Imperial Journal of Interdisciplinary Research (IJIR)
Vol-2, Issue-5, 2016
ISSN: 2454-1362, http://www.onlinejournal.in

Smart Medicine Box

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Abstract: *Proper Medication is necessary to become a healthy but failure of that can create big trouble for a patient. This is extremely problematic for the elderly patient who had problem in keeping track of their medicine. So to overcome this we made this Smart Medicine Box which keep tracks of the dosage and duration between each consumption. Poor eyesight as one of the contributors for medicine consumption errors such as misdosage since the elderly finds it troublesome to read the instruction on the medicine case and identifying the right dosage of the medicine along with that Memory loss is common in old age due to that decrease in speed of information being retrieved. Hence, this Smart Medicine Box will track their medication and inform patient to take right dosage of right medicine at the right time.*

Keywords*:-Smart Medicine Box, Pill box, Medicine dose tracker, Frdm-kl25Z.*

1. Introduction

The medications you have been prescribed are more likely to be effective if you follow your doctor's exact instructions on when and how to take them. Your doctor has prescribed a particular medication because he or she feels it will treat your condition in a specific way. However, this medication is more likely to be effective if you follow your medication course as prescribed. Failure to do so could, in some circumstances, have life-threatening consequences. Common medication mistakes done by Elderly people that they need to take several tablets each day and if they are living on their own they may not always remember. It may be difficult for them to remember the prescribed schedule, particularly when taking multiple medications at different times of the day or having to take a medication on a different schedule, such as once a week. Many people are not sure what to do if they miss or skip a dose of the medication. The proportion of the world's population aged 60 years or over increased from 8 per cent in 1950 to 12 per cent in 2013. It will increase more rapidly in the next four decades to reach 21 per cent in 2050. With this, independent living has become a commonplace for the elderly. [1]

Medication adherence describes the patients' medicine taking behaviour and it is vitally responsible to ensure patients consume the right medicine at the right time which contributes to the effectiveness of the treatment. There are a few problems which have been identified with regards to this issue which are memory loss [3] [4] and poor eyesight [2] especially among the senior citizens. Hence, the objective of this research is to develop a Medicine box which track Number of dosage need to take at a particular time for senior citizen patients.

2. . Literature Review

Taking Medicine at right time in proper amount will lead towards the faster recovery. In reality what happens is that, they get their prescribed medication but fail to follow their health care professional's instructions. Many people while taking prescript medication do not follow their doctors' instructions. Some common reasons for this are People may start feeling better and decide to not finish all of the medication. People may not notice an improvement in their symptoms right away and may stop taking the medication because they think it is not working. Some medications are expensive, and people may skip doses or take less than they were prescribed to try to save money.

2.1 Existing Medicine Tracking & Dispensing System

We found several different pillbox products available in the market. The cheapest one was the traditional pillbox, which contained seven boxes for seven different days of a week. Such pillbox normally cost around 200 INR. [5] However, user had to load the pills to the boxes every week. Mixing different pills in the same box would increase the risk of making mistakes. We also found another type of pillbox, which had the sound reminder, and was able to remind the user to take medicine at user specified time. However, the users still have to put different kinds of pills in the same box, and reload the boxes every week. Additionally, it could only remind the user to take pills once a day. The average costs of

this type of pillbox were about 1000 INR, Therefore, we think it was necessary to build a cheap and functional smart Medicine box that could bring more convenience for the user. [6] We then defined the specifications of our device based on the user needs. From the literature cited, the research proposed an idea of Smart Medicine Box that will adapt the features of time tracking and alarm triggering Additionally, as compared to the existing system, It will remind the user to take medicine not for once per day but thrice per day along with that user does not need to refill the box every week.

