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Geriatric Friendly Medicine Reminder Device Powered by Visual, Voice and IOT Assistance System

Nimish Sunil Das

Department of Electronics and Communication Engineering, L J Institute of Engineering and Technology, LJK University Ahmedabad India.

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Any medical care must include regular consumption of the correct dose at the precise time. Because they are more likely to have chronic conditions, older persons consume more medications than younger adults. The majority of medications are used for years, while only a few are used for a brief period. Based on many research investigations, it has been discovered that on average, older individuals take 3 to 5 prescription drugs, and that owing to fading memory impairments, it becomes difficult for them to remember the dosage time and quantity. The dose is effective if it is given at the precise time and in the correct quantity; otherwise, the patient's health would deteriorate. This study proposes a medicine reminder device based on an algorithm that addresses and eliminates difficulties experienced by older adults, such as remembering time, name, quantity or amount of dose, with some specific description, feedback and assistance mechanisms. The device employs a system clock for reminders based on the time inputted, a television display for presenting medicine and meal images, and a speaker for voice help. Finally, a rack of devices is used to pick up the right dose, and a trigger feedback device is employed to notify the website that the drug has been taken.

Keywords: Algorithm; Chronic conditions; Deteriorate; Eradicates; Older adult; Younger Adults.

Statistical Tally

Global Scenario: One of the most visible results of demographic shift is population ageing; people are living longer all across the world. Most people now a days expects to live well into their sixties and beyond. Every country in the globe is seeing population growth, as well as an increase in the number of elderly people. By 2030, one out of every six persons on the planet will be 60 years old or older. The number of people aged 60 and more is expected to rise from 1 billion in 2020 to 1.4 billion by 2050. By 2050, the global population of adults aged 60 and up will have doubled (2.1 billion). Between 2020 and 2050, the number of people aged 80 and more is predicted to treble, reaching 426 million. While the movement in population distribution towards older ages, known as population ageing, began in high-income nations (for example, in Japan,30%of the population is already over 60 years old), it is currently low-and-middle-income countries that are seeing the most change. Two-thirds of the world's population over the age of 60 will be living in low and middle-income countries by 2050[1].

Indian Scenario: India has a population of 1.21 billion people in 2011. It is the world's

*Corresponding author E-mail: nimish.das@ljinstitutes.edu.in

second most densely inhabited country, only behind China1. In 1997, there were 63.64 million persons aged 60 and up. The estimated number was 98.5millionas ofMarch1, 2012.In India, the number of "senior" individuals (those aged 60 and more) has increased by 54.77 per cent in the last 15 years. In comparison, the working population (15-59 years old) increased by 42.34 per cent in the last 15 years, from 532.6 million to 758.61 million[2]. The old-age dependency ratio, which counts the number of older individuals as a percentage of those of working age, was 0.132 as of March 1, 2012. India's old age dependency ratio is expected to exceed 0.20 by 2050.[3]

Social Scenario: There are a number of other concerns that have an impact on elder care. With an entire generation of women working, the conventional image of the 'housewife' as someone who takes care of the home and children has shifted drastically. Many couples are debating whether or not to have children later in the marriage, or whether or not to have them at all, citing professional obligations as a reason. The absence of grandchildren, as well as a working son and husband, may deprive them of emotional support, which is exacerbated for the elder whose spouse has died. Staying with your daughter while she is with her in-laws 'is frowned upon in India. As a result, things are tougher for elders who have a lone daughter and no other relatives, moreover appointing someone on a rental basis to provide medical help raises security concerns. Now the elder must fend for themselves. And, if a grandchild or maid is kept to take her, that person must be well-versed on all of the medicine, as well as the timings, quantity, and other instructions, which can be tedious to remember[4].

Purpose of development

Medication can be a lifesaver or a tragedy waiting to happen for the elderly. When dosages are missed or too much medication is used, catastrophic consequences can occur[5]. Because chronic illnesses such as high blood pressure, diabetes, and arthritis are more common in older adults, they tend to require more prescriptions than younger people[6]. Other medications, such as antibiotics, pain relievers, and laxatives, may be used just for a brief time to treat infections, pain, and constipation[7]. On average, elderly persons take four or five prescription pills every day, as well as two non-prescription medications[8] Medication problems are widespread. According to the Department of Health and Human Services: (1) Fifty-five per cent of elderly people are "non-compliant" with their prescribed drug orders, which means they don't take the prescribed medication (2) Approximately 200,000 older adults are annually hospitalized due to adverse drug effects[9].

