PROBLEM BASED-LEARNING PROJECT – *FAST SHOPPING SYSTEM*

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Abstract: *The goal of the first PBL project was not to implement a system, but this project made us understand what critical thinking is. Thanks to this project, we have learned to think more widely and analyze the problem from different angles. Our first project is called "FSS: Fast Shopping System". The problem we tried to figure out how to solve was the queue at the markets. Our idea was based on tags that should be put on each product, as well as scanners, which should stand along with the terminals at the cash registers. This system has practically no drawbacks, but there are many advantages. It will attract customers and facilitate their purchase process.*

Keywords: queues, tags, readers, FSS, customer.

Introduction

Problem Based Learning program is an approach of improving student's abilities of analyzing certain issues to the point where they deal with all the sub-problems that are chained to the main one. In the process of doing the needed research, the team has to also think creatively about some possible solutions that will generate positive feedback.

Being freshmen, the crucial purpose of our first PBL project was to develop an early mindset of an engineer. We had to find a way to solve a certain social problem, describe the process of our research and then present the final result. To be honest, it was tough work from the beginning until the very end. It took us a lot of devotement to meet 3 to 4 times per week, after lessons, in order to discuss new ideas. Moreover, debating on every word and gathering information about the new set of issues or sub-issues became a daily routine when it came about working on our project. Sometimes it was very exhausting to keep conversations going on, but we were lucky enough to have wise and cooperative members in our team, as well as an impressive captain, our mentor. He always helped us with a piece of advice and supported us all the way through. It was a pleasure working with him and we look forward to have more projects along his side, as he became more than just a teacher to us, he became our friend.

Nevertheless, this project gave us a set of unique experience. We gained knowledge in various fields, even some not related to our specialty. Learning some features from economy, robotics or even psychology was an excellent improvement to our engineer minds.

One thing we were reminded frequently and sometimes even every day was that it can be very difficult to please each single member in a group of people. That is the reason why from young age humans are taught to work in teams and care for each over. The skill of being able to compromise, understand someone's opinion and explain yours in a manner that it will be accepted by the others is being considered as one of the most important skills a man has to own in order to achieve success nowadays.

1. Searching the problem

From the very first days, our group of 5 people started doing researches on the main issues that people deal with every day. We had that idea of finding the problem that was most frequently faced by citizens of all age and profession. Many choices were not taken into consideration because they were out of IT sphere. For example: ideas regarding bad roads, excessive traffic, dirty streets, too crowded public transport are more related to infrastructure and to the mentality of people themselves, things that are out of our league. Although we were full of enthusiasm, it was quite hard to find the perfectly satisfying social issue that had to be the heart of our project.

After several variants that we analyzed, the closest and the most appropriate idea we could chose was the problem of queues in stores. This issue can be considered a case where a small problem faced by a lot of individuals on a daily basis becomes a major one, that is eventually causing big discomfort for the society as a whole. Obviously, the last thing people want to practice after a long workday is standing in queues for 10 to 20 minutes when you only had to buy, for example, one bread and a pack of eggs. This issue is widely known but it is still present in our super(hyper) markets. Happy that we found our perfect problem our team started working on it. Moreover, we were looking at the problem from different perspectives, in order to be sure that every regarding issue is analyzed and described. It was indeed tough work finding things that were not "ok" to an already found problem or even to its possible solution, but we managed to discover how to think in a way that nor the customers, neither the shop staff would be unhappy with the changes we would

want to implement. Suddenly we felt a kind of responsibility, like we were in charge for the updating of the scanning-paying system in shops that would eventually have to create positive feedback. Our team was finally fulfilled with an amazing topic to work on, so we continued to develop this idea.

As our team worked on ideas of solving the problem, all the potential solutions contributed to the creation of the final one. There were many innovative and amazing ideas on their own, but some of them could be combined so the number of the choices became more accurate. Moreover, at some point we could not decide what solution would be the best suit for people of our country. For that reason, we made a social quiz where we asked people to choose one variant between 4 our main ideas: Cards and scanners, Cameras aimed at departments, Smart cart and tags on products.

