IOT Based Pen Vending Machine

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Abstract - **Vending machines have been a convenient and easy method for buying products, offering quick and easy access to a different kind of products. However, with the integration of smart technologies, vending machines are transforming drastically. These brilliant, interactive and intelligent machines are enhancing user experience and operational efficiency. In this research paper, we are going to take a look at the latest advancements in smart vending machines, focusing on the impact across several industries. Key technologies and innovation, including the Internet of Things (IoT), different modes of payment, and machine learning are discussed. Real-world examples and case studies describe the advantages and challenges for implementing smart vending machines. Also, we provide insights into the evolution of future trends and potential development and expansion in this field.**

Keywords: Vending machines, Smart technologies, Internet of Things (IoT), Real-world examples, Future Development.

I. INTRODUCTION

Continuous efforts have been made to advance innovation in order to simplify life. Everyone in today's fast-paced world is embracing innovation's advantages. This project aims to provide one such smart pen vending machine that accepts the coins as payment mode and dispense the pen accordingly and the vending machine is connected to the cloud for product details, management and monitoring. A microcontroller specifically Arduino serves as the vending machine's central processing unit (CPU), managing the rest of the components which is coin acceptor, pen dispensing mechanism, and Wi-Fi module.

In order to guarantee precise and accurate payment for the dispensed pen, the coin acceptor system is currently set for 5 rupees coin. The pen dispensing mechanism is activated by the Arduino when a coin is inserted in coin acceptor. A pen is released into the allotted collection area by the dispensing mechanism of the vending machine which is controlled by the Arduino microcontroller.

The vending machine also has a Wi-Fi module that connects to a cloud server specifically Blynk server to allow for remote monitoring. Data is sent to the cloud by the Wi-Fi module, including the overall amount of pen dispensed, the amount of money collected, and any updates on the state of operations happening in the machine. Which is a real time operation.

The major components of our pen vending machine are:

1) Coin Acceptor

A coin acceptor is a device used in vending machines to validate and accept coins inserted by customers as the mode of payment for getting the products. The coin acceptor can check the value or amount of the coin based on its size, weight, and metal composition, and then communicates this information to the vending machines microcontroller specifically Arduino.

Coin acceptors are the critical components of vending machines, as they make sure that only valid coins are accepted when the payment is done and prevent the machine from being fooled or tricked by fake coins or tokens. Also, coin acceptors are designed to be highly efficient and it requires minimal maintenance, ensuring that the vending machine operates smoothly and also it is user friendly.

2) Arduino

The Arduino microcontroller can be used by interfacing with the coin acceptor and validate the coins inserted by the customer. The board can be programmed to illustrate the pulses from the coin acceptor and determine the value of the coins. The use of an Arduino board in a vending machine using a coin acceptor can be used to simplify the designing process and reduce the overall cost of the system. The flexibility and ease of programming provided by the Arduino IDE platform makes it an ideal choice for programming the custom vending machine systems.

3) WIFI Module

The ESP8266 is a popular and functional Wi-Fi module which enables microcontroller to connect to Wi-Fi network and communicate over the internet. It is extensively used in the field of Internet of Things (IoT) for connecting devices.

4) Pen Dispensing Mechanism

The Dispensing Mechanism used in this project is unique and consist of two rollers to store pens and is operated by DC motor and is controlled by Arduino to dispense the pen.

II. LITERATURE REVIEW

2.1) W. Alam, F. Sultana, J. B. Saba and A. C. Kofi, "IOT Based Smart Vending Machine for Bangladesh," 2019 IEEE International Conference on Robotics, Automation, Artificial-intelligence and Internet-of-Things (RAAICON), Dhaka, Bangladesh, 2019.

This paper proposes the concept of "Vending Machine" in the prospect of Bangladesh. In this approach we put forward the design a IoT enabled service of a vending machine which will be operated through a mobile application and bKash (digital payment system of Bangladesh) with the incorporation of cloud computing which aims to be cost effective and less time consuming and yet user friendly. The ultimate goal is to introduce a cost effective vending machine solution for Bangladesh enhancing the customer purchasing experience, driving up the demand for mass adoption of the IoT based smart vending machines.

2.2) C. H. Patil, N. Lightwala, M. Sherdiwala, A. D. Vibhute, S. A. Naik and S. M. Mali, "An IoT based Smart Medicine Dispenser Model for Healthcare," 2022 IEEE World Conference on Applied Intelligence and Computing (AIC), Sonbhadra, India, 2022.