There are a variety of reasons why seniors might not take their prescriptions as directed. Here are some of the most prevalent reasons for drug errors and what you can do about them, (1) Vision Issues: Elders with vision problems have difficulty reading drug labels with small print or distinguishing between pills, which can lead to potentially harmful abuse.[10,11]

(2) Memory Loss: Dementia patients may simply forget to take their medications, resulting in missed doses. The inverse is also true: if they don't recall whether or not they took their prescription, they may take it again, resulting in an overdose[12]. Considering this social environment, a lonely elder must remember the name of the drug, the timing of it, the quantity, and extra instructions such as whether to take medicine in the morning, noon, eve, or night, which is even more difficult for a young person. Even if a care giver is assigned to fulfill this work, it becomes expensive and unaffordable to a large segment of society.[13]

MATERIALS AND METHODS

Field Survey and Analysis

Participants in the field investigation were older persons who needed frequent prescriptions and had a variety of difficulties with their vision, hearing, memory, and other senses. 'Purposeful sampling' was used to choose them. The participants were chosen at random, and the age range was set at 60 or older. Data was gathered through a structured interview that comprised both closed and open-ended questions in this user study

An interview was conducted and questions asked in the survey were designed to determine the factors influencing and difficulties encountered in managing the intake of the correct dose at the appropriate time and under appropriate settings. For the survey, a sample consists of 30 individuals. List of Questions asked along with their analysis are as follows:

1) Every day, how many intake doses are due to chronic or specific cause disease?
2) Do you take your dose on your own or do you have someone to assist you?
3) If by own or by assistance do you miss dose or wrong (Error) dose is consumed?
4) Which reasons hinder you from taking your prescription on a regular basis?
5) Would it be beneficial to take the correct dose on a regular basis if any equipment aids you in the above-mentioned issues?

Summary

Most old people take their dose by themselves Whether individuals take medicine on their own or with assistance, mistakes do happen. Some aspects, such as remembering the time, differentiating doses, and having additional information, are big obstacles to taking medicine, and they all believed that the proposed device will undoubtedly assist them in managing their medications.

Proposed solution

Proposed Operating Scenario

The current study proposes a solution in the form of a Homely-based medical management system after analyzing the problem statement and assessing the survey results. This system can be broken down into the two segments below.

• Database segment: This section contains all of the system's data. As if it were a storage place where all of the data is kept. The information stored here can include the name of the medicine, photographs of the medicine, dosing instructions, and other information that has to be remembered along with the dose, such as whether a dose should be taken on an empty stomach or with a specific meal. It may also contain information that allows it to distinguish between different types of drugs.

• Algorithm segment: This portion ties the database data into a meaningful and re- quire structure. It develops a routine reminding structure for medicine management system using the relevant data from the database. It can be broken down into a variety of components, including a timer (Timer), a display unit, an aid unit (alarm, LED), and other components.

Operating Algorithm: flow chart

Flow chart Description: The image of the medicine specified in the dose must first be inserted into the device, which can be done using only a camera or any other storage device, after inputting photographs, related information such as the name of the medicine, the time to take it, and any additional information such as whether to take it before or after a meal, or whether to take it with a special meal. Following the creation of the database, the computer begins monitoring the occurrence of events, in this case, the time to take medicine.

If an event occurs, the device checks for simple or GSM mode. If simple mode is selected, an image of the drug along with further information is presented on the screen. So that the wrong drug is not taken and he/she can easily distinguish between other medicines in the dose, an elderly person can see the name of the medicine as well as an image of the medicine to be taken. Along with the image, there is also additional information provided. The text-to-speech capability is also used to assist not just visually challenged elderly persons, but also to provide effective supplementary assistance in taking medicine. Along with all of this, the event lead in the rack specifies which medicine should be taken, i.e. this component is an added bonus.

After this occurrence, Raspberry Pi will check whether the IR sensor in the rack is halted or not, indicating whether the medicine has been picked up by the patient. If medicine has not been picked up by the patient, the displaying and assisting routine will continue. When the IR sensor is turned off, a text file containing the medicine intake database is created. In the future, we may be able to show this text file on a web page, allowing doctors to keep track of a patient's medication intake history while also being observed by family members. If the gadget is in GSM mode, all information is texted to a specific number. With the help of this series of events, aging people can take the proper dose at the right time without missing a dose, and a database can be formed.

System Block Diagram

The figure shows a block diagram the medicine management system, which comprises a processor (in this case, a Raspberry Pi board), display, camera, speakers (if the display is not a TV),racks, and possible modules. The Raspberry Pi board serves as the system's brain, connecting all other modules like the display, camera, and speakers.

Development of hardware and software

This section discusses the hardware and software, as well as how they are used in the work. It also includes a description of each piece of hardware. The Raspberry Pi Foundation created a credit card-sized single-board computer called the Raspberry Pi. The Raspberry Pi is based on the Broadcom BCM2835 system on a chip (SOC), which incorporates an ARM1176JZF-S 700MHz processor, Video Core IV GPU, and was first delivered with 256 MB of RAM, which was later updated to 512 MB (Model B & Model B+). For boot media and persistent storage, the system has Secure Digital (SD) or Micro SD (Model A+ and B+) connectors. It is the heart of the proposed device, controlling the complete system's software and hardware interface, as well as its domains[14.] Camera module: Any USB camera can be used; the purpose of this module is to capture photographs of medications that will be sent into the system, allowing older adults to know which medications they need to take.

Display Module: This part displays all of the medical information. The system's display is determined by the availability of the user's requirements. If the user has an HDMI TV, it can be used by connecting it to the Raspberry Pi's HDMI connection; otherwise, a regular TV can be linked to the board's video output, or a separate display can be provided if the cost is not a concern. A separate display speaker connection would be necessary if we connected to a separate display. Rack/Shelves: Racks and shelves are used to keep medicines separate indistinct partitions. As an example, when it is time to take medicine, a light in a certain partition glows, indicating to the user where the medicine is to be taken and providing assistance. After taking medicine, it should be stored in the same location where it was taken. To accomplish this, we program me a led to glow for a set period of time until the IR sensor stops, indicating that the patient has picked up medicine from the rack and ending the triggered event until the next dose alarm sounds.

