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Ibox: Smart Medicine Box With Iot Application

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Abstract

The routine in taking medicine or any health supplement pills has become a common situation within the society. Due to the hectic daily activities, people are easily forgot the right time and what medicine to take. This paper presents an original and secured medicine product prototype based on IoT, and the proposed system is designed to help such user to take the essential medicine in the right ratio at the right moment with the support of smart devices as medicine dispenser and its applications. Meanwhile, this proposed IoT application allows users to keep track of the relevant statistics that will be connected to the Internet and protects the privacy of the user data in transit with its system. It is inbuilt with a NodeMCU for alerting the user to take medicine by buzzer and notification and connected to the Blynk software for setting the reminder and storing the data logger.

Keywords: Medicine box, NodeMCU, IoT, Database, Blynk, ThinkSpeak.

1. INTRODUCTION

As a matter of facts, people take vast amounts of medication to ensure that one may have a better life quality. It is notably true amongst older people and patients, who tend to have intricate medication routines. Therefore, people tend to have adversity in following those routines, which can lead to inaccuracy when taking medication, a compilation that can cause serious health consequences resulting from increasing age. The key target is to design a smart medication dispenser to stimulate the treatments of older people and patients that can notify the users to take the medication. In other words, a medium that allowed them to accompany the compliance with the treatment remotely. This project appears as a solution that caregivers could easily use as well.

For instance, it is considering jobs society do which result in any illness that leads to forgetting the essential things throughout the daily routine, more specifically their age plays fundamental roles. As a result, society has a hardship due to the illness where it is compulsory to take medicine at the proper time. Thus, the technology of the home health care device among them is a smart medicine box with a reminder; it follows that

some enhancement regarding the authentication and added features should focus on this project.

Besides, this device component includes some aspect like communications and human phone interaction in technologies, regimen, and supervise users without discouraging health quality of patients [1]. By developing this low-cost communication and analytics device which have a feature of real-time monitoring internet, it is possible to check and keep track of a patient's medication consumption pattern. The IoT provides ongoing, and therefore data transmission of patients has secured from a source point to destination for remote monitoring in a real-time consumption of the user's medication. Thus, there is an obligation for the planning of a low-cost embedded platform for monitoring/application.

2. LITERATURE REVIEW

This section is discussing on some of the variation of product available in the market and some projects developed by other researchers. Even though the medicine boxes have been in the market, whether it is manually or automatically, many different models can already be found with a wide range of different functionalities and intended for different uses and contexts.

Medminder

Medminder is a product that use for dispensing pill. Figure 1 shows the physical of the product which have 28 compartments with days and number of rows [2]. The operation is simple the pharmacist will transfer the patient's prescription to the pharmacy under Medminder. Then, it will pack a tray of pills in a package and delivered it to their customers. The tray will be loaded in the Medminder pill dispenser as shown in Figure 1. Lastly, the product is ready to use with the reminder and monitoring services [2].

Figure1: Medminder physical body

HERO

HERO is a smart product that suitable for personal and home use that stores, dispenses, and manages pills as shown in Figure 2 [3]. It is a non-moveable machine where it sits on your desk and can contain up to 10 unique pills. The loading process is very easy and

require no technical knowledge. The pill is refill in the cartridge and slide it back in. Sorting is now a thing of the past, just pour each pill into its own vial and done. It can hold over a month's offer of 10 completely different pills. Other than that, it is lockable, and password protected product. HERO warns the users if the pills is running low and can order refills [4].

Figure 2: Hero product

Tricella

The Tricella Pillbox is a small and compact product that could detect if the users forgot to take the pills or took the wrong ones as in Figure 3. This can be done by connecting the product to the smartphones. As a result, it will make it easier for families to stay connected and give the help needed to stay healthy [5]. In addition, LED notifications and smart sensors in each pill drawer tracks and reminds when it is time for a dose. With up to six months battery life, the Pillbox is prepared to travel anywhere. They sort their pills into the pill drawers based on what they need to take a given dose interval [6].

Figure 3: Tricella overview apps

ECE 4760 (Smart Medicine Box)

This ECE 4760 is a project of a microcontroller-based smart medicine box using Atmel 1284p MCU. Its targeted users who routinely take drugs or vitamin supplements and nurses who take responsibility for the patients. The project is programmable that

acknowledges nurses or users to specify the tablet amount to consume and the serving time for each day. It contains seven separate sections. This project would significantly loosen nurses or users' responsibility for regularly preloading tablets for patients or users as shown in Figure 4 [7].