Healthcare and medical endeavor are advancing rapidly, and it is rather tricky for technology to support its pace. This paper presents an IoT-based innovative medicine dispenser prototype model. The primary goal of the proposed system is to assist the patients and dependent senior citizens in taking their medications on time without fail, quickly, and more importantly, without the possibility of missing pills, and to eliminate a random chance of over or under dosing. Inaccurate medications can have severe effects such as late recovery, severe disease, also even deceased. The medicine dispenser could resolve such difficulties by alarming the patients to correctly and accurately take suitable meditation. Additionally, it delivers instant communication between the caretakers and patients as it will instantaneously ring the alarm signal when the patient's medication is due. It has evolved vital to take care of the aged and those with poor health conditions in today's era. Hence, the medicine dispenser solves this issue by making the patient self-dependent and reducing contrary situations.

2.3) A. V. Sai, K. D. Reddy, N. S. Ruthvik, A. Rohith, G. P. Reddy and N. S. Rao, "IoT based Quotidian Grocery Supply by Vending Machines," 2021 2nd International Conference on Advances in Computing, Communication, Embedded and Secure Systems (ACCESS), Ernakulam, India, 2021.

Urban localities face the problem of having grocery stores far from the residential areas. This poses a problem in procuring groceries in emergencies and time complex situations. Individual vending machines near households can act as a buffer between the actual market and home, reducing the time and effort required to acquire the same quantity of products. This also improves customer convenience and satisfaction. A Cloud-Based wireless mesh network among vending machines can help in the optimal allocation of its stock. With this intent, this paper proposes an Internet of Things (IoT) based integrated vending machines network that acts as a platform to sell quotidian groceries to its nearby households. When compared with the existing system, the implemented system has a 46.4 percent decrease in its delivery time in the monsoon and a decrease of 14.5 percent in the rest of the year. And also, there is a 5.01 percent decrease in the cost of the products.

2.4) P. Kumar, S. Singh, M. Choudhary and K. Singh, "Solar Powered Medic Vending Machine," 2020 2nd International Conference on Advances in Computing, Communication Control and Networking (ICACCCN), Greater Noida, India, 2020.

In past couple of years, many vending machines have been made which provides different types of products within different number selections. They can be divided into food vending machines, chocolate vending machines, snack vending machine, glucose water dispensing and many other forms of liquid dispensing vending machines. In concern with the medical field, up till this 21st century, we are not able to provide first - aid kits at all over places like schools, stations, and many more areas which are still under up-gradation. This product is used to dispense first-aid items as well as all the necessary medicines, for the persons who need immediate attention where reaching to a doctor might not be the first step for curing the person. The central point of the concept is to deliver alteration usage in the eyes of the people at places where there is no pharmacy nearby.

2.5) D. Wibowo and F. Fahmi, "Contactless and Cashless Smart Vending Machine Integrated with Mobile Device," 2021 5th International Conference on Electrical, Telecommunication and Computer Engineering (ELTICOM), Medan, Indonesia, 2021.

Vending machines are in great demand nowadays, especially in developed countries which are used as a tool for selling product to provide what people needs. The pandemic

and the trend of cashless payment demand more innovative vending machine to be used. In this study a contactless and cashless smart vending machine integrated with mobile device were proposed to answer those challenges. The developed system run as expected. The time needed to connect between the Mobile Vending application and the vending machine is around 2,925 seconds and the time required for sending data on / off the LED on the vending machine is around 0.574 seconds.

III. PROBLEM STATEMENT

A 24/7 available machine that is used to sell and buy products without any human interaction with proper security, beneficial for both customer and machine owner as customer can get their product any time in contactless manner and machine owner can keep track of the revenue earned and produced dispensed by the smart vending machine.

