



An-Najah National University
Faculty of Engineering
Computer Engineering Department



EA Vending Machine

Accomplished by:
Ahmad Khaled Saddouq
Ehab Samer Sarrawi

Supervisor:
Dr. Luai Malhis

Presented in Partial fulfillment of the requirement for a Bachelor
degree in Computer Engineering

Acknowledgment

We would like to express our gratitude to Dr. Luai Malhis and our Computer Engineering Department committee who gave us the opportunity to do this wonderful project on the theme of EA Vending Machine.

We would also like to thank every member of our family, especially our parents, who gave us all the psychological and moral support we needed and that we wouldn't be where we are now without them.

We are also deeply indebted to every member of our department family without exception, from teaching assistants to professors, for what they have given us throughout our study journey. Knowledge is invaluable, they gave us their efforts without asking for anything in return, and we are very grateful.

Finally, our friends who helped us when we needed them and provided support of all kinds, especially when we felt tired or stressed in completing this project on schedule.

DISCLAIMER

This report was written by Ahmad Saddouq and Ehab Sarrawi at the Computer Engineering Department, Faculty of Engineering, an-Najah National University. It has not been altered or corrected, other than editorial corrections, as a result of the assessment and it may contain language as well as content errors. The views expressed in it together with any outcomes and recommendations are solely those of the students. An-Najah National University accepts no responsibility or liability for the consequences of this report being used for a purpose other than the purpose for which it was commissioned.

Table of Contents

Abstract.....	6
1 Introduction	7
1.1 Problem Statement	7
1.2 Objectives.....	7
1.3 Scope of work & Importance	8
2 Constraints and Earlier course work	9
2.1 Constraints	9
2.2 Earlier course work	9
3 Literature Review	10
4 Methodology.....	11
4.1 Technical Choices	11
4.1.1 Hardware.....	11
4.1.2 Software	16
4.2 Methods and Techniques.....	16
4.2.1 System Connections	16
5 Results & Discussion.....	17
5.1 Outcomes of this project.....	17
6 Conclusions and Recommendation.....	21
6.1 Future work.....	21
7 References.....	22

List of Figures:

FIGURE 1: Box	11
FIGURE 2 : RFID.....	12
FIGURE 3: Keypad 4x4.....	13
FIGURE 4: Servo Motor	14
FIGURE 5: ESP8622	14
FIGURE 6: LCD.....	15
FIGURE 7: Portable Power Device.....	16
FIGURE 8: Connections.....	17
FIGURE 9: Box Front View.....	19

Abstract

EA Vending Machine is an automated machine that provides items such as snacks and chips to consumers after credit card, or other forms of payment are inserted into the machine or otherwise made. The first modern vending machines were developed in England in the early 1880s and dispensed postcards. Vending machines exist in many countries and, in more recent times, specialized vending machines that provide less common products compared to traditional vending machine items have been created.

We built a miniaturized vending machine from scratch using an Arduino Uno, Six continuous rotation servos, and a LCD. The device includes a Keypad to make a selection, and a light strip to illuminate the inside of the cabinet. Whether it's Snacks, Chips, or chocolate items you're looking to dispense, the possibilities are endless. Simply insert a card which it's connected to the Data Base for the payment process, choose a product, and repeat.

1 Introduction

1.1 Problem Statement

The coin acceptor is a very useful feature, which can be used anywhere people want to use this feature. However, there are some limitations when using it, such as the user may not have cash with him, so in this case, the RFID card partially resolved this problem, so the user can charge the card, which will help him to guarantee the purchasing process, so if he wanted to buy a specific item, he can check the credit, and he can charge (if required), so he doesn't need cash to buy.

This project presents exemplary technology to make it all possible at an affordable cost. It somehow combines the advantage of charging the credit of the card with full visibility at low costs and satisfactory capabilities.

1.2 Objectives

Our machine provides many advantages which could ease the process of purchasing the chosen items, such as low-cost, simple, easy-to-use, interactive, flexible, reliable, and portable control features. Additionally, our machine provides a specific card that is controlled by the owner of the machine (Admin), so in this case, we have two entities that could control the machine.

The first one is the Admin: The admin has the ability to control all the features in the machine, such as: he can insert the items into the machine, he can decide the prices needed for each item, also he can charge the customer's credit, and in this case we used the database to store the credit of each customer so that each customer knows the amount of credit he got.

