



زانكۆی پۆلیته کنيکی هه ولير
ERBIL POLYTECHNIC UNIVERSITY

Ministry of Higher Education & Scientific Research
Erbil Polytechnic University
Erbil Technology College
Information and Communication Technology Department

Project Title:

Redesign electronic payment vending machine for refrigeration small booth (small model)

Supervisor:

Haval Ahmad Abdulrahman

Prepared by:

- **Ahmad Yousif**
- **Samir Dilshad**
- **Diyar Omar**
- **Rozgar Muhseen**
- **Rayan Salah**
- **Sahar Taha**

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Abstract

This project purpose is to redesign electronic payment vending machine focused on refrigerated snacks within small booths. Aimed to enhance user experience and operational efficiency for specific area of people like a building. It features a simple redesigned cashless system, a simple user interface for ordering products, a transparent window for showcasing products, a refrigeration system to keep products cool and many software features. This project brings awareness to other methods of advertisement and selling of products in the Kurdish region of Iraq.

Chapter 1: Introduction and Literature Review

1.1 Introduction

In today's Kurdish market people do not value the experience of buying a product or the large amount of space a market takes people today take it as for granted they do not recognize the problem with the increase of growth of the human population there would be less space what our main aim is to find a way to use the least amount of space and enhance the user experience and operational efficiency to sell the same products a market would sell we call it a vending machine our model sells light snacks that can be found in any other market but the key difference is it takes a lot less space and a lot less manpower to operate and maintain a vending machine can also be used as advertisement board on its sides you can advertise what ever you want and they can be almost placed everywhere they can sell all kinds of products and the transaction time wouldn't take a minute you just select your product pay for it and its yours that simple and efficient but like everything In this world it has some negatives like replacing peoples jobs, they cost a lot of money, they can be tricked to thinking fraud cash is real cash, they also need maintaining for example products in vending machines might have sold out they would need someone to manually load the vending machine with the products some mischievous people might modify the vending machine to scan peoples faces and to spy on people but nothing is impossible and these disadvantages might not exist in the near future.

1.2 Literature Review

1.2.1 Introduction:

The Kurdish market while it has a significant culture it has the limitation of space due to increase of the population and the many tourists that visit it daily in 2022 6 million and 168 thousand 569 people visited Kurdistan region if we compare it to the year before it 2021 1 million 978 thousand 431 people visited the region that's a 35% increase in just the tourism sector of Kurdistan. when you see the difference between these two years you see the problem space it is necessary to find alternatives in the near future.

1.2.2 Space Optimization:

Several studies highlight the demand of space saving solution in the retail businesses or environments. For example, in 2014 a research paper published by the Journal of Emerging Technologies and Innovative Research highlighted the problem of space saving in the context of furniture's. similarly, the company of Tesla which is mainly known for its electrical cars thought of the same problem and what they did is create a feature called Auto Park which saves space. And in the world of Agriculture space is also important but with each year that space gets smaller and smaller.

1.2.3 Reducing food waste:

Vending machines offer a solution which comes in the form of product management a vending machine only has a specific amount of space for items that space can be controlled and monitored to see what items are the most in demand and what items are not this could potentially decrease food waste and overstocking of not so in demand items.

1.2.4 User Experience:

a vending machine experience is very different and unique, some studies show that a vending machine has a positive user experience while some studies differ two examples would be Lee et al in 2021 which reported a positive experience and the research conducted by Brown in 2020 which highlighted lack of human interaction as a non-positive experience as the design of the vending machine and the products sold in it can impact the user experience for example a vending machine might sell tea or coffee and could have a exterior that resembles a tree it might invoke a relaxing feel to the user or it might sell electronic parts, it doesn't need human interaction which is another part of the vending machine which might enhance the experience for some group of people while another group might experience it differently it has the potential to give any experience if given the proper place body and products.

1.2.5 Potential Drawbacks and Considerations:

Despite the many benefits of vending machines there are some drawbacks that need careful consideration, firstly Automation it means that with the advancements of technology some jobs would be at risk of being fully automated and leaving some people without jobs as highlighted by Singh in 2022 research, maintenance for restocking or any potential malfunctions cannot be overlooked additionally cultural consideration are essential where it was emphasized in the research of Muhammad in 2021 where it emphasizes the importance of understanding and integrating local preferences while introducing new technologies in culturally rich environments.

