IoT Driven Smart Pill Box System

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Abstract- *An IoT Driven Smart Pill Box System is meant supported a sensible and safe medical box that assists patients in taking their pills treatment on time. this technique also can be monitored by the patient parents because it are going to be linked to a phone application. the most aim of this technique is for patients who has to take medicine regularly for having diseases like diabetes, vital sign, breathing problem, heart problems, cancer diseases etc., adulthood patients, patients who has very long prescription for his or her medicine which is tough to recollect to patients and also for his or her care giver. supported these problems we made smart pill box system which solve these problems by fitting timetable of prescribed medicines through push buttons as given in prescription. All pill boxes are pre-loaded within the system which patient has to take at given time. System advancement like blind people take pill from box using vibrator fit the box. Using IOT number of pills into box are going to be monitor by doctor or patient relative.*

The overall results were very acceptable with a faulty alarm generation below 3%.

Keywords- Secured box; Phone application; Autonomous patient; Smart systems;Smart medicine box, Old age patients, Permanent diseases, Setting up timetable, Bright light, Notification sound, Sensing capability.

I. INTRODUCTION

In everyday life most of the people need to take medicines which was not there in past couple of years and the reason behind this is diseases are increasing in large amount. This problem of committing to take pills at right time, taking wrong medicines and accidentally taking of expired medicine causes health issues of patient and this leads to suffer from unhealthy life. Researchers are working to improve, not only this factor, but also the easy monitoring of the patient. Thus, the proposed system consists of a Smart Pill Box Systemthat can alert the patient, via a phone application, about the time to take his medicine,patient missed the medicine andcount of remaining pills in the box.

This system is, for sure, not the first one that helps monitoring and assisting patients. Several previous published works have proposed such systems as the design of smart homes fully equipped by sensors [1] [2] [3] [4], the monitoring of patients' walk and fall the telemedicine systems that monitors patients from home, and much more.

As a human-related system is proposed, the safety and reliability issues are to be considered. Even though medical boxes systems were presented in several previous works, none of them has integrated safety and reliability to the system [5] [6]; neither hardware failure measures nor on time alert messages were proposed by the developed systems.

Thus, this system deals with these inquiries: although it is a low-cost device, it is able to communicate through a phone application and to remind patients to take their correct medication dose on time. All these features are integrated while keeping a special attention on the system safety and failure safe state.

So, based on the above, this paper will be divided as follow: in Section 2, the block diagram and a general overview of the medication box will be shown in section 3, the hardware implementation will be proposed along with the software showing the functioning of the microcontroller and the phone application. In section 4, testing results will be displayed. At the end, section 5 will summarize the work and will show some future works that may enrich this system.

II. SYSTEM ARCHITECTURE

The proposed system consists on a box that can be remind patient about medicine and generate alerton a phone application and LCD screen. A sensor is also used to detect the number of pills present in the box and to identify the number of pills taken by patient. As for the outputs, they are designed at two levels: the first one implemented within the box and consisting on visual, audible sensations and vibrator for blind people. As for the second level, it is implemented within the phone application and it consists on alarms generated as notifications.

Figure 1 shows the block diagram of the whole system while taking into consideration the safety issues. These measurements are modeled at two different levels:

- The processing unit, consisting on two **ATmega328**. the system sends the required notifications to the surrounding outputs. However, if the outputs are different, the system enters the safe state and the user must run the system manually;
- The communication level between the monitoring application (it could be a mobile phone, a PC, an iPad,…) and the processing unit. It consists on the use of a WIFI module (which is considered as the primary communication interface).
- We are giving the 12v ac/dc power supply. The capacitor blocks ac and pass only the dc.

