A Medicine Monitoring and Dispensing System

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Abstract— In general, most of the patients forget to take prescribed medication at the required time. This causes a big problem as it affects the dosage quantum required for the patient that results in not yielding the right recovery result. It is difficult for caregiver to monitor patients round the clock. In order to avoid these problems, a medicine monitoring and dispensary system is implemented.

Medicine monitoring and dispensing system is a dispensing machine. The machine is capable of generating schedules for multiple patients, dispense drugs automatically, and have multiple techniques to remind users that it is time for their medication. By using this system, patients are now reminded regularly to take medicine. The system alerts the patient according to its prescribed medication schedule. It is designed in such a way that general patient can also afford. The system will be equipped with a microcontroller ATmega16 capable of controlling the timing and dispensing mechanism. A buzzer and LCD will be interfaced with the control section for providing different indication and using switches the system can be programmed as per requirements.

Keywords: **Medication, microcontroller, LCD, RTC and AVR**

I. INTRODUCTION

With the advancement in medical and pharmaceutical technologies, medicines can cure or control more and more fatal diseases and help people live actively for decades longer. The benefits of the medicines would be even more wondrous were it not for the high rate of preventable medication errors [1]. As we have seen that the population increases day by day and simultaneously chronic disease increases a lot. The treatment of chronic disease need long term pharmacotherapy. Although these medications reduce the effect of diseases but it is not possible for the patient to remember their prescribed medication. Medication errors occur as a result of failure in prescribing, dispensing, monitoring and administration. They lead to many hundred thousands of serious adverse drug events, thousands of deaths and billions of dollars in hospital cost each year [1].

Medication use is ubiquitous among older adults. According to surveys, 90% of older adults use one or more medications per week, 41% of older adults take five or more medications, and 12% use 10 or more medications per week. Medication-related problems are not limited to older adults. But older adults are disproportionately affected by such problems because they use so many medications. Older people in care homes are among the most vulnerable members of our society, reliant on care home staff for many of their everyday needs. A combination of complex medical conditions may lead to the need to take multiple medications with care home residents taking 7-8 medications on average. Older patients are more likely to be prescribed long-term and multiple prescriptions, which could lead to improper use of medications. This 'polypharmacy' in turn increases the risk of medication error.

There are so many factors responsible for causing medication error. Some of them are related to patients (eg. lack of health literacy, lack of involvement in the treatment), some are related to physicians (eg. prescription of complex drug schedule, communication barrier) and some factors are related to health care system(eg. lack of health information technology, limitation of health visit time).

On the other hand, family members are responsible for the care and management of the old. In the modern age it is difficult for family members to be available all the time to support the aged. Today, in our society most families are nuclear[2]. Elderly would prefer to remain independent and their desire for independence in natural, but it is a worry for their children [2]. Sometimes despite their best effort, the aged fail to remember to take their medication on time because of dementia. This can result in unnecessary disease progression, complications, lower quality of life, and even mortality.

In critical care environments such as the ICU's, SICU's and ANCU's it is impossible to keep a tab on every patient throughout the day. So, a new method is required in this field to help the doctors and the nursing staff to monitor the patients.

Therefore an in-home healthcare devices and technologies are urgently required in order to provide patients with an automatic electronic tool so that they can manage their own medicine regularly. However, there is a lack of research and applications for practical and economical in- home medication self-management systems [1].This paper presents a medicine monitoring and dispensing system which reminds the patient to take medicine on time. Medicine monitoring and dispensing system is a dispensing machine capable of generating schedules for multiple patients, dispense drugs automatically, and have multiple techniques to remind users that it is time for their medication. By using this system, patients are now reminded periodically by the machine through the technology available around them. The design of the system is divided into the hardware and software sections.

The major objective is to keep the device simple, portable and cost efficient.The software used is reliable and stable. Elderly population can benefit from this device as it avoids expensive in-home medical care.

II. Literature Survey

There are a large variety of medicines monitoring devices for non-professional users. Most of them are manual, providing multiple compartments called pill trays. The pill tray has a number of compartments that can be filled with medication. Each compartment can hold different sizes and combination of medicines. The user is required to take the medicine from each tray but it does not provide any alarm to indicate the time of taking the medicine.

Most of the commercial products are low cost, manual operating devices. The problem with the devices is that users must input medicine into these devices and then program their operation. It cannot be used by general patient.

In RMAIS system the medicine containers were placed in such a way that it opposed the reader antenna. Therefore the scale-top plane was unable to detect medicine containers. Because of the way the reader is strategically positioned, read errors do not occur when the containers are positioned on the section by the rotating spoke. However, if the patient places a medicine container on the section, it is likely that it will be placed in the restricted region [4].Earlier most of the medication dispensers were built as stand-alone models. Such devices could not communicate with the external world. In recent years communicable dispensing devices are built in tremendous way. These dispensers also transmit a patient's medication status to a monitoring server.

