International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 6 June 2022, pp: 2355-2362 www.ijaem.net ISSN: 2395-5252

Smart Pillbox For Visually Impaired With Audio Reminder Using Iot

MS.PRAKRUTHI G R, SAHANA K S
Department of information science department of information scienceand engineering and engineering
East west institution of technology east west institution of technologybangalore-560010,india
bangalore-560010,india

Submitted: 15-06-2022 Revised: 25-06-2022 Accepted: 27-06-2022

ABSTRACT - The main purpose of this smart pillbox is to help the visually impaired people to take their medication individually. This paper discusses how the pillbox that can hold up to 9 different medications in small boxes with covers. The pillbox containers would then open upon the command of the patient's medical specialist through textmessages. They would send a text message to the prototype and set a schedule, which would then prompt the device to open at the said time. The implementation of this design allowed the patient to take their medications on their own. The testing results which are demonstrated and tested by the patient and with the researchers have confirmed that the hardware design works as intended. Results on the tests conducted showed one hundred percent success rate.

KEYWORDS--
BRAILLE,PILLBOX,MICROCONTROLLER,GSM MODULE, REAL TIME CLOCK.

I. INTRODUCTION

Blindness is the state of being unable to process any visual information, which could have been a result of an injury,disease, or even an inborn condition. People suffering from blindness would experience a great decline in their quality of life since sight is considered to be critical in most of the things that humans do and helps in motor coordination of the human body when performing tasks. Alleviating some pain points from the experiences of visually impaired through catering to their everyday routine is a very huge help on the struggles that they would have to face daily. It is difficult for visually impaired to take in their medications on their own, most likely they would need a caretaker or a relative to prepare their medications for them. Blindness is often be incurable, and for some cases, vision or sense of sight can be restored on a case to case basis depending on how the blindness of a person originated. Helping the visually impaired to be independent in taking in their medications can be a huge help especially if they take in maintenance medication on a routinely because they may be unable to tell when, where, or what type of medication they should be taking. Although some products have attempted to cater to the visually impaired that dispenses medications .
The intention of this paper is to guide blind patients in taking their medications by reminding them when and where their medications are currently located. Since visually impaired patients may have difficulty in telling time or where their medications are, they constantly need to be reminded unless there is a caretaker to do so. If the patient does not have access to a caretaker, it becomes a huge problem for them who may need to drink different medicine at different points of the day.

Braille is the disposition of raised dots that can be read using the fingers of the individuals who have visual impairments. There are 2 different ways to write using Braille, grade 1 or uncontracted and grade 2 or contracted. Most story books for children are written in grade 1, while grade 2 is used for reading materials meant for adults. Contrary to popular belief, Braille is not a dialect. Rather, it is a code by which numerous dialects might be composed and read. Braille code was created by a blind youth named Louis Braille at the age of 15.

II. PROPOSED SYSTEM

In day to day life, people have trouble remembering the pills they need to take from the medicine bag. Multiple times the problem is that the time required to take the medicine is not known or they can't see because of they are visually impaired. People also have a habit to forget to take the pills. Due to this,some medicines expire.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 6 June 2022, pp: 2355-2362 www.ijaem.net ISSN: 2395-5252

The developed system will remind and aid patients who suffer from blindness of the medication they are to take. The Braille printed on the top of the pillbox lid will serve as information to the patient to differentiate one the pillbox from the others. A speaker was added to provide a sound reminder to the patient when it's time to take medicine.With these innovations, the researchers hope to reduce the patient's dependence on others to remind them of taking their medicine.

The objectives is to develop a pill container that can open at set times while playing an alarm through a speaker and send an SMS message notifying the medical specialist that the lids are opened or closed. With this in mind, the following are the specific objectives of the said study: (1) to design a speaker configuration that can output audio around 1kHz to prevent the speaker from producing a distorted sound while producing a loud audible sound; (2) to individually determineif the pillbox is opened or closed (3); to send an SMS text message to the medical specialist whenever the pillbox is opened or closed; and (4)to automate the opening of pillboxes at set times that are set by the medical specialist.

III. METHODOLOGY

The system was created by determining the main concerns of the visually impaired person who will be using the said device.The development was divided into different parts. First, the researchers developed a conceptual framework that showed the researchers how the flow of a prototype would work. A block diagram was developed to study how different interconnections of components would work with each other to develop the system. Afterwards, hardware development would take place wherein we develop a case for the developed prototype as well as the circuitry for the system then prototypedevelopment would take place.

