A Review Paper on IoT Based Coffee Vending Machine

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Abstract: The rise of the Internet of Things has led to an explosion of sensor computing platforms. The complexity and applications of IoT devices range from simple devices in vending machines to complex, interactive artificial intelligence in smart vehicles and drones. In the paper we put forward the design of the coffee vending machines based on the technology of internet of things and its remote management system, which is aiming at the present problems, such as the high administrative cost and the difficulties in data analysis. This design not only makes the sales and supply information available, it can survey this information into cloud corner through WIFI as well.

Keywords: Internet of Things, Sensors, coffee vending, notification.

I. INTRODUCTION

As we know many people working in companies are coffeeholic and someone even said " May be you can't buy happiness, but you can buy a cup of coffee". It's because it is the best beverage you can have during your working time to refresh your mind. But the provision of the ingredients, the organization of the brewing and cleaning process and the balance generation are complex (social) tasks if you are not able to install a fully automated coffee machine.

Most Indians like drinking coffee every day. According to a report, one adult drank 338 cups of coffee in 2011. Some people drink coffee at a coffeehouse (e.g., Starbucks, etc.), others buy it from a vending machine. Coffeehouses sell a various types of coffee and the taste of coffee they sell is good. In addition, they provide a comfortable mood. Customers can select one according to their own preference. However, the accessibility to them might be lack because they are mainly located at a business district. In addition, the price of coffee they sell is a bit expensive

Coffee vending machines can be installed anywhere such as bus station, office, residential area, building, etc. Therefore, people who want to drink coffee can buy a cup of coffee anywhere and anytime from them. The price of coffee they sell is cheap. However, the type of coffee which people can buy from them is restricted as well as there is no change in the taste of coffee they sell. Furthermore, people cannot know when they have been cleaned and when the materials to make coffee have been replaced.

We have developed a smart vending machine to solve the problem that people cannot know the cleaning status of a vending machine and machine will store the identity of person for authenticated access as well as adjust the taste of coffee they buy.

1. Background
Internet of things
In the world of Internet of Things, also known as IoT, most of the objects or entities that around us will directly or indirectly be available on the network. To connect with Internet of Things, Radio Frequency Identification (RFID) and various sensor network technologies will be generated. Through these innovative technologies, information and communication systems are intangibly surrounded in the environment around users.

The keyword Internet of Things was first introduced in 1999 by Kevin Ashton for Supply Chain Management. Apart from Supply Chain Management, IoT can also be used for numerous applications like healthcare, utilities, transport, etc. However, the meaning of 'Things' has been improved as technology progressed, the key objective of making a computer sense information without the assistance of human involvement remains the same.

Need of Internet of Things
Internet of Things becomes more and more popular day by day due to maximum use of Broadband. Internet as the internet user's increase. Using Internet of Things connection cost can be decreased by Wi-Fi connections, built-in sensors in devices and maximum number of devices connected together by a common medium. Through Internet of Things, internet connectivity can be extended beyond traditional devices like desktop and laptop computers, smartphones and tablets to a diverse range of devices and everyday things that utilize embedded technology to communicate and interact with the external environment, all via the Internet.

2. Relevance

The vending Coffee machine is widely used in various countries and regions of the world. However, in the daily operation and maintenance it continues to use the traditional manual administration and hand-written notes. It is very hard for the disperse vending machine to be effectively managed. One the basis of the present communication network platform, how to make a vending machine to form a chain sales network and provide a more convenient way of marketing and management mechanism, has become the key factors affecting its development. In this paper, the new coffee vending machine is designed based on the technology of Internet of things and remote management system and the present GPRS wireless network. Management personnel can timely understand the vending machine sales of coffee, cup and powder inventory, such as water temperature state information. At the same time according to the position information of each vending machine, working conditions, such as beverage inventory and sales data, the system provides a decision-making reference for the machines on the selling fleet placement position, drinks and beverage distribution. And the system can timely report vending machine fault event, reduce the fault shutdown time.

3. Project undertaken

An empty jug or missing coffee ingredients or unclear bills make you and your team more annoyed and frustrated so developing such a fascinating coffee vending machine with the help of IoT is important. So we are working on making such a machine with different objectives. The objectives of system are:

▶ To monitor Temperature detection.
▶ To monitor water level sensors.
▶ To monitor availability of coffee in machine.
▶ To monitor coffee completion in a jug or mug by mass detection.