IR Sensor: This obstacle sensor is intended to operate with all Arduino boards, including the Raspberry Pi, the 8051, and others. It has a 5-volt operating voltage and its output can be directly linked to the Raspberry Pi's Gpio pins. As a result, when an obstruction is encountered, sensor logic 1 is created at the Raspberry Pi's Gpio pin. It has three I/O pins. GND, out, and 5v input (operating

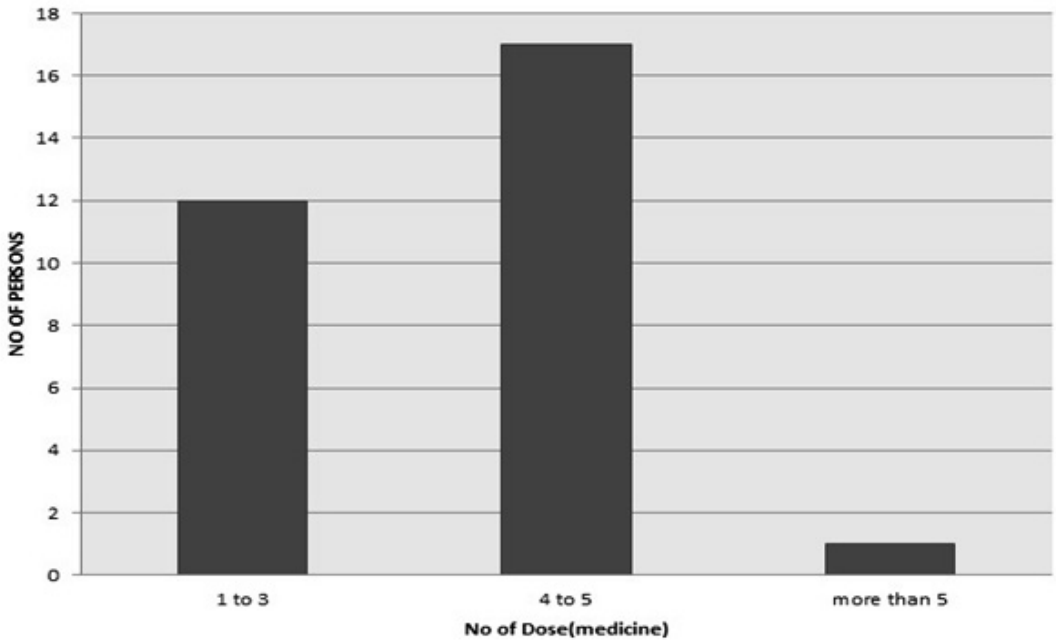

Fig. 1. Graphical representation of intake dose per day

voltage). IR is used in our arrangement. In this notion, this sensor is mostly used to finish one event and maybe to begin another. The event that is to be terminated is the full reminder procedure, such that when the drug is taken, the device begins monitoring for the next reminder (event). It may also be used to generate a database to keep track of when a patient consumes medicine, which can be presented by creating a text file, which can also be displayed on a web page. Initialization

