Automated Medication Kit

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Abstract – Medication errors are common and often occur with patients who are aged or extremely busy in their schedule or else they belong to rural area. The process of ageing and taking several prescription medicines is associated with an increased risk of medication error. Medication reconciliation is an important element of patients' safety. Apart from forgetfulness, some patients are unable to read the names written on the medicine. This may lead to negative consequences for patients. This project proposes design of an automated system which reminds people of their medication schedule and can also bypass the requirement for search of medicines to be taken at a specific time. Doctor's desk is software that communicates with patient's kit (hardware) through RF module.

This project aims to design the kit for such patients to avoid the medical adherence. The kit has 3 compartments for 3 different types of medication and 1 compartment as an emergency kit. Each compartment has one LED which indicates the particular medication compartment during a particular alarm time. The person is notified by a Buzzer. An acknowledgement switch is provided so that whenever patient takes his prescribed dose, a feedback is sent to the doctor.

This project contains a medicine box which is the main part of the product, it also includes GSM module, a voice playback, buzzer, RFID, LED which display the information for patients, a PIC controller to operate the monitoring function .It also contain temperature sensor, blood pressure sensor, heart beat detector. It also display information to the commander terminal PC in nursing centre, in that all the information about the patient is present.

Index Terms – Medication Non-Adherence, Prescription Reminder, Health Care Cost, Remote Health Monitoring, GSM communication module.

1. INTRODUCTION

Medication reconciliation and adherence is a cornerstone of excellent patient care. Gaps in medication can delay optimal treatment, cause risk to patient's health and even more adverse outcomes. Creating patients home medication list, interviewing patients, calling local pharmacies and caretakers often deliver inefficient results as patients maybe old aged, illiterate or busy in their schedules. Electronic Medication service improves medication reconciliation accuracy and health outcomes. Adroit Pharmacy Assist reduces medication errors by notifying the patient and monitoring the patient's health by real time analysis. Medication adherence usually refers to whether patients take their medications as prescribed as well as whether they continue to take prescribed medication on scheduled time. Medication non-adherence is a growing concern to Doctors because of mounting evidence that it is prevalent and associated with adverse outcomes and higher costs of care. Non-adherence should be considered as a public health problem. Studies show that in developed countries, medical adherence is about 50%. The situation in developing countries is even worse. Steps are taken to reduce Non-Adherence problem. Several software are available which reminds the patients about their medication schedule. Costly automatic electronic timed reminders are available for medicine notification. Mobile Apps like Medisafe, Dosecast, Pillboxetc are also available for Android and iOS (iPhone Operating system) users. Many of these apps have similar functionality but slightly different user interfaces, they remind the patient during the medication schedule. The rural population lacks the access to software and hence the problem persists. Even old aged patients are illiterate or busy in their schedules. Electronic Medication service improves medication reconciliation accuracy and health outcomes. Adroit Pharmacy Assist reduces medication errors by notifying the patient and monitoring the patient's health by real time analysis. Medication adherence usually refers to whether patients take their medications as prescribed as well as whether they continue to take prescribed medication on scheduled time. Medication non-adherence is a growing concern to Doctors because of mounting evidence that it is prevalent and associated with adverse outcomes and higher costs of care. Non-adherence should be considered as a public health problem. Studies show that in developed countries, medical adherence is about 50%. The situation in developing countries is even worse. Steps are taken to reduce Non-Adherence problem. Several software are available which reminds the patients about their medication schedule. Costly automatic electronic timed reminders are available for medicine notification. Mobile Apps like Medisafe, Dosecast, Pillboxetc are also available for Android and iOS (iPhone Operating system) users. Many of these apps have similar functionality but slightly different user interfaces, they remind the patient during the medication schedule. The rural population lacks the access to software and hence the problem persists. Even old aged patients are sometimes not comfortable with software and they also tend to forget.

2. RELATED WORK

AUTOMATED MEDICATION KIT is made up of two major components: Doctor's Desk and Patient's kit (box). The kit notifies the patient by a buzzer when it is schedule for a medicine and the LED for respective medicine compartment

glows. The box contains multiple small compartments in which only one particular medicine will be kept in each. The box has an LCD and LEDs to interact with the user an for notifications. Analysis of heartbeat rate, temperature and blood pressure is communicated to the doctor's desk, which is terminal software, is communicated via RF module. The schedule of each medicine for the patient needs to be programmed by the Doctor on his side. It is then communicated to the patient's box and it tracks the schedule, notifies the patient, and all the patient has to do is take the medicine kept in the box indicated by a led. Apart from time of the medicine, it stores information like number of pills to be taken and for how many days the medicine is to be taken. Hence the Patient need not go to the doctor repeatedly and the need for caretaker is eliminated.

