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Smart Medical Box

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Abstract - *Many of the people around us have health issues such as Diabetes, Blood Pressure, Thyroid and much more health issue. So, in such a busy life, they forget to take medicine on time. The proposed model of the smart medical box is a single board microcontroller based assistive device for people. The use of Bluetooth device to have communication with an application on mobile phone. The application on phone at the time of medication starts the alarm, and send the message to the medical box, then box rotates and comes with the medicine at the opening position and there is a sensor on the box which on putting a hand on it, the door will open for medicine. This paper presents an overview of an assistive device for monitoring non-compliance of medication by providing a single platform. This work gives insight into mechanical design, system architecture and design of android application and security. This device helps in maintaining medication to the patients and helps to increase the life expectancy.*

Key Words: **Medical Box, Bluetooth Communication, Microcontroller, Arduino IDE, Servo Motor.**

1. INTRODUCTION

Bluetooth Technology is regarded to be as the big thing in technology. In the current scenario, and physical things have potential to communicate with each other using Bluetooth technology. There has been a lot of demand for Bluetooth Technology in the field of Fitness and health industries. The development of technology in fitness and healthcare industries is increasing day-by-day at the same time many new diseases are being found to be spreading.

In most of the health issue and disease, medicine plays an important role to recover. Sometime they won't take medicine on time, recover from disease took more time. They might my taking Extra dosage thinking they didn't take medicine. It is too dangerous to health. This may lead to another medical condition, which is not desirable.

A clock based medical box to remind the patient about the course of medication was developed. A user interface was developed for the patient as well as the doctor to monitor the dosage of the medicine taken by the patient. An additional user interface for doctor and pharmaceutical store was made to order medical supplies on behalf of the patient to get the medicines delivered at the patient's doorstep. The quantity of medicine is constantly updated in the database on every dosage.

Currently, the monitoring of patients is hospital-centered which is tedious and disturbs their daily schedule. Hence, a home-centered monitoring solution is proposed. In this system, the patient can send the status of his health condition with the help of bio-sensors like an electrocardiogram (ECG), blood pressure (BP), body temperature through a wireless communication network. .

This data is sent to the higher-level system using end-to-end encryption and stored in a database, where it is analyzed and stored securely.

2. THE MODEL

The entire system requires good coordination between the hardware and the software.

2.1 SYSTEM ARCHITECTURE

The total system architecture depends on Single Board microcontroller, Arduino Nano in this project. There is one sensor which gives the input to the microcontroller. Data transfer through Bluetooth. Two Servo motor is used of 9g torque. One Servo motor is connected to the rotating box, another servo motor is connected to the opening panel. Rotating box have 6 trays in which different medicine is kept. At the time of medication, the mobile phone application sends the data to the medicine box and according to that data, medication box will rotate.

At the time of morning Medication alarm on phone will be set and data will be sent to the medicine box and morning tray opens for medication. In the same way, Medication will be done for afternoon and night.

The information is stored in the mobile phone application, in such a way that user can access the data of medication. The user is able to set the timing of the medication. The user will able to share information regarding medication to doctor. The loss of data will be less and secure.

