Smart and Assistive Pill Box Using IOT

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Abstract—**Life without health is like a hell. A healthy body represents a healthy soul and healthy mind. Whenever the person feels sick, immediately he takes the medicine to get rid of that illness. Medicine is one of the best source which helps to recover our health in case of any health issues. It's just not enough to take a pill, it is also important to take pill in correct time. Taking a single pill in a day is not a big deal. But in case of long prescription in a day it is somewhat difficult for a person to remember that long prescription. There may be a chance to confuse in taking the correct pill. So, to reduce this problem an assistive technology has been introduced, this reminds the person to take the particular pill at a particular time. Most of the people take the help of their family members or care takers. This technology makes the person independent in taking the medicine. No personal care taker is required for giving the medicine. In this paper design of an assistive pill box is proposed. This capsules box is designed using raspberry pi which takes the entire control of the box, this prototype contains: Led's to indicate the correct pill, programmable alarm along with IR sensors in each compartment, notifications to the medicine taking person or family members has been given by using IOT technology. The main aim of this development is to support the elderly or aging people in following the medication schedule and to reduce risk of taking wrong medicine in wrong time. This is the technology that cares and never quits.**

Keywords—Assistive pillbox, medication schedule, raspberry pi, IR sensors, Led's, IOT

I. INTRODUCTION

We all know that India has the second largest population in the world and is jutted to overtake china's top ranking position in next forty years. Our population statics says that in 2017 estimated population in India is increased to 1.32 billion people. Probability of people dying between 15 and 60 years is 214/1000(males), 138/1000(females). Now a day's different varieties of diseases are spreading very fastly in the environment and the people are affecting much. In such environment every person should take care of their health. Even though taking care about the health, at certain age i.e. older age body will become weak and there will be chance of attacking some sort of diseases. In order to fight with those diseases we should take the medicine regularly. According to the projections people today spend over $270 billion on drugs which are prescribed by the doctor and $ 340 billion for non prescriptive medicines.

Out of total population 13% of people are senior citizens accounts over 30% of prescriptions and spends about 40% of money on drugs. Naturally having a long prescription confuses the people mind and leads to consume the wrong medicines or people may forget to take the medicines at correct time. Intake of wrong medicines may cause the serious health issue. In reality what happens means many people takes the prescribed medication from the doctor but, fails to follow the prescription and the instructions given by the professionals. Most common reasons are: some people may get confuse in taking the right pill and may takes the wrong pill, some people forgets to take the pill at a time and skips the dosage or takes the high dosage, after following the medications for some day's people may feels better and decides to stop intake of medicines, some people may not notice the improvement in their health condition in little span of time and may stops taking medicines by thinking it's not working, some people skips the dosage due to the expensive of medicines.

To overcome the some problem like confusing and skipping the medications and intake of wrong medications and having heavy dosage some people will maintains the care taker and some people takes the helps of their elder family members, but these two are not the permanent solutions and makes the people dependent on others. To make the patient dependent traditional pill box has been introduced but it does not made the complete independent. Day by day technology has been increased and many types of pill boxes came in to market. When compared to the traditional pill boxes the proposed new technology namely "smart and assistive pill box using IOT" will be the best technology to follow the prescribed medication schedule correctly

Section 1: Gives the brief introduction on importance of following the medication schedule. Section 2: Provides the literature survey on implementation of pill boxes. Section 3: Says about the proposed methodology. Section 4: Provides the information about hardware components. Section 5: Describes the implementation. Section 6: Shows the experimental results and section 7: finally concludes the project.

II. LITERATURE SURVEY

In this section detailed literature survey on people health and technologies assisting the people in following the prescribed medication schedule has been described.

Based on the World Health Organization report, people aged 60 years and above are increased from 8% to 12% from 1950 to 2013. In the next four decades it may increase to 21% in 2050. About 80% of the people are prescribed the medications that have to be taken 2- 4 times a day. With increase in the blood pressure, diabetes, heart related diseases, thyroid and many other diseases among the people

are became common, due to this situation regular medication is became necessity in every one's life. Among this remaining people are having a problem of forgetting to take the medication at proper time. Focusing on these two problems, firstly a traditional pill box with a reminder includes normal alarm has introduced in the market. But it doesn't work on checking whether it is correct pill or wrong pill, and not on checking the dosage of pill.