1.2.6 Conclusion:

While Vending machines have the potential to evolve the Kurdish market into a more space saving more efficient and more use friendly way to buy products there needs to be a careful consideration of both the advantages and draw backs that were mentioned, before even thinking about wide spread implementation.

Chapter 2: Methodology

This chapter outlines the approach taken to design, develop, and implement the redesigned payment system for our vending machine project.

2.1 Assessment and Design

Despite the redesign of the payment system it has its limitation because it only accepts RFID cards that are registered in the database, as mentioned before we chose RFID cards as our payment system not because of its security but because of its ease of use anyone can simply understand the concept of holding something near a scanner to pay for a product, the scanner we chose is MFRC522 it has many features but we chose it because of its availability and ease of use it almost has a Zero percentage of error, its software capabilities allow it to read cards from 1 meter away from the module it detects each card's unique ID and they do not need any batteries to work multiple tags can be read by the module without confusing one card with another they are rugged and weather proof unless someone intentionally destroys the card.

2.2 Development and Integration

The development of the payment system had some challenges but it was not impossible to do but came with the sacrifice which was a PIN based security system for the cards, the software we used to program the system is the Arduino IDE which is in C++ the program allows RFID cards to only be read by the RFID reader when a product is selected and the selection is confirmed and only then the card can be read.

2.3 Testing and Evaluation

The method was a process of testing 4 different cards, 3 cards were registered in the database system while 1 card which acted as a rouge card was not in the database each of the cards were scanned using the RFID reader, we first tested the 4x4 Keypad to see if the buttons function correctly next the display to see if it would show the correct screens based on the input then we tested the RFID reader to see if it differentiated between the different RFID cards then the motors to see if they would turn on when all the payment steps were completed and finally to see if it would dispense the desired products.

2.4 Justification

What inspired us to create such a simple system was the internet in today's society you can purchase almost anything without the need to directly interact with a person the payment could be PayPal visa or a master card which all can be used to purchase stuff online our system too inspiration from It we took its seamless transactions and ease of use and implemented it in our system while it does not have a complex security system like master cards it makes the transaction process easier, we are slowly walking into a digitalized market in the near future we might not have paper money or coins left it would all become digital, the Kurdish people need a way or rather become comfortable with the change our system might not be as good as others but it sure does its job at normalizing digital payments.

2.5 Parts We Used

In this section we want to address the parts we used in the process of creating the vending machine.

2.5.1 Arduino Mega



Arduino Mega the brain of our project why we chose it? Arduino is an open-source electronics platform based on easy-to-use hardware and software. Let's go into further detail about its capabilities.

The first capability is that the Arduino can be programmed using the C++ programming language, we were very pleased that we could code using a programming language we knew and not an entirely new language we needed to learn and program with, it has 85 programmable pins, a USB type B 2.0 that acts as both a power supply and can be connected directly into a computer to program the Arduino using a A/B USB cable, a DC power jack which can be used to supply the Arduino with external power supply for when you are finished with the programming process and want to test the code out without the need to have it connected to a computer, why we chose it over Arduino Uno version? Because we needed the extra pins of the Arduino Mega. it costed us 20,000 IQD to buy. It operates at 5V and 40 mA.

2.5.2 Liquid Crystal I2C 2x16 display



This Display acts as our user interface it is easily programmable with the help of I2C module, this module takes less pins the display alone is 16 pins but with the help of the I2C module the pins become only 4 also while programming instead of individually saying which pixel should show what the module allows us to write a

string of characters then selecting which pixel should be the start position and it will write the string of characters it is simply fast, easy, and also affordable. Let's go into some of the capabilities of this display, first of all it is made up of 34 pixels, 16 columns and 2 rows. It has a green backlight which can be turned on to see the text displayed on the screen in dark areas. It has a character width of 2.95 mm and a character height of 4.35 mm. Its voltage requirement is 5 volts DC and the current requirement is 2mA (with backlight on). There was also the choice of a touch screen but we couldn't find any user-programmable screens. Sadly, but this display does its job by showcasing products and the steps of the transactions for the user. Overall, a great screen, easily programmable, and very affordable, only costing us 5000 IQD.