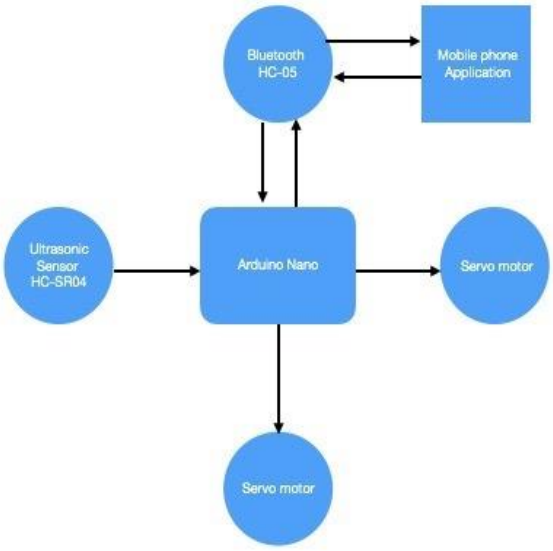

Fig -1: Block Diagram of the system

2.2 MECHANICAL DESIGN

The Medical box consists of 6 different trays of a circular box, for different duration of medication. The single circular 6 tray box is connected to a Servo motor. The servo motor shaft is connected at the center of the 6-tray circular box. There is a hollow Circular box comparative bigger than 6 trays circular box. The 6-tray circular box is placed in a hollow circular box. The Cover of the hollow circular box had compartment shape panel which is connected to another servo motor for the opening of the panel. The 6-tray circular box having a servo, servo bottom part is connected to the hollow circular box cover.

2.3 DATA PROCESSING

The data which transfer between Medical box and mobile phone application is an end to end connected and secure. The Bluetooth module has more channel; hence it is impossible to jam the network and data will be secure. The input given through a sensor about medication is sent to the microcontroller and through Bluetooth, the data is being sent to mobile application and data will be stored on the application. Hence, it is easy for user and doctor to have data of medication on the phone, which will help them to predict about diseases.

3. SENSORS AND ACTUATORS

The medical box integrates various sensor and actuator. The Sensor is used for keeping track of the medication and actuator is used for the movement of the medical box. The sensor used in the case is an ultrasonic sensor and IR proximity sensor. The actuator used in this case is servo motor.

3.1 ULTRASONIC SENSOR (HC – SR04)

The Sensor used to calculate the distance. So, we use the sensor for the opening of the panel, of the medical box by putting a hand over the Sensor. The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in the air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module. To calculate distance, we can use the formula:

Distance = Speed * time

The ultrasonic sensor calculates the distance using the speed of sound. When the sound is propagating in air, the speed of ultrasonic sound is 344 m/s at room temperature. The time is calculated, when a wave hits the object and comes back to the sensor, this time is used for calculation of distance. The features of the ultrasonic sensor are:

1)Operating Voltage: +5

2)Theoretical Measuring distance: 2cm to 450cm

3)Accuracy: 3mm

4)Measuring angle covered: <15deg

5)Operating current: <15mA

6)Operating Frequency: 40Hz

Fig -2: Ultrasonic Sensor (HC-SR04)

The distance of ultrasonic sensor can be in cm, inches and mm. The 4-pin (HC-SR04) module, whose pin names are VCC (5V), Trigger, Echo, and Ground respectively. HC-SR04 distance sensor is commonly used with both microcontroller and microprocessor platform like Arduino, ARM, PIC, Raspberry Pi etc.

The VCC pin is powered by the onboard 5V pins, the current consumed by the sensor is less than 15mA and it can be directly powered by a microcontroller. GND pin of the module is connected with GND of the microcontroller. The Trigger and Echo pin are both I/O Pin of the microcontroller. The trigger pin has to be made high for 10uS and then turned off. This action will trigger an ultrasonic wave at a frequency of 40Hz from the transmitter and the receiver will wait for the wave to return. Once the wave is returned after it getting

reflected by any object the Echo pin goes high for a particular amount of time which will be equal to the time taken for the wave to return back to the sensor.

3.2 SERVO MOTOR

The Servo motor is a linear actuator that allows for precise control of angular or linear position, velocity, and acceleration. The Servo motor is used to control the 6 tray Circular box, and to control the panel for an opening during medication. The Servo motor which is been used to control the 6-tray circular box, some modification is done. Modification of Servo motor for continuous rotation. The Servo motor for the panel is movable between 0 to 180 degrees.

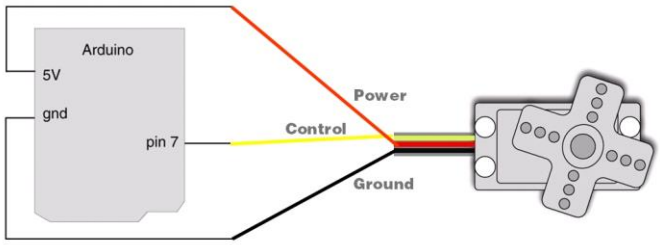

Fig -3: Servo Motor

A servomotor is a closed-loop servomechanism that uses position feedback to control its motion and final position. There are 3 pins of Servo motor namely VCC, GND, and Control pin. The power required for Servo motor SG90 is 5V VCC on board, the current consumed by the motor is 550 mA. The GND pin of the Servo motor is connected with GND of the microcontroller. The Control pin is connected to the I/O pin of the microcontroller. The control pin of the Servo motor is used for controlling the angle of the motor.

