Any Time Medicine Vending Machine
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Abstract:
This paper describes the prototype of the All Time Medicine Vending Machine for the use of every person in need of medicine. Medicines is an essential part in looking after wellbeing, averting ailment, overseeing, interminable conditions and curing sickness. Unsurpassed Medicine (ATM) is a machine which conveys the medication in crisis cases and guarantee accessibility of medications 24x7 and thus the name "Record-breaking Medicine". ATM will be extremely valuable in sparing life if there should arise an occurrence of a mischance on parkways, remote ranges, provincial territories and spots where therapeutic stores are not inside the compass in the event of crisis. In any event first help can be made effectively open with the assistance of this framework. This venture comprises of Advanced RISC Machine (ARM) processor which controls the other sub frameworks, Global System for Mobile correspondence (GSM), pharmaceutical allocator, and stock control. GSM sends the message to the stock control when the solutions should be refill. Pharmaceutical allocator is the capacity part of the machine which stores the prescription.

I. INTRODUCTION
In the current years, there has been a considerable increase in communicable and non-communicable diseases, and with people getting more aware about their health there has been a considerable growth in the healthcare industry. In the coming years, digitised services, mobile technology and improved data services are expected to play a critical role in improving healthcare delivery, especially in the rural areas. Some companies are now coming up with lucrative, yet cost effective technologies and digital solutions to combat the health issues and improve healthcare delivery. But the number of companies invested in this area are still few and the technology is limited. Many countries are still having backward infrastructure when it comes to healthcare and on top of that, most of the healthcare professionals and services are concentrated in the urban areas leaving the rural regions underserved. A WHO and World Bank Group survey released in 2015 showed that 400 million people around the world did not have access to essential health services. The report also found that, across 37 countries, 6% of the population was tipped or pushed further into extreme poverty because they had to pay for their health services. In India, which having the world’s second largest population of 1.3 billion, the healthcare infrastructure is not nearly enough to cater to the needs of the population. The Primary Health Centres(PHCs) in rural India are short of more than 3000 doctors. A study on ‘Consumer Perceptions, Availability, Role, Services Provided, Medicines and Expectations of Pharmacists in India’ by D. B. Anantha Narayana et al done in 2011 showed that in India only 4% of the people taking part in the survey didn’t visit medical shops, while 12% didn’t have a medical shop in the locality. In times of emergency, particularly in remote areas, people have nowhere to go and obtain their required drugs or face difficulties in obtaining drugs at correct time. There has been an increased attention and effort from private sector and start-ups in India, to provide quality healthcare diagnostics and services at lower costs. This paper describes the prototype of the Degrees of social status are closely linked to health inequalities. Those with poor health tend to fall into poverty and the poor tend to have poor health. According to the World Health Organization, within countries those of lower socioeconomic strata have the worst health outcomes. Health also appears to have a strong social component linking it to education and access to information. Intelligent pillbox is an automatic medicine vending machine. A vending machine is a machine which dispenses items such as snacks, beverages, alcohol, cigarettes, lottery tickets, cologne, consumer products and even gold and gems to customers automatically, after the customer inserts currency or credit into the machine. The Medicine Vending Machine as the name suggests is a vending machine that will dispense the required medicine as per the user’s choice. It provides an all-encompassing solution to an individual looking for immediate symptomatic relief for trivial health problems. It can also decrease the current costs of open medicine cabinets. By having an over-the-counter vending machine in the workplace, worksites without clinics or pharmacies can benefit from increased work efficiency and avoid underperformance of ill employees. Moreover, it prevents hours wasted waiting in queues at clinics for trivial problems like colds and headaches. This situation gets especially magnified when a location is suffering from a localized epidemic or pandemic.

II. LITERATURE REVIEW AND COMPARATIVE STUDY
With people becoming more aware and concerned about their health, the research and development work on the area has grown considerably and is expected to continue to do with increased support from the governments and private organisations and companies. In this section some of the existing research on healthcare and medicine access has been discussed which motivated the design and methodology of the ATM device.

