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Design of Smart Medicine Reminder (SMR) Box with an Android application

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ABSTRACT: This project presents a Smart Medicine Reminder (SMR) prototype. The main purpose of this system is to help the patients, primarily seniors, take their medications on time in an easy way without the possibility of missing pills, also reduce the risk of over or under dosing accidentally. Not taking medications correctly can have serious consequences such as delayed recovery, illness and even death. The Smart Medicine Reminder (SMR) could solve such problems by informing and alerting the patients to take the appropriate dose at the right time. Also, it provides direct communication between the patients and the caregivers as it will immediately notify the caregiver in case the patient missed his/her pill. In addition, SMR provides the user with a touch interface available as an application on their smartphone which will allow them to remotely manage and control pill schedules and usage data.

KEYWORDS: Arduino, Arduino IDE, ESP8266, proximity sensor, Android studio, Wamp, Firebase Cloud Messaging, Host-gator server.

I. INTRODUCTION

Medication adherence is a growing concern throughout the healthcare industry with doctors, healthcare systems, and other stakeholders (insurance companies) since the elderly or senior patients' medication has a big issue of drugs misuse. It is very likely for them to forget to take their pills on time. Especially, those who take multiple medications at the same time. Also, they might take wrong dosage accidentally which may lead to unfortunate consequences such as death. This is a clear proof that it is a widespread problem and clearly related to adverse patient outcomes and higher healthcare costs. Many medical errors are due to the fact that people in charge of patient or elder's medication have to deal with sorting huge amounts of pills each day. This paper consists on the conception, design and creation of a pillbox prototype intended to solve this deficiency in the medical area as it has the ability of sorting out the pills by itself as well as many other advanced features, with this device being intended to be used by hospitals or retirement homes. This medication pill box is focused on patients who frequently take medications or vitamin supplements, or attendants who deal with the more seasoned or patients. Our Medicine box is programmable that enables medical caretakers or clients to remind to take pills, and the service times for every day. Our shrewd pills box contains six separate sub-boxes. In this manner, medical caretakers or clients can set data for six distinct pills. At the point when the pill time has been set, the pillbox will remind clients or patients to take pills utilizing sound, light and vibration. The warning of pills should be taken will be shown by an android application which is held by the patient. Contrasted and the conventional pill box that requires clients or attendants to stack the crate each day or consistently. Our shrewd pill box would essentially discharge medical attendants or clients' weight on much of the time preloading pills for patients or clients and overlook the measurements which must be taken.

In addition, a study has been done by group of professors at University of Washington about medication adherence in three home healthcare agencies on one hundred forty-seven older participants taking three or more medications, which resulted in 30.6% participants were under adherent and 18.4% participants were over adherent with at least one medication. The main purpose of SMR system is to help the patients, primarily seniors, take their medications on time in an easy way without the possibility of missing pills. It can also reduce the risk of over or under dosing accidentally. The smart medicine reminder (SMR) could solve such problems by informing and alerting the patients to take the appropriate dose at the right time.

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II. EXISTING SYSTEM

To state a few: -

- An electronic pill dispenser realized using pic microcontroller with keyboard and an LCD that lets the user schedule his/her pills manually on a plate. It dispenses the pills and generates an audio alarm to alert the patient. Also, an SMS is sent to the caregiver phone number in case the pill wasn't taken.
- A pill dispenser was created using a combination of infrared sensors and Arduino microcontroller with alarm system to help the patients take their pills at the correct time. The alarm system was implemented using a popup notification on smartphone.
- Another pill dispenser that is created using Arduino microcontroller that dispenses only one pill at a time to prevent overdose. Then it notifies the user via SMS that the pill is ready to be taken. Also, it was connected to an android application that is used by the caretaker to edit the dates and times of the pills to be dispensed.

