

# Smart Vending Machine

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**Abstract** - The main aim of our project is to adopt smart technology in vending machines to make the method ease using internet of things. This paper characterizes the design, implementation, and employment of cashless and secure payment system in vending machines by using internet of things (IoT) technology. Our proposed methodology consists of a server end database, where the information is stored in that system. Further, the more users can access the vending machine through the screen on system or web page and the desired products can be purchased in an easy manner. The DC motors and spring based mechanical structure of vending machine to push the material out. The process is done through wireless communication. Further, data storage and accessibility can be done with Wi-Fi or internet connection.

**Key Words:** Smart Vending Machine, Raspberry Pi, DC Motor, Automation, Python3.

## 1. INTRODUCTION

Automatic vending machines are automation devices that are a need at present situation to set selling system of any product by this way. It has a wide application domain range in the public sector. It has applications specialized in food domain like snacks, Eatables, Chocolates etc. Things at present i.e., evolving now very rapidly. Many changes like revolution that has come into existence in conventional system that has changed towards automation. Automation with a reduction in working time is needed at present. In this system we use the Raspberry pi as the controller of the system which gives the command to the dc motors and run the web application on the screen. Were like other system DC motor and spring combinations are used in this system to dispense the product. For payment options for these machines contained both the combination of UPI (Digital payment option) and Cash. There is a vendor dashboard for the trace the product records also we can track the machine status, change the payment gateways, check the temperature of the machines, enable & disable the cash and UPI services.

## 2. Motivation

The basic idea of using vending machines is to provide products such as food, beverages and so on instantly when

the consumer needs and pay without being assisted by anyone within a near distance. Also, it provides 24-hour service that ensures product availability, especially at night [1]. Moreover, people can purchase products in a secure manner that allows them to buy private products like sanitary napkins and others. With the availability of vending machines in offices, public restrooms, and other places, one can now save more time and effort in buying what they need from a store [2]. As it is a digital platform in a vending machine the product quantity, product consumption rate and transactions can be monitored.

## 3. LITERATURE SURVEY

Publishers Asmita P. Bodhale, Prof. J. S. Kulkarni in Case Study on Different Vending Machines paper compares various aspects or response like space, time, speed, power dissipation of a vending machine that is automated product to create our day-to-day life more suitable and to cover market viability.[3]

Publishers Vishal Tank, Sushmita Warriar, Nishant Jakhiya, paper explain the amount is authenticated and identified using an image processing unit controlled by a Raspberry Pi, a credit card sized controller capable of processing still images.[4]

Publishers Anup Kumar Kolya, Debasish Mondal, Alokesh Ghosh, Subhashree Basu, paper presents the design and implementation of control strategy for both the speed and direction of a direct current (DC) motor using Android-based application in smart phone. The Raspberry Pi 3 with a motor driver controller has been used to implement the control action via Python-based user defined programming.[5]

Publishers Ali Abdyaseer Kadhum, Munther Mohammed Abdulhussein, they have implemented servo motor that can be controlled to rotate in even 360 degree using normal DC motor and an optical encoder. This helps to reduce the cost required to buy a servo motor spatially for heavy duty tasks.[6]

Publishers Sandesh More, Sagar Sonawane, Mandar Mhamunkar and Prof. Anuja Gote. present a solution

where the payment part is bypassed to the online sources. Here we are solving an intricate problem with a simple algorithm providing an interface to the user that even a layperson can easily understand.[7]

Publishers B.V.N.R.Siva Kumar, Kurisetti.Siddhartha Roy, C Bapaiah Naidu, Addanki John, use of IR sensor for ship dispenses or not dispenses confirmation, If the ship is detected by the sensor, it sends a signal to the Arduino nano for opening of the bridge and if the ship is not detected by the sensor, it sends the signal to the Arduino nano for closing the bridge.[8]

Publishers Sooraj, Bony Mons, Dr.Jisna Kuruville in IOT (internet of things) Based Vending Machine with Cashless Payment Conducted So Far: Cashless Payment System in Vending Machine using IOT. A vending machine is an automated machine that provides items such as snacks to employees; a card is inserted into the machine. This is cashless payment concept.[9]

#### 4. Methodology

In our proposed system, you must come to the machine and tap on the screen to see the product list. After selecting the product tap on continue, it will redirect you to the payment page. where you can make payment through cash or UPI. After a successful transaction spring will rotate and product will dispense which can be collected through push tray.