4. DATA HANDLING AND STORAGE

The data produced by the Arduino Nano microcontroller is transferred to the application through the Bluetooth. All the data is stored in the application. The table of dosage is made and updated accordingly. Data is stored on the mobile phone.

Fig -4: Block Diagram of Phone and Medical Box Interface

5. USER INTERFACE

The project total depends on the application of user interface, how much the end user is satisfied with the result. The novelty of the project depends on the user-patient and the doctor. The alarm setting is user-friendly, and access to the data is also user-friendly. Hence data is easily read, write and deleted using the button.

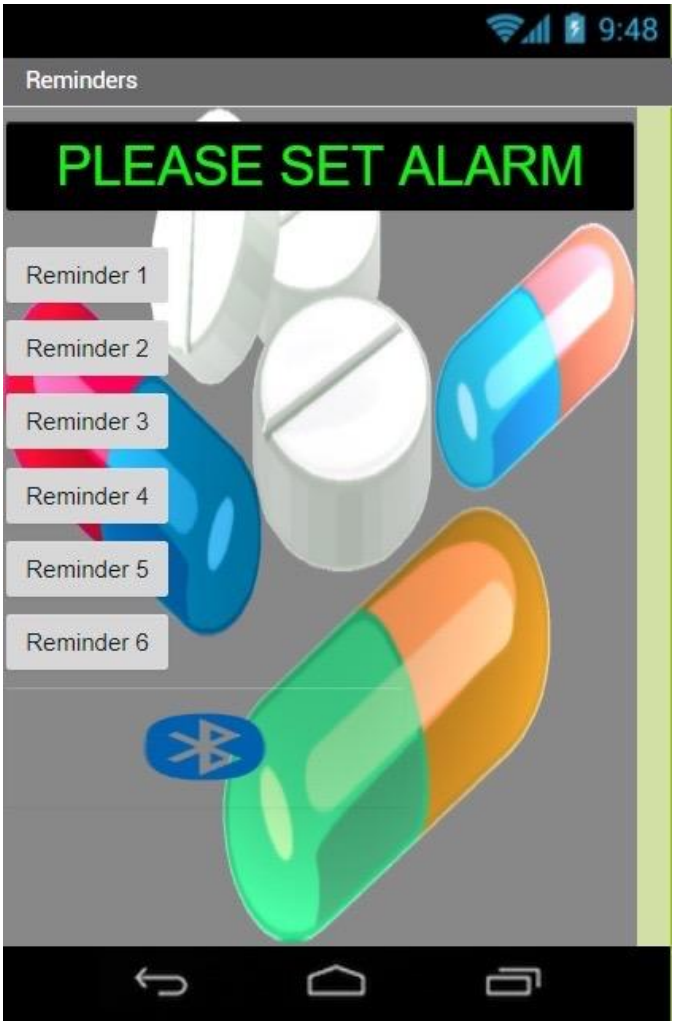

Fig -5: User Interface

The Login Page is used for security of the user. Whenever a user has to login using his login ID and password to set the remainder of the medication, he first navigates to the logs into his account and then he can access his app. The alarm page can be replaced with Google firebase and use Google's more secure API for login Integration with the app. The effort is also being made to integrate the existing login screen with a Single Sign-On (SSO) option for users to sign in on one go by using Google, Facebook or Twitter API's. The app itself is currently built using MIT App Inventor. If the login credentials are incorrect then the user will not be allowed to log in and will have to register first or enter the correct user credentials in order to use the app.