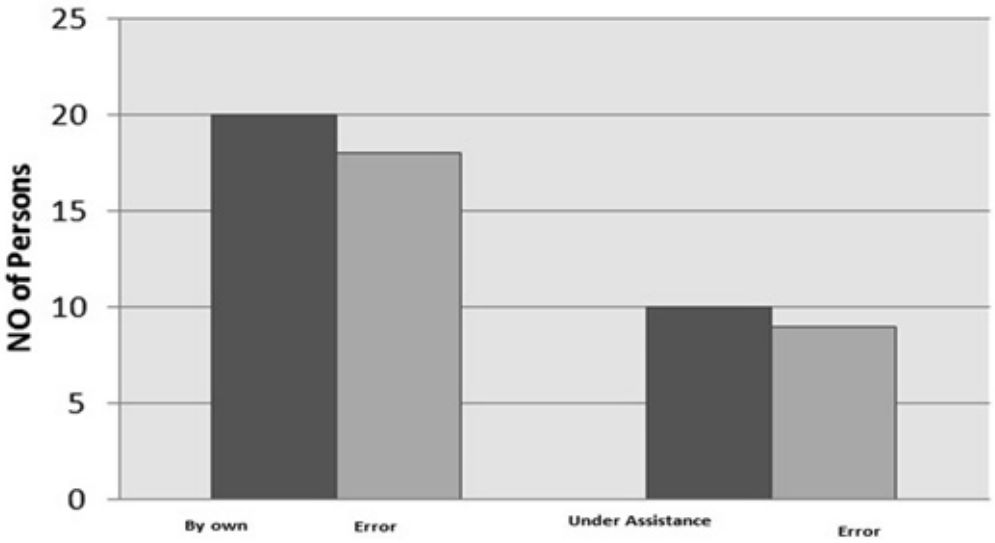

Fig. 2. Graphical representation of medicine intake medium and error

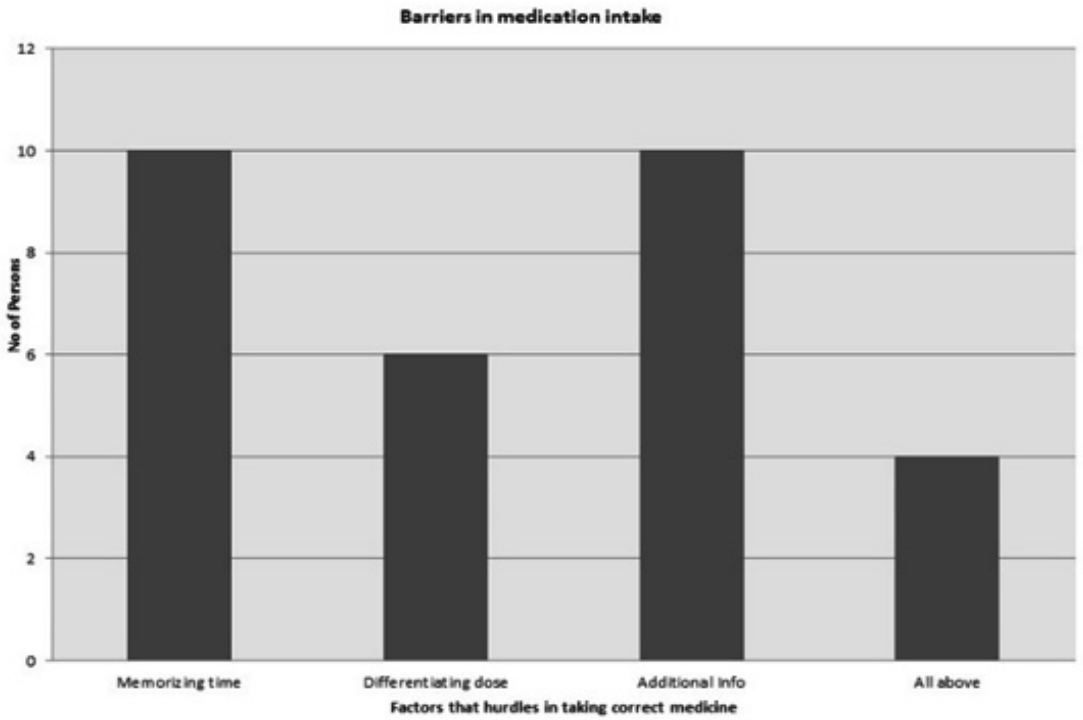

Fig. 3. Graphical representation of barriers to taking a dose

and supportive software packets for System Development In this section supportive packages and software are given which were installed for meeting up different requirements of system program which including basic packages along with text-to-voice packets, packets used are given below:

1.Gstreamer[5].
2.Feh[16]
3. Say[16]
4.Minicom
5.Lighttpd

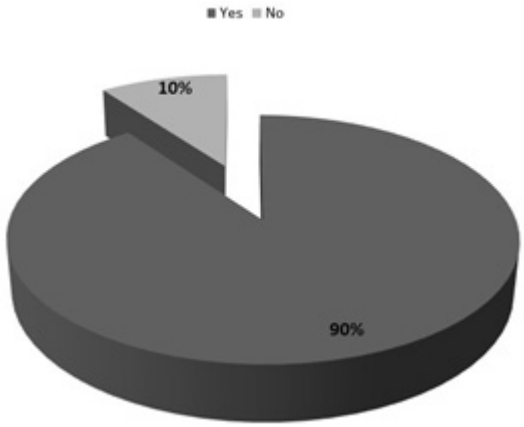

Fig. 4. Pie Chart of whether the proposed device will help or not

Database Creation: This section collects data from the user to establish a database. The data can include the number of doses, the time of dosing, and anything else we want, such as special information, a description of the tablet, and so on, which will be heard in speech form. This step is essential because it creates a file called info.config, which is required by the monitoring part. The monitoring portion basically assists the patient in taking medicine in the correct quantity and time.

The info.config file once created can be edited by using WinSCP software, with help of which a shortcut is created on desktop. Simply by double clicking on it we can change details in the info. Config file and also insert images of medicine in it via computer, laptop, mobile etc, more over as we are using raspberry pi we can insert details directly.

GSM addon Section: It is an add-on component as it can be used in conditions where internet facilities are not viable or available and patient's loved ones need to be updated whether the patient has consumed his dose or not so instead of updating on the website it will send as small text

