Smart pill Dispenser using Internet of Things

Kartik Arora,
Electronics and Communication Engineering (UG),
Vellore Institute of Technology
Vellore-632014, Tamil Nadu, India

Ujjwal Singh
Electronics and Communication Engineering (UG),
Maharaja Surajmal Institute of Technology,
GGSIPU, New Delhi-110058, India

Abstract - **Medical industry is progressing and it needs technology to support its pace. Our fast paced and hectic life calls for the need of automatic and smart technology, moving on we need to make sure all our prescriptions are in order and medicines are taken on the right time and in the right quantity. Pill dispensers are in need of desperate upgrade as their manual technology is obsolete, rather than just dispensing a pill we implement a pill dispenser that not only provides you the medicine but also keeps a record of your medicine cycle and the amount it dispenses each time. The paper implements a medicine dispenser that employees the use of an ultrasonic sensor which on activation for a certain amount of time as per the requirement, it senses a hand in its range will dispense a medical pill. The medical pill to be dispensed and the amount of time for which the ultrasonic sensor remains active is controlled by the Arduino Uno Microcontroller which simultaneously sends an alert to the person in need of the pill via a GSM module on the respective SIM card.**

Keywords— Medicine, I2C, Internet of things, Wireless communications, Embedded system, smart device

I. INTRODUCTION

Landmark study on medical errors states that medication errors and adverse drug reactions are the most basic and frequently occurring errors. These errors are responsible for the increased chances of patient fatality and if not turning fatal these errors result in expanding the financial costs of the entire treatment as now the treatment requires to reverse the harm done by these errors and then pay heed to the central issue. Although in the recent few years we have seen electronic dispensers capturing the market and reducing the ME and ADR [1], [2]. Medication errors are known to occur throughout the medication use process of ordering, transcription, dispensing, and administration, with prescription errors introduced during ordering account for more than 50% of all errors. Administrative errors account for about 30-40% of all the errors that can be prevented. Our GSM based Ultrasonic dispenser is designed to eliminate two common causes of administration error: misunderstanding of medication directions and inconvenience of rigid medication schedules. Being almost fully automatic, the dispenser schedules individual doses of the user's medications and also alerts the patient when a particular medication is about to run out of stock. The smart dispenser also makes sure that the toddlers around the dispenser are not able to access the dispenser which is a basic advantage of this implementation as it prevents

hazardous effects that may occur if the medication goes in the wrong hands of toddlers.
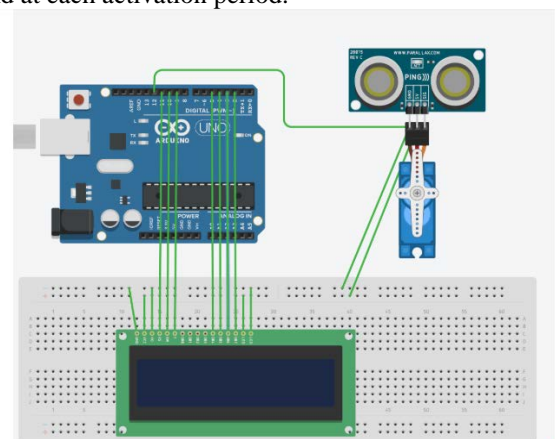
II. ARCHITECTURE

In general, drivers of hardware components provide the dispenser controller with two kinds of facilities: hardware control and event notification. The former consists of commands which the controller can call to request services. The latter is the primary means of communication from hardware to controller.

The controller commands the alert module as well as the dispenser in order to make the system functional.

The prototype uses a microcontroller which activates the GSM module to notify the user for the medication based on a pre- decided time. Simultaneously it activates the pill dispenser for short period of time to dispense a pill. The dispenser to avoid any sort of misinterpretation is mounted on a height of 66 inches from the ground.

Pill Dispenser the dispenser involves the use of an ultrasonic sensor depending on which the dispenser dispenses pills to the patient. The sensor is active for a certain period of time after the alert message has been sent to the user. This allows to prevent dispensing the pill to the wrong person as the patient will be time bound to take his/her medicine. Further the dispenser also makes sure that no toddler or a physical device present in the room is able to deceive the sensor for Bing a hand, this is made possible by situating the dispenser at a formidable height from the ground and controlling the range of the sensor.

The dispenser keeps a track of the amount of pills left in stock and displays it on an LCD. This is governed by initially setting the number of pills placed in the dispenser and at each activation period.

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Alert Module the alert module is a combination of a GSM sim900 module which has a sim card mounted. This enables us to alert the patient via text SMS.

