assume the context of the application, what the components are, who the actors are, what data we will store and why. So, below, there will be the assumptions we make about the system to be developed.

- Each loyalty point can only be granted or taken from a specific card.
- As mentioned earlier in the beginning of the database topic, each card must be mapped to a UUID code that is revealed when the card approaches the NFC reader.
- Therefore, each point is associated with only one UUID. However, each UUID (card) can have many points and one balance derived out of these points given or taken.
- Each UUID is associated with only one customer, nonetheless, each customer can have many UUIDs.
- System should deliver a way to check the balance of each UUID based on the history of the points assigned to each UUID.
- The act of giving and taking points is named as a transaction. When points are being given to a specific UUID, then we have a new transaction record with a positive point value. When points are being taken due to promotion redemption, a new transaction record will be added with a negative point value.

Based on the assumptions above described, there is a need of at least 3 conceptual entities for the database model. An entity of customers, an entity of cards and a entity of transactions.

Chen Entity Relationship Diagram

As far as the GDPR is concerned, the system won't be storing PIIs (personal identification identifiers) of a customer, such as names, emails, address, profile photo or passwords because there is no need. For the customer entity, it will be stored only the following attributes:

Customer

- id;
- Registration Date;
- A list of cards/UUIds in possession.

The reason as to why we need a customer entity is just to satisfy the need of one customer having different UUIDs. If the customer did not exist, each UUID would be treated as different customers, even if the same person may hold two different cards/UUID.

For the Cards entity, the relevant attributes are as follows:

Cards

- id;
- Registration Date;
- UUID;
- Balance
- A list of associated transactions.

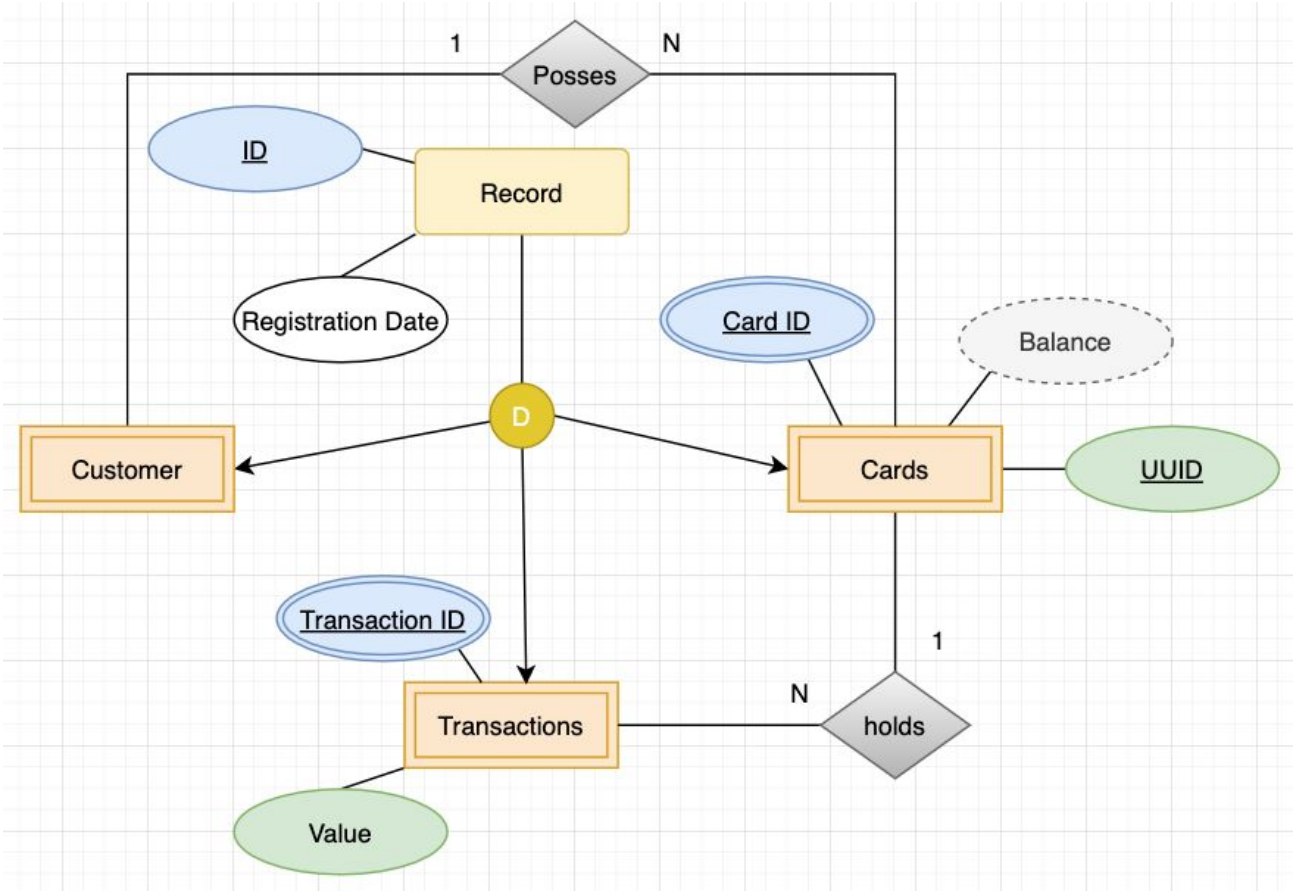
For the transactions, it is important to keep track of the date the transaction happened, which card this point will be added to and the value of the point.

Transactions

- id;
- Registration Date;
- Value;

So here is the ERD representation of the structure detailed above:

Figure 6.1.1: ERD class representation of the database entities.