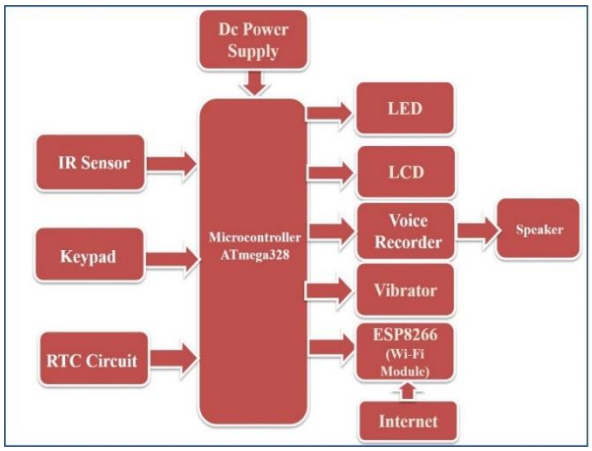

Figure 1 – Block diagram of the safe medical box

- The implemented system is about monitoring of pills in medicine box. Two ATmega328P microcontrollers are used for controlling device. First ATmega328P microcontroller is used to control Vibrator, Recorder KIT, LED, IR Sensor and RTC circuit.
- First ATmega328P is used to take input from IR sensors present in each medicine box, and output of same is pass as an input to second ATmega328P microcontroller which controls LCD , Keypad and WIFI module to generate alert message in Blynk mobile application.
- IR sensors is interfaced with microcontroller. Crystal oscillator is also used as frequency source for RTC.
- At the power supply level, the redundancy is applied; hence, the good functioning of a single system is enough to maintain the good work of the whole system;

III. HARDWARE AND SOFTWARE IMPLEMENTATION

A. Hardware implementation

Although this system is designed for the medication alarm and monitoring, It is mainly targeting old age, dangerous disease patients ,as Parkinson because they usually forget if they have taken their medications and psychologically ill people who do not want to take medication anymore or take more than the allowed doses to put an end for their lives. A major point that was taken into consideration during the choice of the hardware parts is the overall cost of the system as this was one of the major issues.

Concerning the processing unit, several choices were available. However, the implementation of the microcontroller was more eligible considering its low cost, its size and, most importantly, its ability to perform the required tasks. A wide range of microcontrollers exist onthe market today. However, the ATmega328 was chosen, .due to its cost efficiency, low power dissipation, programming lock for security purposes and real timer counter with separate oscillator.

ATmega328, Real Time Clock , Sensor and WIFI module is key component of system.

Atmega328

Atmega328 is an 8-bit and 28 Pins AVR Microcontroller, manufactured by Microchip, follows RISC Architecture andhas a flash type program memory of 32KB. It has an EEPROM memory of 1KB and its SRAM memory is of 2KB. It has 8 Pin for ADC operations, which all combines to form Port A (PA0 – PA7). It also has 3 built-in Timers, two of them are 8 Bit timers while the third one is 16-Bit Timer. ATmega328 is UNO's heart. It operates ranging from 3.3V to 5.5V but normally we use 5V as a standard.

ESP8266 Wi-Fi Module:

ESP8266 is an impressive, low cost Wi-Fi module suitable for adding Wi-Fifunctionalityto an existing microcontroller project via a UART serial connection. The module can even be reprogrammed to act as a standalone Wi-Fi connected device–just add power! This module is used to connect Blynk android application and send alarms in same.The feature list is impressive and includes:

Specification:

- 802.11 b/g/n protocol
- Wi-Fi Direct (P2P), soft-AP
- IntegratedTCP/IP protocol stack

IR Sensor :

An infrared (IR) sensor is an electronic device that measures and detects infrared radiation or sense certain characteristics in its surrounding environment. It does this by

either emitting or detecting infrared radiation. Infrared sensors are also capable of measuring the heat being emitted by an object and detecting motion. IR sensors used in Smart Pill Box Systemto detect the number of pills in the box and to identify the number of pills taken by patient.

Real-time clock :

A real-time clock (RTC) keeps track of the current time. Although the term often refers to the devices in personal computers, servers and embedded systems, RTCs are present in almost any electronic device which needs to keep accurate time. The term real-time clock is used to avoid confusion with ordinary hardware clocks which are only signals that govern digital electronics, and do not count time in human units.

B. Software implementation

In this part, the software of the microcontroller and the one of the mobile applications will be presented.

Concerning the **Atmega328**code, a general flowchart will be presented in figure 2. It shows the core mechanism of Smart Pill Box System. Notification or alert message send on mobile application or the work of the microcontroller concerning the calculations of the numbers of pills.In more details, on start system initialized all the modules. System user need to set RTC clock, setpillbox and pill box interval.Whentime is matched then corresponding pill box or medicine dose is missed then system generates alarm which displays on mobile application and on LCD screen with LED notification & vibrator.