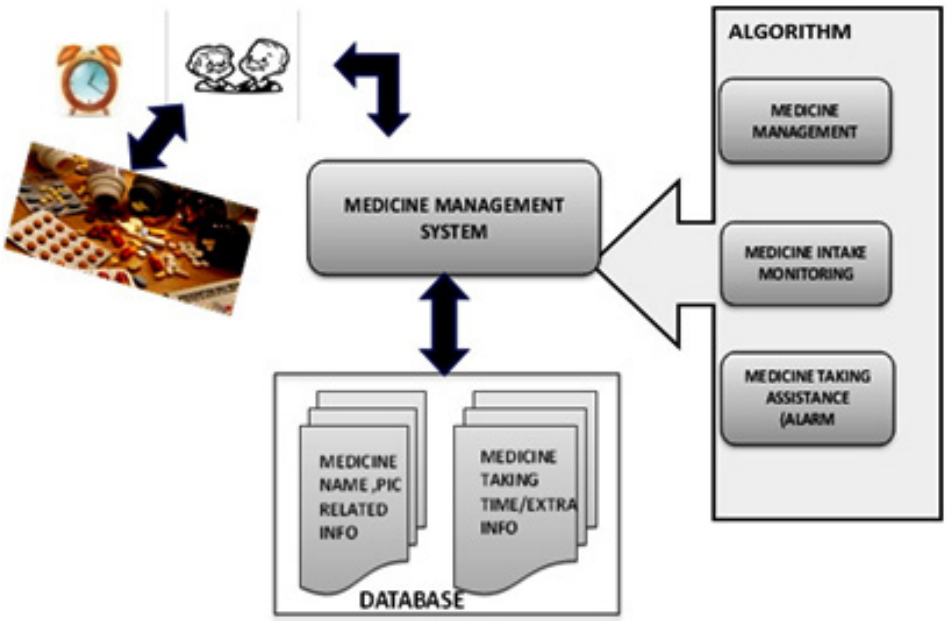

Fig. 5. Proposed Operating Scenario

message to concerned person informing him that patient has consumed his dose at a given time[17].

IOT Section: This section consists of database creation of patient dose intake history which is very useful for the doctors for patient's case study as well as it updates intake dose time on website live such that patient's loved one can also track details of patient's dose intake time though they are not present nearby, it is achieved by a simple text file creation which is triggered by IR sensor present in rack where medicine is kept, so the moment patient picks up medicine from the rack sensor's signal is halted and event of text file creation which includes time and date of dose intake is initiated which can be seen in below snapshots.

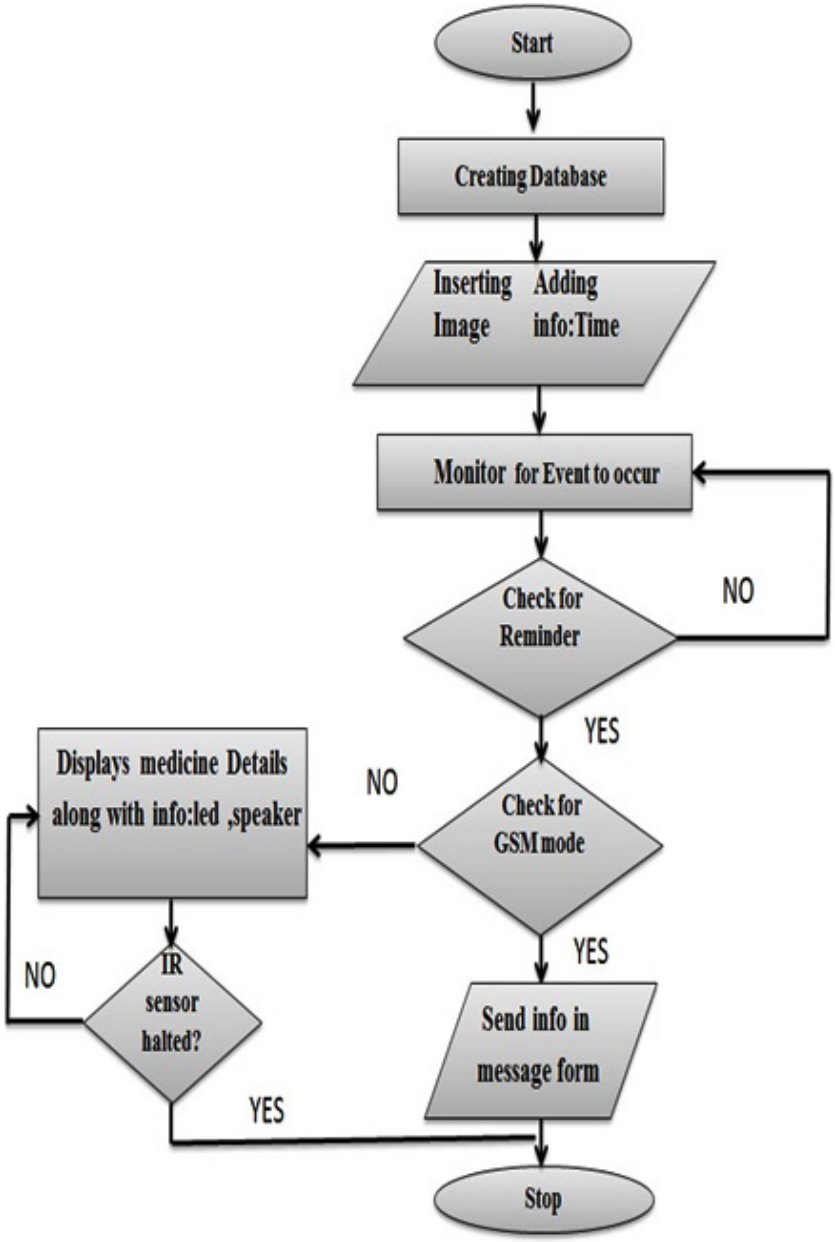

Fig. 6. Operating flowchart

RESULT AND DISCUSSION

In this section real-time functioning of the device is explained we can split the real-time functioning of the device into basic two-phase which show final outcome as well as how the outcome is prevailed with a detail discussion of every step as below:

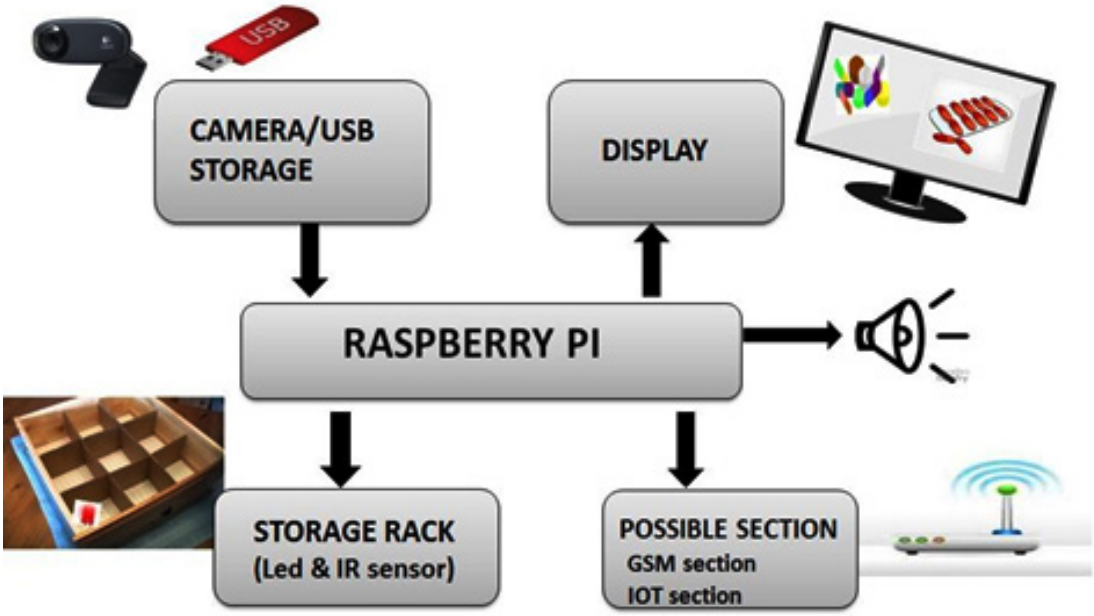

Fig. 7. System block Diagram

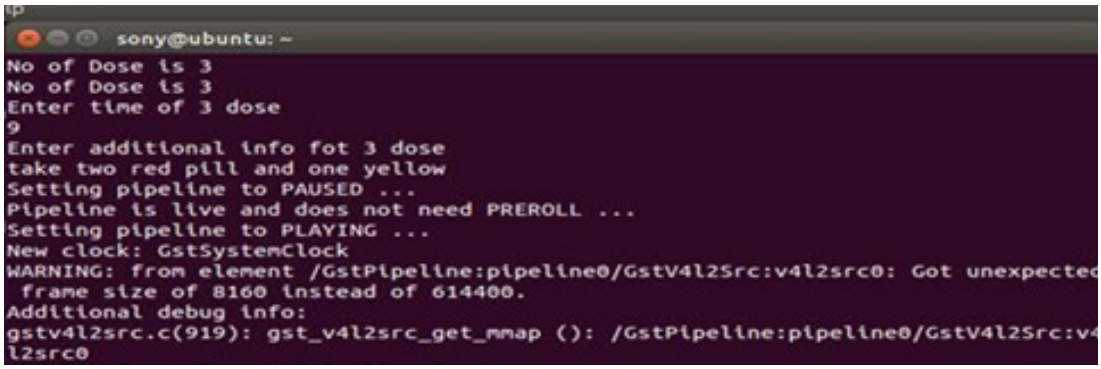

Fig. 8. In taking Dose information

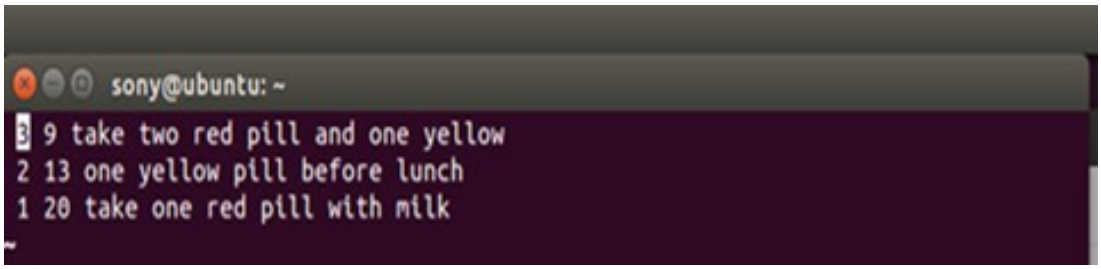

Fig. 9. Database created in file info.config

Triggering of the event or initializing of event

Initially, a database of patients is created which includes how much of dose is to be taken by the patient. The number of doses, the second data is at what time morning, afternoon, evening or night, third data can be consumed medicine before having food or after having food, or any special instruction if any, this all data will be heard as voice.