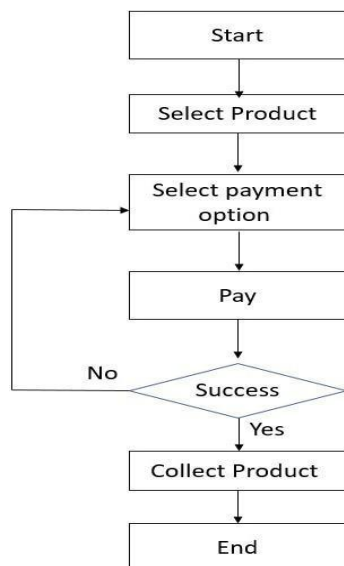


Fig-1:Flow Chart of Proposed Method

#### Software Prototype

##### A. Selecting the product:

Click on Tap to Start button as shown in fig. 2(a), In selecting the product firstly, you must select a single

product as shown in fig. 2(b) and then you can add more Products to cart by Add More button which will appear on the screen as shown in fig.2(c).

More products can be added to the cart using “+” button & can be removed from cart using “-” button as shown in fig. 2(d).



Fig-2(a):Home Screen of Machine



Fig-2(b): Single Product Selection

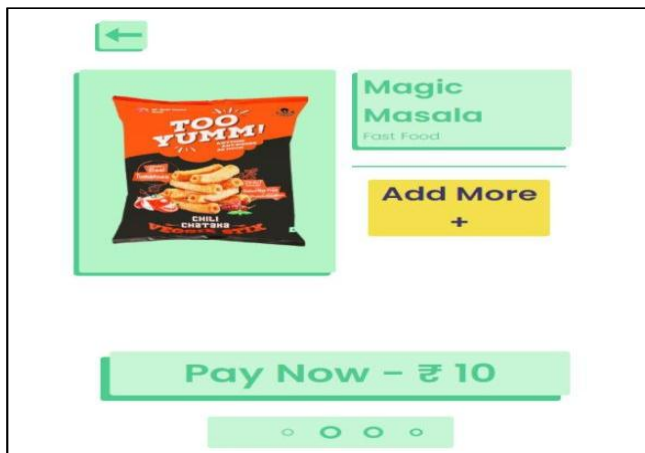


Fig-2(c): Single Product Screen

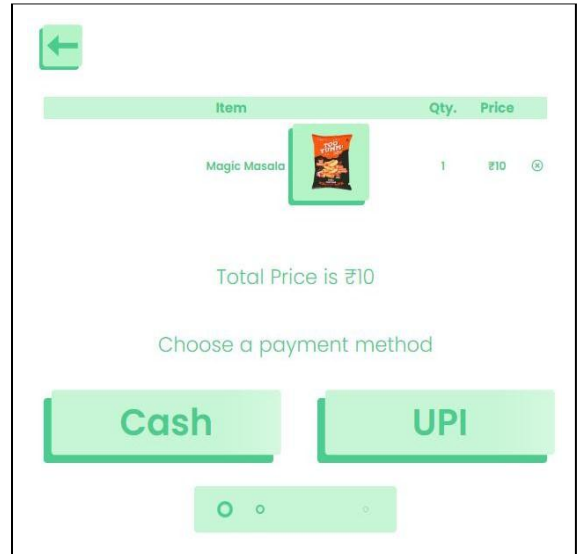


Fig-3(a): Payment Selection

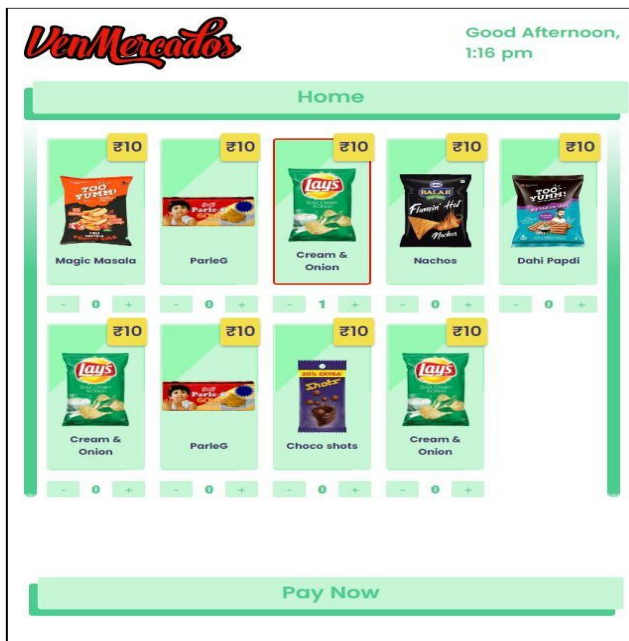


Fig-2(c): Add More Product Screen

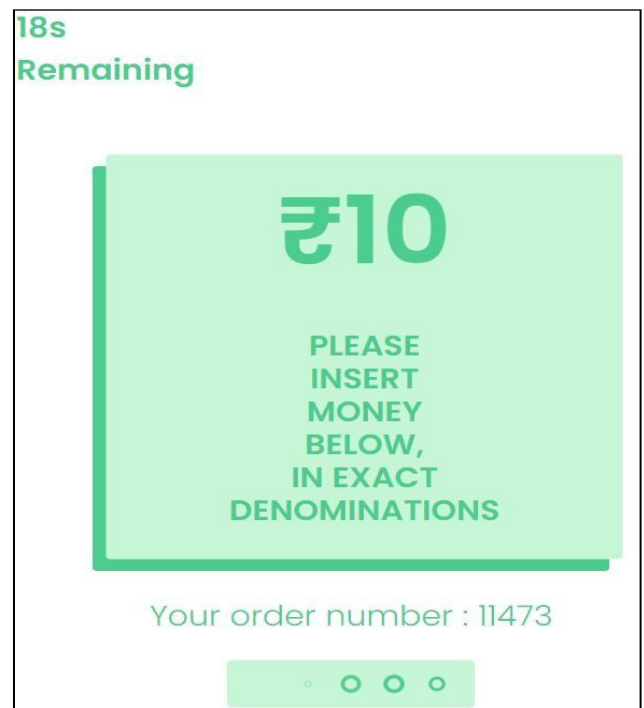


Fig-3(b): Cash Screen