IV. OBJECTIVE

The objective of introducing a vending machine with a coin acceptor is to provide a convenient and easy way for customers to purchase products while also benefiting the owner in their business. By providing customers with a quick and easy way to purchase products, business owner can increase their revenue and also get customer satisfaction. Also, vending machines with coin acceptors require very small maintenance and can be operated 24/7, providing a cost-effective solution for businesses. Furthermore, the main objective of introducing a vending machine with a coin acceptor and doing it IOT based is to benefit both user and owner. In a public space, the objective may be to provide visitors with the access to essential or hygiene products.
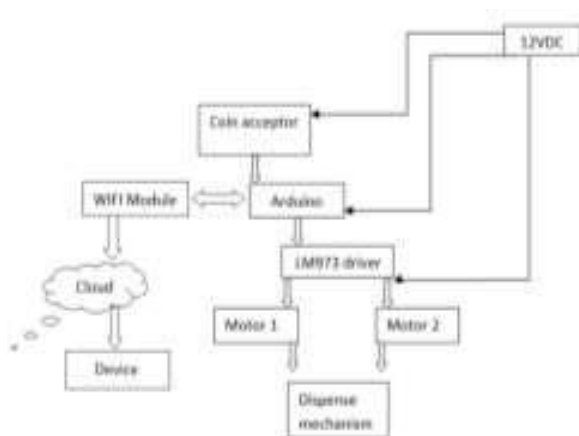
V. SYSTEM DESIGN

Figure 1: Block Diagram

The block diagram represents the components and connections of a smart vending machine system.

1. Coin Acceptor: This component accepts the coin from user. It detects the value of the inserted coin on the basis of size weight and metal composition and connect with other components.
2. Arduino: The Arduino board serves as the central processor unit for vending machine. It receives input from various components and controls the operation of smart vending machine.
3. Motor: The motor is attached to the dispensing mechanism which is responsible for dispensing pens. When a valid coin is detected, with the help of Arduino microcontroller the appropriate motor gets activated to release the well-suited product.
4. WiFi Module (ESP8266): It is device that can be integrated with different types of sensors (such as IR sensor in our case). It helps in data communication between device and network with the help of internet access. It plays an important role in connecting and communication.
5. Display: The display (such as an LCD screen) gives information to customers, such as availability, price and other information about the product.
6. Power Supply (12V DC): The smart vending machine needs a power source to operate all its components.
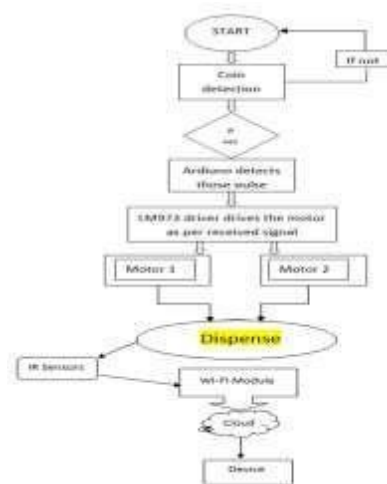
VI. PROPOSED SYSTEM

Figure 2: System Flowchart

The flowchart describes the overall process of smart pen vending machine. When a customer inserts a coin into the coin acceptor. The coin is detected based on its size and weight.

Now if the coin is valid, the coin acceptor module sends the pulse to the microcontroller which is the central unit if the machine but if the coin is not valid, the module rejects the coin. In next step the Arduino detects those pulses which it received as the input from coin acceptor and then the motor driver(LM973) drives or rotates the motor as per the received

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signal. The Arduino microcontroller activates one of the motors which is attached to the dispensing mechanism depending on the selected dispenser. Now these motors rotate and dispense the relevant product. Now the WiFi module is also integrated into the system which helps in communication with the cloud for sending relevant data or information to the owner of the machine including all the transaction and product dispensed. This cloud can be accessed with smartphone or laptops.
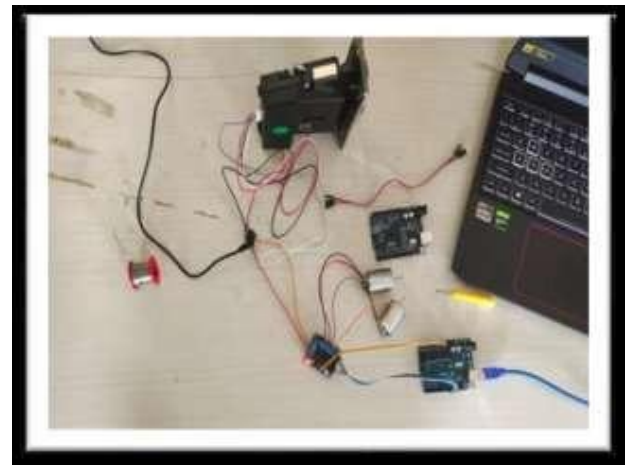
VII. CONSTRUCTION STAGES
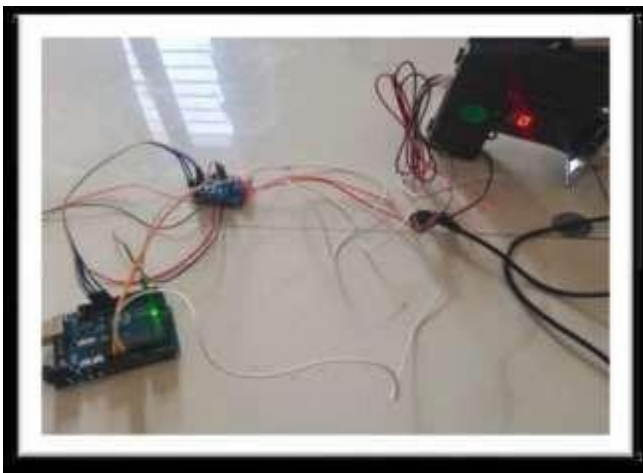
(a)