3. System Analysis

3.1 Problem Definition

In developed and metro cities several trends suggest that incidences of oral medication non-compliance and its attendant consequences have increased. Hence in order to improve medication compliance we decided to work on a project which will be very helpful to older and geriatric people. The main objective of this research is to design and implement a medicine box using embedded platform which is capable of controlling the proper medication facilities. [5]

3.2 Proposed System Feature

The proposed system is a programmable device that will remind the user about the medicine or pill to be taken at specific day and time. When the pill quantity and time have been set, the medicine box will remind users or patients to take pills using sound. RGB LED's are used for indication purpose and LCD is used for display purpose such as how many medicine needs to take from particular sub-box, how many medicines are left in particular sub-box. Different colors of RGB led are used for different purposes. [7]

4. System Design and Implementation

4.1 Block Diagram of Smart Medicine Box

We designed a high-level block diagram to demonstrate the overall design of our device. There are seven major components for our device, including a Medicine box containing four separate sub boxes, a speaker module, an RTC module, FRDM-KL25Z, RGBLED, SD-card Module and a 4x20 characters LCD screen.

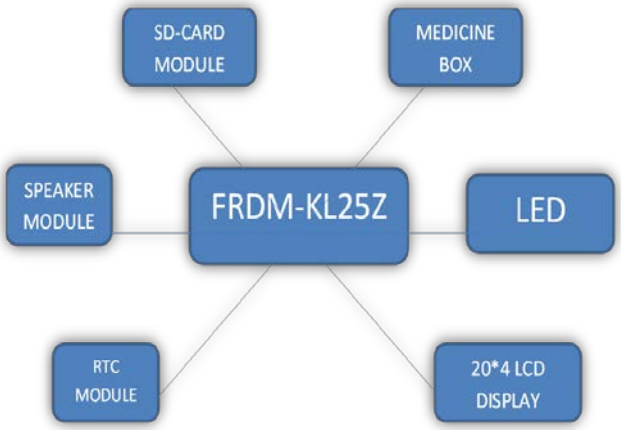

Figure 1 Block Diagram

4.1.1 Hardware:-

The FRDM-KL25Z has been designed by Freescale in collaboration with embed for prototyping all sorts of devices, especially those requiring the size and price point offered by Cortex-M0+ and the power of USB Host and Device. It is packaged as a development board with connectors to break out to strip board and breadboard, and includes a built-in USB FLASH programmer.
It is based on the Freescale KL25Z, with a 32-bit ARM Cortex-M0+ core running at 48MHz. It includes 128KB FLASH, 16KB RAM and lots of interfaces including USB Host, USB Device, SPI, I2C, ADC, DAC, PWM, Touch Sensor and other I/O interfaces.

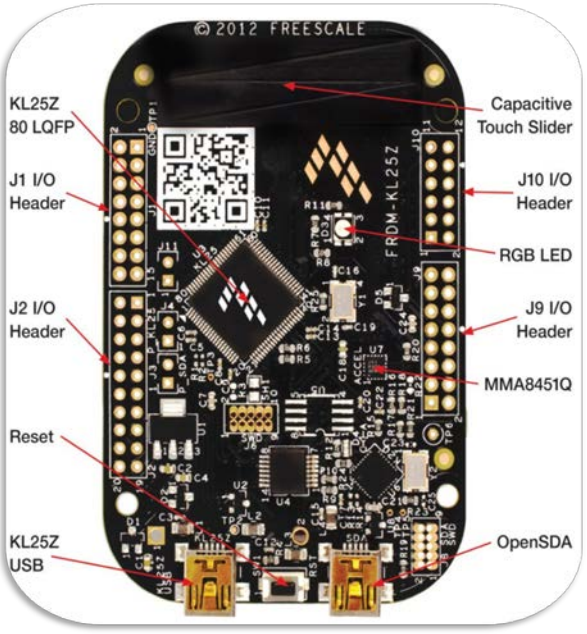

Figure 2 FRDM-KL25Z

The FRDM-KL25Z is fully supported in the embed platform, so it gets access to the free tools and SDK that provides experienced embedded developers with powerful and productive tools for building proof-of-concepts. This board is used to execute all the commands needed in our project i.e. Heart of Our project.

4.1.2 LCD:

Liquid-crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. In our project 20X4 LCD is used to display the information about Medicine box such as the Number of medicines in each sub-box and Remaining medicines in sub-boxes after consumption of medicine.

4.1.3 Speaker Module:

The speaker module is used to play the synthesized sound to remind the user to take pill i.e. is used to generate a sound at the time of pill taking which will remind the patient to take his or her medicine at the specific time.