### B. Payment Selection Method

There are two payment selections methods Cash and UPI, Payment selection screens are shown in fig.3(a). where in cash we must purchase a single product and must insert notes of the same amount because there is no cash dispenser system which will not accept notes other than product amount. After selecting cash there will be a screen that appears as shown in fig.3(b). After this we must insert the note though cash acceptor.

For multiple product purchases, we can pay the amount by digital payment option which is UPI. Where in UPI there will be QR code appear on screen we have to scan QR by any UPI app like Phone pay or Google pay, UPI screen is as shown in the fig.3(c)

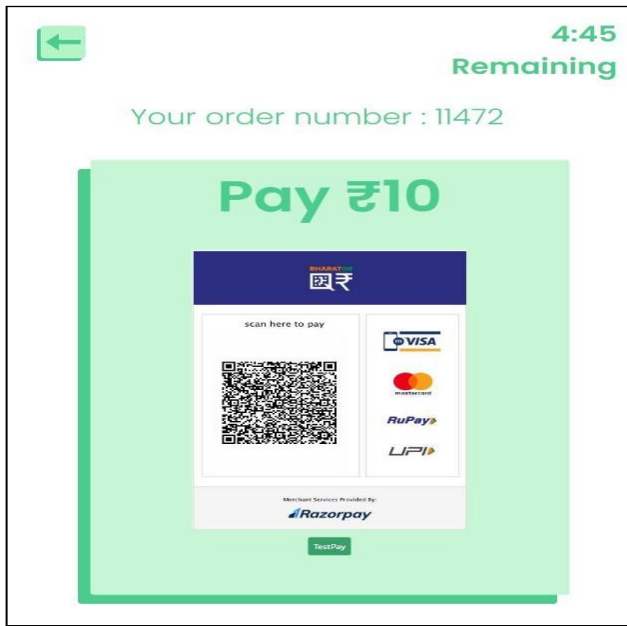


Fig-3(c): UPI Screen

**B. Collecting Products**

After successful transaction UPI system by API and Cash acceptor by Raspberry pi will give the confirmation and machine will dispense products by rotating the springs of selected product rack and person can collect the product by push tray as shown in the fig.4