The second one is the Customer: the customer has the ability to purchase the items from the machine using the Keypad and his own credit card, so he can select the item that he wants to buy and he can get it easily.

1.3 Scope of work & Importance

The idea of purchasing items using credit card would be very useful since you can have a card that could be charged and you can use it without the need of having cash while purchasing.

The Vending Machine program can be used for important and practical purposes, as mentioned before, additionally, the machine size will be very useful so that we can use it everywhere and anytime.

The easiest way to control the machine or to use the machine is only you just need to take out your card if you to buy one of the items and insert it into the machine, if you have enough credit to buy the items then you can easily choose one of the six items in the machine using the Keypad and you can buy it then the machine will push your item out of the machine using the motor.

Businesswise, with all the above features, we can conclude that Vending Machine is a great product to develop and sell.

The features, techniques, and methods used for manual implementation will be discussed in detail throughout this report. The next section talks about the limitations and difficulties we encountered during the development of the project, as well as highlights previous cycles that we have benefited from in implementing and working on this product. What follows is a literature review where similar solutions are addressed and differences are discussed.

In the methodology chapter, the ways and techniques used to implement the project are explained and justified with screenshots. Chapter 5 represents the results and outcomes of the project. The last chapter addresses the conclusions.

2 Constraints and Earlier course work

2.1 Constraints

Some problems and difficulties were encountered during the construction and work of this project, first of all, it was to design a good wood box to hold all the internal parts like the Keypad, LCD, rotation motors, items, NodeMCU, Card and set of wires and. Also, there was a compatibility issue between some of the electrical parts, such as the Esp8266, as we had issues with the incompatibility with the LCD and other parts.

The last challenge was the lack of ideas, the difficulty of choosing an idea for the project, and the difficulty of moving and meeting between partners to work better and easier.

2.2 Earlier course work

The knowledge gained from the courses taken during our time in university helped us build this project, mentioning if: Wireless Communications, Microcontrollers, Object Oriented and also as an Arduino course is taken outside.

3 Literature Review

Vending machine plays an important role in human's life for every situation. An automated Stationary vending machine system is introduced to reduce the man power, time and energy. It is similar to an ATM through which we get the required items at vending machine any time & any place.

There have been similar projects submitted related to the idea of Vending Machine and giving some cool features with a real-life example, an example of this is Credit Based Vending Machine [1], a respectable project that was done 3 years ago by Indian Students at Bangladesh University of Engineering and Technology, it offers features such as giving the user the ability to purchase using credit card.

There were similar projects that we saw on the internet and a lot of social media sites and great respectable educational videos in the field, an example of this is a special sitethat illustrates part of the project idea with explainer videos [2], a respected project that has been implemented, and it offers the advantage of Features we have made.

However, what makes our project noteworthy besides the ones mentioned above are the following:

First, Useful is not meant to be a competitive product for ideas we've seen on websites [3] for example, because it's made using simple and modest resources, even though it offers similar functionality.

Secondly, the low cost of this project is a strong point, since it gives very satisfactory results compared to its cost since the actual value received from the product in terms of price can be a deal-breaker. It is very advantageous compared to what it offers and what other products offer given the price.

4 Methodology

EA Vending Machine consists of one main part, the wood box that consists of all the sensors, Servo motors, items, Keypad, LCD, and RFID Card.

After payment has been tendered, a product may become available by:

- The machine releasing it, so that it falls in an open compartment at the bottom, or put in by the admin.
- The unlocking of a door.

.

4.1 Technical Choices

4.1.1 Hardware

4.1.1.1 Box

The Box was designed to be the place where we will be implementing all the equipment, so it has the Servo Motors, Keypad, NodeMCU, wires, and the LCD, which is all connected together to make everything works correctly