In 2014 students of Taiwan implemented a pill box which reminds the user to take the pill and informs the family members remotely when the elders taken the pill, in this information to the family members are given through Skype. [1]

In 2015 author Aakash sunil salgia introduced a smart pill box with a basic ideology of integrating the alarm system for reminding the user along with different sensing technologies like load based sensing, light based sensing, capacitive based sensing for measuring the dosage along with GSM module to give alert to the user and the chemist. [2]

In 2017 a group of students has implemented a Intelligent pill box which is automatic and programmable device. Aurdino mega 2560 is used as platform along with automatic door opening and closing system, alarm system, GSM module and display unit. It is highly cost effective. [3]

In 2017 an author introduced a bidirectional smart pill box monitored through internet and receiving remind messages. In this implementation web aurdino module is used as a platform and the Wi-Fi router is used to send the alert messages and LCD for displaying the information. [4]

III. PROPOSED WORK

In the previous existing systems pill boxes are designed using web aurdino module with different compartments embedded with a sensor in each compartment send the signals to the web page whenever the user takes the pill. Send the message to the care taker and also receive s the return message through Wi-Fi connectivity in order to achieve the two way messaging. No record of medicine intake by the user along with the name and timing has been maintained. [5]

In this proposed system smart pill box is designed using module named raspberry pi3 along with an IOT technology for sending alert messages, and also it is embedded with the sensors and LED's and a buzzer in it. indicates the right pills in the compartment with the help of LED's, it sounds the alarm with help of buzzer to remind the user, and also it sends the notification to the user mobile and remote relatives/care taker using IOT in the form of SMS and mails. It is programmable device where we can set the alarm timings in our mobile through an application named as HTTP shortcuts.
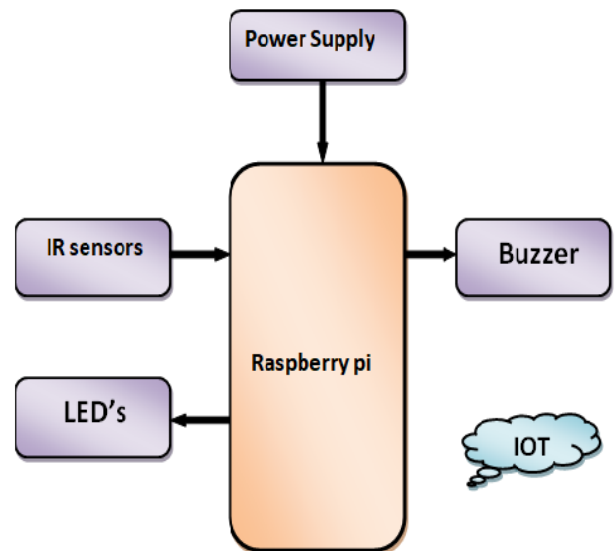

Fig. 1. Block diagram

IV. HARDWWARE COMPONENTS

This section explains about the hardware components along with their specification which are required to implement the proposed system

A. Raspberry Pi

Raspberry pi is tiny and affordable computer board. Its size and shape represents the credit card. Irrespective of its size, performance is equal to the desktop computer. Raspberry pi is a low cost high capable board. It acts as a heart of the entire project. Thos raspberry pi available in model A and model B in 3 different versions. In the implementation of pill box raspberry pi 3 model B is used, where all the remaining components are connected to it as shown in the fig. 2. Pi 3 is built with quad-core ARM cortex - A53 64 bit processor whose performance is 10 times faster than pi 1 [6-7]. Following are the specification of raspberry pi3 model B:

- GPIO - 40 pin extended GPIO
- SOC Used – Broadcom BCM2837
- RAM – 1 GB RAM
- 4 USB 2.0 ports
- In built Wi-Fi
- Processor speed – 1.4 GHz
- HDMI PORT
- Storage - Micro SD for storing data and operating system
- 15 pin MIPI Camera interface connector
- MicroSDHC Slot for on board storage
- On board network – 10/100 Mbit/s Ethernet
- 802.11n wireless network
- Bluetooth – 4.1