Conceptual Framework - The conceptual framework of the system is shown in Figure 1. The user must set the timer for the alarm along with the medicine that must be inserted into a certain pillbox container. In the process area, the data for the alarm timer is then executed, and converted in preparation for the output text message.

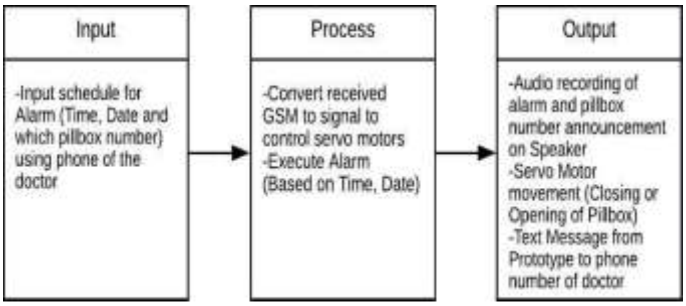

Fig 1. conceptual framework

After the timer for the alarm expires, an audio recording of the pillbox's number will be played through the speaker with the servo motors opening the lid indicating that the medicine must be consumed immediately. The lid will close a few minutes later.

patient required i.e. if the user wants to set 8.00 am as its morning medicine taking time then they can do with the help of this module.

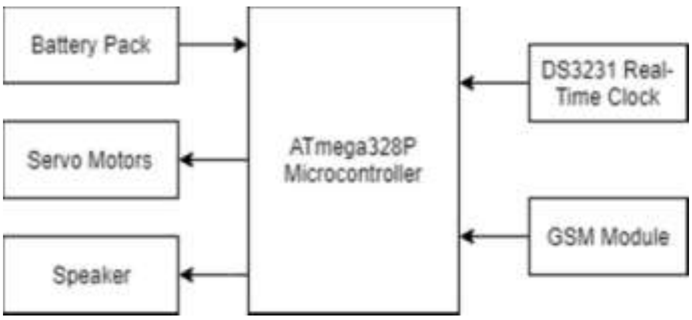

Fig 3. Block diagram

Block Diagram - The block diagram of the system consists of the ATmega328P Micro-controller, Battery Pack, Servo Motors, Speaker, DS3231 RTC, and theGSM Module.The ATmega328P micro-controller acts as the main component of the device. It controls the servo motors for operating the pillbox's lid. The battery pack is used to power the whole system. DS3231 RTC is used for comparing the inputted time in real-time. The speaker is used as an output device to indicate which container will open. The GSM Module is used for communication using text messages.

MAJOR COMPONENTS USED ARE:
ATmega328P: This acts as the brain of the system. It is responsible of controlling the servo motor in operating the pillbox lid. And it is also responsible for sending the signals and receiving them to make the system functional.

Servo motor: Servo motor is responsible for opening and closing of the lid of the pillbox with 3D printed on it.

Battery: The battery servers as the device's power source allowing the portability with the pillbox container as well.

GSM Module: GSM (Global System for Mobile Communications, originally Groupe Special Mobile), is a standard developed by the European Telecommunications Standards Institute (ETSI).It was created to describe the protocols for second generation (2G) digital cellular networks used by mobile phones and is now the default global standard for mobile communications – with over 90% market share, operating in over 219 countries and territories. The SIM800L module supports quad-band GSM/GPRS network, available for GPRS and SMS message data remote transmission.
DS3231 RTC:Real Time Clock (RTC) module uses the DS1307 to keep track of the current year, month, day as well as the current time. It includes small lithium coin cell battery that will run the RTC and can be accessed via the I2C protocol.
Speaker: The speaker is used to give off an auditory alarm or notification indicating that a pillbox is to be dispensed at a said container.

Hardware Development - The ATmega328P acts as the brainof the whole prototype and controls and correlates other IC pins that would then later on further enable the other functionsof the prototype.

The pin configurations on the ATmega328P are composed of 6 digital and 6 analog inputs wherein the necessary pin connections are properly connected towards other components. For example, port bit 0 or pb0 is connected to a 10k ohms resistor which can then produce the necessary current for the speaker to flow, while a base- emitter is attached on the other end to properly ground the circuit. A further iteration of this to prove the design is to replace the simple buzzer by a speaker wherein the researchers could formulate or rather calculate what would be the best lower and upper cut-off of current levels to supply the appropriate amperes on the amplifier to prevent the sound from being too distorted. However, this defeats the purpose of providing the optimal solution towards the needs while lowering the cost of the proposed project.