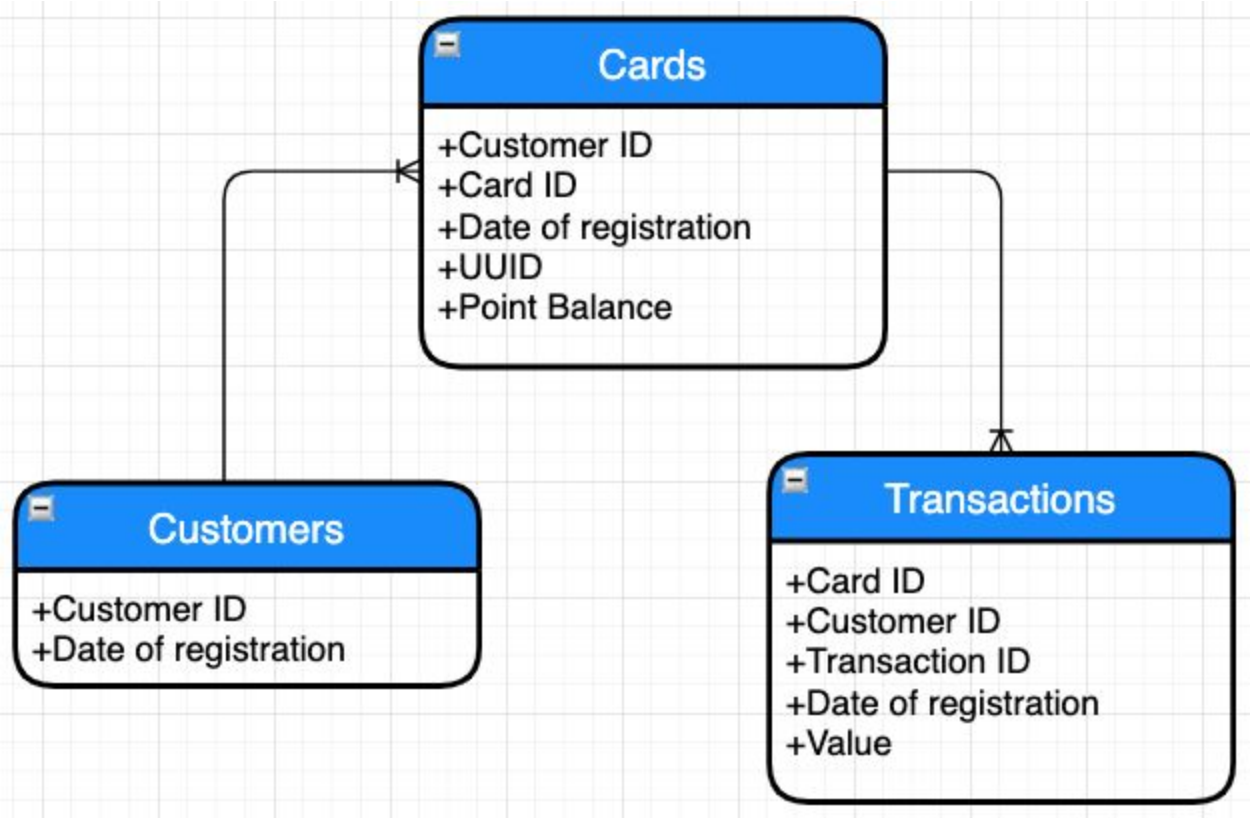
Due to the fact that the three entities share the same attributes, e.g: Customer has id and registration date, so have the transactions and the cards entity, as far as the concept of abstraction is concerned, those attributes should be raised to a parent abstract class representation named as a **record**. Notwithstanding the fact that the three entities are child classes of the record class, a customer can never be a card or a transaction and vice-versa, therefore they have a disjoint sibling relationship. As Briot and

Yonezawa (1987) states, the basic idea of inheritance, also known as knowledge sharing, is the reuse of object descriptions to refine it into a more specialized one, rather than defining a new object from scratch. This is what is happening to the entities of the diagrams above. Some records are specialised in becoming customers whereas others are specialised in becoming transactions or cards.

Crow's foot notation

The diagram below displays the crow's foot ERD of the entities in the first normal form (multi valued attributes split into different columns, such as the primary keys) and their respective relationships.

Figure 6.1.2: Crow's foot notation representation of the entities normalised in their first normal form.



Database physical tables diagram

When it comes to data handling, the less resources you use to manipulate or store it, better the performance of the system that will execute the basic database operations is. Those basic database operations are insertions, updates, deletions and selecting. In order to accomplish this, the tables should be decomposed to eliminate data redundancy and undesirable operations anomalies, and here is where the normalisation steps come into play.

The repetitive attributes, such as date of registration and customer, card and transaction ID will be moved to one unique table named records. Then these keys will be a referenced constraint of the column id for the records entity. Furthermore, an extra column called type will be added to differ what type of record is being inserted, whether this is a customer, card or transaction.

The derived column "balance" of the "cards" entity, displayed in the diagrams above will be disconsidered and not used to store data. Instead, its atomic value is meant to be generated and calculated whenever requested/asked and the function is based upon the transaction history. This will reduce costs of storing unnecessary data:

Table 6.1: Representation of a derived balance column based upon the transaction history.