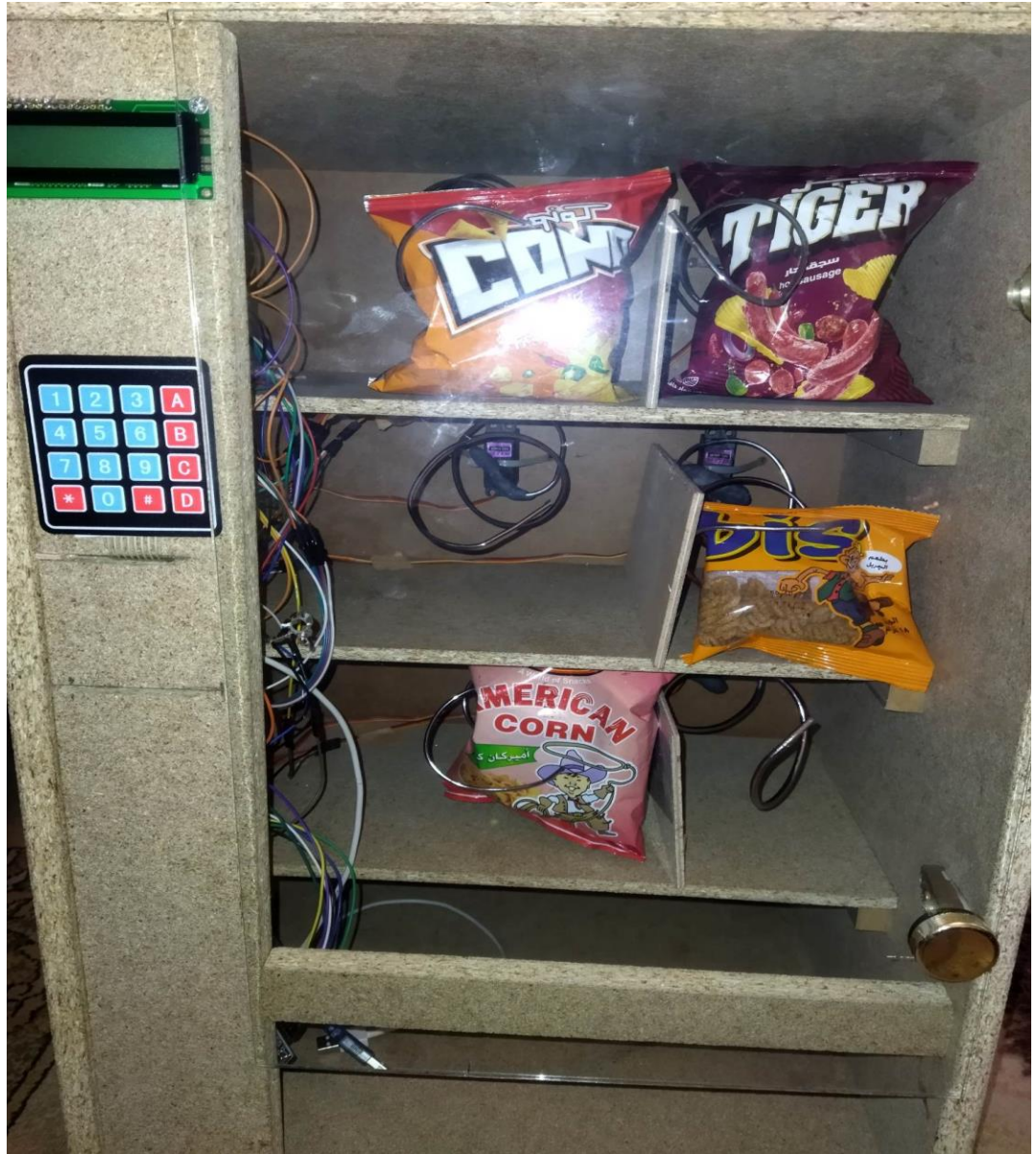


Figure 1: Box

4.1.1.2 RFID-RC522

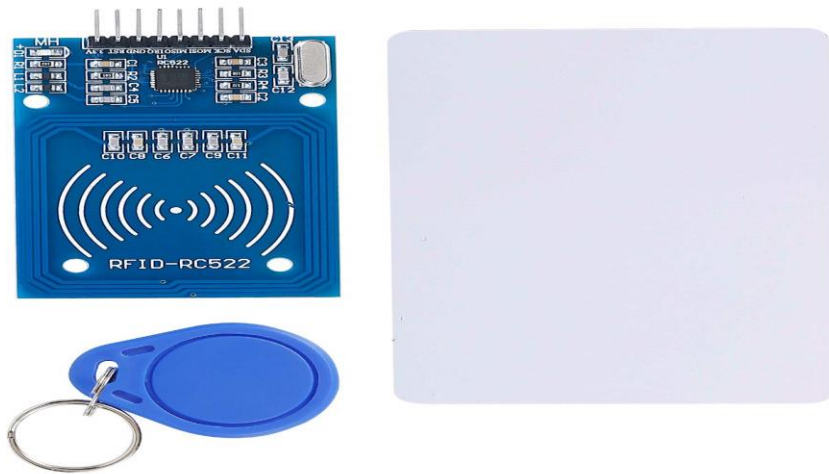


Figure 2:RFID-RC522

What is an RFID-RC522 ?