Finally, we have seen that electronic medication dispensers are very essential for improving medication adherence and reducing medication error. They prevent overdosing and under dosing through lockdown of the medication-dispensing tray, dispensing of medications according to the preconfigured medication schedule, and the medication time alarm. Again from patient's perspective, it should be portable so that a reminder can be sent to patients when they are not at home. So, the key point carried out from the above discussion and finally, the requirements of the proposed system is suggested here. The major requirements for proposed system are the performance, serviceability, reliability, cost and safety. The existing systems are either costly or too complicated for general patient to use. Complicated design makes the current system prone to errors due to the multifaceted input procedures.

In our days, there have been many advancement in the field of Electronics and many cutting edge technologies are being developed every day, but still 8 bit microcontrollers have its own role in the digital electronics market dominated by 16-32 & 64 bit digital devices. Although powerful microcontrollers with higher processing capabilities exist in the market, 8bit microcontrollers still hold its value because of their easy-to-understand-operation, very much high popularity, ability to simplify a digital circuit, low cost compared to features offered, addition of many new features in a single IC and interest of manufacturers and consumers.

So the proposed system should have the following characteristics.

- Cheaper than existing system.
- Easy to repair.
- Portable and lightweight.
- Simpler design along with easy user interface.
- Reduce error of medication process.

III. METHODOLOGY

A. Objective

The aim is to design a medicine monitoring system which is user friendly and cost effective. The system will have a microcontroller with various additional devices through which it can remind the patient.

B. Implementation

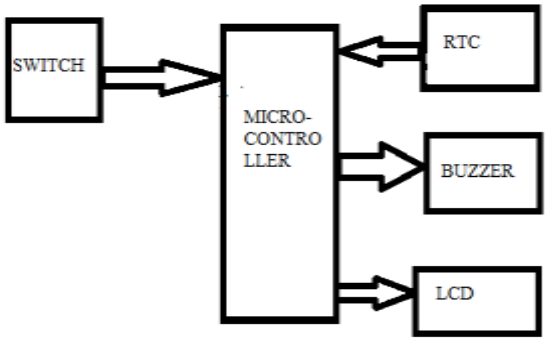

Fig1: Block diagram of proposed system

The proposed system consists of two sections –hardware and software. Hardware parts include microcontroller, keypad, switch, LCD display, RTC and buzzer. All the additional devices are interfaced with the microcontroller. A 5V power supply will be required for the microcontroller unit. The microcontroller is selected in such a way that it will meet the required functionality of the proposed system without wasting money on unneeded features. When the user presses the command key, it will enable the user to program the timing of the medication. The Microcontroller is so chosen that the system does not require any additional external peripheral chips and memory.

The buzzer will provide a sound to warn the patient regarding the time to take the medicine. The prescribed time will be set through the switches interfaced with the controller. Another switch can be interfaced with the controller in order to turn off

the alarm provided by the system. This switch can act as an indication when patient take their prescribed medication. Push button switch can be used for this purpose.

The keypad input is a standard 16 key alphanumeric keypad. Using keypad, the system can be programmed as per requirement. Through keypad the patient can enter different choices according to requirement. A 4*4 matrix keypad can be used for this purpose.

RTC is a real time clock. A real-time clock (RTC) is a computer clock (most often in the form of an integrated circuit) that keeps track of the current time. DS1307 is a low power RTC. So, DS1307 can be used for implementing this research work. The controller will first initialize the RTC and then it will continuously read the time from RTC. When the timings read from the RTC equals the timings set by switch and keypad, the system will on the buzzer and display a message on the LCD screen. The system can be further modified by connecting a medicine/pill tray so that all the prescribed medicine will be available in the system. A motor may be required for dispensing required amount of medication.