4.1.4 Medicine Box:

We want our box to be less specious so we decided to go for Rectangle box instead of circular box. So we divided our Rectangle box into four equal sub-boxes where each box contains one LED which is on the front side of the box and buzzer is on the left side of the box. The LCD display is on the top of the box and the heart of this box i.e. FRDM-KL25Z will be inside the box. The design is as shown Below.[8]

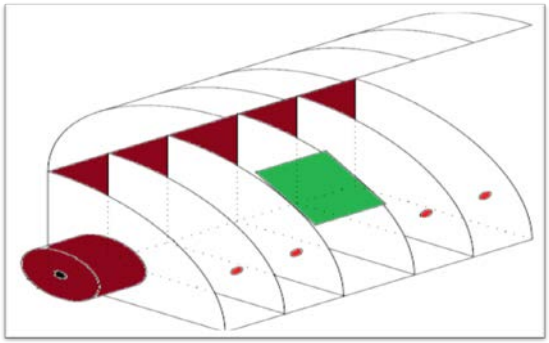

Figure 3 Medicine Box Design

4.1.5 LED:

LEDs emit light in a very narrow band of wavelengths, emitting light of a colour characteristic of the energy bandgap of the semiconductor material used to make the LED. To emit white light from LEDs requires mixing light from red, green, and blue LEDs, or using a phosphor to convert some of the light to other colours. In our project it will indicate from which all sub-boxes patient need to take medicine and it will glow for fix period of time i.e. 30 sec. we will use blinking blue led as an indication of less than 10 pills in the sub-box, blinking green led as an indication for less than 5 pills in sub-box and blinking red led as indication to take medicine from particular sub-box.

4.1.6 Real Time Clock Module:

This 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 for minimum of 5years without an external 5v power supply. It is accessed via the I2C protocol. In our project it used to set a specific time as per the patient required i.e. user wants to set 8.00AM as its morning medicine taking time than they can do with the help of this module.

4.1.7 Microsd Transflash Breakout Board:

This micro SD card breakout is of push type. It Uses SPI interface which is found on any SD card. It Works with supply voltage up to 5v. In our project we uses this module as an data logging module i.e. it saves preferences given by the patient about when to take medicine from which sub-boxes.

4.2 Proposed Smart Medicine Box Functions

1. Reminder to user on daily basis.
2. Keep the count of number of pills in each sub-box.
3. Displaying all the information on LCD.
4. Easy to Setup and use.

4.3 Software design:

Our project is based on embed platform. The embed Software Development Kit (SDK) is an open source C/C++ microcontroller software platform relied upon by tens of thousands of developers to build projects fast. The embed Compiler is a powerful online IDE that is free for use with hardware implementing the embed HDK, and tightly integrated with the embed SDK and Developer Website. Under the hood, it relies on the industry standard ARM professional C/C++ compiler, pre-configured and tested to generate fast, efficient code without fuss. Login from anywhere to get instant access to your development environment, on Windows, Mac, and Linux. You can

even work from tablets! Whilst the embed Compiler provides you your own private workspace, it is also fully integrated with the mbed.org Developer Website so you can easily import libraries and examples. Tera Term is an open-source, free, software implemented and terminal emulator (communications) program.

