

Smart Vending Machine using Internet of Things (IoT)

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Abstract: The existing tea and coffee vending machines in India does not provide online payment option. This creates inconvenience for the customer as it consumes more time. Also, this type of vending machine always requires human supervision. The main aim of the project is to make a vending machine that provides online payment using web application. This solution allows users not to worry about problems with cash and change, in turn increasing the number of customers served per unit of time. This method of payment saves time greatly at customer's as well as service provider's end as we can monitor the quantity of premix and water available. Such vending machines can be very much useful in offices, railway stations, colleges etc. since unlike shops these machines can provide products throughout the day without requiring human supervision. The customer uses a smart phone to select his preference of beverage and make online payment. Adding this feature will increase the scope of using vending machines for tea and coffee wherein users will be able to choose tea/coffee their choice and make cashless payment for the same.

IndexTerms - Advanced Vending Machine, Web Application, Smart Phone, Online Payment, Cashless, Ethernet Shield, Premix, Boiler, Ultrasonic Sensor

I. INTRODUCTION

Vending machine is an electronic machine that disperses products to the user once a certain amount of money is paid. Basic function of the vending machine is to accept payment from the user for a choice of product and dispense the product for which user has paid for. The Tea or Coffee vending machine dispenses hot tea and coffee. Older models used instant coffee/concentrated liquid coffee and hot or boiling water along with condiments such as cream and sugar. Some modern machines prepare various coffee types such as mocha and lattes, using ground drip coffee and some fresh-grind to prepare coffee in the machine. If we make a conventional vending machine which smart, it can be easily operated.

It will accept payment in cashless manner and take orders online with help of mobile application or web page. ^{[1][2]} To update the vending machine means to ease the use and it's working. It will have a more interactive user interface and reduces operational cost. It requires no human intervention for ordering and payment, so it reduces human efforts. Also, since payment by coins is eliminated the efforts for having the coins of specific value are banished. This advanced vending machine can be accessed at any time of the day without inconvenience. It is cost effective than vending machines available in the market.

II. SCOPE OF PROJECT

The cost of already existing vending machine is very high in addition to this the feature of online ordering and payment is not available in a considerable amount. The proposed vending machine for beverages is cost effective and enabling online ordering and payment makes use of two main domains i.e. Embedded Systems and Information Technology along with some part of Mechanical domain. The project can be used in restaurants, offices, schools, colleges and many other places. Vending machine with online payment will give 24 hours service without any inconvenience. In conventional vending machine there is a threat of fake currency being inserted; making the vending machine cashless will eliminate this flaw.