Fig-4: Push Tray

**Hardware Prototype**

We have used the Raspberry Pi 4 Model B, Motor PCB, IO PCB, Thermistor PCB, Touch Display, Cash Acceptor, Compressor, IR sensor. As we have used raspberry pi for our project because we want the device which can do all the software and hardware integration with perfect result and synchronization between software and hardware. Fig. 5 is the block diagram of the vending machine hardware components.

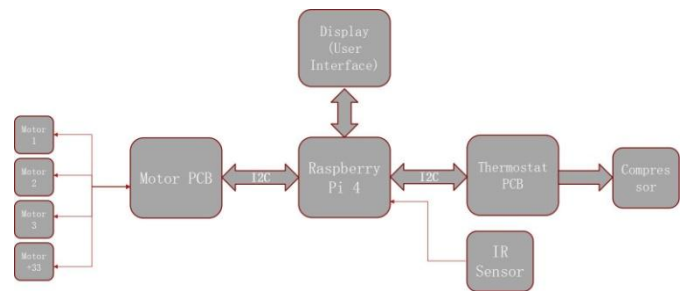


Fig-5: Block Diagram Of Vending Machine

**Raspberry pi 4 Model B**

Its key features include a high-performance 64-bit quad-core processor, dual-display support at resolutions up to 4K via a pair of micro-HDMI ports, hardware video decodes at up to 4Kp60, up to 4GB of RAM, dual-band 2.4/5.0 GHz wireless LAN, Bluetooth 5.0, Gigabit Ethernet, USB 3.0, and PoE capability (via a separate PoE HAT add-on). Raspberry pi is shown in fig.6

We use the Raspberry pi for the following functions: -

1. Control the DC motors for the rotation of springs which are connected through I2C protocol.
2. Run the web page on screen which is connected to the Raspberry pi HDMI port 1.
3. To Controlling thermostat PCB for compressor.

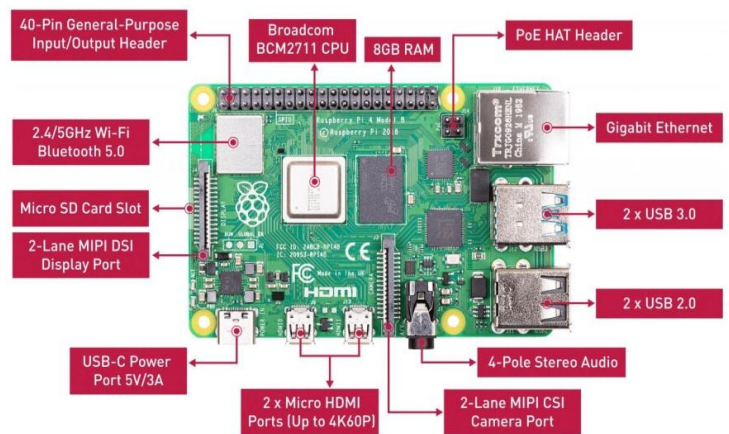


Fig-6: Raspberry Pi 4 Model B

**Motor PCB**

Functions and specification of motor PCB are as follows: -

1. Motor PCB is built in-house to connect the 36 motors to a single system as shown in fig.7.



2. We use various IC's like PCF8574, ULN2803, 74HC540, L293DD, LM2576HVS-5, PC817 etc.
3. PCF8574 is used for I/O expansion and I2C communication.
4. ULN2803 consists of eight NPN Darlington pairs that feature high-voltage outputs with common-cathode clamp diodes for switching inductive loads.
5. PC817 is Optocoupler to prevent reverse current damage of Raspberry Pi4
6. L293DD Motor driver IC is used for driving DC motors.
7. 74HCT540 is an 8-bit inverting buffer/line driver with 3-state outputs.