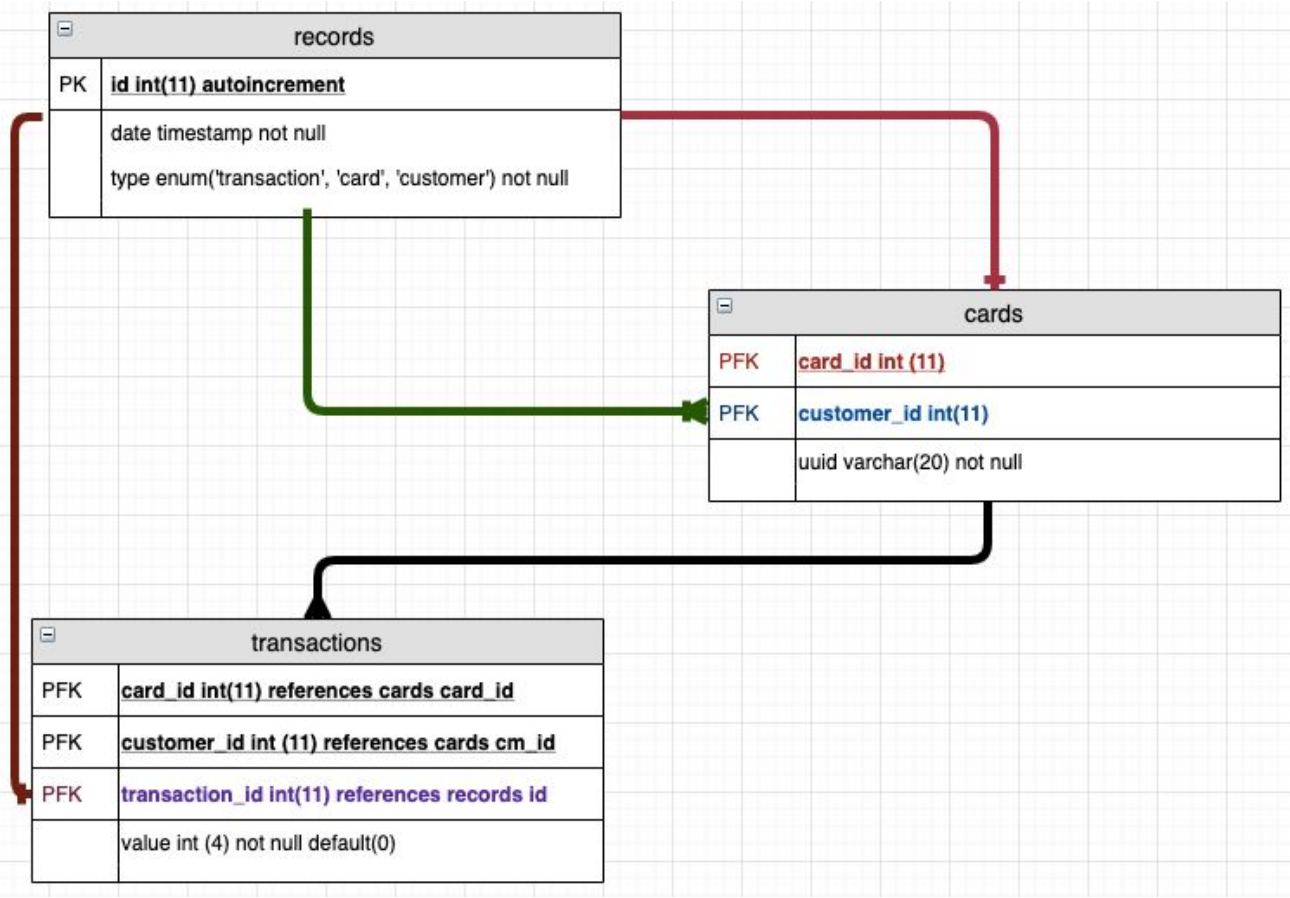
Card	List of Transactions Values	Balance
1	[v1,v2,v3...,vn]	*balance = f(tList) = tList.reduce((accV, currentV)=>accV + currentV);*
2	[1,1,1,1,1,-5,1]	*f([1,1,1,1,1,-5,1]) = 1+1+1+1+1+(-5)+1 =* ***1***
3	[1,1]	*f([1,1]) = 1+1 =* ***2***

The entity "customer" is dropped, because it does not have any specialized attribute and its relevance was only conceptual in terms of analysing the structure from the class diagram entity perspective. As a matter of fact, customers will only be stored in

the records table with the “customer” tag in the column type.

In the end, the following diagram represents how the data will actually be stored:

Figure 6.1.3 - Normalised physical database entities.



6.2 Docker

As this application is designed in a way to make it highly scalable for future surge of clients, we need to make it easily deployable (off-the-shelf). There are many available technologies that allow the deployment of applications to be more efficient and scalable.

According to Boettiger (2015), Docker tries to solve the problem of “dependency hell”. Because different machines demand different ways of installing dependencies, one specific dependency may conflict if installed in another machine. The docker solves this problem by creating a unique environment and encapsulating all the dependencies/parts of the system in one virtual machine, containerizing it.

Also, the author mentions that the containers are fast to create (deploy) and destroy. As a container merely has to terminate the processes running in its isolated space, starting and stopping a container is more similar to starting and quitting an application, which is what we are proposing.

Furthermore, Docker relies on a copy-on-write model, so that making changes to the application rapidly. This attribute is very important to the project because we may add or adapt the features in the future. Because the Raspberry pi, a device with limited storage and resources, was chosen to host the application, we need a very performant and lightweight way to deploy the program and Docker is an excellent option at making the best use of resources of the hardware (Turnbull, 2014).