III. PROPOSED SYSTEM

The proposed SMR system takes the idea of automated dispenser to the next level as it has some functionalities that are not included in any other automated dispensers. An account is provided for each patient and no one else can access it except the patient and the caregiver if the credentials were provided to him/her. Also, some statistics are provided about the pills taken with their alarms and the already existing ones. Online database of the users, pills and their alarms are also a great feature that helped in the design of the project. The pills can be edited and created using an android application remotely through smartphones**.**

Fg.1: Basic design of the SMR prototype

IV. MOTIVATION

There can be a lot of individuals out there who need constant help may it be our elderly people, family members, the ones who have special needs. Elders are more affected by the timing of taking a certain drug than others, in order to prevent any dysfunction or illness timing is a must. But as with aging comes poor eye sight and poor memory, what if the patient has a dementia like Alzheimer. Some people may forget to take the medicines at the correct time and can forget the medicines which they have to take. In order to eliminate the factors of always needed observation like nurses or taking a risk of a missed dose, we had to find an easy, portable and efficient solution. Pill boxes already exist but most of them are either has limited use, doesn't fit for elder ages or even has a big size that makes it not suitable to take it with you anywhere. In order to make a really useful smart pillbox it had to be easily integrated with the recent sweeping smart technologies. While at the same time it had be fit for the elders and their limited knowledge and experience to implement the ease of use. Size and portability were also an important fact that we had to keep in mind.

• To come up with an Innovative idea that can be helpful for society.
• Medicines help us to cure the diseases.
• There are ample reasons for not taking medicines some listed in graph.
• Main Reason for not taking medicine is that they forget.
• Some of the few other reasons are shown in the graph

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V. PROBLEM STATEMENT

There can be a lot of individuals who need constant help such as elderly people, family members are affected by the timing of talking a certain drug, in order to prevent any dysfunction or illness timing is must.
As pills have taken such an important role in everyday life there has been the past years an increase in the number of medical neglect cases related to incorrect medication given to patients, such as the case of the nurse who gave a patient a paralytic instead of an antacid that was prescribed by the doctor, causing the patient's death . After seeing so many of these cases it is evidently crucial that the correct pill is taken by the correct person at the correct time, otherwise taking an incorrect one or not taking one at all may expose the patient to several dangerous situations, ranging from mild health issues up to death.

VI. FLOWCHART

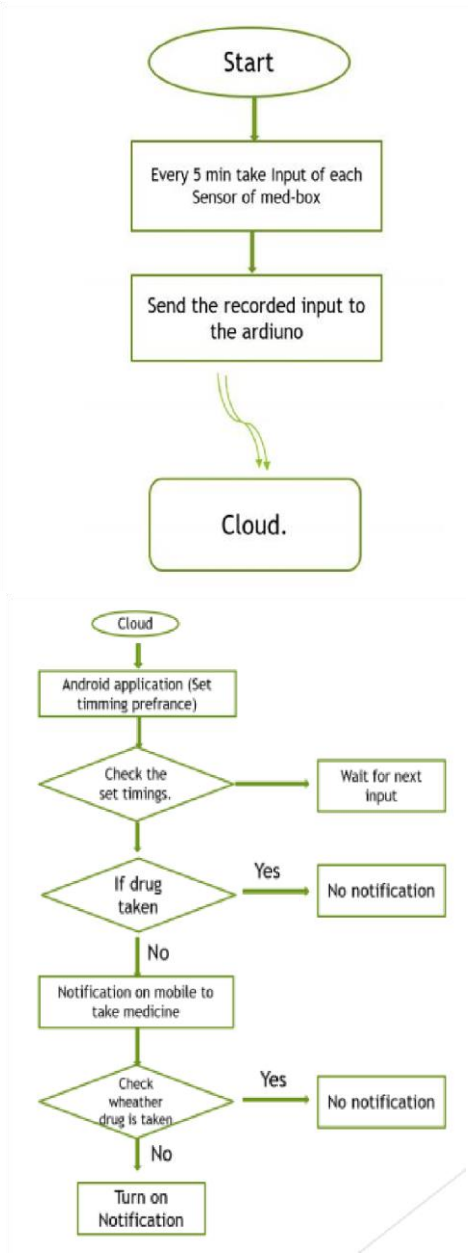

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Fig.2: Flow of Hardware part

Fig.3: Flow of Software part

VII. PROJECT REQUIREMENTS & SPECIFICATIONS

1 HARDWARE COMPONENTS

1.1. Arduino

- The Arduino Uno is an open-source microcontroller board.
- Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor.
- Arduino can read both analog and digital signal.
- Arduino in our project is used as a controller to process the data received from the sensor and sync it to the esp8266 to send data to the cloud server.
- The user writes the Arduino code in the IDE, then uploads it to the microcontroller which executes the code, interacting with inputs and gives outputs.