[1] developed a medicine dispenser for prototype for caregivers as well as the patients of Alzheimer’s disease. In the device the caregivers have to input the medicines or refill the dispensers for the by scanning the medicines using bar code scanners. The patients have to touch the screen of the GUI and the medicine(s)
will be dispensed out. If the patients failed to take their medicines in given duration of time the caregiver gets notified through SMS. [2] discussed the construction of smart medication dispenser having a high degree of scalability and remote manageability. The dispenser has a real-time clock to keep track of the patient’s medicines and when the patient presses a button at the correct time the predetermined medication is dispensed out from the medicine tray. They have used infrared sensors to keep track of the quantity of medicines dispensed out. They have also used LAN to periodically transmit medicine status without intervention of patient. [3] have written about the generation of mobile based prescription that exempts the need for elderly or sick people to go to the doctor to obtain written prescription. They have used NFC (Near Field Communication) enabled mobile phones that can communicate with NFC tags attached to objects and each drug box has this tag attached. This way the patient can request the mobile prescription from the doctor, the doctor uses a mobile application to see the patients’ requests and prescribe the drugs, and finally at the pharmacy this prescription is wirelessly sent to the store’s computer and an NFD reader is used to obtain the drugs. [4] discussed the development of a prototype of a smart medical refrigerator which keeps track of a patient’s medications and alerts a healthcare provider, family member or physician over a standard telephone line if the patient does not take the medications in the set time frame. [5] design and fabrication of the prototype of a low cost automated medicine dispenser for the use of pharmacist which has the capability to count medicines and dispense it into a vial. They have used standard size servos for dispensing out the medicines and infrared sensor to count the number of medicines dispensed with accuracy of 90%. [6] details the design and fabrication of an autonomous Arduino controlled device that allows a caretaker to configure tablet medication delivery to patients. [7] describes medication control using RFID (Radio Frequency IDentification) and IoT (Internet of Things). They have used RFID tags for identification and gaining access to medical records of patients and have used IoT for quick doctor patient interactions and sending IoT based warnings to the doctors, physicians or other medical attendants. In the ATM device normal medicine dispensing operation has been combined with website and a GUI that gives novelty to our project. [1] and [5] developed a medicine dispenser but did not incorporate a communication system with the doctor or an online prescription system. On the other hand, [3] have described a mobile based prescription system which is sent to the drug store to get the medicines. The ATM device combines all of these into a single system giving it a greater range of applications. ATM has the website and mobile application that allows the patient to contact a doctor and remotely obtain medical prescription. Unlike some of the previous versions of medicine dispensers, the ATM only allows one to obtain medicines with a prescription, increasing the security and preventing illegal trade of drugs. Compared to the other medical dispensers, the ATM does not restrict itself to a single group of audience. Its portable structure and remote accessibility allows it to be set up at any location and to be used by doctors, pharmacists and by the patients in need of quick medical support. The novelty of the ATM device is that it combines the medical dispensing system, the web-based communication with doctor and online prescription system to provide complete medical support, almost equivalent to that of a small clinic.

II. TECHNICAL BACKGROUND AND PRELIMINARIES

In this section we have provided a few technical backgrounds that will help to ensure better understanding of our proposed technique.

A. Raspberry Pi

Raspberry Pi is a small, affordable single board computer. It has USB slots and plugs into a computer monitor, mouse and keyboard and also has internet access through Ethernet as well as WIFI. Other peripherals can be attached through the various pins and connectors on the surface of the Raspberry Pi. The low cost and small size of the Raspberry Pi makes it very useful in electronics projects. The Raspberry Pi supports many operating systems but the one used in this device is the Rasbian OS.

![Figure.1. Raspberry Pi Board](http://ijesc.org/)

B. Python

Python is a general-purpose interpreted, interactive, object-oriented, and high-level programming language. Python uses Object Oriented Programming and is very similar to PERL and PHP. Python supports GUI applications. Tkinter is not the only GUI Programming toolkit for Python, but it is the most commonly used one. It has been used to create the user interface for the medical vending device.

III. DESIGN AND FUNCTIONING

The All Time Medicine and Health (ATM) device can be divided into two main parts that are essential to the working of the device, namely, the webpage, web server, android application and the Raspberry Pi processing based on Python GUI. In this section, a detailed description of the design and functioning of the systems and subsystems of these two parts has been given. Along with these two main parts we have also developed a mobile application that has the same functionalities as the website, except it is easier to use in a phone.

A. Circuit Diagram

![Figure.2. Shows the circuit diagram of the project](http://ijesc.org/)
User Authentication:
User authentication is a process that allows a device to verify the identity of someone who connects to a network resource. The user has to insert their card and enter password. If the password is correct the system will accept the transaction or else, it will display the appropriate error message. Medicine Dispensing: Once the authentication process has been carried out, user will select the medicine and pillbox will dispense it.