III. PROPOSED DESIGN

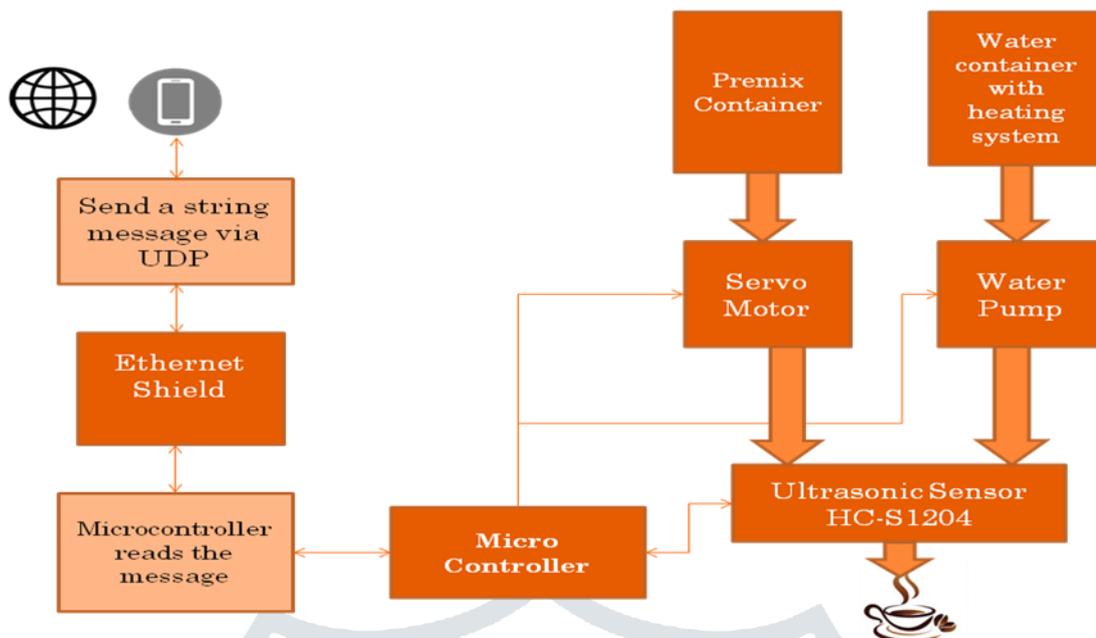


Figure 1 Basic Block Diagram of Automated Vending Machine

Web Server

Web server sends UDP message to the Ethernet Shield. A Web server is a program that utilizes HTTP (Hypertext Transfer Protocol) to assist the files that form Web pages to users, in response to their requests, which are forwarded by their computers HTTP clients.^[3] We have created a web page which will get the login information of the customer. After which the customer can review the products and place order. The payment of the order is done via online payment gateway.

Ethernet Shield

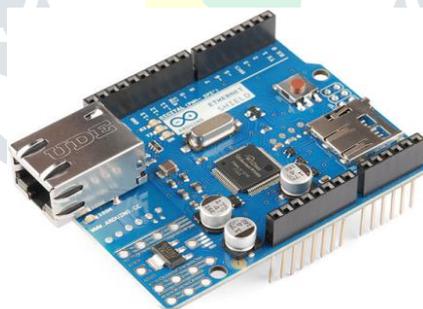


Fig.2 Ethernet shield

The Arduino Ethernet Shield easily connects Arduino micro controller to the internet. This shield enables Arduino to send and receive data from anywhere in the world with an internet connection. This shield allows communication between web server and micro controller.^[4]

Micro Controller



Fig.3 Arduino UNO

The Arduino has several facilities for communicating with a computer, another Arduino, or other micro controllers. All the servo motors, Ethernet shield, temperature sensor, ultrasonic sensor and water pump are controlled using Arduino. Also, the communication to the web server using Ethernet is controlled via Arduino. [5]

Servo Motor



Fig.4 Servo motor

Servo motor works on the principle of PWM (Pulse width modulation), which means its angle of rotation is controlled by the duration of applied pulse to its Control PIN. [6]

Premix Container



Fig.5 Premix container

It contains the premix power. The quantity of premix falling in the container is controlled by delay of servo motor. The delay is set according to the input from the web application by customer.

Water container with Heating System



Fig.6 Heating coil

The water is heated with the help of a heating coil, to maintain its temperature within a range. A temperature sensor is used to continuously monitor and report its temperature variation to micro controller so that power consumption will reduce. [7][8]

Temperature Sensor



Fig.7 Waterproof temperature sensor

We have used a waterproof temperature sensor DS18B20 to measure the temperature of the water in the container. It measures the temperature from -55°C to $+125^{\circ}\text{C}$ (Fahrenheit equivalent is -67°F to $+257^{\circ}\text{F}$) to the micro controller. In this project we are maintaining water temperature in the range $+55^{\circ}\text{C}$ to $+90^{\circ}\text{C}$.^[9] This is done by toggling a heater coil in ON and OFF modes using relay.

Relay



Fig.8 Relay module

It is used to control the AC current of heating coil by switching between on and off modes. The ON and OFF modes are controlled by the micro controller, depending upon the temperature range of water. The temperature sensor will give temperature value to micro controller and it will toggle the relay according to the range.^{[8][10]}

Water Pump



Fig.9 Water pump

It is used to pump out the desired amount of water from the boiler container to the customer's cup. It pours the required quantity according to the size of the cup.^[7] This is done by applying delay to the water pump using microcontroller.