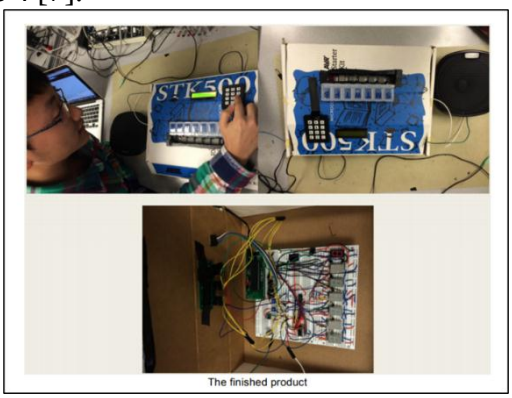

Figure 4: Prototype of ECE4760

The Smart Medicine Box (SMB)

Introduce the Smart Medicine Box (SMB), which is a model utilized by patients, nurses or yet users who tend of older people. The SMB is produced to enhance medication acquiescence and links it to an application installed on a PC. The software connected to the phone for more accessible convenience. The system divided into three main elements. The first one is the microcontroller which connected to all the hardware parts. Then, the second part is the software which represents the control unit connected on the PC. It connected to the hardware components to control the input and output of the project. The mobile app is the final part. The mobile app presents the number of medicines in each section. Every system part is wirelessly joined using the XBee module [8]. Figure 5 shows the finish prototype.

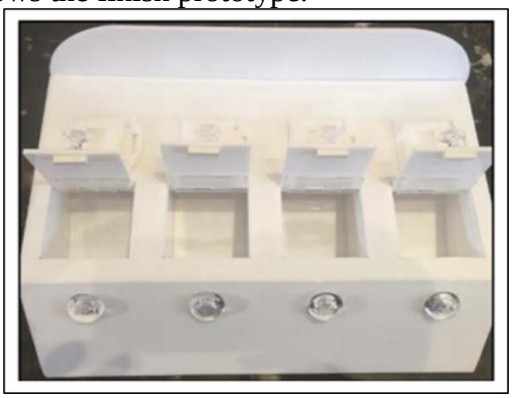

Figure 5: Prototype of SMB

3. METHODOLOGY

Design

The development of this iBox starts with the sketch design. Due to the factor of practicality, a box design is chosen with the consideration to fit the microcontroller chip on the box. The initial sketch design and the actual medicine box can be referred to Figure 6.

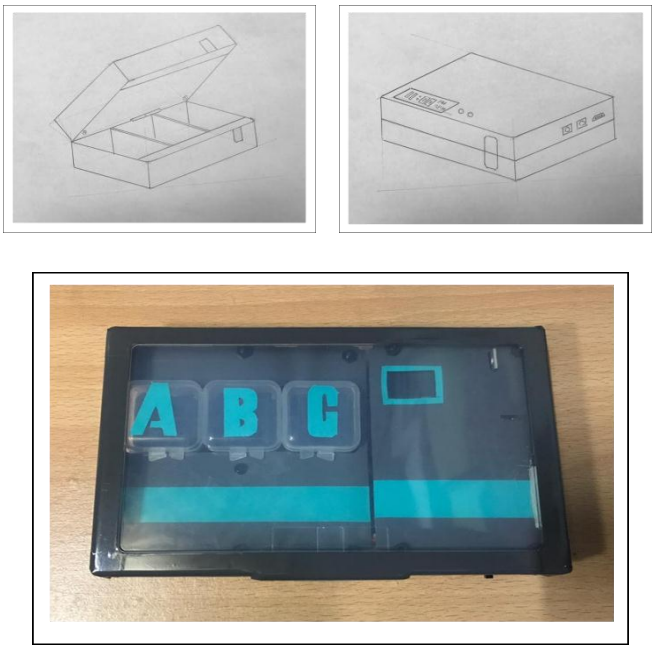

Figure 6: Initial sketch design (top) and actual Smart medicine Box (bottom)

Electrical components and connection design

The iBox was developed with the combination of few input and output electrical components. Table 1 shows some electrical components used for iBox with is functionality.

Table 1: electrical components and its functionality

Electrical component	**Function**
Magnetic switch	To detect the action of opening and closing the iBox cover.
LDR	To detect the action of taking the medicine.
NodeMCU ESP-12E	Act as the main controller and sending the peripheral components status via internet.
LiPo battery	Main power source that able to make the iBox portable.
Buzzer	To produce sound as to alert the user.
OLED Display	To display message and current status of pill's schedule.
LED	To notify the status of iBox.