The GSM supports quad bands and works on a frequency of 850/900/1800/1900MHz. The module can be used to access the internet and for oral communication as well with the help of a speaker and microphone. For the implementation we use the module just to transmit SMS messages to the user.

Erfinder GSM Module
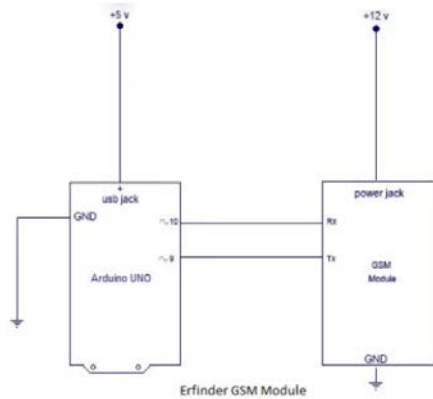
III. HARDWARE CONCEPT

Power supply

A power supply provides electric power to an electric board. It regulates the current from the source to an appropriate voltage, current and frequency to power the load. The ideal input voltage to power an Arduino is 7V - 12V with an ideal output current of 200 mA. Generally a DC adapter with output voltage of 9V-12V, output current of 250 mA along a 2.1mm plug of centre positive pin.

Alternatively Arduino can be powered through a USB with the help of a laptop that draws limited current of 500 MA through the USB port at 5V.

LCD Display

The 16x2 display used is a basic display device that find various applications over the 7 segment display. It can display 16 characters over 2 lines and each character is displayed in 5x7 pixel matrix. The module works with 2 basic registers command and data.

The command registers performs functions like initializing it, clearing the screen, setting cursor position, controlling the display etc. The data is the ASCII value of the character displayed on the screen.

This project finds application to display the user's remaining number of medicines, "Medicine time" or "Reload Medicine" message. The display is activated once the system is powered with the initial commands and the data is displayed as per the data fed by the user. The data displayed is updated at the medicine time and every time the servo rotates.

GSM 900 Module

A GSM module works on various frequencies. GSM 900 works with a quad-band frequency of 900MHz. It can not only be used to access the internet but also for oral communication. The module is managed by AMR926EJ-S processor which controls phone and data communication

through TCP/IP and the communication with the circuit interfaced with the module itself through UART.

It also consists of an integrated analog interface, A/D converter, RTC, SPI bus, I2C protocol and PWM module. The radio section is compatible with class 4 i.e. the 900MHz band.

Here it finds application to send a message, "Message time", to the user at the medicine time updated to the system by the user.

Microcontroller

Amongst the various microcontroller available in the market to control a device, Arduino is and open source hardware and software company that provides microcontroller which can sense and control objects or components in real world.

It consists of Atmel 8 bit microcontroller with different availability of flash RAM.

Arduino board is programmed through a software, integrated development environment (IDE) which is written in JAVA and the code to program an Arduino board called the SKETCH for user's purpose is written in C#.

The open source nature allows the publication of various free software libraries.

Here the Arduino is used to control the functioning of GSM 900, Servo, LCD display, RTC module and the ultrasonic sensor.
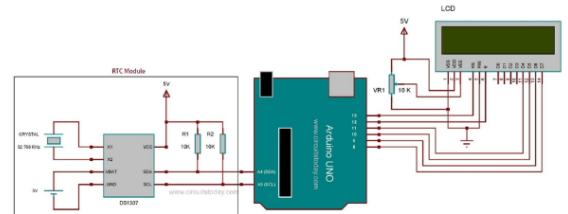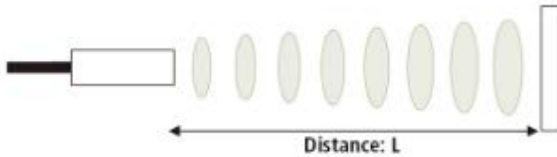

Servo

A servo is a device that aids in rotary motion with precise angle, acceleration and velocity through a motor coupled to a sensor with feedback.

The angle that the shaft of the servo moves to can be controlled through Arduino in terms of degree it rotates to.

In this area servo finds application to rotate the medicine box with a hole at the top to dispense the medicines stored in the box by rotating at different angle varying with the medicine to be dispensed.

Ultrasonic Sensor

An ultrasonic sensor is used to measure the distance between an object through ultrasonic waves. The sensor emits ultrasonic waves and receives the reflected waves from the object. The distance between the object is measured through the time taken to receive the waves after emission.

Distance L = 1/2 × T × C

C=sonic speed
t=time
L=distance

Here ultrasonic sensor senses the presence of hand which when detected activates the servo to dispense medicine.