II. RELATED WORK

1. Platform choices and design demands for IoT platforms: cost, power, and performance trade-offs
Deming Chen, Jason Cong, Swathi Gurumani, Wen-mei Hwu, Kyle Rupnow, Zhiru Zhang
The rise of the Internet of Things has led to an explosion of sensor computing platforms. There are various devices which use the concept of IOT and the complexity and application of IOT in those devices varies from small devices like vending machine to large devices such as smart vehicles Developers target more aggressive objectives and protect market share through feature differentiation; they just choose between low-cost, and low-performance CPU-based systems, and high-performance custom platforms with hardware accelerators including GPUs and FPGAs.
Both CPU-based and custom designs introduce a variety of design challenges: extreme pressure on time-to-market, design cost, and development risk drive a voracious demand for new CAD technologies to enable rapid, low cost design of effective IoT platforms with smaller design teams and lower risk. In this article, they have presented a generic IoT device design flow and discussed platform choices for IoT devices to efficiently trade-off cost, power, performance and volume constraints: CPU-based systems and custom platforms that contain hardware accelerators including embedded GPUs and FPGAs. They demonstrate this design process through a driving application in computer vision.

2. The Internet of Things Coffee Vending Machine
Zhen Lei Yang, Ling Yun Zhao, Liangtian Gu, 2015 Trans Tech Publications, Switzerland,
In the paper the author has put forward the design of the coffee vending machines based on the technology of internet of things and its remote management system, which is focusing on current problems occurring in existing system such as difficulties in analysing data and really high cost of administration. This design not only makes the sales and supply information available, it can survey this information into cloud corner through GPRS as well.

3. IoT Based Coffee Quality Monitoring and Processing System in Rwanda
Joachim Rutayisire, Sandor Markon and Ndacyayisaba Raymond
Coffee is Rwanda's main source of income, thus improving processing and monitoring has a large potential economic impact, in this paper they have introduced low-cost sensor Technology, by utilizing embedded system to monitor coffee washing station processing method and store centres, the system will be reporting the status of PH, moisture, temperature and humidity as basic information to keep the standard quality of coffee, continually monitor these stages and alerting right time to move from one stage to another to meet requirement of export market. In this paper we describe the background of coffee quality major issues through processing and monitoring, our proposed e-Kawa solution and preliminary experimental results obtained in lab testing. They believe that similar technologies could be beneficent in local coffee processing anywhere else with similar conditions.

4. Smart Coffee Vending Machin e Using Sensor and Actuator Networks
Kwangsoo Kim, Dong-Hwan Park, Hyochan Bang, Geonsoo Hong, and Seong-il Jin

This paper focuses on how technologies contribute to making our daily life be more convenient. A lot of people buy coffee from coffee vending machines and they don't even know how clean they are or if they are really clean or not. So to know the cleaning status of these machines, they have developed a sensor and actuator network and installed it inside a vending machine. The network monitors the indoor environment of the machine and adjusts the taste of coffee according to the choice of the customer. A customer uses a smartphone to see the environmental data as well as to control the amount of all the ingredients of coffee such as coffee, sugar, and powered coffee creamer. The machine and the phone exchange their data via Bluetooth. This system supports the better personalized service.

5. Smart World of Internet of Things (IoT) and It's Security Concerns

Talwana Jonathan Charity, Huang Jian Hua

Due to increasing number of internet users, the use of broadband is also increasing day by day and it is becoming popular. Hence the connection cost of this broadband should be decreased due to Wi Fi connectivity and built-in sensors in devices as well the maximum number of devices should be connected to it through a common medium. To meet all these requirements, the technology called as Internet of Things is evolved. Internet of Things (IoT) can be considered as a connection of computing devices like smart phones, coffee maker, washing machines, wearable device with an internet. IoT create network and connect "things" and people together by creating the proper relationship between people-people, people-things or things-things. As the number of device connection is increasing day by day, it increases the Security risk along with it. Security is the biggest issue for IoT at many companies across the world. Furthermore, privacy and data sharing can again be considered as a security concern for IoT. Companies, those who use IoT technique, need to find a way to store, track, and make sense of the large amounts of data that will be generated. Few security techniques of IoT are necessary to implement to protect your confidential and important data as well for device protection through some internet security threats.

III. ABOUT PROPOSED SYSTEM AND FLOW OF SYSTEM

1. Proposed Methodology

In traditional approach wherever the coffee vending machine is placed or installed, man need to be physically present there to serve the coffee and to continuously monitor the system. But sometimes it is not possible for man to be physically present there. This proposed system is designed in such a way that a customer can order his coffee via a mobile app. It provides complete authentication of the customer using RFID (Radio frequency identification) reader.

It consists of the PIC18F877A microcontroller, temperature sensor LM35, water level BC547 sensor, RFID reader, 16*2 LCD display, Wi-Fi module ESP8266, relay driver ULN2803 where PIC16F877A is a master controller and all rest parts are interfaced with it. Here the relay driver is used to give a start to coffee heater, coffee selector and the pump.

The level of the ingredient in the machine is continuously monitored by the sensor. Microcontroller PIC18F877A is used to read the data from the sensor. The temperature sensor will maintain the constant water temperature.