The overall system block diagram can be referred to Figure 7.

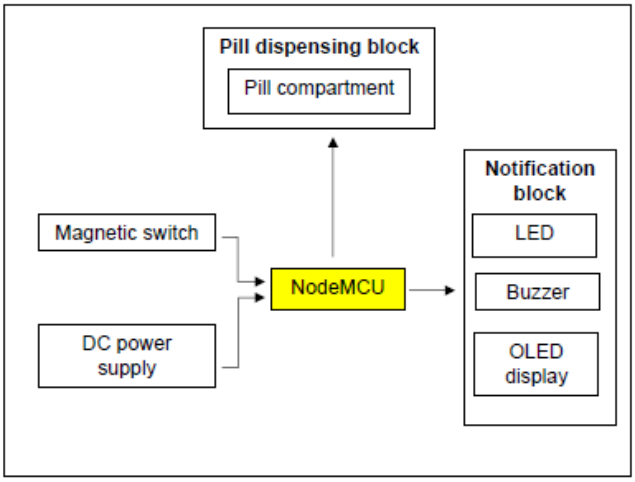

Figure 7: overall system block diagram of iBox.

It can be observed that the Node MCU is the main controller where it received information from the magnetic switch and LDR (at pill compartment). The information is processed and the suitable status is displayed at the notification block.

System flowchart

Figure 8 shows the iBox system flowchart. The program sequence is simple and did not requires huge memory allocation. The user will set the time according to the medicine scheduled by the doctor by using the Blynk apps. Then, if the time is correct it will notify by 2 notification, LED and buzzer is on. If the user takes the medicine, the data will be stored in the cloud and this is triggered by the reed switch.

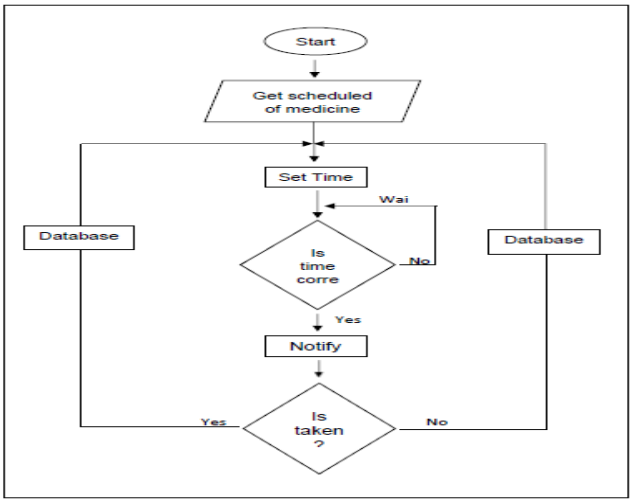

Figure 8: iBox system flowchart

Software development

For the software development section, it will consist of all the application use for developing the coding and the apps for the phone. The Arduino IDE is used to developed the code for NodeMCU and Blynk is as the user interface.

Generally, Arduino software is an open-source electronics environment consist of software and hardware that make it easy to write and upload code to the board with the help of NodeMCU-compatible microcontroller. The Arduino software consist of integrated development environment (IDE) and the core libraries.

Mobile application used for implementation of Internet of Things (IoT) is Blynk App. The Figure 3-21 shown below is the logo of the Blynk. It is available for both operating system android and iOS. Blynk is user-friendly IoT platform that can be connected to any shield or board. It is easy to use and build with the widget available.

4. RESULTS AND DISCUSSION

Figure 9 shows the final design of the smart medicine box. As can be observe in the figure, the pill container are placed separately with an LED indicator. The controller of the system is located at the right side of the Smart Medicine Box.

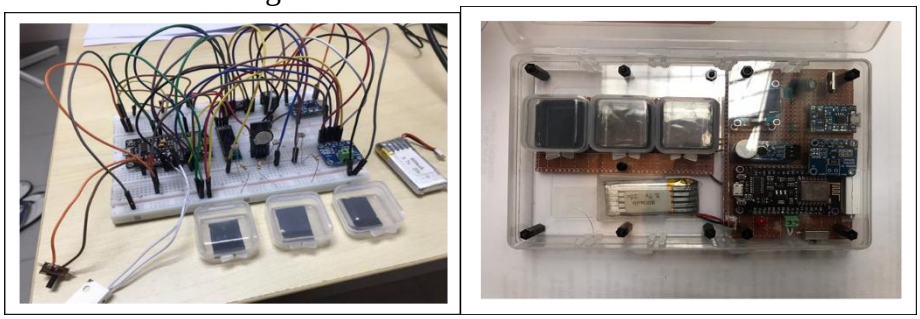

Figure 9: Wiring testing (left) and final hardware design (right)