Along with database image of medicine present in rack along with time can be also stored. So now when time set for intake of dose a buzzer rings, after the patient is supposed to come and switch on display and along with that in background whatever details stored in data base regarding medicine can be heard, the image displayed will visualize how medicine looks as well as with what patient is supposed to intake it say in below three images different medicine photos are there one shows with light snacks , second

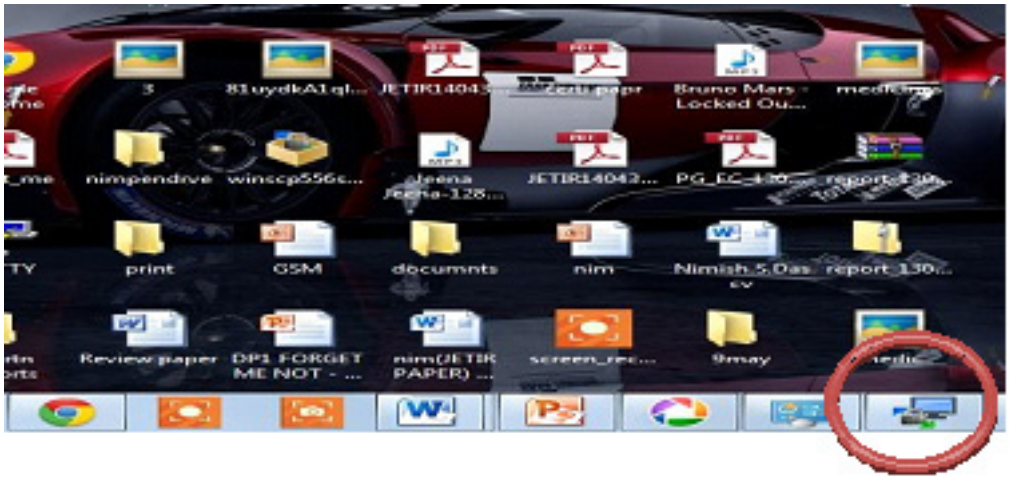

Fig. 10. Desktop shortcut creation for accessing Raspberry pi data

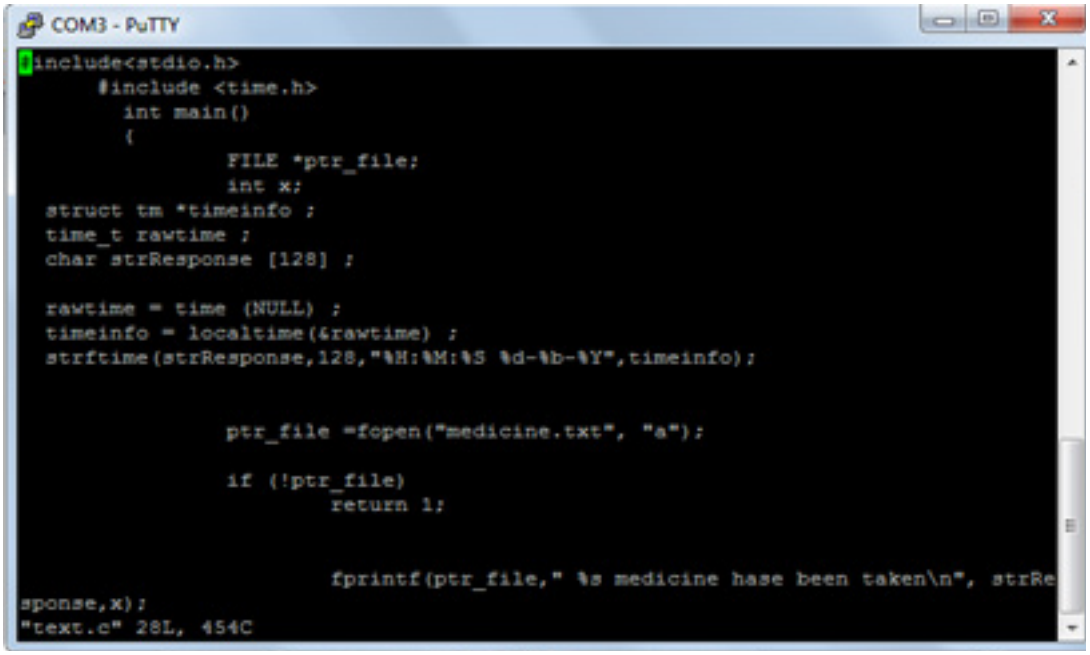

Fig. 11. Text file creation for maintaining a history of medicine intake patient

with meal and last one with milk. Images can be modified as you required and stored.

Along with display and voice assistance a led will also glow in the rack(shown in the red circled area) showing the right place to patient that from where topic right medicine, as there can be multiple racks which will depend on dose patient need to intake so we need led indication for indicating which side of rack medicine is there, as patient will see image of medicine which he is supposed to intake on display and then with reference to that image, he will pick medicine from that particular section of rack where led would be also glowing so patient gets double assistance and possibility of picking up wrong medicine is avoided.