In this project a PIC microcontroller reads data from the RFID reader. The RFID reader sends 12 bytes of data at 9600 baud rate. The microcontroller displays this data on LCD screen and sends the data to the Wi-Fi module ESP8266. The data is send to the Wi-Fi module at 9600 baud rate. The ESP 8266 module uses AT commands to send the data. The data is sent to the Thingspeak cloud. The Thingspeak cloud receives data in Coffee Vend channel. An android app is used to read data from the Thingspeak cloud. The android APP uses Read API key to read data from Thingspeak channel. Then android app receives data from the Thingspeak channel and displays in the text window. Then we must click on Prepare Coffee button on the app. The app sends data on cloud. The microcontroller receives the data from the cloud and starts the procedure. The microcontroller first checks if water in the tank is available or not. It displays Water Level Low message and waits until sufficient water level is reached. Then it starts the heater and when the temperature reaches 70 degree it stops the heater. Then it adds 1 spoon of coffee mixture in heated water with the help of dispenser. Next it pumps the ready coffee to the cup by a 12V Dc pump.

2. Goals and experiments

The goals of the system are as following which must be achieved by the system and experimentation regarding these goals must be performed.

- Authentication using RFID to ensure security.
- It manages the responsibilities for brewing, buying in a schedule and annotates team members by sending a notification to buy or fill coffee ingredients in coffee machine.
- Coffee "booking" for a specific time (Meetings) from anywhere using calendar function.
- All information will be evaluated in the cloud.
- Cloud system also calculates automatically the number of coffee drunk and also bill generated by the user and the coffee machine on the whole. At the end of the month it can generate statistics about each person's usage.

3. Flow of the system
a. Flowchart 1:
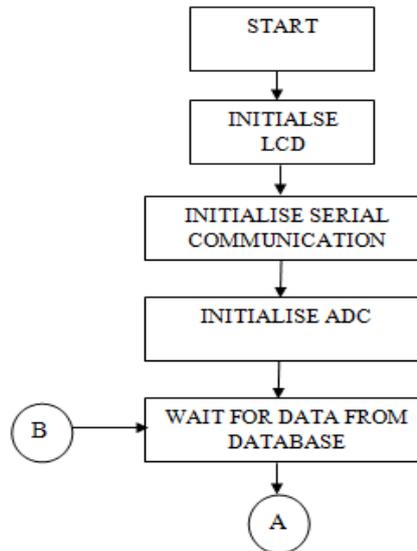
Fig.1 Flow chart 1

b. Flowchart 2
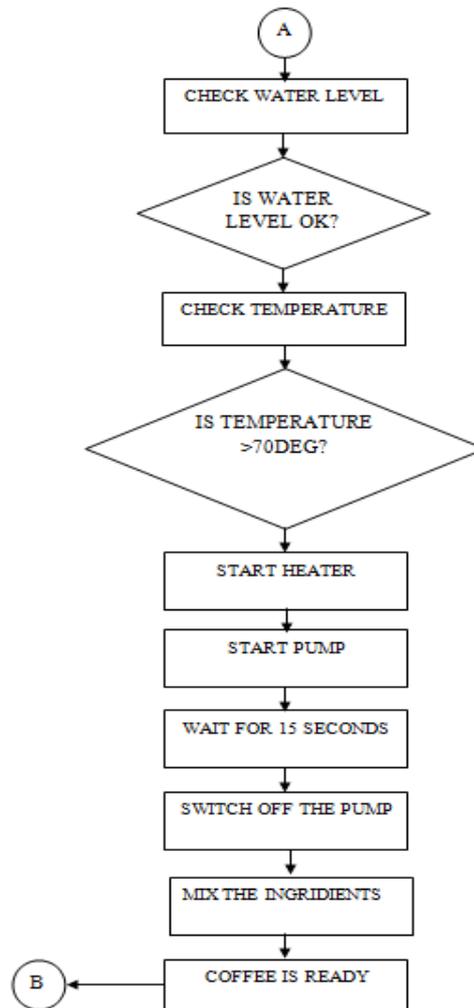
Fig.2 Flowchart 2

IV. DESIGN AND ARCHITECTURE OF SYSTEM

1. Block Diagram and block diagram description

In this project the customer can order his or her coffee via a mobile app. A notification is send to the concerned department prior before any ingredient gets emptied in the machine. In above figure we have a block diagram of the IoT based coffee vending machine