Blynk development

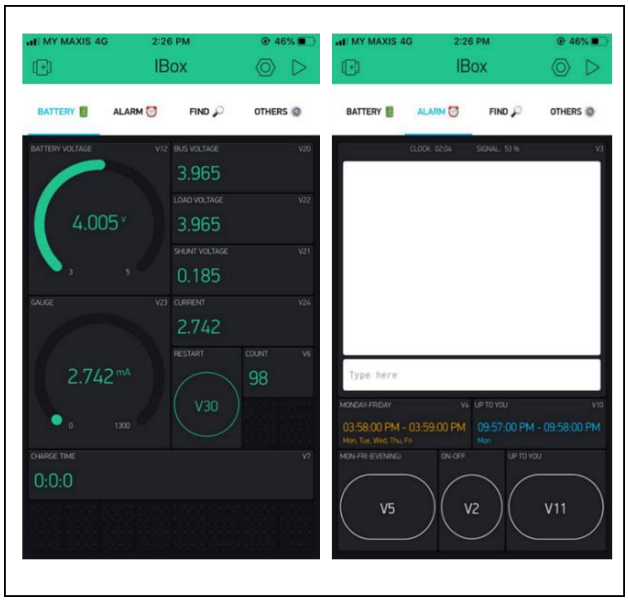

Figure 10: Final interface on Blynk application

ThinkSpeak development

For ThinkSpeak, before making the real with soldered component. It is a good practice by doing simulation on a software. The software that use is Proteus. This is to show how the function should look like and make sure the LDR can send data to the ThinkSpeak as the users lift the pillbox. The simulation on Proteus can be referred to Figure 11.

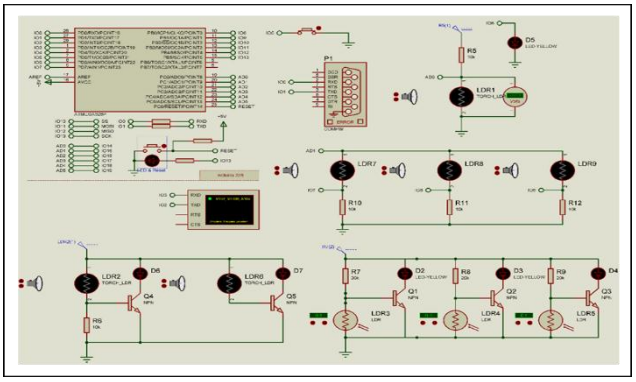

Figure 11: Simulation on Proteus

Arduino IDE development

For software development, the primary function is to make the device communicate with the project via Wi-Fi. The objective is satisfied as this the prototype already fulfils the two problems that arise which are, scheduling and real-time monitoring of data.

Blynk Testing

In this project, NodeMCU has been used to enable the microcontroller to connect to Wi-Fi network and make simple IP connections. Figure12 shows the offline notification and Figure 13 shows all the possibilities of the notification in Blynk.