Termination of event

As soon as the patient lifts the medicine strip from the rack as shown above there IR sensor is present which terminates the event as it indicates that the patient had picked upright the medicine and would have consumed it. Along with terminating event it also updates the time in the database, as well as time, which is also displayed on the website as shown in the below image indicatingthatpatienthadconsumedhis/herdosewhichcanbeseenbytheirlovedonewho are not present near them, there is also another algorithm working which reduces the count every time event gets over which help to count how many doses remains in strip and when it's to be refilled. In the proposed work Nginx as a webserver is used for data communication i.e. to save data and update on webpage, Nginx is an open source web server that includes reverse proxy, load balancing, mail proxy, and HTTP cache capabilities. Moreover, its free of cost which was beneficiary at time of development.[18]

Advantages or Benefits of proposed System

Basically, this system overcomes many hindrances for older adults to take medicine and also eradicates the possibility of any medical

Fig. 12. Time slot and meal base medicine Image for the assistance of the patient

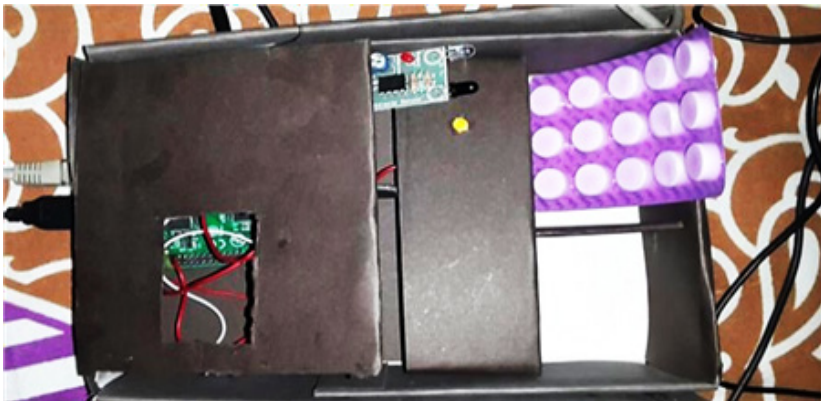

Fig. 13. Rack slot for holding Medicine

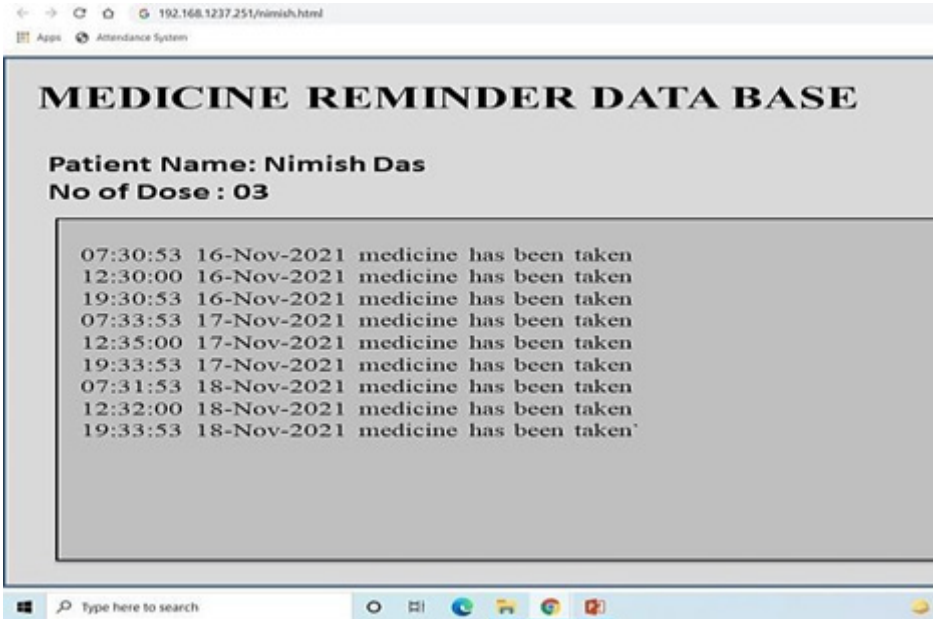

Fig. 14. Website displaying intake time of dose by patient

accidents. Each section has its own benefits as mentioned below. The buzzer is set to remind time of dose if TV is off, rest if TV is in on condition it will pop up reminder. The camera and USB section is utilized to input medic photos, as well as track patients' condition, live by accessing the camera remotely. The display helps patients to visualize details such type of dose in form of an image, a number of doses, a portion of each dose or some specific details such as medicine to be taken before or after lunch or dinner or with some specific add-ons, as some patient hearing ability is weak hence patient do not intake wrong medicine and follows right instructions and if the visual capability is weak text speech also runs side by side to display. Rack along with indicating led helps patients to take medicine and update on the website once the medicine is picked up so that it benefits the concerned person to know whether the patient has in taking a dose or not. Overall this system aids patients to take the correct medicine, with a prescribed number, at the prescribed time and with prescribed instructions along with maintaining a record of the patient's intake which can be utilized by doctors later.

CONCLUSION

This study aims to address the difficulties that elderly people have in taking their medication on a regular basis. Time management, dose differentiation, recognition of medicine, or remembering additional dose information are some of the common characteristics that have been identified through literature analysis and survey, and the work aims to address these issues, with help of a medicine holding rack which helps to pick correct dose, voice assistance which will provide a description and other details as voice tag for that person who cannot visualize details on the screen, display which will provide a description and other details in form of image or video on screen i.e tv screen and server updating of intake of medicine patient which will also create patient history dose intake for further analysis. Hence with a straightforward reasonable solution, the mentioned device will decrease damage to elderly people caused by incorrect medicine consumption or missing doses.

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