The GSM module is essential in the proposed project to accomplish objective 3, which is to deliver text messages or prompt to the medical specialist, patient or the caregiver of the patient which tells them what pillboxes were taken out of the case and at what time, making it an effective way to monitor whether the patient has properly taken their medication. This GSM module that will be used will be a SIM800L Module that allows quad band configuration, for the use case on this prototype, the configuration is set to be used with any 2G SIM card that will work globally, each message that needs to be send would only take up 15 characters or 15 bytes for each transmission, a single message that would be less than 160 bytes would need 1 PHP or 0.02 USD phone credit from the sender. This means that the device does not need any credit for it to work as the credit will be charged from the doctor or the one initiating the command through text. It is also worth noting that, it is written in the scope and limitation 2 that the prototype would only serve as a reminder and if the patient takes the pillbox out of the case then it would register or consider that the patient has taken the pillbox intending to take their medication. As a result, the GSM module is toggled on or off through its pin 1 or the PWRKEY which is connected to PD4 of the ATmega328P microprocessor since PD4 can serve as another external interrupt source. The external interrupt source would be the GSM module, hence justifying it being tapped on pin PD4. Since the main functionality of the GSM module is to simply transmit messages and not necessarily do phone calls or other functionalities that a basic phone could do, it would only need the TXD and RXD pin which can be found on pin 9 and pin 10. The transmitter or the TXD is connected to PD0 of the

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 6 June 2022, pp: 2355-2362 www.ijaem.net ISSN: 2395-5252

ATmega328P microprocessor, which is the receiver of the ATmega328P. The RX pin of the ATmega328P is then connected towards the TX pin of the GSM module for them to have 2-way communication. This goes the same for the RXD pin of the GSM module which isconnected to the PD1 pin of the ATmega328P module transmitter. With this set up the GSM would now becapable of receiving and sending text messages. This will rely heavily on coding the microprocessor to provide the proper prompts of messages that the patient or the caregiver has to receive.

Prototype Development - After assessing the whole process of the whole prototype assembly and creation in both hardware and software components, the researchers proceeded in the actual process of creating the prototype. For the device, the researchers have used the ATmega328P as the main processing unit for the prototype which would then be communicating with the sim800L GSM module alongside checking for the clock pulses of DS3231 RTC to determine the current time on the system. Powering the system is a battery pack that would be connected to the main board of the system. The ATmega328P is also responsible for telling when the servo motors would move supplemented by the time provided by the RTC. The next step is to develop and design the schematic diagram as to how the components will be wired together to prepare for the PCB development. The PCB is shown in Figure 3.

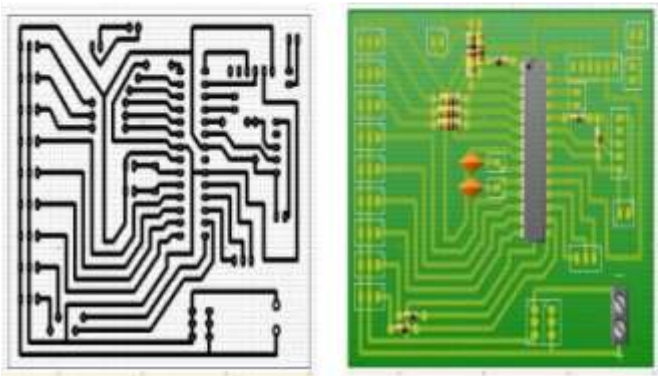

Fig 3. prototype deployment

The PCB has been drafted and created with the use of PCB Express software. The researchers then proceeded to the development of the PCB layout encompassing connections between the ATmega328P alongside other necessary components to ensure the proper functionality of the prototype. After the development, etching, and soldering ofthe PCB, the researchers then tried and tested out the prototype tosee if the objectives of the prototype have beenmet.

Fig 4. Casing design

The prototype is then 3D printed with Figure 5 model and assembled. In the dimension of the prototype, the researchers estimated of 7-10 days to finish the said printing and have the prototype finished. The prototype would feel like a regular box or a cube when held at hand with the pillboxes opening and closing depending as to what the medical specialist would set. All the patient has to do is to simply touch the top of the pillboxes to determine whether they have the right pillbox and take the medicine from it.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 6 June 2022, pp: 2355-2362 www.ijaem.net ISSN: 2395-5252

Fig. 5. Pill containers which acts as lid

In Figure 6, this shows what the end user interact with while using the said device. The device consist of 9 different lids to store the medications and on the top of it there is a 3D braille print where the end user can use to interact.