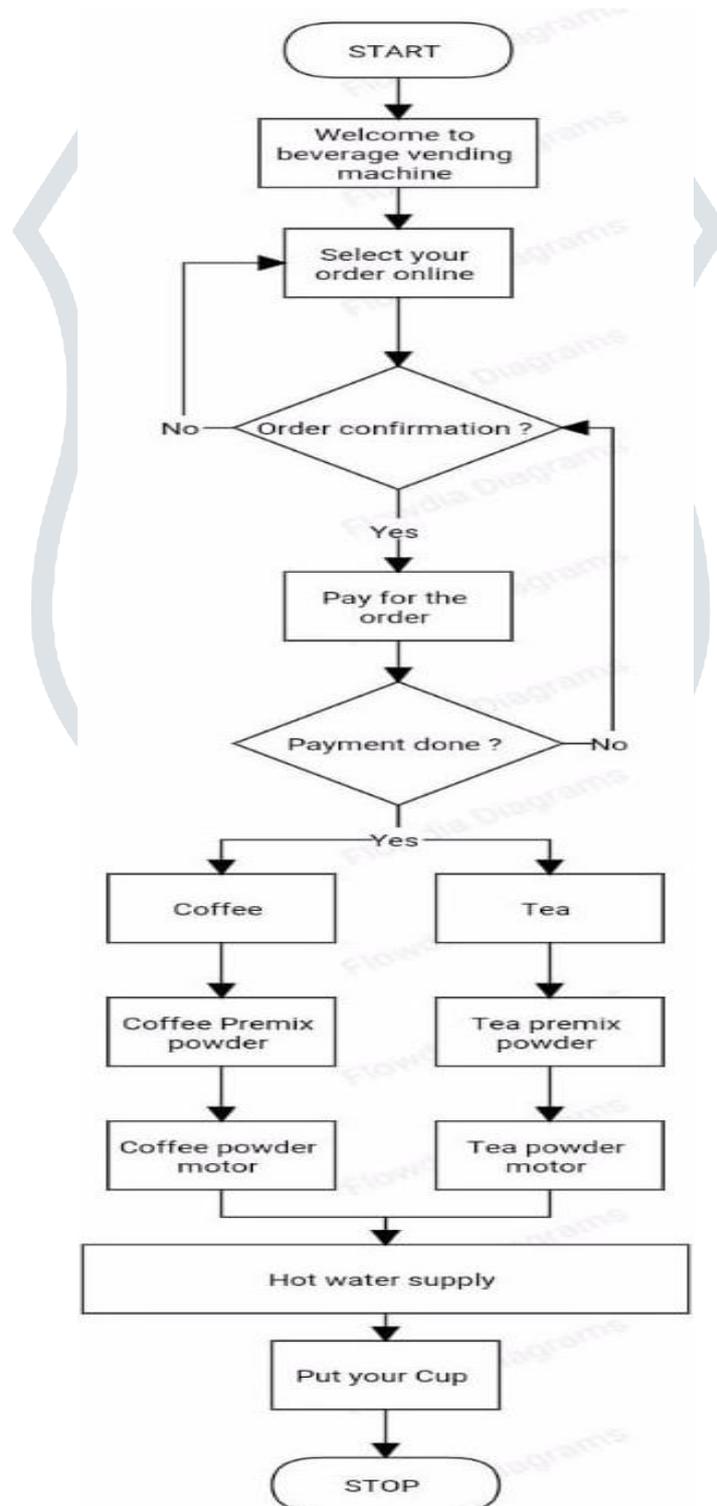
Ultrasonic Sensor



Fig.10 Ultrasonic sensor

It senses the presence of customer’s cup and sends signal to Arduino to allow pouring of tea or coffee. In the absence of cup, the pouring process is not initiated.^[7]

IV. FLOW CHART



V. TECHNICAL APPROACH OF THE PROJECT

Initially, we will study how the current vending machine functions. Then, we will plan out the improvements to be made to the current vending machine. After that is done, we will start to design the different sections of the Vending Machine such as the boiler and pump. Once that is done successfully, we need to program the controller accordingly. After the design of each section is done we will design the circuits and a layout for the printed circuit board. Then we need to acquire the required components and solder them onto the printed circuit board. We will create a web page which will get the login information of the customer. After which the customer can review the products and place order. The payment of the order is done via online payment gateway. The input that is going to be required will be from the user via the web application. Then we will check the interfacing section of the vending machine which is the Ethernet shield. After that the input will be given to the internal devices such as servo motor, boiler, pump and IR sensor and the output will be the ordered product. Then the quantity of the premix will be updated for digital monitoring.

VI. OBJECTIVES

Apart from making the vending machine easy to operate, we are also planning to make a web application for it which can connect to the Internet and vending machine to support real time monitoring for various ingredients. Thus, the Vending Machine will enable more interactive user experience.

VII. EXPECTED OUTCOME

The conventional vending machine accepts coins and gives consumers the selected products or beverages. These vending machines required more hardware because it uses separate electronic coin acceptor and many times it doesn't work properly, and coins get stuck in machine. Due to this customer does not get products or beverages which were selected. The vending machine which we are making will have features which will increase the efficiency of vending machine as well as it will be user friendly to customers. As we are using online ordering and payment system it reduces the complexity of the hardware. In this vending machine we will be using mobile application or web page for online ordering and for payment system. As ordering and payment is done by customer the message is sent to vending machine via internet and according to the selected item the customer is served by the machine. Thus a vending machine which is cost-effective than the machines which are already available and which has more enhanced features will be made.

VIII. CONCLUSION

The project can be used in restaurants, offices, schools, colleges and many other places. Vending machine with online payment will give 24 hours service without any inconvenience. In conventional vending machine there is a threat of fake currency being inserted; making the vending machine cashless will eliminate this flaw. This project uses IoT to control its internal functions.

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