RFID tags are a type of tracking system that uses radio frequency to search, identify, track, and communicate with items and people. Essentially, RFID tags are smart labels that can store a range of information from serial numbers, to a short description, and even pages of data.

Why RFID-RC522 ?

Our project works by inserting a card into the machine to buy the chosen item, and this process is done by charging an amount of credit into the card then the user can use it to buy the item, and also we assigned a unique id for each user so that all users can have their own credit.

4.1.1.3 Keypad



Figure 3: Keypad

What is Keypad 4x4?

4x4 Keypad. Keypad is used as an input device to read the key pressed by the user and to process it. 4x4 keypad consists of 4 rows and 4 columns. Switches are placed between the rows and columns. A key press establishes a connection between the corresponding row and column, between which the switch is placed

Why Keypad 4x4?

The Keypad 4x4 is one of the most important equipment in our project, since it's the door to the next steps, for example: after we insert the card, the user must use the keypad to select his item, so since our machine consists of 3 rows and 2 columns, so we linked each item within a specific keypad button so that the user can decide easily the item that he wants to buy.

4.1.1.4 Servo Motor



Figure 4: Servo Motor

What is Servo Motor?

Servo motors are great devices that can turn to a specified position. Usually, they have a servo arm that can turn 180 degrees. Using the Arduino, we can tell a servo to go to a specified position and it will go there

Why Servo Motor?

Servo Motor is used to push the select item out of the box, so if the user chose his item, then the servo motor will rotate 360 degree and push it down, but here it very worthy to mention that, the Servo Motor rotates usually rotates 180 degrees, so according to our experience, we changed the way it rotates from inside to make it rotate 360 degrees.

4.1.1.5 ESP8622



Figure 5: ESP8622

What is ESP8622?

The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.

Why ESP8622?

The ESP8266 module enables microcontrollers to connect to 2.4 GHz Wi-Fi, using IEEE 802.11 b/g/n. It can be used with ESP-AT firmware to provide Wi-Fi connectivity to external host MCUs, or it can be used as a self-sufficient MCU by running an RTOS-based SDK.

4.1.1.6 LCD

We used the LCD to show whether the user has enough credit to buy or not, showing whether there are products or not, whether the process of purchasing succeeded or not, and whether the user's ID number exists or not.

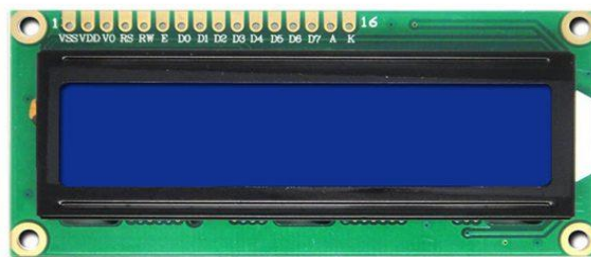


Figure 6: LCD

4.1.1.7 Portable Power

We used the portable power source for the box, for the Arduino and for the NodeMCU, as we chose this source because it contains very important features, including charging speed, ease of use, and flexible transportation from one place to another.



Figure 7: Power Portable device

1.1.1 Software

The software for this project consists of two main parts, the first is the box that receives data via Wi-Fi from the NodeMCU module on a motors connected to the Arduino, and the second is the C code for the Arduino, and it is explained as follows:

1.1.1.1 Arduino code

A simple code to read and from the sensors and Keypad, it processes the data and applies some thresholding to make the data read smooth and ready to be sent to the box, and it also manages the communication between the Wi-Fi module and Arduino.

1.2 Methods and Techniques

1.2.1 System Connections

The Box has many connected wires, the RFID is connected with the NodeMCU, and the Keypad 4x4 and the LCD are connected with the Arduino, and the Servo Motors are connected with the Arduino.