In this stage we set up the coin accepter to particular coins and sense the pulse given out through the coin accepter in Arduino board with the help of Arduino ide application.
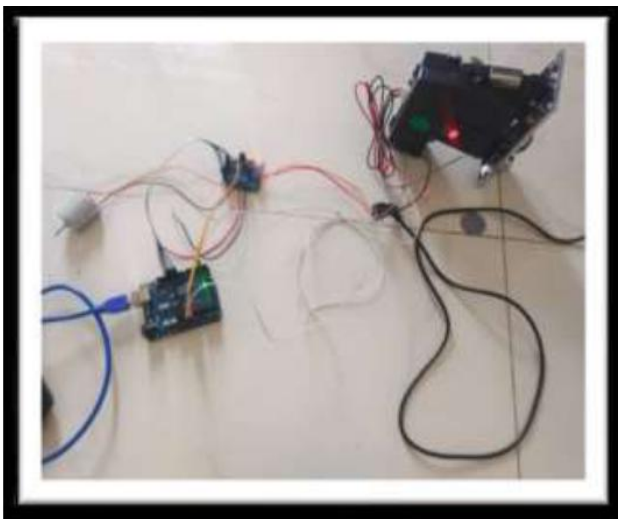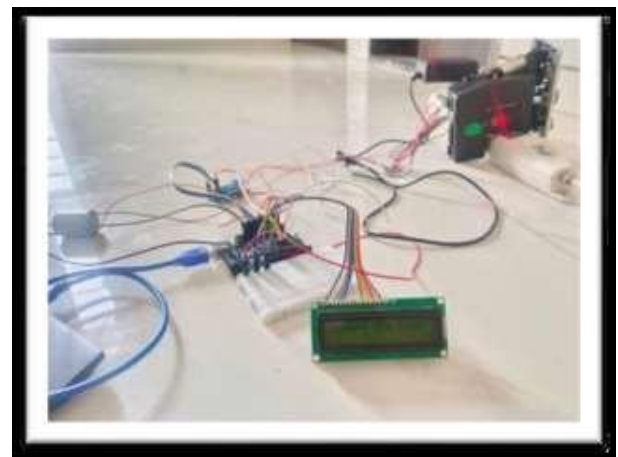
(b)

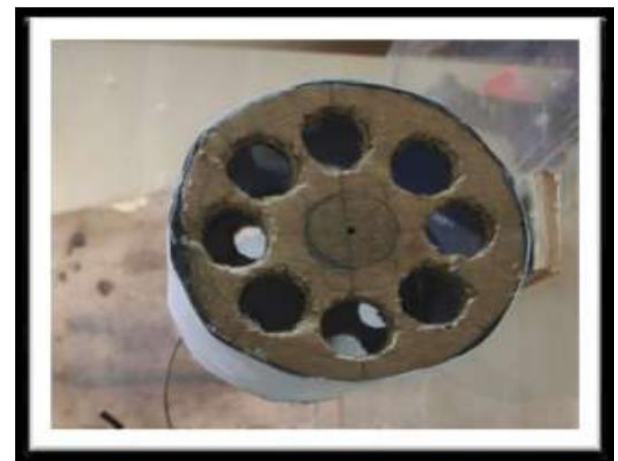In this stage we connected the motor driver to 12VDC motor and Arduino board.