The idea "Card and scanners" consists of the following system. In the store at the entrance there will be cards. Every department in the store will have scanners, that will show an intermediate list of products listed on the card. To put the product to the list in the card, the buyer must scan the card with scanners, then the product. Taking all the necessary products, the buyer goes to the cashier. Here, the cashier punches not every product individually, but only a card on which all products are already recorded. After scanning the card, buyer should pay for products and the information from the card will be deleted.

"Cameras aimed at departments" are the cameras, that see the divisions between departments, but the system knows in which department which product is located. All doors at departments are closed, they can only be opened with a card. When a buyer opens the door to the department with a card, then the system opens a list with the products of this card. The system determines the product, taken by the customer with the help of the cameras and add it in the list of products on this card.

"Smart carts" have the cameras, that are located in two diagonally opposite corners of the chamber. When a customer puts a product in a basket, the cameras determine the product. Also, each basket has a tablet, where the system displays information about the added product (image, name and price of the product). When the buyer wants to complete and pay for the purchase. He enters the basket number into the terminal. The entire shopping list is displayed on the terminal screen. And the buyer can pay for the purchase in cash or by credit card.

The last idea is based on the tags that are put on products when they are brought to the market. A customer as usual takes products and put them in a basket or a cart. At the exit from the market, instead of cash registers, there will be terminals with scanners. To scan the product, the buyer will not need to get the product from the basket. Scanners will identify the product by its tag and list it on the screen. In the database of the market for each type of product will be stored separate tags.
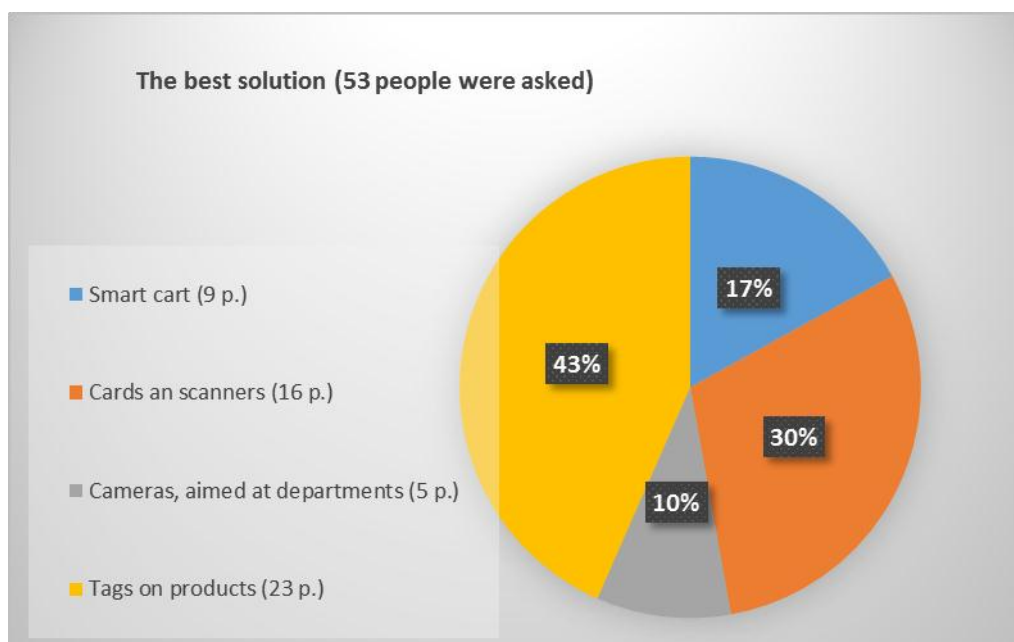
Here are the results of our quiz:

Fig. 1 Quiz on Best Solutions.

According to our expectations, the quiz showed that "tags on products" was the solution that people considered the most functional and useful.