2.5.3 Keypad(4x4)



This part acts as way for the user to interact with the vending machine allowing users to select products, conform their purchases and to tell users when to pay for their products, it is a very easy to use easy to program part and relatively cheap costed us 3000 IQD, it's made up of a matrix of 4 by 4 meaning 4 rows and 4 columns the first 4 pins are the row pins the last 4 pins and the column pins, some of its capabilities include a long lasting life time

a operating temperature between 0C to 50C meaning it can be used relatively cold places and hot places, it has a Ultra-thin design with an adhesive back which can be stuck into clean surfaces, it's Operating Voltage is around 3V – 5V DC and a Current Consumption of <5mA. Overall, a very easy to use interface for our project but as mentioned before we would have chosen a touch screen since it would done both the work of the display and the keypad at once.

2.5.4 Buzzer (5V)



this component acts as a way to know if a button is registered or if a card is read, it really acts as audio or a output device for confirmation, the user might press a button or put his card near the RFID reader and might not know if something has happened this device ensures this type of confusion doesn't happen as it will emit a Beep whenever something happens.

2.5.5 MFRC522 and RFID cards



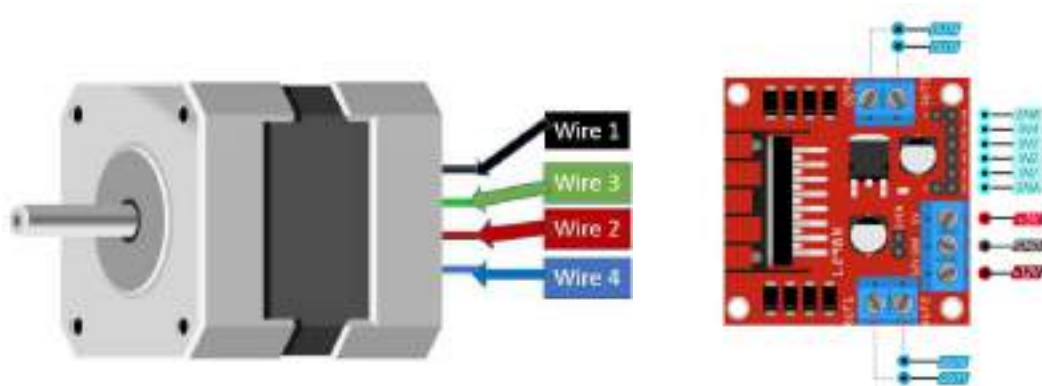
You might ask what is a RFID? Radio Frequency Identification (RFID) refers to a wireless system comprised of two components: tags and readers.

These components act as our projects payment system the MFRC522 module reads the cards unique ID codes.

Some of its capabilities are it operates at a 13.56MHz Operation frequency, its operational temperature is between -20C and 85C, its reading and writing distance is <20mm and it has a Data communication speed of 10Mbit/s Max.

Now onto some of the capabilities of the RFID cards, the main component of the card is the chip, what are they? RFID chips are integrated circuits (IC) inside RFID tags. Despite their small size, they are highly-integrated microchips that contain all the components of a controller, memory and microprocessor. The chip operates by receiving energy via the waves the antenna emits in our case the MFRC522 module. They do not need any batteries, there unique ID can be changed to a desired ID, they are tuff and weather proof so you do not need to worry to have dropped them even from on top of a building they would still work fine, overall, these two components have achieved the desired outcomes we wanted when we created the payment system.

2.5.6 Stepper Motor with L298N Motor Driver



This Motor is used to dispense the products it has a spring attached to it the shaft, we used this motor because of its power most motors won't even be able to spin around the spring this motor easily spins the spring and the products that are loaded on that spring it came with the L298N motor driver which allowed us to control the speed and direction of motors.

we have 4 of the same type of motor.

Some of the capabilities of the Stepper Motor are, its power requirements are 12V and 400mA per motor, it has an output shaft with a diameter of 5 mm and a torque of up to 100 g/cm.

It is a powerful motor can handle a large number of products loaded onto it.

Now for the driver capabilities, The L298N is a dual H-Bridge motor driver which allows speed and direction control of two DC motors at the same time. The module can drive DC motors that have voltages between 5 and 35V, but from our testing anything above 12V destroys the driver, with a peak current up to 2A.