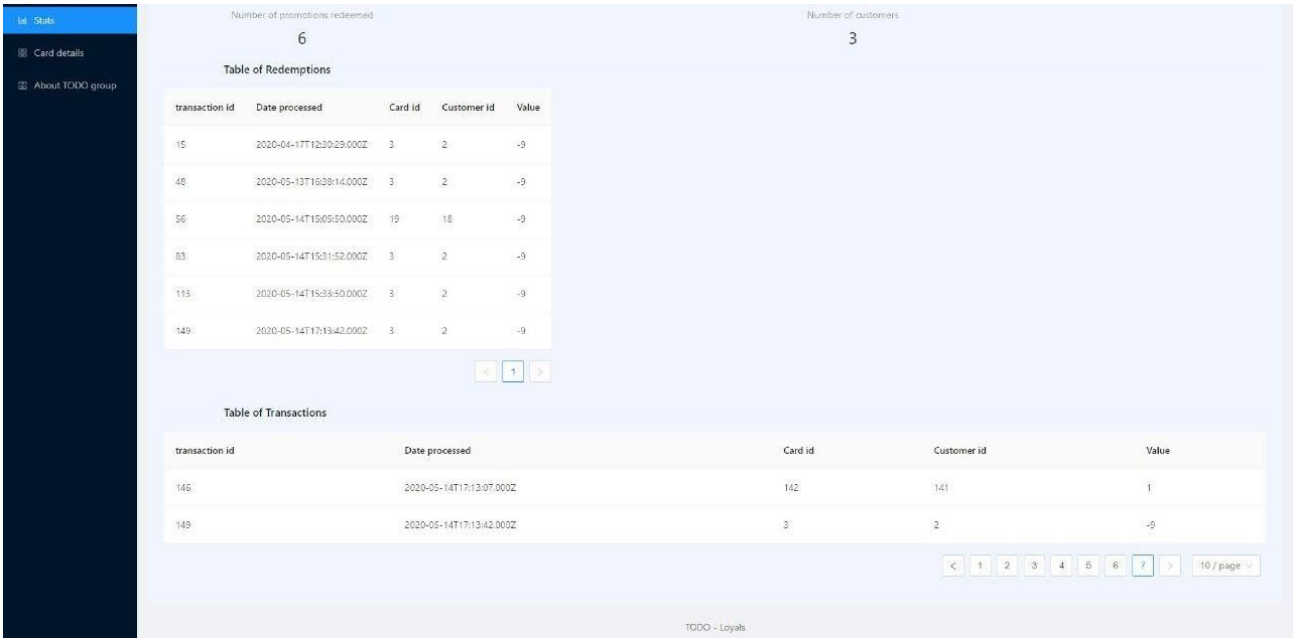
6.3 User Interface

As this project is just a MVP-candidate, we decided to do a simple web-page to aggregate all information that is stored in the MVP-database on a Web-Page, showing how the system works in the real time.

Currently this page is built only for one NFC-reader, but would also show the data of many NFC-readers if they existed. The next step would be to develop a web-based system where every client (coffee shops) could login to only their reader and see the statistics and transaction in process.

More screenshots of the web-page could be found in Appendix A.

Figure 6.3.1: Screenshot of the web-page

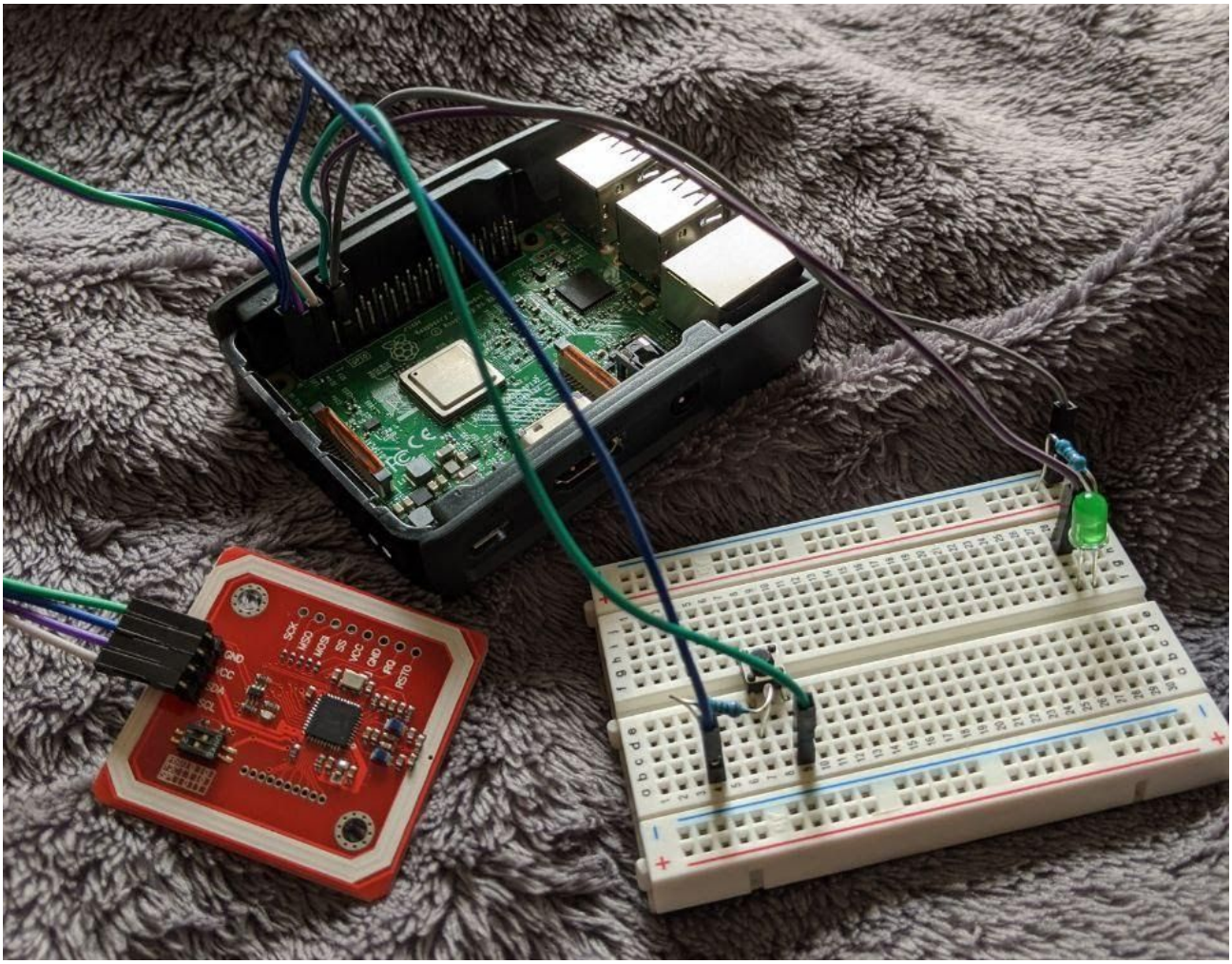


6.4 Hardware Interface

Overall, the final result is far from being perfect, as none of the team members have proper training in electronic engineering. We recognize that in order to make it more safe to use and easy to interact it needs a custom waterproofed hard shell. It was one of the final steps for our team: to find a 3D-printer and make a prototype of this box. Unfortunately, with the current quarantine situation it was not possible to make one. Nevertheless it could be easily fixed, whenever the workshops open again.

From the hardware point of view it only requires the power connector and the stable connection to the Ethernet or Wi-Fi. Other parts will be pre-configured by @TODO team and will be hidden from customers.