C. Flow Chart

Database Updating:
Once the medicine has been dispensed the balance and database will be updated. User’s database will be updated with current balance and number of pills dispensed. Stock database will be updated with current stock value.

Inventory Control:
Controlling the inventory of drugs is critical to functioning of machine. If the medicine gets over, the system will send notification to refilling

A. User interface:
The user portal of the ATM device consists of a monitor and keypad, a camera for live conference, a heartbeat sensor and the medicine vending mechanism, and all of these are supported by the backbone of the Raspberry Pi processor. The Graphical User Interface (GUI) has been created with the Python ‘tkinter’ library. The GUI allows the user to have a live video conference with any doctor for immediate medical assistance as well as access the prescribed medicines. The patient enters his/her username, password and the prescription number provided by the doctor into the GUI through the keypad. The Raspberry Pi, which is connected to the internet, then receives information about the prescribed medicines from the SQL database in the form of a string. The GPIO pins of the Raspberry Pi are connected to the motor drivers in the first prototype, while connections are made to the LEDs in the second prototype. Based on the received data, the Raspberry Pi gives instructions to the motor drivers to dispense out the medicines or gives instructions to make the LEDs glow the exact number of times to demonstrate the dispensing operation.

1) Monitor and keypad- The Raspberry Pi has an HDMI port to directly connect to a visual display, monitor or PC. The monitor has VGA port and an HDMI to VDA adapter cable is used to make the connection. Any standard keyboard and mouse works with the Raspberry Pi and they are connected to the board using USB slot. The Raspberry Pi is basically a simple computer and on adding the keyboard and mouse it becomes an easy to use interface for the user.

2) Camera-The Raspberry Picamera module is capable of taking full HD 1080p photo and video and can be controlled programmatically. Libraries for using the camera are available in both Shell (Linux Command Line) and Python, and in this system Python has been used to programme the camera. Instead of using the camera module a standard USB webcam can also be used to take video on the Raspberry Pi but to programme it the webcam package will have to be downloaded and installed. The Raspberry Pi has no analog input pins, hence an analog to digital converter (ADC) has been used to read out the analog signals from the pulse sensor. The ADC uses the SpiDev library that has to be installed in the Raspberry Pi. The camera and heart beat sensor, both of which are connected to the RaspberryPi, make
the user interface very useful in medical emergencies. The camera allows the user to have a video conference with any registered doctor available at that point of time and get a medical diagnosis. The heartbeat sensor allows the doctor to get more information about the patient’s current medical condition.

3)Vending mechanism -For the medicine vending operation we have demonstrated two mechanisms as a proto type of the industrial ending machine. First is the conveyor belt system connected with dc motor and motor drivers for the conveyor belt to dispense out the prescribed number of drugs. The system uses a Raspberry Pi to control the speed of a DC motor attached with conveyor belt to dispense out the drugs. The speed of the motor is directly proportional to the voltage applied across its terminals. Therefore, if the voltage across the motor terminals is different, then the speed of the motor is also different. Pulse Width Modulation (PWM) is produced at the output by the Raspberry Pi board according to the written program and depending on the duty cycle, the average current flowing or the average voltage given through the motor changes, so the motor speed also changes. A motor driver IC is interfaced to the board for receiving PWM signals and sending preferred output for speed control of the DC motors. Infrared sensor has been used to keep track of the number of medicine dispensed by the conveyor belt. Second, is the LED display.

The Raspberry Pi board comprises programmable instructions, that controls the light intensity based on the pulse width modulation signals produced. As a prototype of the actual medicine dispensing operation we have an LED assigned to each of the medicines in the vending machine that glow the number of times the medicine dispenses.