(c)

In this stage we coded the Arduino as per our required specified function.

(d)

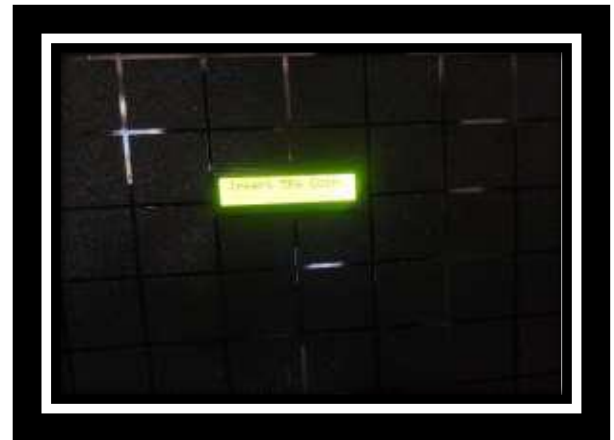In this stage we added 16x2 LCD to our Arduino board and updated our code as required.

(e)

In this stage we started to work on the dispense mechanism for our product which is pen and this is totally a DIY method.

(f)

In this stage we started to work on the frame work of smart vending machine.

(g)

In this stage we have setup the IR Sensor in the pen dispensing area which is connected to Wifi Module to send data to cloud.

(h)

Final model of smart pen vending machine.

VIII. RESULT AND DISCUSSIONS

(a)

When the machine is in ideal state the lcd screen displays "Insert 5 Rs coin".

(b)

After the insertion of 5 Rs coin, the pen gets ready to dispense and the lcd displays "processing".
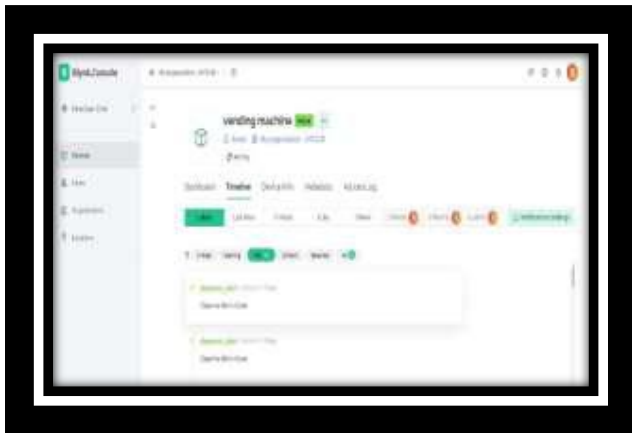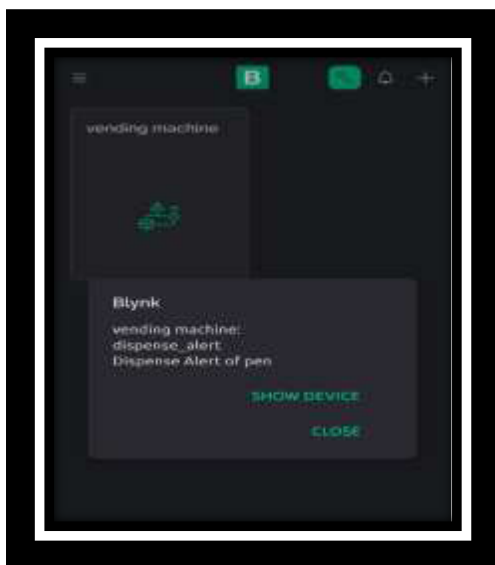

(c)

After the pen is dispensed in the dispensing area the lcd displays "Thankyou Visit Again".

(d)

After the pen is detected by the IR Sensor in the dispensing area the notification is sent in the real time to the Blynk cloud server via wifi module (which is accessible by the vending machine owner).

(e)

A notification is also sent on the mobile device of vending machine owner as an alert.

IX. CONCLUSION

Smart Vending Machine provides the convenient and reliable way for user to purchase products with any human interaction which is very efficient method when it comes to hygiene. Because of being IOT based they provide real time information or data which is beneficial for the owner of the machine. In future scope smart vending machine will evolve more and more resulting to delightful experience for customers as well as owner of the machine.

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