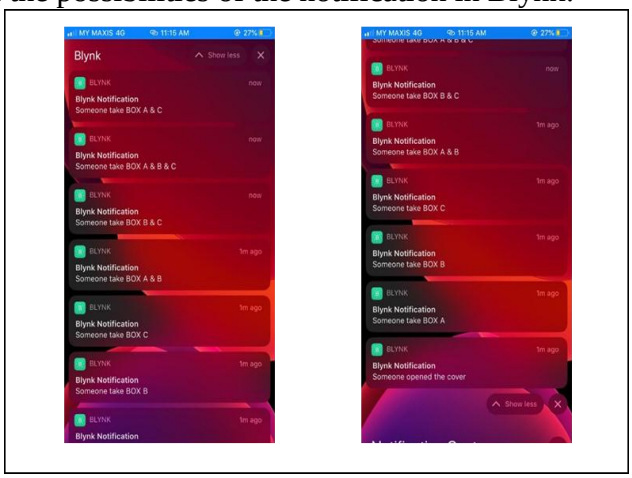

Figure 12: Offline notification

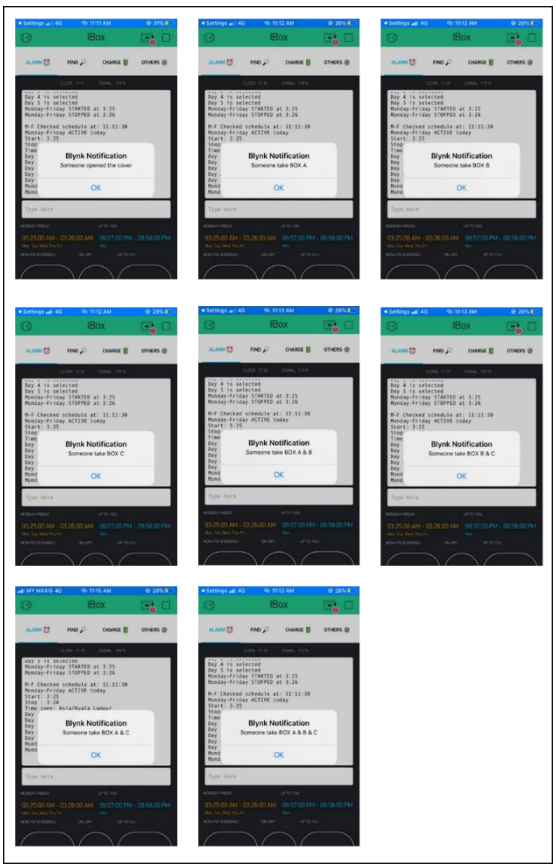

Figure 13: Notification Blynk

ThinkSpeak Testing

In testing the ThinkSpeak connection, Figure 14 is the data plotted in a line graph to shows the relationship between the ThinkSpeak and Blynk.

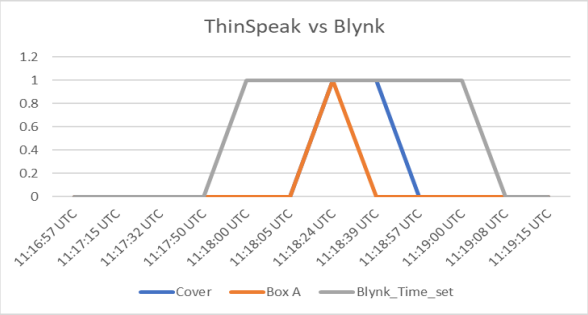

Figure 14: ThinkSpeak and Blynk time connect for iBox

By looking from the graph, it can be observed that the pattern of the data transferred in between maximum 30s range. We can examine and study the users' pattern of consuming medicine. Thus, it helps the doctors and researchers to improve the way of consuming medicine.

Table 2: Read value of the status of each reed switch at the medicine slot

Time	Cover	Field2, Box C	Field3, Box B	Field4, Box A
2019-10-30 11:16:03 UTC	0	6	4	0
2019-10-30 11:16:21 UTC	0	46	27	13
2019-10-30 11:16:38 UTC	0	47	27	12
2019-10-30 11:16:57 UTC	0	83	54	29
2019-10-30 11:17:15 UTC	0	107	75	39
2019-10-30 11:17:32 UTC	0	86	41	18
2019-10-30 11:17:50 UTC	0	45	22	10
2019-10-30 11:18:05 UTC	0	53	43	29
2019-10-30 11:18:24 UTC	1	33	7	65530
2019-10-30 11:18:39 UTC	1	34	12	2
2019-10-30 11:18:57 UTC	0	43	19	6

Figure 14: ThinkSpeak multiple update

Table 2 shows the read values from the iBox cover and the pill slot in which the reed switch and the LDR are used as the indicating reading value. On the other hand, Figure 14 shows the update observed from the ThinkSpeak. Even though the data update in ThinkSpeak is delay by 15s (maximum 30s as it is a free database) but still the data that is collected is enough to say the users time taken to take medicine is consistent. For instance, users set a reminder at 11:18 am, and the data obtained in ThinkSpeak is at 11:18:24 am, which is under the 30s, and the data update next is on 11:18:39 am, which is 14s. The data update shows consistency and precision between range $14 < s < 31$. If the data for reed switch shows 0, then the cover is closed or else if the data shows value 1 means that the cover is open. For data in field2, field3, field4, which is LDR. The data higher than 65000 explain that the pillbox lifted and if the data is lower than 1000 shows that the pillbox is in the original position.

5. CONCLUSION

This paper has presented the method of integrating the IoT into the medicine box. The presented project could become a guideline for anyone especially who is new in applying the IoT . By applying the IoT concept, a real time reminder and notification can be created in assisting user for his medicine taking routine.

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