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<td>Name of Test:</td>
<td>LCD Testing</td>
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<td>LCD</td>
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<td>Sample Input:</td>
<td>Power supply</td>
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<tr>
<td>Expected output:</td>
<td>LCD should display “Welcome to pillbox” message.</td>
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<td>Actual output:</td>
<td>LCD displays “Welcome to pillbox”.</td>
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<tr>
<td>Remarks:</td>
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### Figure 5. Unit test case for LCD

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<td>Items being tested:</td>
<td>Camera</td>
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<tr>
<td>Sample Input:</td>
<td>Scan the medicine</td>
</tr>
<tr>
<td>Expected output:</td>
<td>Prescribed medicines will be selected</td>
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<tr>
<td>Actual output:</td>
<td>Selected tablet</td>
</tr>
<tr>
<td>Remarks:</td>
<td>Pass</td>
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</table>

### Figure 6. Unit test case for CAMERA

### IV. APPLICATION AND FUTURE SCOPE

In today’s world where health problems are becoming more and more common, everyone requires medicines at some point of their lives but not everyone receives the proper medicine and healthcare in time. Statistical studies made by the OECD in the year 2014 showed that the expenditure on healthcare made by many countries was low to the point of regressive and most of the healthcare services failed to reach the low-income population of the countries. The survey even showed that the number of doctors and nurses available per 1000 of the population was also very low. AWHO and World Bank Groups survey released in 2015 showed that 400 million people around the world did not have access to essential health services. The report also found that, across 37 countries, 6% of the population was tipped or pushed further into extreme poverty because they had to pay for their health services. The situation has progressed since then but there is still chance of growth and improvement. In India, healthcare has become one of the largest sectors both in terms of revenue & employment and the industry is growing at a tremendous pace owing to its strengthening coverage, services and increasing expenditure by public as well private players. But most of the health care growth is focused in urban India and the rural regions are still lacking in proper healthcare services. The Primary Health Centers (PHCs) in rural India are short of more than 3000 doctors. In one of the studies, it was indicated that 143 public facilities found absenteeism of 45% doctors from PHCs with 56% of time found to be closed with an unpredictable pattern of closure and absenteeism during regular hour visit. This means that many people in the rural areas are still unable to access proper medicines or get doctors opinion for their diseases in time. In this project we have aimed to provide a solution to this problem. With the ATM device quick and efficient diagnosis and medicines can be provided so that no person has to suffer for the lack of medical assistance. Since setting up a vending machine is simple and cost efficient, even the remote places can have the ATM devices set up. In remote areas and villages where such facilities aren’t available easily, this device can be a boon. Most, importantly this portal can help people get the required medicine(s) very quickly in case of emergencies with the consent of a registered doctor. At places where setting up pharmacies are difficult, for example, rough mountain terrains or remote highways, just an internet connection could make a difference.
connection just an internet connection will be required to get the medicines from the ATM device. Not only does this device provide medicines in emergency cases, but also makes the drug business more secure and reduces the cost of these drugs compared to the retail outlets. Pharmaceutical crime, involves the manufacture, trade and distribution of fake, stolen or illicit medicines and medical devices, counterfeiting and falsification of medical products, their packaging and associated documentation, as well as theft, fraud, illicit diversion. Where online pharmacies could have been a welcome change in the drug distribution system, invasion of this system by illegal operators has put safety of the consumer/purchaser at stake. Today pharmaceutical crimes have increased a lot and patients across the world put their health, even life, at risk by unknowingly consuming fake drugs or genuine drugs that have been doctored, badly stored or that have expired. Also, there are increased cases of people making unauthorized purchase of drugs at the pharmacies without prescription. The ATM device will help to combat these problems by making the drug transactions secure and monitored. Since the patient will have access to the medicines only on getting the prescription number from the doctors there will be no way to buy non-prescribed medicines. The devices can be further linked with government identifications like social security number in USA or ADHAAR number in India, which will make the entire system even more secure and allow the government to track the drug trade in the countries. Lastly, the things that that doctor, patients, or any one for that matter crave for in the healthcare system are efficiency, security and simplicity. Our product would provide people with an easy- to-use, readily available and secure system, that anyone irrespective of their knowledge, especially those living in rural areas, can use so that everyone can get medical services at the time of need and get it in time.

V. CONCLUSION

The system we have designed and fabricated is a prototype and there is still scope for adding more features and making it industry ready. We have used the Raspberry Pi for both its low cost and its simplicity, The pillbox offers a flexible and simple solution for extending basic healthcare to all places, at a very moderate cost. The machine will dispense prescribed medicine. The machine adds an intelligent medicine unit, which sends a refill notification message to the nearest pharmacy when the number of medicine strips decrease below a certain level. The intelligentpillboxistechnicallyfeasibletoallthepeoples. It will be very helpful and it gives ease of access. It is important to consider how the technology may affect quality of medication delivery and use.

VII. REFERENCES


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