Fig -6: Login Page

Once the user has successfully logged in to the app he can now set the alarm. The next page he will be met will be to set an alarm. This stage is very easy and is homogeneous to setting an alarm or time on your android device. This was done deliberately to make sure that the Interface is not confusing to the new user and it can be easily navigated for every user. The alarm page gives an option for setting up to 6 alarms based on the number of medications the user needs throughout the day. There is a Bluetooth icon using which the user will be redirected for syncing and connecting the medical box with the application. The interface has been primarily designed to be very user-friendly. Alarm setting is easy, how we set our phone alarm in the same way we can set the alarm for medication.

After the user has successfully set up the alarm he will then be greeted with another screen which will show an alarm set confirmation box. This will be used so as to provide a feedback to the user that the app has successfully set up the alarm. The user can set up to 6 unique alarms the alarm music will depend on the default ringtone on the phone set by the user.

Fig -7: Alarm Page

After the alarm, the period has reached the desired time when the user needs to be reminded about the medicines users data will be displayed on the screen which includes a greeting message Hi followed by the user's name, his current age which is collected during the registration process and 3 messages to the user. The 3 messages which will be displayed are-

Total Medicine available:
Total Medicine consumed:
Intake of medicines missed:
All of these fields will help the user analyze their daily quota of medicine intake and if they have missed anything throughout the day. The first message will count and tell how many medicines the user has available or is yet to consume throughout the day. The second field tells about the number of medicines consumed by the user for the entire day and the third field will tell the user if he has missed any medicines throughout the day and if yes then how many will help keep the user on track with his medicines.

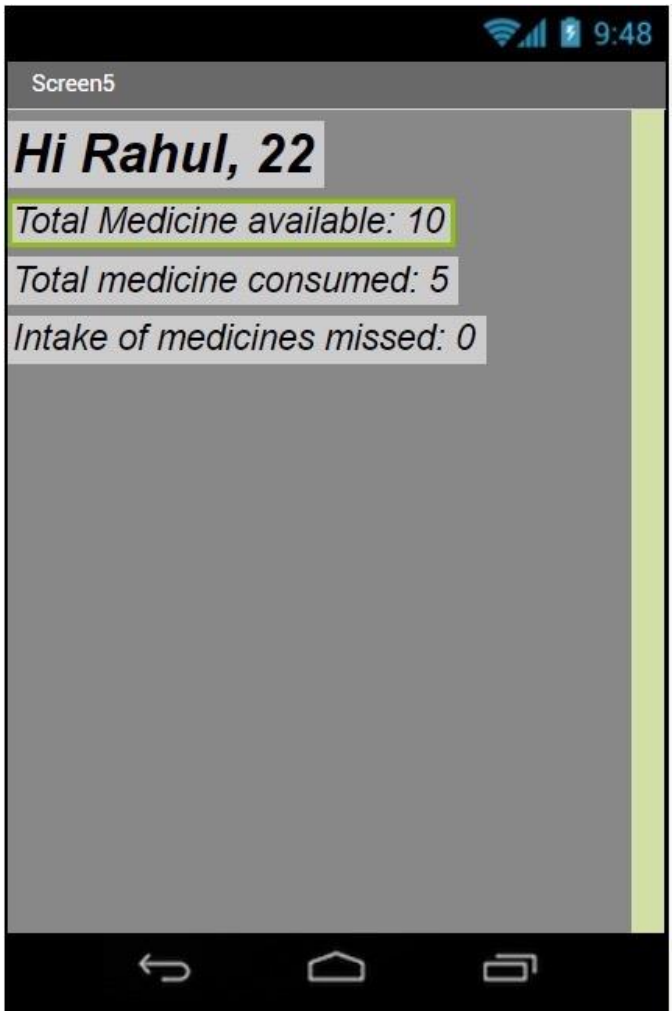

Fig -8: Data Page

6. CONCLUSIONS

The project gives the assistive device for the people around us and helps them to follow medication on time. It avoids extra dosage and gives them a good healthy experience. The system is easy to use and accessible to individuals irrespective of their age. The system helps people stop procrastinating and take their meds on time which is crucial in healing the human body.

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