RTC Module

An RTC module is a real time clock. It is based on DS1307 i.e. it is lower power consumer, full binary-coded decimal (BCD) clock with 56B of NV RAM it follows I2C and bidirectional bus protocol for transmission of address and data. The clock/calendar is automatically adjusted for a month less than 31 days but need to be reset for months with 31 days. It works in 12 or 24hr format in AM/PM format. The DS1307 has a built-in power-sense circuit that detects power failures and automatically switches to the backup supply.

The basic idea to use RTC module in this application is to sync the system to real time to send message to user at exact time when his medicine is due.

IV. RELATED WORKS

There are a large variety of medication administration assistance devices for users. Most stand-alone devices (e.g., [3]–[5]) available today are manual, the user has to load the device with the prescribed medication and reset the system after each use, this is a major improvement in our pill dispenser.

Like schedules used by our dispenser, medication schedules used by automatic devices and scheduling tools such as MEDICATE Tele-assistance System [6], [7] and Magic Medicine Cabinet [8] can be adjusted to compensate for user tardiness and condition changes. Our dispenser is a stand-alone tool, and is capable of adjusting the schedule as per the requirements of the patient or a change in prescriptions. The dispenser is designed for individuals who do not need constant monitoring and supervision but instead need a device to track their pill cycle during the course of the day. The device is a supplement for all the reminders on paper or our mobile phones that constantly nag the user with notifications, not just the notifications the user is now free from keeping a track of all his pill refill, instead the device keeps a track for the user and reminds him when refill is required.

V. A USE SCENARIO

The user when dealing with the dispenser has the tools to adjust the dispenser's schedule according to their requirements or their prescriptions. The user programs his prescription details in the microcontroller i.e. specifying the number of pills to be used, the timings of the day when the dispenser is supposed to alert the user regarding his medication. On entering the essential details the user is free

to handle his/her daily chores and need not be bothered about his medication routine or the dosage requirements. The dispenser will be activated at regular intervals and the medicines will be dispensed depending on the presence of the user. The dispenser is designed for individuals who do not need constant monitoring and supervision but instead need a device to track their pill cycle during the course of the day. The device is a supplement for all the reminders on paper or our mobile phones that constantly nag the user with notifications, not just the notifications the user is now free from keeping a track of all his pill refill, instead the device keeps a track for the user and reminds him when refill is required.
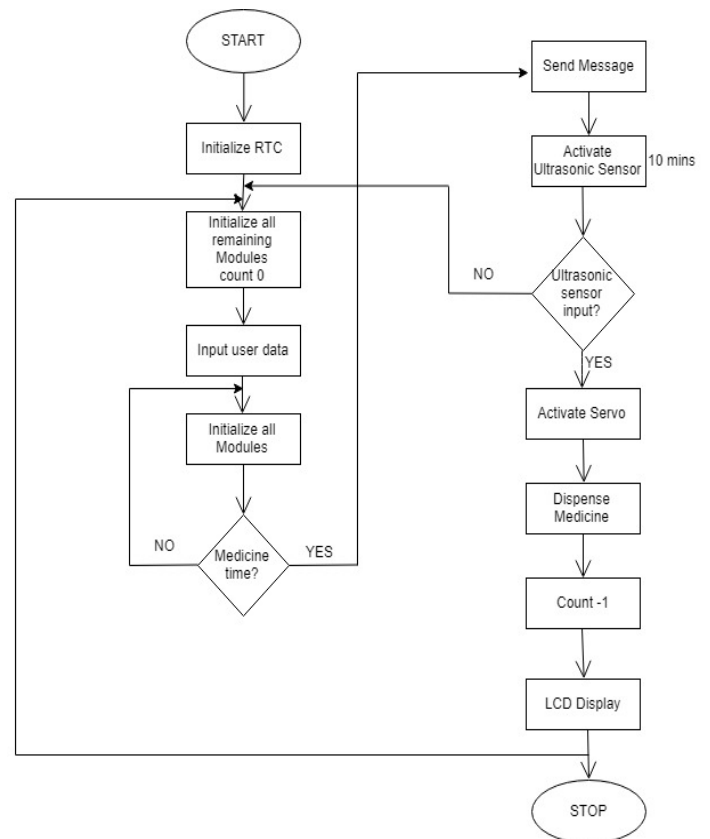
VI. CONCLUSION

The pill dispenser provides a means of regular medication at predefined time intervals. The dispenser makes sure that the user is alerted every time he/she needs to take a dose, this

way the user need not worry about setting reminders for his daily medicine schedule.

The dispensing mechanism is designed to make sure that no stray objects can cause the pill to leave the dispenser thus making the system less vulnerable. More over the automated system makes sure that the right amount of dosage is being consumed by the user and this rules out the possibility of over and under dosage.

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