At the beginning we read the RFID card after inserting it into the box, so if the RFID has a credit (enough money), it will be printed on the LCD, and also if there is no enough money in the card, the LCD will print a message, also if there are no enough products in the box, the LCD will print a message also, and lastly, if the purchase operation is succeed, the amount will be discounted from the Card, and so the quantity of the chosen product, and this will also send a message to the LCD.

The following figure explains the connections in the system:

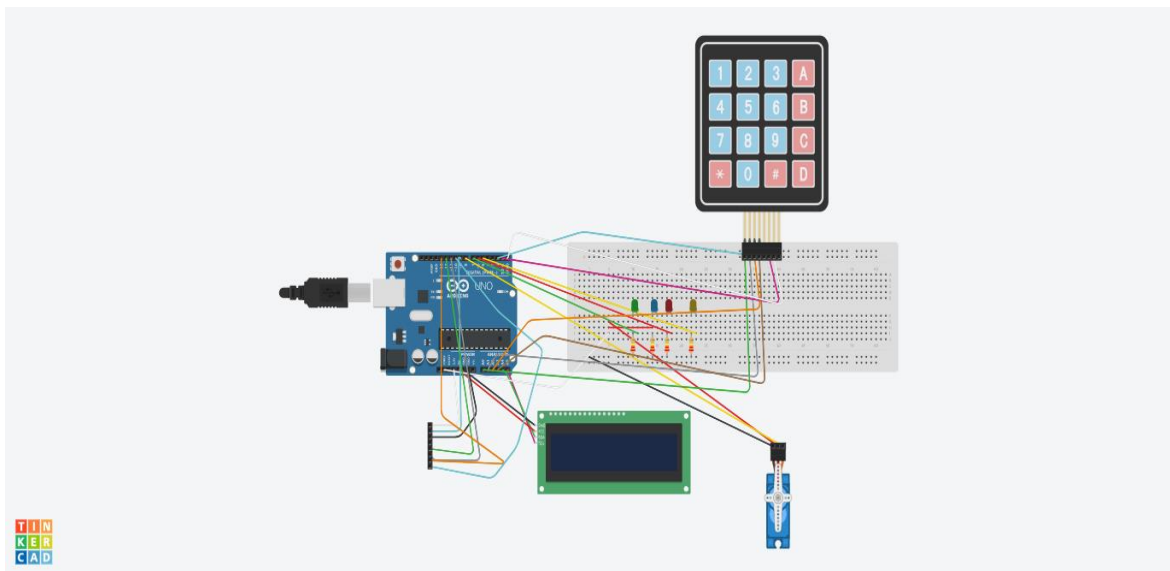


Figure 8: Connections

1.2.1.1 Data transferred between Arduino and box

So far, the data is transferred between the Arduino and the NodeMCU, the Arduino sends the number of the chosen product to the NodeMCU, and the NodeMCU responds within a message as we mentioned in the last part (if a product exist or not, the amount of credit is enough or not, and etc...).

2 Results & Discussion:

This project presents a product prototype for use with projectors and presentations, with the following features:

- Full control of the box with RFID card checking the validation of the user credit and the number of remaining items Keypad to control the motors.
- It is easy to set up and use.
- Easy to understand for all age groups.
- Very easy to set up and use.
- Easy to transport and work with anywhere.
- Reasonable and cheap cost.

2.1 Outcomes of this project:

- View and see in 3-D
- A system for sensing the surrounding obstacles and stopping based on them.
- Easy and Flexible System.



Figure 9: Box Front View

3 Conclusions and Recommendation:

The model of the vending machine successfully detects the Card and pushes items out. It is also proved to be customer friendly. The system developed in this research work can be used as a base for future development.

Working on this project increases our skills and understanding of some hardware and control issues, and how to deal with different sensors and choose the best parts to fit the need of the project.

3.1 Future work:

This project can be improved and worked on to support more features and capabilities:

- Increase the number of the item slots
- Increase the size of the box.
- Provide a security system to prevent the machine from being stolen.
- Develop the payment process to be an electrical process using web site and mobile application like Jawwal Pay.

4 References

- [1] https://www.researchgate.net/publication/350007340_Credit_Based_Vending_Machine_-_Technical_Report
- [2] <https://blog.arduino.cc/2018/06/07/these-high-school-students-built-their-own-vending-machine/>
- [3] <https://blog.arduino.cc/2016/06/29/venuino-is-a-diy-arduino-vending-machine/>