4.4 Implementation Steps:

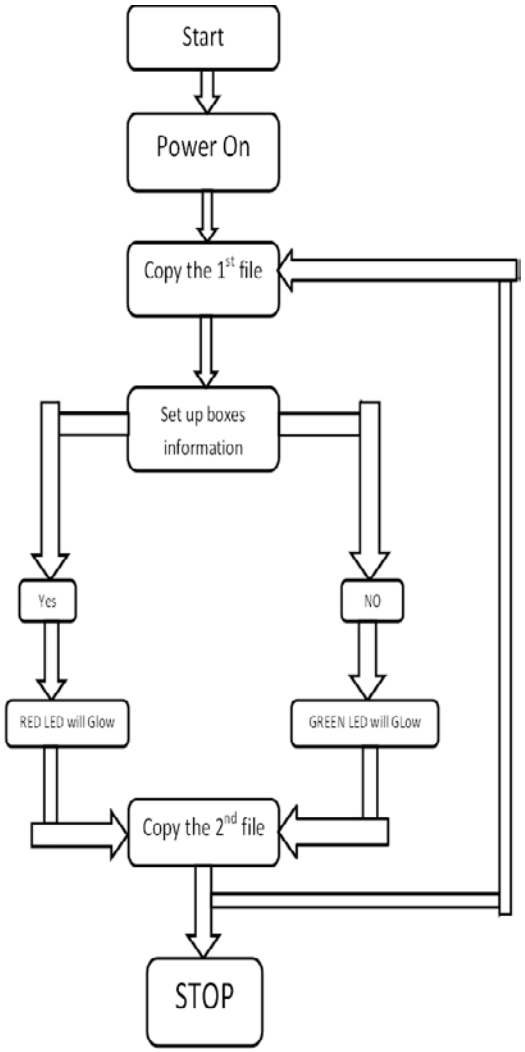

Figure 4 Flow-Chart

Figure 4 illustrates the sequence of activities in our project. When the SDA port is connected to PC it will start. The patient needs to download some files from the server which include 2 .bin file and 1 Tera-term installer file, After installing the tear-term onto your pc connect it to serial port of FRDM-KL25Z port i.e. by selecting serial option. After that copy the 1st file i.e. smart medicine box-1.bin file into your hardware and start snaring the question asked Use below table to enter numeric i.e. if you want to have 20 medicines in sub-box1 then press T. After answering all questions copy the 2nd file i.e. smart medicine box-2.bin into your hardware and check the information displayed on LCD, if any error then go back to step 1 again.

Table 1 ASCII to Numeric Mapping

ASCII CHARACTER	NUMER	ASCII CHARACTER	NUMBER
A	1	**a**	27
B	2	**b**	28
C	3	**c**	29
D	4	**d**	30
E	5	**e**	31
F	6	**f**	32
G	7	**g**	33
H	8	**h**	34
I	9	**i**	35
J	10	**j**	36
K	11	**k**	37
L	12	**l**	38
M	13	**m**	39
N	14	**n**	40
O	15	**o**	41
P	16	**p**	42
Q	17	**q**	43
R	18	**r**	44
S	19	**s**	45
T	20	**t**	46
U	21	**u**	47
V	22	**v**	48
W	23	**w**	49
X	24	**x**	50
Y	25	**y**	51
Z	**26**	**z**	**52**

5. Results

Table 2 Test Cases

Scenario name and description	Input	Steps	Expected output	Result
Data Logging	Press Reset key	Pressing the reset key of FRDM-KL25Z	Back to start of step 1	pass
Entering No. of Medicine	Press any alphabet from Keyboard	Pressing T on Keyboard	It should show 20 on Screen	pass
While answering the questions	Press Y key	Pressing Y on Keyboard	RED light should glow	pass
	Press N key	Pressing N on Keyboard	GREEN light should glow	pass
	Any other key than Y and N	Pressing any other key on Keyboard	No light	Pass
Output	Termination Switch is pressed	Pressing switch S3	Buzzer should turned off and expected LEDs should glow	pass
	Refill switch is pressed	Pressing switch S4	Sub-box counter should be resented	Pass

6. Conclusion and Future Work

6.1 Conclusion

This project has focused on the problems faced by senior citizens concerning adherence to their prescribed medication. It not only aids the elderly who live independently but also the caretakers of the elderly by reminding right amount of medicine at the right time. The smart medicine box using embed platform has been experimentally proven to work satisfactorily. This medicine box which is a sort of semi-automatic is not only useful for geriatrics but instead it is can prove useful and a user friendly tool for all of us. Embed provides a greater efficiency to our project. It helps it to be cost efficient also. The other advantage of this box is that it is very easy to use and the complexity is less. This ensures that the elderly patient consumes the right dosage of medication at the right time, provided he or she accepts this new, unusual method of medication.

6.2 Future work:

There are several aspects we need to work on our device in the future to meet the future revolution. Firstly we can add BLE feature for remote access to this box secondly we could use Raspberry pi for this box so that patient does not need to connect it to pc for setup purpose. Mechanical design can be improved by adding some mechanical structures to it.

7. Acknowledgements

We would sincerely thanks to the peoples who guided us throughout the course for this project work. We would like to express our sincere thanks to Prof. Prashant Upadhyay for his guidance, encouragement, co-operation and suggestions given to us at progressing stages of the project.

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