1.2. ESP8266 to connect to server:

- In our project esp8266 works as a node of connection between Arduino and cloud server.
- The ESP8266 can be controlled from your local Wi-Fi network or from the internet (after port forwarding). The module can be programmed using an Arduino/USB-to-TTL converter through the serial pins (RX-TX).
- In place of SSID, type the name of your Wi-Fi Network and in place of PASSWORD, type the network password. Within few seconds, we will get a confirmation response as WIFI Connected.
- Esp8266 is mounted on Arduino.

1.3. Infrared Sensor:

- IR sensors are highly susceptible to ambient light and the IR sensor on this sensor is suitably covered to reduce effect of ambient light on the sensor. The on-board potentiometer should be used to calibrate the sensor.
- An infrared light emitting diode (IR LED) emits light of Infrared range 700 nanometres (nm) to 1 mm. This light is not visible by naked eyes but can be seen by a camera (that is why these are also used in night vision cameras). A photo diode gives response in term of change in resistance when light falls on it. An IR LED and a Photo diode are used in a combination for proximity and colour detection. An IR LED (transmitter) emits IR light, that light gets reflected by the object, the reflected light is received by an IR receiver (Photo Diode). Amount of reflection and reception varies with the distance. This difference causes to change in input voltage through IR input. This variation in input voltage is used for proximity detection.

2. SOFTWARE REQUIREMENT:

2.1. Android studio:

- Android Studio is the official integrated development environment for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development. It is available for download on Windows, macOS and Linux based operating systems
- License: Freeware +Source code Operating system: Windows, macOS, Linux, Chrome OS Developed by: Google, JetBrains Written in: Java, Kotlin, C++.
- Android Studio is the official Integrated Development Environment (IDE) for Android app development, based on IntelliJ IDEA. On top of IntelliJ's powerful code editor and developer tools, Android Studio offers even more features that enhance your productivity when building Android apps.
- In our project we havebuilt the android application with the help of Android studio. This android application fetches data from the cloud and checks whether the notification show be given or not.

2.2. Wamp:

- WAMP is sometimes used as an abbreviated name for the software stack Windows, Apache, MySQL, PHP. It is derived from LAMP which stands for Linux, Apache, MySQL, and PHP.

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- As the name implies, while LAMP is used on Linux servers, WAMP is used on Windows servers. Because WordPress isn't usually installed on Windows Servers, WAMP has become popular among developers as a method of installing WordPress on their personal computers.
- The "A" in WAMP stands for Apache. Apache is server software that is used to serve webpages. Whenever someone types in your WordPress website's URL, Apache is the software that "serves" your WordPress site.
- The "M" in WAMP stands for MySQL. MySQL is a database management system. It's job in the software stack is to store all of your website's content, user profiles, comments, etc.
- WAMP software stack can be downloaded from wampserver project's download page. For Microsoft windows users, it comes in an easy installation package with a control panel. Launching the WAMP manager control panel starts Apache, PHP and MySQL web services on the local computer
- WAMP and other software stacks with similar names and features are a good way to develop websites on a local machine without transferring the files to a live website. Theme designers and developers prefer to have this because it speeds up their development time.

2.3. Firebase Cloud Messaging:

- Firebase Cloud Messaging (FCM) is a cross-platform messaging solution that lets you reliably send messages at no cost. Using FCM.you can notify a client app that new email or other data is available to sync. You can send notification messages to drive user re-engagement and retention. For use cases such as instant messaging, a message can transfer a payload of up to 4KB to a client app.
- Send notification messages or data messages Send notification messages that are displayed to your user. Or send data messages and determine completely what happens in your application code. See Message types.
- Versatile message targeting Distribute messages to your client app in any of 3 ways— to single devices, to groups of devices, or to devices subscribed to topics.
- Send messages from client apps Send acknowledgments, chats, and other messages from devices back to your server over FCM's reliable and battery-efficient connection channel
- How does it work: An FCM implementation includes two main components for sending and receiving: A trusted environment such as Cloud Functions for Firebase or an app server on which to build, target, and sendmessages. An iOS, Android, or web (JavaScript) client app that receives messages via the corresponding platform-specific transport service. You can send messages via the Firebase Admin SDK or the FCM server protocols. For testing or for sending marketing or engagement messages with powerful built-in targeting and analytics, you can also use the Notifications composer.