Figure 6.4.1: Final MVP-Candidate



7. Conclusion

Coffee shops are part of an industry that is currently thriving, where in countries like the United States of America coffee-related activities are responsible for nearly 1.6% of the country (NCA, n.d.). It was also made clear that customer loyalty and customer retention is highly important for a business. Kenny and Susanty (2015) affirm that “the value of a strong brand lies in its power to capture customer preference and loyalty”. The booming coffee industry and the importance of customer loyalty lead our team to develop a system as a turnkey solution for loyalty programs in coffee shops.

The prototype built provided all main features needed in a loyalty system, those features being tracking customer interaction with the business in the form of points, and showing when the user is entitled to a prize. By attaching the participation in the loyalty system with a payment method, the system also solved some of the issues that card-based loyalty systems have, such as the customer forgetting the loyalty card or losing it.

The system does present a few drawbacks. By using a medium of payment as the way to participate in the loyalty program, customers may be stopped from taking part in the program if they do not have a NFC Chip device. Also, as of the moment this document was written, the customer does not have a way to check his or hers points easily. Although the API does provide that functionality, the customer has no real way to check the UUID of the card so that the customer can make a request to the API (not to mention that would require very specific knowledge). Lastly, since points are still attached to the NFC Chip identifier, a customer that uses different devices at separate times, like a contactless card and a smartphone, would not have a way to join the points. That makes the system not ideal to be used instead of loyalty cards, but ideal to be used alongside it.

Several expansions can be made to improve the system. Creating a website where users can login and verify their points and check other data could improve customer satisfaction. That would also make it possible for customers to have all their devices under the same user. A mobile application might also improve brand loyalty.

8. Appendix A

All of the source code for the system can be found in the Git repository available at this link: https://github.com/marcelus20/todo_loyals.

In the link provided, it is available the source code of the following system parts:

- Backend environment;
- Frontend environment;
- Raspberry Pi client coding;
- Database generation;
- Docker composition and integration of all environments (Except Raspberry Pi);

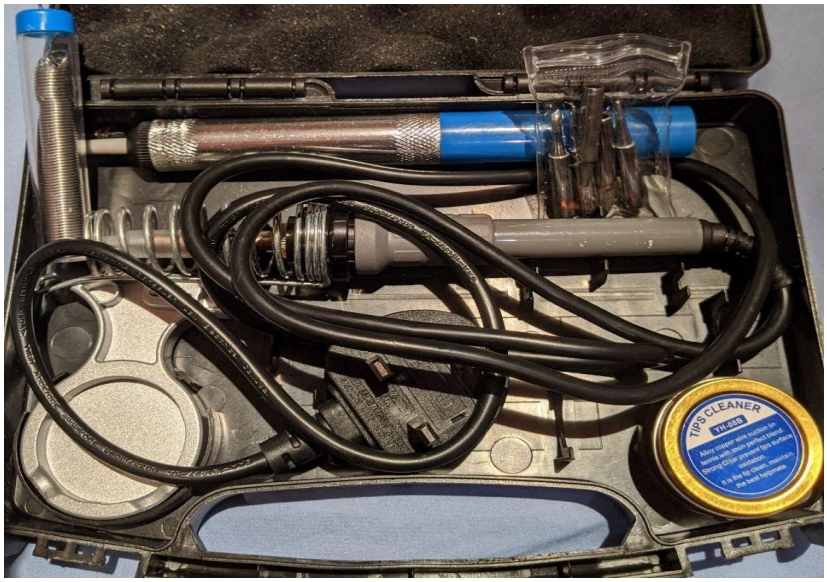
8.1. Soldering of NFC-Reader

In the time of work on the physical device, we faced a problem with the connection of wires to the NFC-reader, mostly someone was holding the reader in the hands. To fix this problem it was decided to solder the pin header with NFC-reader.

Figure 8.1.1: Soldering tools

Soldering tools used:

- Soldering Iron
- Conical Iron Tips
- Brass
- Iron Stand
- Solder



The technique is simple:

1. Inserting the pin header into the holes of the reader and turning the board over.
2. After turning the soldering iron on and need to touch the tip of the iron to the copper pad and pin header, hold like this for 5 sec.
3. Now touch the solder to the joint and continue holding the iron on the copper, trying to avoid direct touch solder with iron.
4. In the end, release soldering iron and give it time to cool down.