Fig. 2. Raspberry pi 3

B. IR SENSORS

IR Sensors is defined as a infrared sensors. This IR sensor is used in detecting the obstacles. Infrared radiations from the IR sensors are having a wave length longer than visible light wave length and smaller than microwaves. These infrared waves are invisible to the human eye. There different types of IR sensors namely: Active infrared sensors and Passive infrared sensors. Active infrared sensors are used in this implementation. This IR sensor consists of IR LED and photo diode which are commonly called as IR source and detector. IR source continuously emits the radiations whenever the obstacle comes that that radiation are reflected and detected by the IR detector [8]. In this project IR sensor sense weather the pill in the compartment has taken or not.

C. Alarm system

In the implementation of this pill box piezo electric buzzer is used to give an alarm .it requires only 5v as working voltage. It sounds the alarm whenever the current time is equal to the saved alarm time, which indicates the user to take the pill. It also sounds the alarm whenever the user is taking the wrong pill or pill from the wrong compartment.

D. IOT – Internet of Things

IOT stand for internet of things. This is the new technology. It is the network of physical devices, home appliances and other items are embedded with sensors electronics, actuators to which enables connectivity between these things to exchange the data and providing the direct integration with the physical computer world. In this project IOT is used to fix the timings in the web page, send the alert messages e mails to the user and care taker

V. IMPLEMENTATION

In this section implementation of pill box has been described briefly. For implementing the pill box firstly we have to draw the pin diagram. In that pin diagram we can have brief view on the connections of each and every component. Hardware implementation of an assistive pillbox can be done with the help of required components by following the pin diagram as shown in the figure[ ] step by step and the software which makes the hardware to work in a proper manner is implemented with the help of personal computer. For
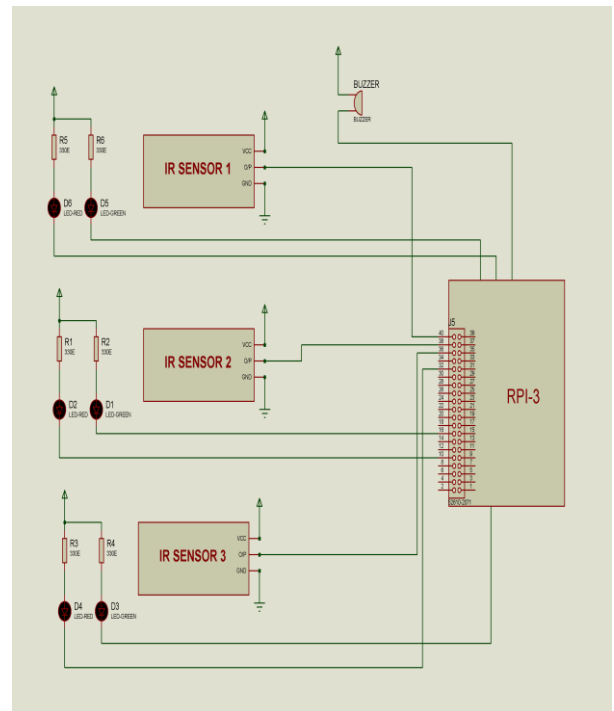
building the code python language is used, the written code is stored in sd card and it is inserted in the pi platform.

Fig. 3. Pin connections of pill box

As we can see the connections of each and every component in the pin diagram. To implement this project we have taken a plastic box with four compartments in it. But we are using only 3 compartments in it. For each and every compartment a red led, a green led, IR sensor is required. Entire pill box requires one piezo electric buzzer for giving the alarm.

A. pin connections:

Raspberry pi 3 consists of 40 GPIO pins. Among these 40 pins only 10 pins are used randomly. Pins which are used to connection purpose are shown in the below table.