Now onto the spring each spring is different in diameter and length mostly due to not finding a manufacturer which sold the springs we needed but we found 3 nearly identical springs and 1 smaller spring they are all mounted on to the spring shaft using a plastic holder specifically created for each spring.

Overall, the combination of all 3 components makes a great dispensing system for our project with a low chance of failing.

2.5.7 Refrigeration

The cooling and preserving of the products is done with mini fridge it needs a few modification for example the front of the fridge needs to be see through and also be durable enough for anti-theft purposes it needs to have a pickup box to collect the products after purchasing the pickup box also need to have a way to stop people from just reaching in and grabbing products so the lid would be longer than expected in order for it to hit a plate which would stop attempts of stealing.

The cooling cabinet or mini fridge we chose is from the brand Universal we can't show any images sadly because its unfinished as it is.

2.5.8 Power Supply



We chose a power supply adapter which would share the same power as the fridge the adapter would turn the AC power that is supplied to it and turn it into DC power it supplies 12V and 1A of power it is enough to supply power to the Arduino, the screen, the keypad, and one of the motors. the screen has a sleep and also goes to sleep when a motor works, it wakes up when a button is pressed, also the 4x4 Button even though it was said it needs 5 volts to work it really doesn't use the 5 volts constantly only momentarily when a button is pressed. Overall, this adapter supply sufficient power to the whole system when needed.

Chapter 3: Results

we have nearly finished the project, what is left is the assembly which proves somewhat challenging we still need a custom front for the refrigerator and we still have to mount the motors but the software side of the project is completed, and there is the wiring management which we haven't encountered yet. Although with all this said we will finish the assembly and finish the project before the dead line. 100% of the software is completed while the hardware part is close to 60% finished, the challenges we faced when creating the software were somewhat impossible to us when we first started but slowly it got easier for example we had the challenge of how to create a database to store all these different cards with all there unique IDs and all there values passwords into one database, we thought and found our solution which was surprisingly simple, a simple function in C++ which acts as a database in our project, the housing of the motors needs some modifications as it stands it isn't complete but our circuitry is completed it only needs to be applied which is the true challenge for us but we will hopefully the solution for our problem might be simple but we have yet to find it.

Chapter 4: Discussion

We have faced many challenges, at the start of the project we wanted our payment system to be compatible with master cards but no one wanted to help us so we decided to redesign our payment system to RFID we also made the some wrong decisions when choosing the components we were hasty we first chose Arduino Uno as our brain but it quickly turned out we have chosen wrong it didn't have enough pins and the store refused to the Arduino back so we bough the Arduino Mega which was surprisingly or rather shockingly less expensive than the Uno even though it offered more capabilities sadly that didn't last long as the Arduino Mega got fried due to exceeding of the power requirements we also changed type of motor 3 times until we landed with the motor we currently have, also the problem of the input we wanted a touchscreen but no one had a programmable touch screen compatible with the Arduino, we also had a trouble with the mounting of the springs we had them custom made but the real issue was the springs no one had the springs we needed they were either car spring which were very big and huge and were impossible to modify or small soft springs which would deform if we loaded products on them we managed to find a few springs which met our criteria and we were thankful its no joke that the spring was the hardest part to find we also had another component get fried which was the MFRC522 we also accidentally fried this one too as we were trying to create a small circuit including a potentiometer and we were non the wiser we changed the resistance ignorantly and we only found out the RFID reader got fried because the 50kohm potentiometer also got destroyed the refrigerator was found easily small booth refrigerator has enough space for the components, with all said and done we had fun choosing and building this project.

Chapter 5: Conclusion and recommendation

5.1 Conclusion

Our vending machine successfully developed and redesigned and implemented the payment system. While the assembly process proved a challenge like the housing for the motors and the springs, we were able to provide a simple seamless way for customers to purchase products using a vending machine.

5.2 recommendation

Based on the experience we gained building this project future vending machines could benefit from the challenges we overcame and the systems we have created and implemented by utilizing a pre-built housing for motors and springs which could save time for the assembly process or the seamless payment system for ease of use, we hope our project helps the development of the world for a better future.