2.4. SMSAPI GATEWAY:

- SMSAPI GATEWAY SMS API gateway is a comprehensive free SMS platform (gateway) offering single window ad-free SMS and API solutions to corporate and entrepreneurs.
- SMS Gateway is an HTTP (HyperText Transfer Protocol) connectivity that serves Internet content to mobile subscribers via short messaging service (SMS).
- The SMS Gateway connects to an SMSC (Short Message Service Centre) on one side and connects to applications on the Internet on the other side. The SMS gateway functions as a "gateway" between the network carrier and the user who send the information through internet.
- The mobile sets are now days used most widely and very commonly. The SMS can be sent to any mobile user of any service provider with no or a minimum charge.
- This system is designed using a GSM modem. The GSM modem is configured as a receiver which sends the SMS to a computer after receiving it completely
- The SMS sent by the user is written in a particular format. The computer receives the message and decodes it and identifies the task to be done. Accordingly, the computer send request to the SMS gateway insisting it to send massages to set of users which satisfies a given condition.
- In this way the devices connected to the controller is operated through an SMS. The advantage of SMS based control is as follows,
  -This is cheaper and the SMS can be retained in the network even though the network is busy for some time.
  -The SMS can be written through internet without any cost.

2.5. HOSTGATOR SERVER:

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- Web server can refer to either the hardware (the computer) or the software (the computer application) that helps to deliver Web content that can be accessed through the Internet.
- The most common use of web servers is to host websites, but there are other uses such as gaming, data storage or running enterprise applications.
- A Web server is a program that, using the client/server model and the World Wide Web's Hypertext Transfer Protocol (HTTP), serves the files that form Web pages to Web users (whose computers contain HTTP clients that forward their requests).
- Every computer on the Internet that contains a Web site must have a Web server program. Two leading Web servers are Apache, the most widely-installed Web server, and Microsoft's Internet Information Server (IIS). Other Web servers include Novell's Web Server for users of its NetWare operating system and IBM's family of Lotus Domino servers, primarily for IBM's OS/390 and AS/400 customers.
- Web servers often come as part of a larger package of Internet- and intranet-related programs for serving email, downloading requests for File Transfer Protocol (FTP) files, and building and publishing Web pages. Considerations in choosing a Web DEPT OF ECE, JCE BELGAUM 13 Multi-Face Recognition Based Attendance System server include how well it works with the operating system and other servers, its ability to handle server-side programming, security characteristics, and publishing, search engine, and site building tools that may come with it

VIII. WORKING PROCESS

1. HARDWARE WORKING PROCESS

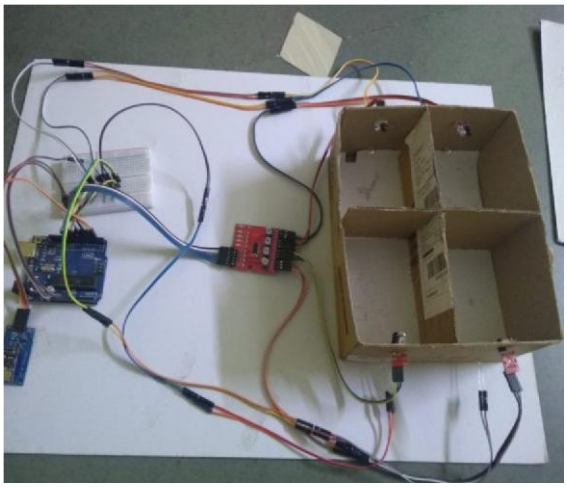

Fig.3: Over view of the hardware device

Fig.4: Close view how IR sensor is placed

The above figures show the over view and connection of the hardware part of the smart medicine reminder prototype.Here the IR sensor placed in the cardboard is used to detect whether the medicine is taken by the user or patient with the help of infrared rays. This data is passed on to the Arduino board through the IR module. Then the data is processed in the Arduino in accordance with the code uploaded in it with the help of Arduino IDE. As Arduino do not come up with the inbuilt Wi-Fi module an ESP8266 is mounted in the Arduino and connect to TX-RX pin. With help of this esp8266 data is sent to the cloud server. This is mechanism of the hardware to the cloud(fig.3)

2. CREATING CLOUD

For this project we have purchased a cloud server from HOSTGATOR and choose the “Baby cloud” plan which provides unmetered SSD disk space and 4GB RAM with 4 Cores and free SSL certificate. The web page for the project is done on Wamp server. Wamp operates on Windows operating system. It is also used to create and manage the data base (Baby Cloud). We have designed the web pages using the html and PHP.