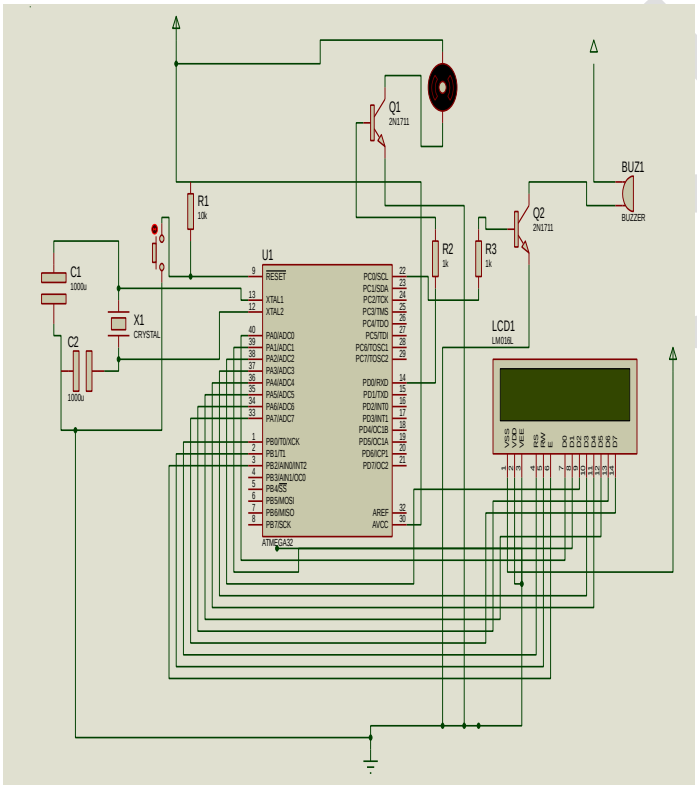

Fig 2: Circuit diagram of the proposed system

The real time information is provided by RTC DS1307 which works in I2C mode. The current date and time is stored in a variable after each reading. A 5 X 10 array of character type is declared to store time of 5 different medicines which can be increased or decreased according to user requirements. When the menu button is pressed it activates a menu of 7 different options such as Add Medicine1, Add medicine2, Add medicine3, Add medicine4, Add medicine 5,Set time and Quit. The switch connected to PD2 and PD3 are used for scrolling through the menu options.

If the Set time option is selected, the microcontroller read the current time from RTC and displayed on LCD. The program is written in such a way that when PD2 or PD3 is pressed, it will increase or decrease the value of hours, minutes and seconds. When menu button is pressed it will move to minute setting, second setting and eventually AM-PM settings. We can change hour, minute and second as well as AM-PM. After completing the setting it will come back to menu. When OK switch is pressed the microcontroller write back the time into RTC.

To set the alarm time for a particular medicine same procedure is applied but instead of writing into RTC it will store the individual settings in the alarm array. The Quit option will move back to normal operation of the system. During the execution of the program, every time it read the current time from RTC and display on LCD. At the same time it will compare the current time with each and every entry stored in alarm array. An inbuilt function strcmp() is used to compare the current time with alarm time available under string.h. When alarm time match with current time the microcontroller run the motor driven by setting bit value at PC2 and PC3.Initially ,the motor rotates in clockwise direction until it press limit switch1.The limit switch1 is used in such a way that the tray will open up to a specific limit only.

During the activation of the motor, the controller activates the buzzer. When the switch (connected to PD6) goes low, the controller turn off the buzzer and rotates the motor anticlockwise. Then the second limit switch (connected to PC4) control the closing of the tray at a specific limit. Again the second entry will be picked up by the program and display alarm time. Thus the process continues until all the entry pick up by the program.

The momentary switch connected to PD6 is responsible for manually opening and closing tray. Using the switch we can load medicine into the box.

IV. RESULT

Fig 3.Internal view of the box

The above Fig displays the internal view of the medicine box in which two limit switches are used in order to limit the movement of tray.

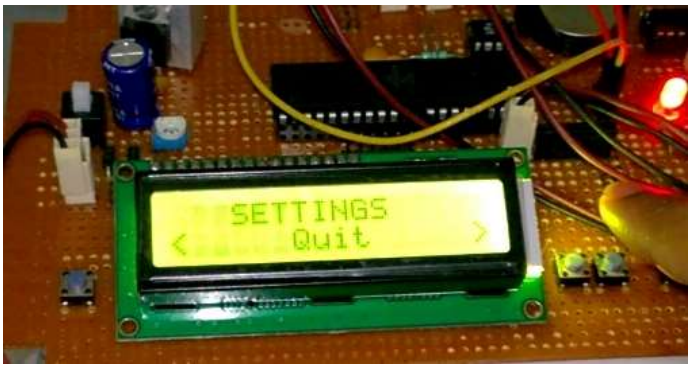

Fig 4.Message displayed in the LCD

In the above Fig. one menu option i.e Quit is displayed. In this way all the menu options are displayed on LCD.

Fig 5: Time settings using the keys

After selecting the menu for any medicine we need to set the alarm time for the particular medicine. The alarm time is displayed on LCD in this way as shown in fig3. Here a pointer "==" is drawn in the second line. With the help of it we can select the alarm time. When "OK" is pressed then the particular alarm time is set.

Fig 6: Display the opening of the box

In this way the medicine tray is opened when a particular alarm time match with current time of RTC.

V. Conclusion

. When required to take medicine on a daily or hourly schedule, many people have a problem in recalling the time when the medicine was last taken. Similarly, many patients are unable to remember or determine the previous dosage of medication taken or whether it has been taken at all. This entire problem will be solved by the proposed system. This research work will be mainly focused on developing a simple, cost effective and portable system so that it can be affordable by anyone. Also the patient will benefit from the system as real time information is provided.

The system can be further modified using wireless technology. If wireless technology is used the system can send messages or email to inform family members. A GSM based wireless devices will be required for that purpose. Therefore if the patients do not take their medicine at prescribed time, the system directly alert their family members by sending message.

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