3. PORPOSED METHODOLOGY

To implement any system in a hardware form it is very important to initially build the block diagram and then proceed to design the appropriate circuit diagram.

In the initial stage of planning of our project, we decided to design two hardware desks for doctor and the patient, so that the doctor feeds the prescription through keypad which would be displayed on the LCD. Then this information with the help of CC2500 will be transmitted to patients' kit. During the planning stages of our design, we researched different ways to implement and discovered that we could either proceed by doing this through software or hardware support. So we decided to keep Doctors kit as software and the patients' kit as a hardware part.

Additionally, we took into account the short time span we had for this project, and believed it'd be more effective to focus on developing our design than getting caught up in designing the software. Terminal software was used as a doctors' desk which is used in getting the information serially.

3.1 System Level Architecture

The diagram in Figure 1 represents the patients kit. Below it, an overview of the doctor communicating with the patient is shown. The vital components used in the hardware part were the microcontroller, transformer, LM 7805, LCD, crystal oscillator, RTC, CC2500, Heart Beat sensor, temperature sensor, blood pressure sensor.

A transformer is connected in the kit so that direct power is drawn from the power supply (here the need of battery is eliminated). The transformer is a Centre-tapped step down transformer which converts 220 volt into 12 volt. Voltage regulator 7805 is connected to convert 12 volt to 5 volt. A PIC 18F25K22 microcontroller is used. A16X2 LCD is used for display. RF module CC2500 is used for serial communication. Microcontroller and RF module communicate on different serial communication pattern. Max 232 converts RF to TTL and TTL to RF. The circuit is designed on a PCB.

The kit has 3 compartments for 3 different types of medication and 1 compartment as an emergency kit. Each compartment has one LED which indicates the particular medication compartment during a particular alarm time. The person is notified by a Buzzer. An acknowledgement switch is provided so that whenever patient takes his prescribed dose, a feedback is sent to the doctor.

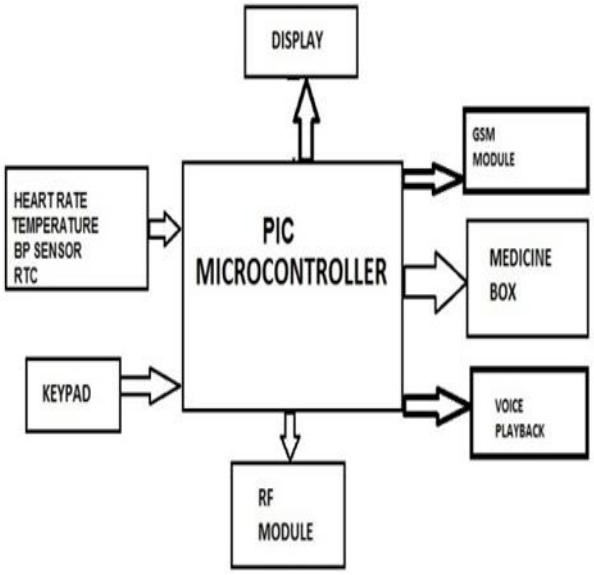

Figure 3.1-1: Block Diagram of Patients kit

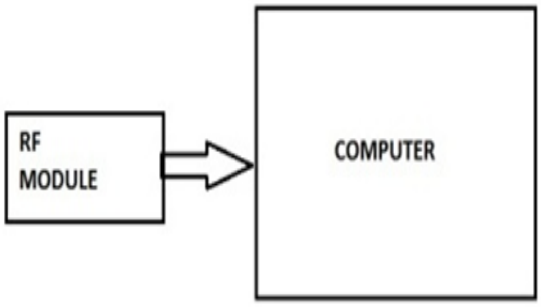

Fig.3.1-2 Doctor's desk

The architecture shows the working and it gives the overview of how the project works. Figure 3-1 shows the block diagram of patients' kit which has PIC microcontroller in its core. The microcontroller takes the input from Temperature sensor and heart beat sensor.