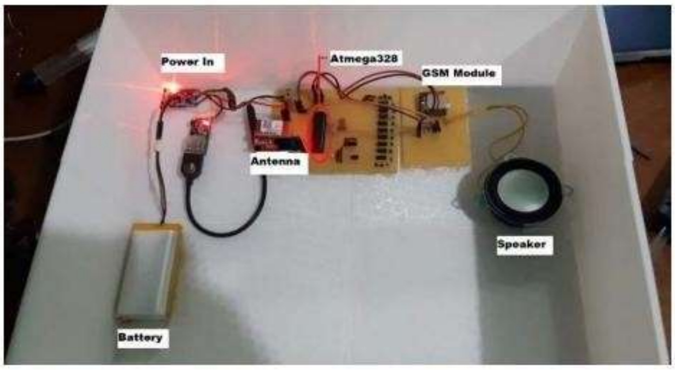

Fig 6. Underlying the components

The Figure 7 shows how the components are connected toeach other. Some of the components are highlighted and it shows how the components makes movement of the motor,once attached possible. Several components are highlight in this picture which enables the prototype to function as intended.

Fig 7. Braille medication container (opened)

In Figure 8, the container lids are shown to be closed which protects the medicine placed inside from external dirt, once a schedule is set and the prototype has processed the command sent

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 6 June 2022, pp: 2355-2362 www.ijaem.net ISSN: 2395-5252

through the text message and the schedule has matched with the set time,it will play the audible beep and would lift the cover automatically.

Fig 8. Braille medication containers (closed)

The figure 8,the container lids are shown to be opened which indicates the patients to take the tablet. The lid will close automatically after 5 minutes. And the braille printed on it todifferentiate one from other.

V. RESULTS AND DISCUSSION

The developed device is tested based on the 3 different condition, the device audio test, device GSM reception test, and lastly the pillbox motor opening and closing test. The test follows the following basic assumption. (1) the device is kept in the location where the signal coverage is high. (2) the user have enough load balance to their mobile phone.(3) the device is completely charged.(4) the servo motor are not obstructed by any means.

DEVICE AUDIO TEST: The test is conducted concerning the objectives stated in the study. The testing is verify that the speaker produces an audible sound for the alarm. The sound produced as 1kHz frequency, which is included in the human hearing range frequencies (0.02kHz-20kHz). Table 1 shows the test of audio.The device receives the text message with the consideration that the GSM module can receive signal in the prototype's location, it would then produce an audible beep indicating that the schedule is set which was executed properly during testing. This test mainly focuses on the functionally of the speaker.

Table I. Results for Device Audio Test

Trial	Set Alarm			Confirmation (YES/NO)
	Day	Time	Pillbox Number	Alarm Sound
A	M	13:00	1	YES
B	T	13:00	2	YES
C	W	13:00	3	YES
D	Th	13:00	4	YES
E	F	13:00	5	YES
F	S	13:00	6	YES
G	Su	13:00	7	YES
H	M	13:00	8	YES
I	T	13:00	9	YES
Success Rate				**100%**

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 6 June 2022, pp: 2355-2362 www.ijaem.net ISSN: 2395-5252

DEVICE GSM MODULE TEST: the device GSM receptiontest , shown in Table 2, is done to test the specific objective allowing the device to schedules on mobile devices through the use of the GSM module. This goes hand in hand with the testing with Table 1. This test checks whether the GSM module functions as intended and receives the said textmessage.

Table II. Results for Device GSM Reception Test

Trial	Set Alarm			Confirmation (YES/NO)
	Day	Time	Pillbox Number	"Schedule Set" is Played Indicating Reception of Text MSG
A	M	08:00	1	YES
B	T	08:00	2	YES
C	W	08:00	3	YES
D	Th	08:00	4	YES
E	F	08:00	5	YES
F	S	08:00	6	YES
G	Su	08:00	7	YES
H	M	08:00	8	YES
I	T	08:00	9	YES
Success Rate				100%

PILLBOX MOTOR OPENING/ CLOSING TEST : The **pillbox motor test as shown in Table 3 is done to verify whether each pillbox opens or closes when a schedule has been set through the medical specialist or caretaker's device. Once the scheduled time is met the designated pillbox should open and close after 5 minutes. This test focuses on the device motor and whether the ATmega328P has processed the text message.**

Table III. Results for Pillbox Motor Test

Trial	Set Alarm			Confirmation(YES/NO)
	Day	Time	Pillbox Number	Correct Pillbox Number and Expected Opening /Closing Occurred
A	M	18:00	1	YES
B	T	18:00	2	YES
C	W	18:00	3	YES
D	Th	18:00	4	YES
E	F	18:00	5	YES
F	S	18:00	6	YES
G	Su	18:00	7	YES
H	M	18:00	8	YES
I	T	18:00	9	YES
Success Rate				100%

The three tables above showed the various tests conducted to determine the accuracy of the functionality of the system based on the objectives stated in the study. The pillbox systemcontains nine different containers available. The test were conducted all the days in the week on different interval times. The "yes" answer in each test denoted that the device produces the expected result while a "no" answer means the result was negative. Results showed that all tests conducted produced "yes" results or success rate of 100% . The success rate is calculated using the Equation given below,

$$SR=R*100$$

Where, SR denote success rate, R denote result.