Figure 8.1.2: Soldering technique

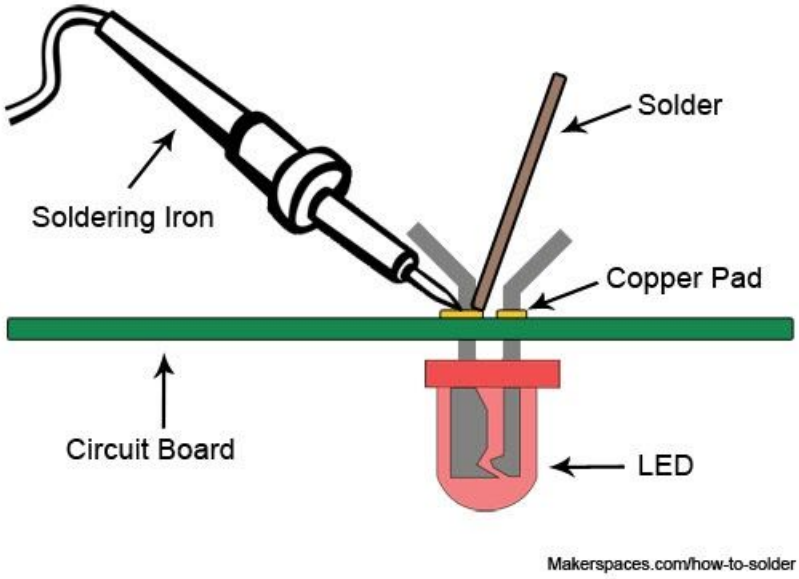


Figure 8.1.3: NFC-Reader after soldering

8.2 WEB-PAGE

Figure 8.2.1: About TODO Team

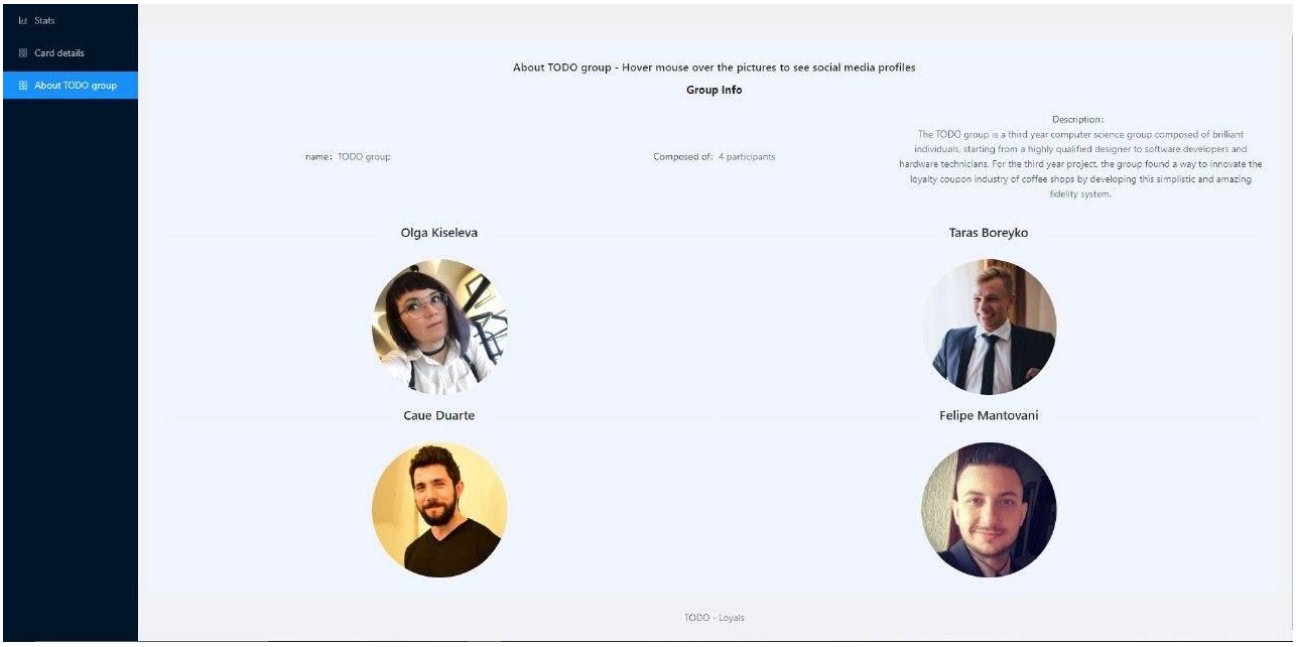
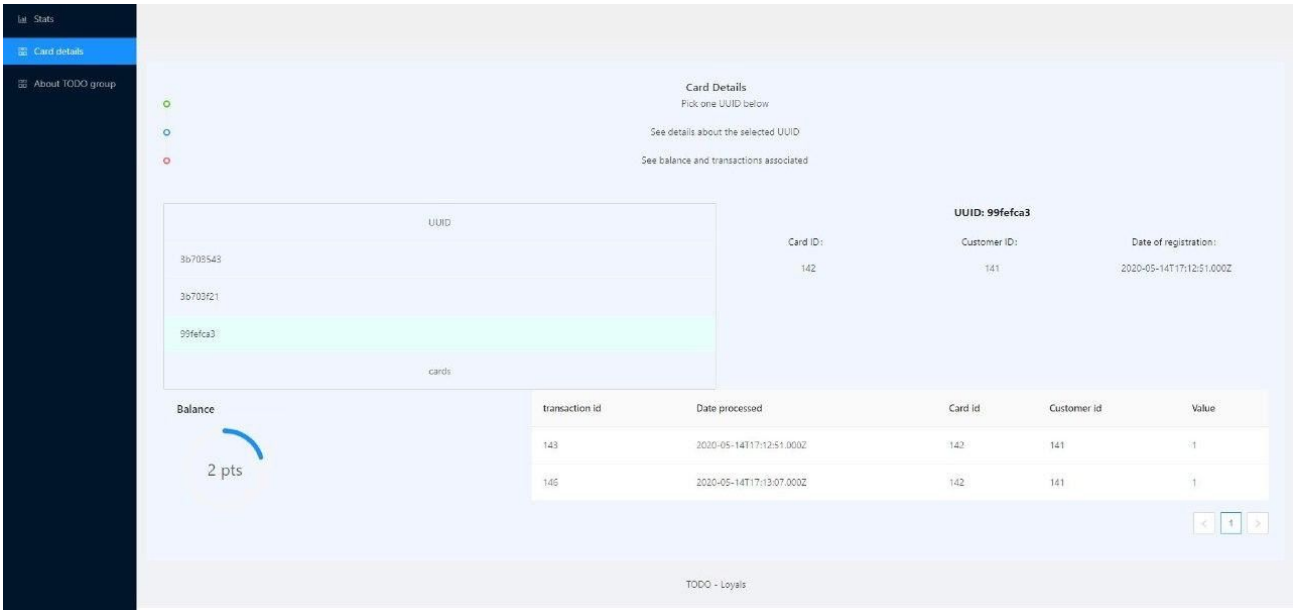


Figure 8.2.2: Card details and statistics



9. Appendix B

9.1 Individual contribution

The strength of the team is in its members. The team members can learn and perform at their best when combining their strengths and sharing their weaknesses to each other in order to achieve a common goal. In this section, we will be summarizing the contribution of each participant for Semester 1 and 2 on this project. It is also important to mention that, during the work on this project, none of the team members were left alone with isolated standalone tasks. We have been encouraging each other to collaborate, integrate, aid and check on the other peer assigned task to ensure the accomplishment.