The result obtained by each microcontroller concerning the sensor and the detection of the number of pills taken by the patient are compared together. If patient missed to take medicine or the number of remaining pills is low then the system generates alarms. The main microcontroller also checks medication box using IR sensor as per medication time. A notification message is generated on the mobile application whenever medicine dose missed by patient or medicine needs to take as per time set in system. As for the mobile application program, the data are sent, along the pills dosage and the schedule for taking the medication, to the processing unit. After a beeper is generated by the main microcontroller, the patient puts the remaining pills in the medication box. The number of pills will be then generated on the mobile application.

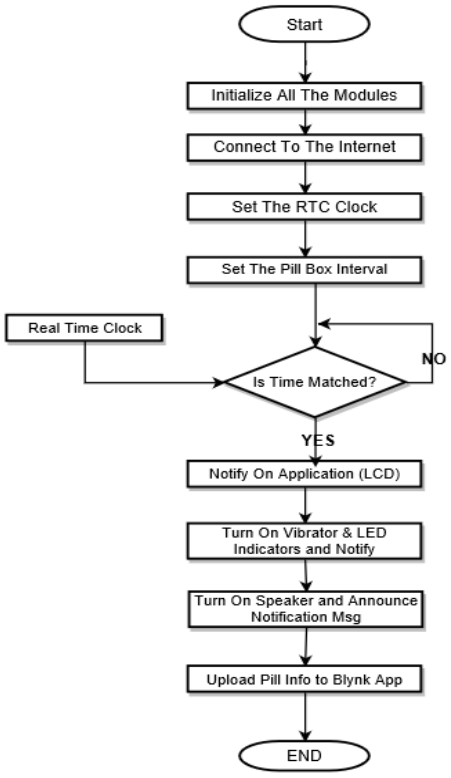

Figure 2 – General Application Flowchart

IV. TESTING RESULTS

As for the system outputs, they are designed at two levels: the first one implemented within the box and consisting on visual, audible sensations and vibrator for blind people. As for the second level, it is implemented within the phone application and it consists on alarms generated as notifications.

The proposed system holds devices and modules with built in sensors which are connected to an Internet of Things platform, which integrates data from the different devices and applies analytics to share the most valuable information with applications built to address specific needs. This information can be used to detect patterns, make recommendations, and generate alert messages to notify patients or their caretaker. This system consists IR sensors and RTC which keep track of medicine dose time. As soon as RTC reach to that time ,IR sensors check corresponding medicine box for medicine dose. With the help of this information system generates informative/alert message that reminds patient totake medicine, missed medicine or medicine box is empty. This system generated alert messages transferred through WIFI module on a phone application, also message display on LCD screen , LED used for indication and vibrator used to notify blind people, Please refer figure 3 for project setup.

V. CONCLUSION AND FUTURE WORKS

This paper presented a safety-related and low-cost medicine box that can assist and monitor patients concerning the accurate intake of their medication. This system is able to detect the faulty dose of pills taken, the missed medications and the unavailability of pills in the medical box. Alarms are being generated with medication box and via a mobile application that can be installed on the patient relative's phones in order to help monitoring him.

Although this system was well operating, several adjustments can be made in order to increase its use and ameliorate its behavior. A major drawback of this system is that it can contain only one type of medication. This can be solved in future versions of this system. Also, the system can be designed using a smaller surface which may lead to reduce box size.

The remote informing system combines with the Skype software so that the caregivers can help the patient. In the future, we hope that the energy saving and portable can be considered.

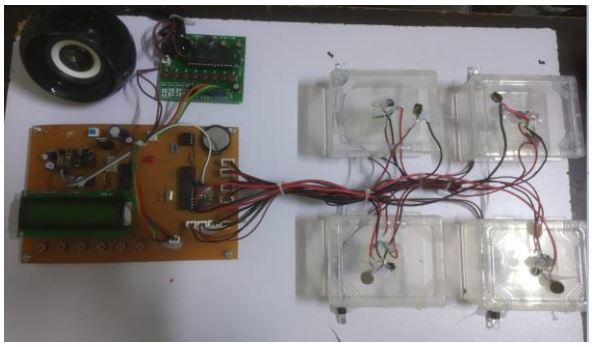

Figure 3 – Photo of the developed medicine box

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