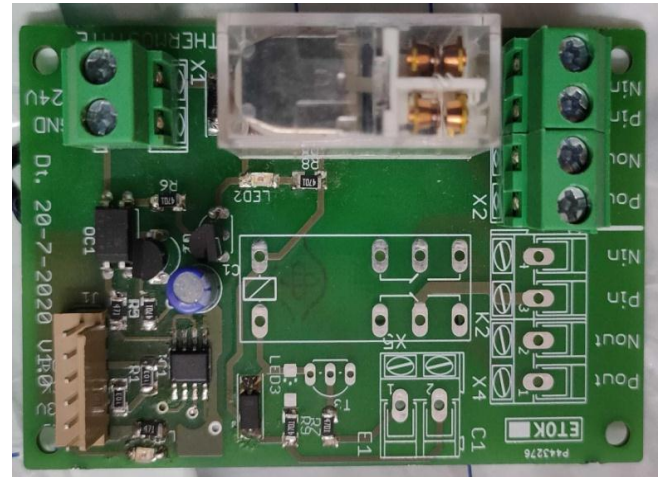


Fig-7: Thermostat PCB

### IR Sensor

IR Sensor is the heart of the system used to detect where product is dispensed or not dispensed. It consists of one transmitter side and one receiver side. If a product falls between receiver and transmitter it gives the signal of confirmation.

### 4. RESULT

The web page we developed to select or interact with the machine worked properly. Where we can select the product and pay for it by UPI. After that controller (Raspberry Pi) gives commands to motor PCB which further rotates the DC motor and dispenses the products. After the UPI transaction is done it gives the proper feedback to the vending machine. IR sensor which is used to detect the product fall or not gives the failed transaction status, so we give the refund. The record of vending machine product stock and purchase history is saved at server end with every transaction.

### 5. CONCLUSION

The emerging technology Internet of Things (IoT) covers a wide scope of devices, applications, and industries [10, 11]. We presented a design of Raspberry Pi based vending machine as it is multipurpose system we can use it with many item-like snacks, beverages, stationery, medicines etc. This process can reduce the workforce required for the process and efficiency is increased. The main objective of this project is to design an automated vending machine to reduce the workforce. We successfully implemented a fully functioning vending machine. Although dealing machines are being used extensively currently. Having paper allocating machines is essential in premises, services wherein scholars or workers need to stay by

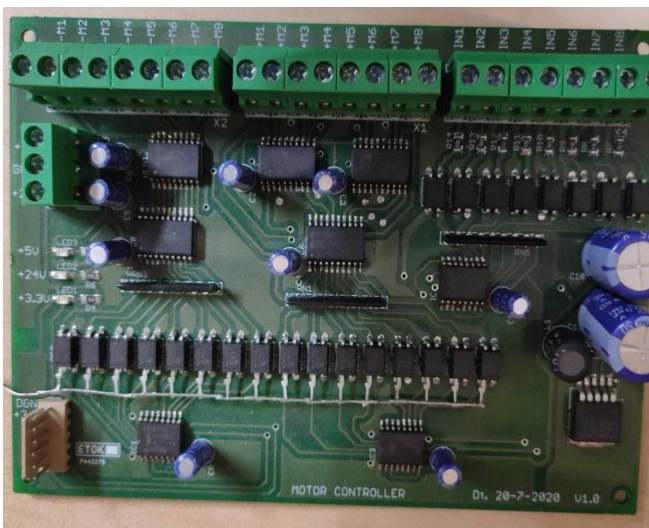


Fig-7: Motor PCB

### Thermostat PCB

Thermostat PCB is consist thermostat IC DS1621S and Relay as shown in fig.8, DS1621S is thermostat IC that measures temperature and sends to Raspberry Pi. Relay is used for switching on or off compressor according to temperature.

long ranges. This type of machine reduces mortal sweats and provides accurate results.

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