Cauê Duarte (2017228)

Caue's role was to research the technical aspects of the project and to provide the ground for the rationale behind the project. That included extensive research on various topics related to ideas presented in this document, such as:

- Researching the international coffee market. Although ingrained in a large part of daily life, when considering the scope of the project, it is crucial to demonstrate the attractability of solutions in said market. That was done by researching the retail side (coffee shops), production side (coffee grain production) and customer behavior (coffee consumption and coffee shop choice).
- Detailing the solution that the group is proposing and how it would address the problem in hand involving loyalty-systems in coffee shops.
- Researching the technologies that are part of the project. After the proposed solution was idealized and its many physical parts defined, it was needed to explain what each one of those parts encompases technology-wise. For that, it was explained what are Raspberry Pi, what is the NFC technology, and how they could be integrated and used as a loyalty system solution.

Task	Result
Research involving the international coffee market.	Created the introduction that brought data essential to explaining the details of the international coffee market, its growing stage and the allure that such a market can have for solutions involving technologies.
Described the Proposed Solution.	Synthesized the description of the proposed solution that was the results of the group's research, brainstorming and thinking process.
Explaining the main technologies used in the project.	Delineated the technologies that will be used in the project and their main features. That included a description of Near Field Communication and Raspberry Pi.
Assembling and testing of the Raspberry Pi and the NFC Reader module.	Made the wiring and connection between the Raspberry Pi and the PN532 NFC Module V3. Successfully read NFC information of contactless cards and smartphones using the NFC Reader and the Raspberry Pi. That is the first step into integrating the NFC data into the final product, a working loyalty system.
Making the proper acknowledgements	All parts that were involved in one way or another in the build of this document and the system have been cited in the acknowledgement section
Writing the project's conclusion	The goals achieved, flaws of the current system and possible expansions were all mentioned in the conclusion of this document, which could be used as next steps if the group continues to move forward with the project.
Sections of the report he contributed.	Contributed to various sections in this document, such as 1, 1.1, 1.3, 2.1, 2.2, 2.3, 2.4, 2.5, 6.

Felipe Mantovani (2017192)

Felipe's role would be mainly technical aspects when it comes to coding and developing the API as well as mostly the backend structure. He suggested multiple ideas, such as:

- **Blockchain scanner for finding fraudulent wallets:** Analysing the bitcoin or similar cryptocurrencies blockchain as parameter, he suggested a development of a system that could monitor the whole history of a wallet and the transactions related to that wallet in the public blockchain protocol. This way, the system could notify the whole network and the authorities whenever it identifies that a possible wallet is involved with fraudulent activities such as robbing, hacking and so forth. This way, participants of the network could be made aware that if they receive funds from a certain wallet, they would be receiving funds as a result of a crime.
- **Development of a Linux distribution system:** To get the linux open source code and develop from scratch a new Linux system with emphasis on the network security for small servers.

Prior to the current loyalty project, the team was thinking of developing something for the Dublin Transport app. His research on this was on finding a public API where the app could retrieve real time from.

When the team settled on the Loyalty System app idea he suggested blockchain implementation of the tokenized rewards platform, possibility of transferring points between customers and researched on open source technologies available for developing a whole loyalty system for retail business as well as other apps available to develop the system upon the business model.

After the team decided to work with NFC based technologies and the final picture was there, he took a number of tasks. Below you can find the full list of tasks with results.

Task	Result
Suggestion on applying the blockchain technology to accomplish the rewarding functionality.	After a research on the two most common blockchain types, proof-of-work and proof-of-stake, considering the customers having the app installed on their phones, the better option would be proof-of-stake because it would not demand too much processing power of their phones for the “mining” process. The problem is that the team decided to stick with a different development system to each. Furthermore, it has been discussed the possibility of customers exchanging tokens between them and used in different coffee shops, but it turned out to be infeasible as

	the shops may not allow it to happen.
Gathering of Proximity Technology related articles to aid on the team brainstorm.	As a result my peers could understand more how the NFC technology works and make decisions on how we were going to develop our app upon it. The other peers contributed on video tutorial NFC related content.
The creation of the Github repository and assigning the other peers of this project as “contributors”.	As a result we have the foundation code of the app ready.
Research of the usage and implementation of docker containers.	As a result, the team now understands that docker would be a better approach for the deployment of the app and easy-to-test app functionalities in different environments. Docker has been partially set up in the code already.
Research on the GDPR and how this regulation could be brought upon this project.	After researching this, he was able to create their own policy based on the General Data Protection Regulation that can be found in the Ethics and Data Storage section of the work.
The revision of the document writing aspects.	Felipe read through the entire document to correct and revise any typos and grammar mistakes.
Sections of the report he contributed.	The product and Functions (the use case scenarios), intended and targeted audience, a tiny contribution in the project scope, implementation and building. Also, the Ethics and Data Storage section, DOCKER, DATABASE (Assumptions, diagrams), Product Functions (state and sequence diagram), User classes and Characteristics.
AWS EC2 running instance	Where the container will be hosted for while in production environment for testing purposes.
Database creation and Tables designing	The table relationships were thoroughly designed to maintain a robust and concise system structure. The concept follows a top to down approach starting from the idea of Classes blueprints and then it is narrowed down to physical data storage schemas to guarantee reduction of duplication of data as well as the redundancy.

Development of the frontend interface.	The frontend web based application to showcase the state of the database. Any updates applied by the Raspberry Pi device can be visible in the web app.

Olga Kiseleva (2017136)

Olga's main role in this project would be project management, as it correlates with her class representative skills. Also, since all team members are considered to be strong in technical aspects, it is more interesting for her to try her management skills. Her secondary role is Graphic/UI designer because her first degree is Graphic Designer.

During this semester she suggested multiple project ideas such as:

- **Dublin Transport App**. This application on the concept level was planned to be a competitor of "TFI Real Time Ireland" official application, this application would be reliable on Dublin Transport API. The API and how unstable it was working for non-official applications quickly became a main concern for the team and this idea was left outside of the scope. But by the time it happened, Olga already designed some examples of the future interfaces and was working on the app style guide.
- App that will imitate one of the popular multiplayer board games;
- Web-based application to learn how to program while playing.