LED'S	GPIO Pins	IR sensors	GPIO pins
Red -1	5	IR -1	16
Green -1	6		
		IR -2	20
Red -2	13		
Green -2	19	IR - 3	21
Red -3	26	Alarm	GPIO Pins
Green -3	12	buzzer	4

Fig. 4. Pin connections

B. Working of smart pillbox:

In order to make the pill box working initially power supply has been provided to the raspberry pi. We can use the power bank or phone charger or laptop can be used as a source of power supply. Power is supplied to the pi through a cable.

When the raspberry pi powered on all the IR sensors, led's and the time are initialised. After waiting for few seconds make sure that the raspberry pi is connected to the Wi-Fi network or not, and then we have to set the timings for alarm 1,alarm 2, alarm 3 to take the pills in the 3 compartments as per schedule prescribed by the doctors. We can set the timings by logging in to the web page created for it or otherwise we can use the mobile application named HTTP shortcuts for setting the medication time. Timings which are given in the web page will goes to the server. Raspberry pi reads the date and time from the server and stores in it. Simultaneously it reads the current time also whenever the alarm 1 timing is equal to the current time then the green LED which is placed at the compartment 1 will glows and buzzer will gives a beep sound to indicate the user that the time to take pill 1 has arrived. It also sends a SMS and E-mail to the user mobile phone as "It's time to take pill 1" along with the time. If the user has taken the pill from right compartment then the green led will turns off and a message is sent to the user and caretaker as "pill 1 has taken" along with time. If the user has not taken the pill then Green Led in the compartment will keeps on glowing for 2 minutes and then it will goes off. If the user takes the wrong pill or pill from the wrong compartment then immediately buzzer will sounds and the red LED in that particular compartment will glows and also a message as "unauthorised compartment" is sent to both the user and care take. If the user has not taken the pill within two minutes then also a message as "pill triggered but not taken". This messaging is done with the help of iot technology. Smart and assistive pill box is very user friendly. It is also small in size and is easy to carry anywhere.
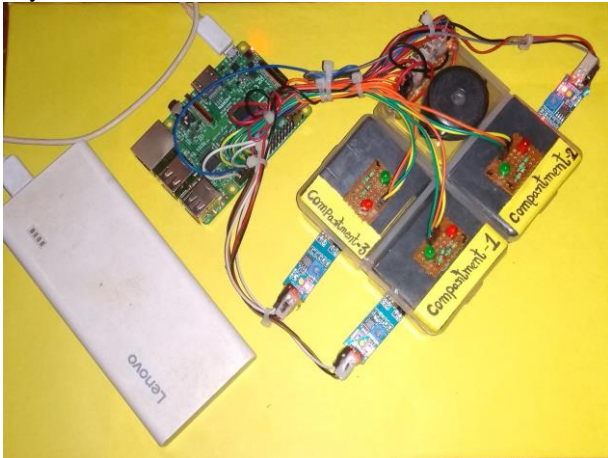

Fig. 5. Power supplied to the pi

Fig. 5. Real time view

VI. RESULTS

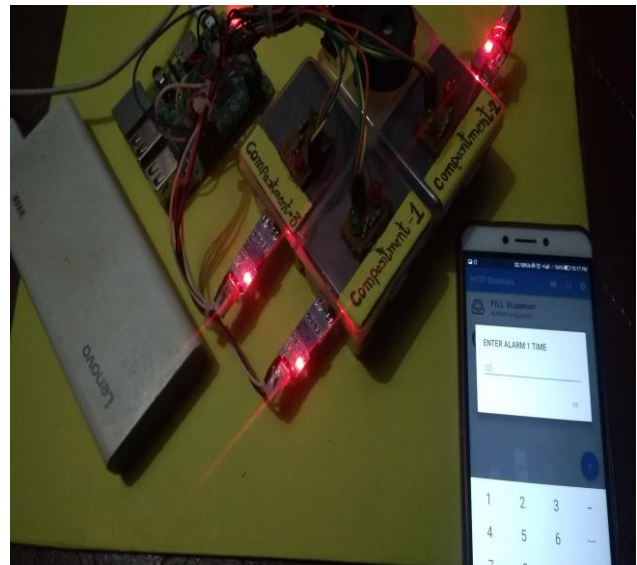Experimental results of this smart and assistive pill box using IOT is shown below