VI. CONCLUSION AND FUTURE WORKS

This study aimed to address the specific need of a patient which is to provide a way for the patient to be indentured when it comes to taking their medications even if they have visual degradation. The patients are said to be take multiple medications and goes to the medical specialist weekly for a check-up. The developed system thus hold nine different medication inside and the braille printed on the top help the patient to take said medicine on said time. The pillbox has successfully played the sound through speaker and MP3 player component in the prototype , and it can also respond and receive text schedules for the patients medication time. The prototype was able to complete all of the objectives that were set for the design.

The system can also be designed for web-based or online based scheduler where the medical specialist is more adept at using the internet instead of GSM - based scheduling, which also helps if GSM signal is hard to be detected in the area which can be achieved through the development of a web application or a web portal wherein the device could be connected to the internet and receive the commands depending on the doctor's judgement and action on the web application. Such as adjustment of scheduling for medications depending on the patient's needs.

REFERENCES

[1] W. Antoun, A. Abdo, S. Al-Yaman, A. Kassem, M. Hamad, and C. El- Moucary, "Smart Medicine Dispenser (SMD)," 2018 IEEE 4th Middle East Conference on Biomedical Engineering (MECBME), Tunis, 2018, pp. 20-23. doi: 10.1109/MECBME.2018.8402399

[2] G. A. Mugisha, F. Uzoka, and C. Nwafor-Okoli, "A framework for low-cost automatic pill dispensing unit for medication management," 2018 IST-Africa Week Conference (IST-Africa), Windhoek, 2017, pp. 1-10. doi: 10.23919/ISTAFRICA.2017.8102411

[3] M. J. Samonte, E. D. Laurente, K. M. Magno, and C. Perez, "Braille3D: using haptic and voice feedback for braille recognition and 3D printing for the blind," IOP Conference Series: Materials Science and Engineering, vol. 482, p. 012027, Nov. 2019

[4] L. A. D. Arbes, J. M. J. Baybay, J. E. E. Turingan, and M. J. C. Samonte, "Tagalog text-to-braille translator tactile story board with 3D printing," IOP Conference Series: Materials Science and Engineering, vol. 482, p. 012023, Nov. 2020.

[5] Juan Marcelo Parra 1, Wilson Valdez, Andrea Guevara, Priscila Cedillo,Jose Ortiz Segarra,"INTELLIGENT PILLBOX: AUTOMATIC AND PROGRAMMABLE ASSISTIVE TECHNOLOGY DEVICE",Proceedings of the lASTED International Conference Biomedical Engineering (BioMed 2017).

[6] J. P. S. da Silva, D. Schneider, J. de Souza,and M. A. da Silva. A role- playing-game approachto accomplishing daily tasks to improvehealth. In proceedings of the 2013 IEEE 17thinternationalconference on computer supportedcooperative work in design (CSCWD), pages350–356. IEEE, 2013.

[7] Medisafe iConnect, an Affordable SmartPill Management System Apr.2016. URLhttps://www.medgadget.com/2016/04/ medisafe- iconnect-an-affordablesmart-pill-management-system.html.

[8] "An Electronic Pillbox for Continuous Monitoring of Medication Adherence",Tamara. L. Hayes, Member, IEEE, John M. Hunt, Member IEEE,28th IEEE EMBS Annual International Conference New York City, USA, Aug 30-Sept 3, 2006..

[9] C. Fărcaş, I. Ciocan, N. Palaghiţă and R. Fizeşan, "Weekly electronic pills dispenser with circular containers," 2015 IEEE 21st International Symposium for Design and Technology in Electronic Packaging (SIITME), Brasov, 2015, pp. 125-129. doi:10.1109/SIITME.2015.7342308

[10] M. M. Garcillanosa, K. N. T. Apuyan, A. M. Arro, and G. G. Ascan, "Audio-assisted standalone microcontroller-based Braille System Tutorfor Grade 1 Braille symbols," 2016 IEEE Advanced Information Management, Communicates, Electronic and Automation Control Conference (IMCEC), 2016.