As the team agreed to work on the idea of the Loyalty System app, Olga was the one who suggested and encouraged the team to research NFC technology, which turned out to be a great initiative that brought some degree of innovation. After this moment in time, the team was fully settled, and the following tasks were done by Olga:

Task	**Result**
Research planning and project management techniques.	Olga worked on the project plan, she tested multiple tools to draw a Gantt-chart and project roadmap. After research and consulting with a team: the project plan was set on Gnatter.com, and the 8 months plan was split for 2-weeks long sprints, as well as Agile Methodology was chosen.

Set document structure.	As a result IEEE template was chosen as a current document structure, adopted accordingly to the requirements of CCT and used by the team.
Research a team-task management and product backlog software.	As college provided each team with a basecamp page for the project task management, Olga became a person in charge of it. She set up tasks for each team member. Also, it was her suggestion to use Trello as a product backlog.
Team communication with Supervisor, each other and college.	One of Olga's responsibilities was to communicate with the supervisor, organize team meetings. Furthermore, when one of the team members was sick, she was a person to go-to for project updates.
To do a research of the coffee shop networks and compare loyalty systems.	She researched and compared 5 different coffee shops' loyalty programs to each other (Section 3.1). This information helped to outline Minimal and Maximum project configuration (Section 3.6) and define a functionality that must be presented by the end of the year in the NLS-Project prototype.
Work on the current document.	She wrote multiple sections in the current document, such as 1, 3.1, 3.5, 4.1, 4.6, 4.7, 6.3, 6.4 and 9.2 and corrected many others.
Team communication during the pandemic.	One of Olga's responsibilities was to ensure that communication and information flow was set up and all team members can reach each other, all team mates are up to date.
Product management.	Olga was keeping track of the final product and always tried to look at it from the customers and business perspective. It was her suggestion to add a front-end part.
Database design and creation.	She also took part in this task, as she was the one who suggested an improvement into DB design in order to make it more scalable and secure.
Team support and participation in the team life.	As a Project/Product manager of this project, Olga was the one who was solving the day to day problems, e.g. she bought all the components for NFC-reader, she found Soldering Iron, she organized storage in the college and

	kept the team in loop about it.

Taras Boreyko (2017284)

Taras's role would be to help with coffee shop loyalty system research, how often they are used by customers and if it's practical. Furthermore, Taras will help with technical parts like coding, research about the NFC components we need to build the module and tutorials or articles about how to configure this system and components connection with physical device system.

The main idea of this loyalty system was suggested by Taras. At that time he researched problems of today's loyalty systems. But in his vision, it should be one system for multiple coffee shops and it didn't have the main idea of technology that would be used. It was suggested by the team to develop a system for one coffee shop as it will be more relevant and better for future business implementation. The final decision was to build a loyalty system around the NFC technology, that could make the project more innovative, in the table below you can find all tasks that Taras was involved in:

Task	**Result**
Research coffee shop's loyalty systems and problem statement.	Because Taras works part-time as a barista in a coffee shop he could see the main issues of the old fashioned today's loyalty systems. With main ideas and tips from teammates, a working plan has been created on how to improve this area.
Research components for the NFC module and where to buy them.	In the research, it looks like the best module can be created from main components Raspberry Pi 3 Model B+ and PN532 NFC module that have Android libraries to work with Google Pay in the future. The ELEGOO Electronic Fun Kit would be handy because it has a big variety of components and Generic 1602 16x2 Character LCD Display can be used for displaying information to the user.
Find information about setting up the NFC	In the process of research around 5 different tutorials have been found on how to set-up PN532 NFC module with

module with particular components.	Raspberry PI, and which are saved on basecamp, but the team decided to go along the **blog of stigok:** *https://blog.stigok.com/2017/10/12/setting-up-a-pn532-nfc-module-on-a-raspberry-pi-using-i2c.html*
Research on how many customers are using paper card loyalty systems on a regular basis.	In order to find out the percentage of customers using paper loyalty system cards and percentage of those who are not, Taras concluded that the research has shown that only 50% of customers are, in fact, using the paper based system.
Connection of the all components, NFC-Reader, Raspberry Pi and, coding and testing	Taras working in the group manage to read data from NFC-cheap cards or smartphones and pass it forward. Worked on the code that was written on Python. Soldering of the NFC-Reader.
Insure that all members of the group have access to the device.	The last weeks of the project were done just online because of carantin and Taras responsibility was to give some access to the physical components. By connecting the device to the internet and some extra software and hardware was provided some chance for group to be involved and work on the system.
Work on the current document.	Was involved in various sections of the document such as: 3.4, 3.5, 3.6, 4.1, 5.1, 6.1 and structuring the references in Harvard format.

9.2 Sample Group Project Ideas

1. **Student Calendar (Based on Moodle API Web/Mobile Development)**

   Project Description

   The project involves creating an app and a Web-page that will be connected to the Virtual Learning Environment of the college e.g. Moodle based on the existing API. Each student would be able to login to this page/app using Moodle college credentials. After login, the app will show a simple calendar with all assignments and tests dead-lines, create events, set reminders to students in the app and export all dates into Google Calendar (or any other of the app).

   Technologies: Moodle API, Python, Java Script, Database, Kotlin, Docker.

2. **Public Transport application (Web/Mobile Development)**

   Project Description

   This was a concept that was being analyzed before the Real ***Time Ireland App*** was created. It had the same concept - to develop an application where users can check information about all Public Transport in Ireland, e.g. Irish Rail, Dublin Bus, DART, LUAS and other private bus companies. The aim of this project was to work with multiple public API's and try to build a mobile app that could potentially unite the functionality of multiple apps in one.

   Technologies: Swift, Kotlin, Docker, Google Maps API, Dublin Transport API.

3. **Web Service to find a sitter for your pet (Web/Programming)**

   Similar to services that help finding a cleaner, taxi or deliver food, the concept of this web service was to find a pet sitter. It looked like a really nice idea to build a web service that will work on similar principles such as AirBnB and JustEat. Service providers would be able to meet clients who need someone to take their dogs for a walk or possibly take care of their pets while the owner goes traveling, for example.

   Technologies: JavaScript, AJAX, MongoDB, Python, external libraries such as Material-UI (see: https://material-ui.com/)

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