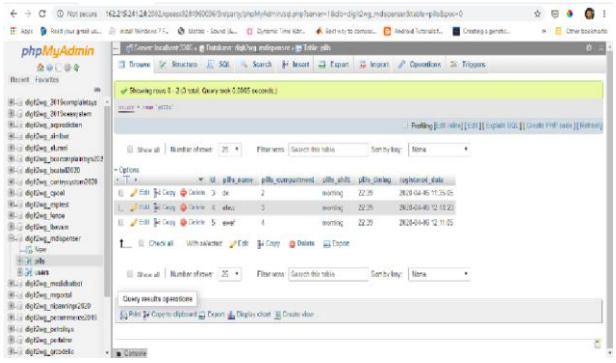

Fig.5: Creating a database to store the value.

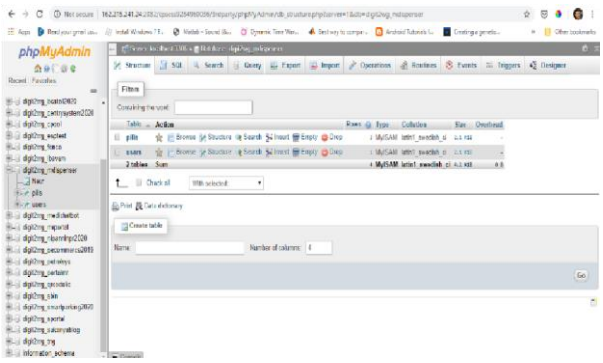

Fig.6: Structure and table created using php MyAdmin.

3. ANDROID APPLICATION

Android application is built in Android studio with the help of JAVA script. In our project the Android application offers a feature where user or patient can set timing and give the name for each pill as desired. And the main role of the application is to fetch data from the cloud server and check whether the user or patient has taken the pill on time or not. Suppose if the pill is taken the notification will not be displayed else if the pill is not taken then the notification will be displayed on the user’s android smart phone. Refer Fig.2 and Fig.3 for the clear vision and understanding

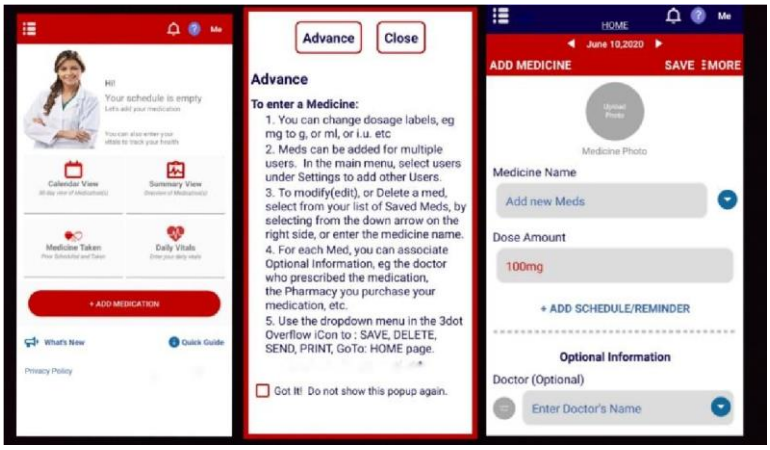

Fig.7: Interface of an android application (Example)

IX. APPLICATIONS AND ADVANTAGES

- Time to time Reminder to take Medicine.
- Easy Android User Interface to Monitor.
- Easily accessible to family members.
- Avoiding taking of wrong medicine.
- Avoiding wastage of Medicine.
- Compactible
- Flexible
- Easy to detect the errors if any.
- No complex connection
- User friendly
- Low cost

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- Zero maintenance.
- Especially very useful for aged people.

X. CONCLUSION

The proposed SMR system takes the idea of automated dispenser to the next level as it has some functionalities that are not included in any other automated dispensers. An account is provided for each patient and no one else can access it except the patient and the caregiver if the credentials were provided to him/her. Also, some statistics are provided about the pills taken with their alarms and the already existing ones. Online database of the users, pills and their alarms are also a great feature that helped in the design of the project. The pills can be edited and created using an android application remotely through smartphones.

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BIOGRAPHY

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