Block diagram consist of the following blocks:
1. Water level sensor
2. Temperature sensor
3. RFID reader
4. Wi-Fi module
5. Relay driver
6. Wi-Fi Module
7. Microcontroller
8. LCD display
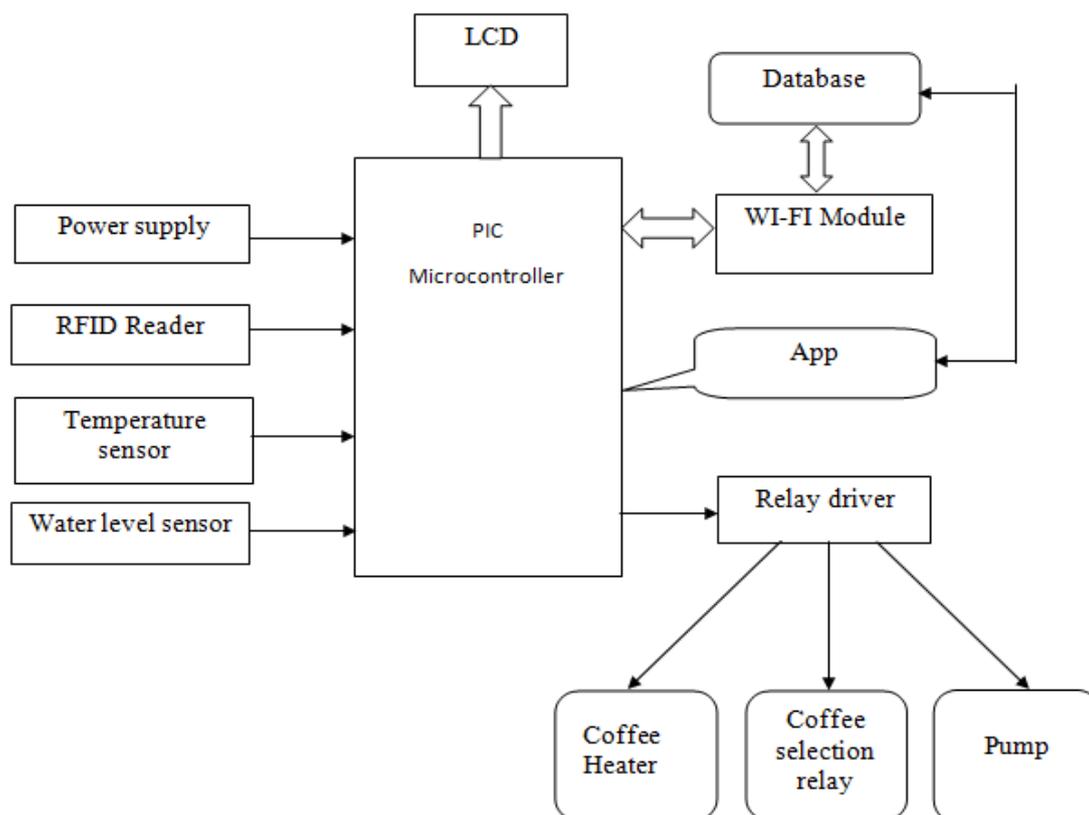
Fig.3 System Block Diagram

Block description in detail

1. **Water level sensor:** Here we use BC547 water level sensor and resistor circuit. This simple transistor based water level indicator circuit is very useful to indicate the water levels in a tank
2. **Temperature sensor:** The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the Centigrade temperature.5°C Ensured Accuracy (at 25°C) Rated for Full -55°C to 150°C Range Operates from 4 V to 30 V.
3. **RFID reader:** RFID reader uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically stored information. The RFID reader sends 12 bytes of data at 9600 baud rate. It can detect up to 7cm of range
4. **Wi-Fi module:** In this project we are going to use an ESP8266 Wi-Fi module which establishes wireless connectivity between microcontroller and web server.
5. **Relay driver:** A Relay driver ICULN2803 is an electro-magnetic switch that will be used whenever we want to use a low voltage circuit to switch a light bulb ON and OFF which is connected to 220V mains supply.

6. **Microcontroller:** Here we used PIC16F877A microcontroller, which operates with a 12 MHz crystal. It is a master controller whereas rest all parts are interfaced with it.
7. **LCD display:** The LCD module (16*2) is used to display the status (material level i.e. ingredient) of the machine.
8. **Power supply:** Power supply is of 230 V, which is given to transformer which step down the voltage to 9V. Then this step-down AC is converted to DC. By using regulator this DC is regulated to 9V to operate whole circuit.

V. CONCLUSION& FUTURE SCOPE

Conclusion

The implementation of IoT based coffee vending machine helps the customer to order the coffee according to their taste via a mobile app. They just need to select the type thy want and just click on order coffee. The level of ingredients is continuously monitored and before they get emptied in the machine. The notification alert is send to the concerned department to fill the required ingredient. It aims at advanced management of the whole coffee vending machine previously used.

Future scope

We should implement this coffee vending machine in several places of the cities, some area may not have a continuous power supply for this system to be worked efficiently. This issue can be solved by using solar panels in future. Solar panels can be used with the solar batteries which do not require a continuous power supply. We can add different flavours in the same machine so the customers can have more options with them. Secondly, we can consider anti-disaster vending machine in which free drinks can be served to the peoples.

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