3.2 Logical Structure

While designing a circuit, some logical steps are to be followed. The circuit gets initiated and it checks continuously whether it is time to take the dosage or not. If yes then the LED will blink and buzzer will go on. Acknowledgement switch

must be pressed after taking the medicine. Similarly, the circuit will check for second and third dosage.

Sometimes when the patients parameter measured are abnormal, the doctor would send the command for emergency medication box. The LED on the emergency box would glow. Figure 3-3 shows the flowchart of emergency situation.

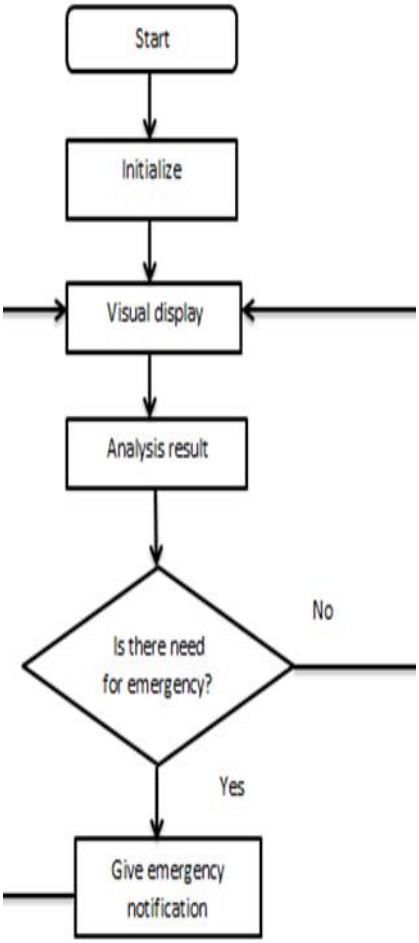

Fig 3.2-1: Flowchart for checking Emergency dose

3.3 System Description

The whole project is divided into two parts: the hardware part of the patient and the software designed for the doctor. The hardware on board has initially a power supply section which steps down the voltage to 5volts. Then this is directly given as an input to the microcontroller. Heart rate sensor, temperature sensor, blood pressure sensor are interfaced with the microcontroller. The LCD displays the prescription for the patient in form of number of doses. The LED on the respective box glows at the time of the dosage, simultaneously the buzzer turns on. The data is sent serially on doctors software.