Fig. 7. Setting the time for alarm 1

Alarm timings are given through web page or we can use a mobile application named HTTP shortcuts. It is the short cut for the web page. When we click on HTTP shortcuts icon it shows two options, pill dispenser for configuring the alarm another is pill alert which shows that the timings given by the user executed or not. When we click on the pill dispenser it displays the screen with the label "Enter the alarm 1" as shown in the fig 7. After entering the time click on "Ok". Then immediately it shows the label asking to enter the alarm 2 and alarm 3. It is programmed to take the timings in hour bases.
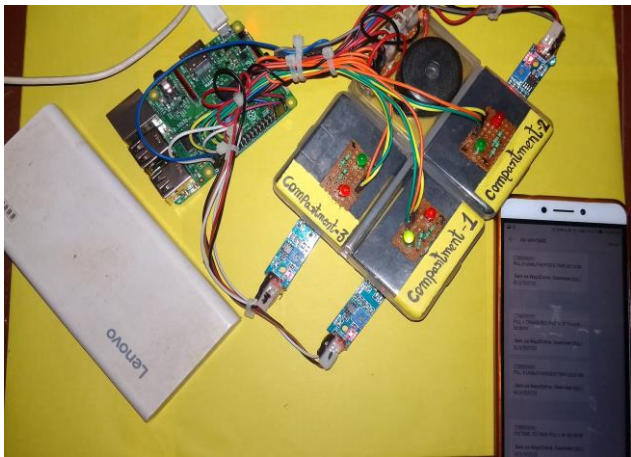
Fig. 8. Execution of alarm 1 and message alert

If a wrong pill has taken by the user, immediately red LED will glow in the particular compartment as shown in the fig.9 and a beep sound is given and simultaneously a SMS will be sent to the user "unauthorized pill" to indicate that the user it is a wrong pill.
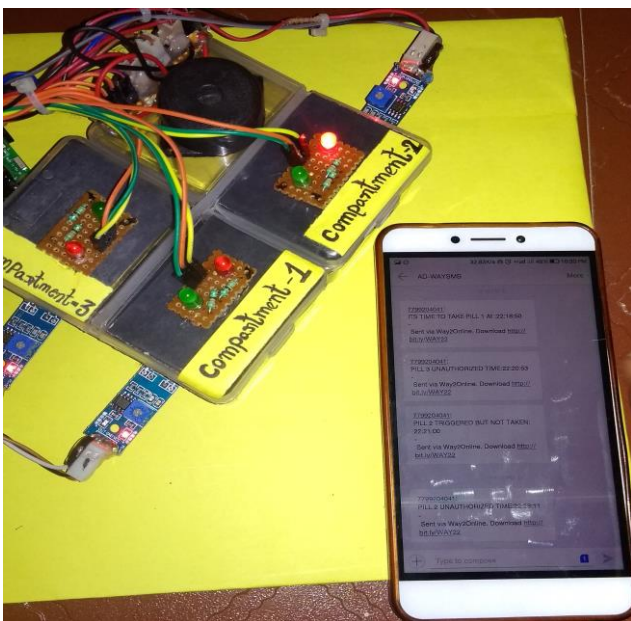

Fig. 9. Indication of wrong pill

In this project IR sensing methodology is used for dtecting from which compartment the pill has taken. In the fig 9 we can view the IR led and photo diode. Whenever the kit is switched on IR led starts emmitting the infra red rays continuously when the user takes the pill it detect the user hand as an obstacle and IR rays are reflected to the photo diode. Raspberry pi reads those signals and the response is shown with the help of LED's