2. Description of the main solution

The results of the quiz (*Figure 1)* gave us a fresh look upon the problem. As it is seen in the diagram, the majority chose RFID tags, so we started analyzing this solution. The main idea of it is to glue RFID chip sticker tags to all the products in a store. That is supposed to be the first part of FSS, the gluing process. The next part is the scanning one. The scanner will be embedded on the floor. And the terminal will be located on the side. It will work like this, the buyer passes through the separated strip, stops with the cart at the terminal, so that the cart is in the scanning field (or puts the basket on the floor on the scanning field). Pays for the purchase using the terminal and goes further to pack the products. This happened to be a little tricky as it is unusual, compared to the classic system, but considerably faster on the other hand. The reader scans all the products in a cart at once, without wasting too much time in a queue while the cashier scans each product separately. It's speed still depends on the number of products, although it is still approximately 10x faster, maybe more with some upcoming advanced technology. Another feature of the reader is that it will be directly connected to the terminal, which will be placed next to it. All the information about products will be sent to the terminal in "a blink of an eye". There will be created and shown the list of products with all the needed information about them: name, price, image and quantity. Moreover, it will be an option of deleting a product after taking it out of the cart. As the cart is being constantly scanned until the customer pays for the products, if an item is removed, it's tag will no longer be visible for the reader and eventually a window will pop up asking if this product has to be deleted. In the right side (for example) of the screen there will be three icons: pictures of three different packages, inscriptions on top of them: "Small", "Medium", "Large" and under every picture the price of the package. If the customer wants to add a package to the list of products, then he clicks on the icon and the package is added to the list. If the buyer wants to remove the package from the list of products, then he clicks on the icon of the package in the list, the screen prompts: "Do you want to remove the package?". If the customer clicks "yes", the package is removed from the product list. The next and final stage of the system is the payment method. As a customer checks his list and is ready to pay, he is given the choice of paying by cash or by card. Depending on the option, he will insert the amount of money, in bills and coins if needed, or will insert the card and follow the steps shown on the screen. Only after the bill is payed, the RFID tags are disabled and the customer can move forward, without disturbing the security system. All these features combined made FSS easy adaptable and user friendly from our point of view. Our team wanted to create a system that would generate as much positive feedback as possible and would made shopping process more enjoyable.

3. System components

The technology used by our system is not new and there are many recommendations and requirements for them.

- Radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically-stored information. Passive tags collect energy from a nearby RFID reader's interrogating radio waves. Unlike a barcode, the tag need not be within the line of sight of the reader, so it may be embedded in the tracked object. RFID is one method of automatic identification and data capture (AIDC).
- Frequencies. FSS is projected to use UHF canals to be able to reach all the products in a 2.5m.
- An Active Reader Passive Tag (ARPT) system has an active reader, which transmits interrogator signals and receives authentication replies from passive tags. Fixed readers are set up to create a specific interrogation zone which can be tightly controlled. This allows a highly defined reading area for when tags go in and out of the interrogation zone.

Hardware:
- RFID Tag - a passive RFID chip-sticker tag with 1024 bytes memory size. Those will store the information about the product such as: price, name, manufacture and expiration date, date when bought and also the information if the tag is active (so the reader can read it).
- RFID Reader – an Active Reader Passive Tag (ARPT), Ultra High Frequency (UHF) RFID Reader with an area enough to cover the area of a shopping card and a range of 2.5m. Those will be a part of the replacement for cases we know.
- RFID Terminals – includes readers and has the ability to display the list of scanned products and to serve customers.

- Server – store the information about every purchase. Acts as a database. Can be used to track when and how much product was sold.
- Scales – regular scale with an RFID tag-printer.

Software:
- Reader's soft – reads data from all tags within certain area and make a list of those that is displayed on a screen for a costumer (the whole process can take up to 10 seconds, depends on how many products a costumer has in a card).
- Scale's soft – measures the weight of product and prints an RFID tag with all the information needed for a reader.
- Server's soft – receives data from Terminals and stores it. Provides additional information about price sales and bonuses.

Conclusions

Fast Shopping System is the result of hard work and full dedication of team "*Future*". The process of creating the system had its ups and downs, but we must say that it was an amazing "adventure" in which we combined many different skills, some even not related to each over. Moreover, we faced many challenges that improved our communication and team-working skills, as well as tested each member's EQ. This PBL project taught us how to develop a solution for a social problem using IT skills. The most entertaining part was solving sub-problems met while selecting possible solutions, as there we had to think about errors or unpleasing circumstances that would prevent our system from working properly and on its higher potential. Our system has many advantages and with all its features it could be easily implemented in market in our country. By our analyzes, it would add accessibility to customers and make the process of shopping less stressful.

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