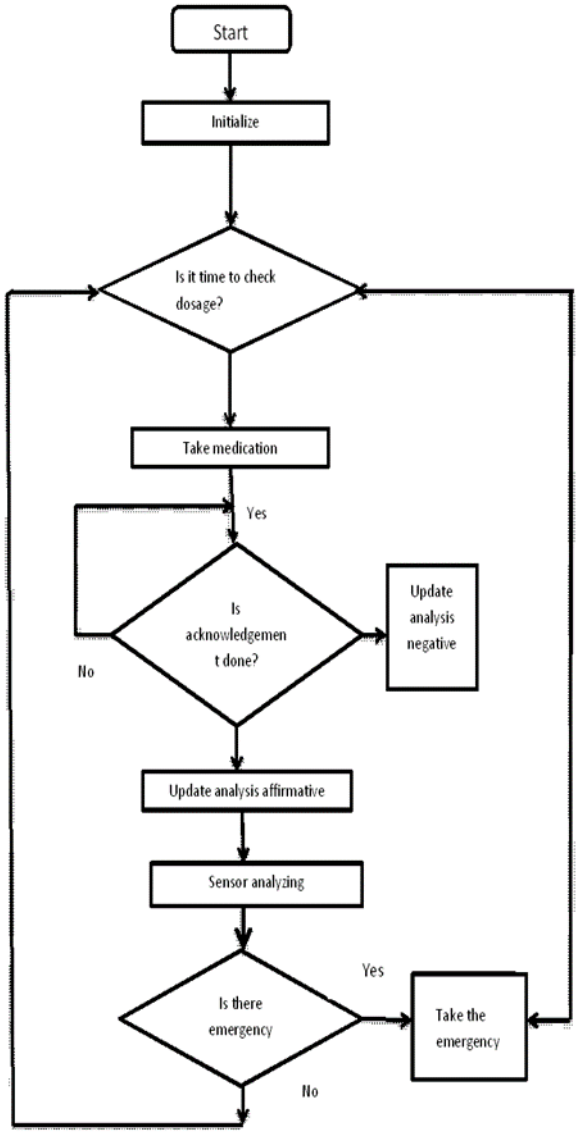

Figure 3.2-2: Flowchart for checking Prescription

4. RESULTS AND DISCUSSIONS

The kit is extremely easy to use and can easily be modified. The kit with the patient notifies by buzzer and an LED of the respective medicine compartment glows during the medicine schedule. After the patient intakes the medicine, a provision for acknowledgment by switch is also provided. The patient acknowledges by pressing an acknowledgment switch. The numbers of medicines taken are displayed on the LCD. Analysis of heartbeat rate, temperature and blood pressure is done. These records are then sent to the doctor's desk which is a terminal software. If the doctor feels need for emergency then the doctor can give the emergency command which will then consequently notify the patient for emergency medicine schedule.

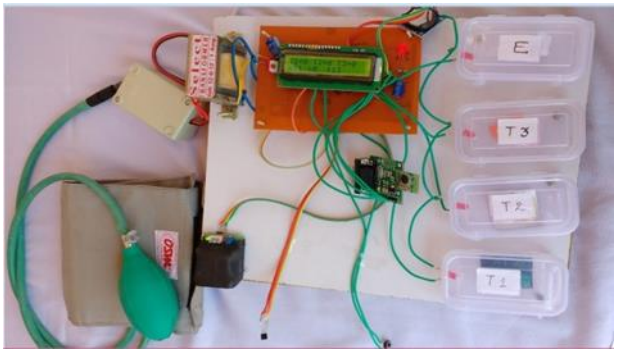

Figure 4-1: Snapshot of Patients kit

The above figure shows how the patient kit works. The medical boxes are arranged according to their dosage numbers. The box having E is the emergency kit which blinks only when the doctor directs the patient to do so.after pressing the acknowledgement switch, calculating parameters would be displayed on the LCD. At that time index finger is to be placed for calibrating heart rate. Temperature and blood pressure are also measured simultaneously.

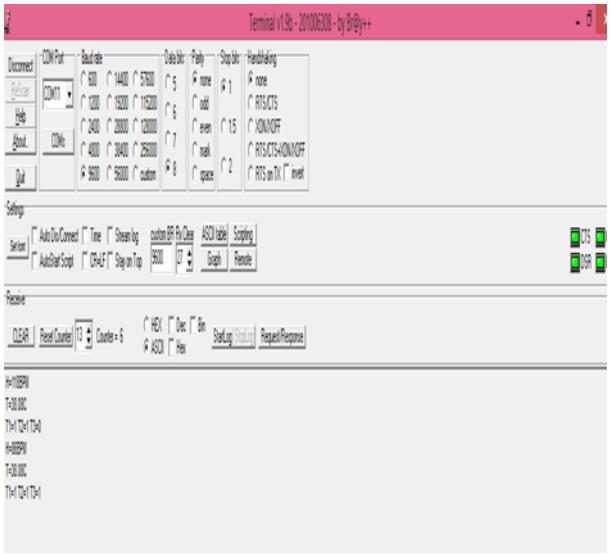

Figure 4-2: Snapshot of Doctors software

The above figure shows the software on doctors' desk. The readings on the snapshot shows that dosage no.1 is taken therefore T1=1, dose no. 2 is taken therefore T2=1 and since the third dose is not taken T3=1. In the second reading, all the three doses are taken, so all the three are communicated as1.

5. CONCLUSION

We validated the effectiveness and advantages of our proposed methodology by doing software testing. Each module of the program was verified with various test cases. The device was programmed in such a way that it uses the available memory of microcontroller18f25k22 efficiently. The prototype was well designed and tested with all possible cases. Though the project was developed for rural areas, it can be extensively used in urban regions in massive hospitals. The goal of this project was to reduce medical non adherence and decrease the dependency of patient on others for their medication. The kit notifies the patient about their medication schedule and the doctor also receives the analysis of the critical monitoring factors on his terminal. The user can easily use the kit without any prior knowledge about the medicine in detail, only he must be informed about how the kit works and what role he has to play when the time comes. The sensors are handy and user friendly.

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