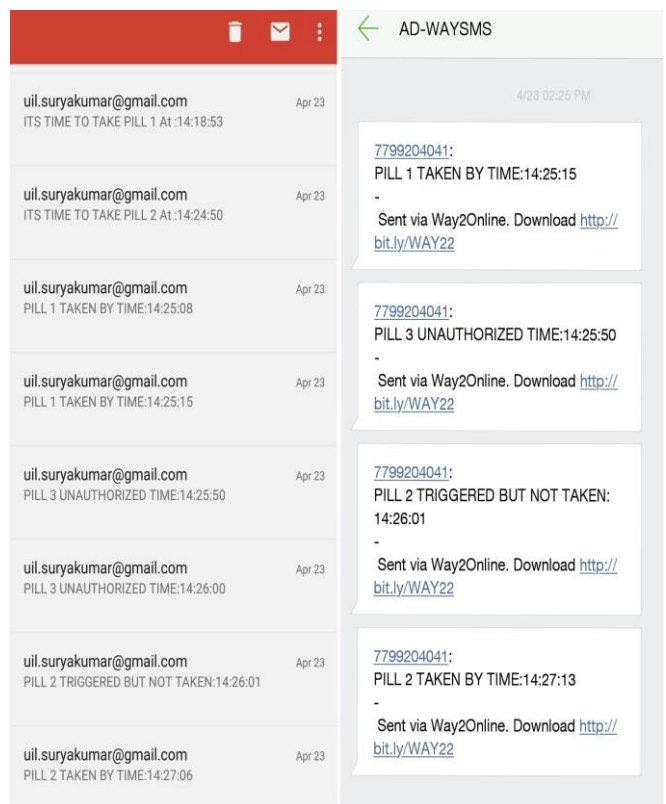*Fig. 9. View inside the compartment*

Fig. 10. Received mails and SMS

All these mails and SMS are stored in the mobile for further uses. a medication intake record can be maintained. By this list of mails and SMS family members or personal care takers can have an eye on the user's medication intake. By this assistive technology there is no need for a user to dependent on personal care taker or the family members. User or older person or patient can't skip their medicine to take and there will be no chance to have a wrong medicine.

VII. Conclusion

In this paper an approach of designing an assistive technology i.e. Smart pill box using IOT which may help the people to follow the medications regularly without skipping the dose and to awaken the people from taking the wrong pills are achieved. Initially we have to connect the raspberry pi to the local hotspot to enhance the facilities of IOT, fill the compartments with pills separately, and set the alarm for each and every compartment containing the pills in it. Wait till it gives alarm, whenever current time is equal to given alarm time then it gives the buzzer sound along with led indication with a green color in particular compartment and simultaneously SMS and mails are also sent to the user and the family member/caretaker, while taking the pill it sense through IR sensors placed in compartment and resends the SMS about the status of medication. This smart pill box reduces the risk of taking the wrong pill and causing the adverse drug reaction, it decreases the number of deaths due to the drug reaction and human errors. This assistive pill box is mostly needed for the diabetes people, people who take multiple medicines, children's, old age people, Alzheimer patients, and people with complex medication schedule. In future it may be extended to dosage calculation, monitoring the person to check whether he is swallowing the pill or not, lock system can also be provide for the box and can be made to work automatically.

References

[1] Hsiu- Ling Tsai, Chung Hsiang Tseng, Long - Cian Wang, Fuh-Shyang Juang "Bi-directional Smart Pill Box Monitered Through Internet A nd Receiving Reminding Message From Remote Relative " IEEE International Conference On Consumer Electronics-Taiwan. 2107.

[2] Shih-Chang Huang, Hong-Yi Chang, Yu-Chen Jhu, Guan-You Chen, "The Intelligent Pill Box – Design And Implementation" ICCE – Taiwan 2104.

[3] Juan Marcelo Parra, Wilson Valdez, Andre Guevara, "Intelligent Pill Box: Automatic And Programmable Assistive Technology Device" Biomedical EngineeringIASTED International conference 2107.

[4] Aakash Sunil Salgia, K.Ganesan and Ashwin Raghunath, "Smart PillBox" Indian Journal Of Science And Technology, Vol 8(S2) January 2015.

[5] Viral Shah, Jigar Shah, Nilesh Singhal, Harsh Shah " Smart Medicine Box" Imperial Journal Of Interdisciplinary Research(IJIR) Vol-2, Issue – 5, 2016

[6] https://en.wikipedia.org/wiki/Raspberry_Pi

[7] https://www.raspberrypi.org/products/raspberry-pi-3-model-b/

[8] https://www.elprocus.com/infrared-ir-sensor-circuit-and-working/