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IoT Based Smart Medical Kit Using ESP32

Prof. A. S. Utane[1], Sejal Sambhe[2], Aakash Belsare[3], Ujwal Meshram[4], Charusheela Bhambore[5]
[1]*Assistant Professor,* [2, 3, 4, 5]*Students, Department of Electronics & Telecommunication Engineering, Prof. Ram Meghe Institute of Technology & Research, Amravati, Maharashtra.*

Abstract: ***This research paper aims to contribute in the field of smart healthcare. The focus will be on systems designed with the approach of minimize effort of managing patient's medication, providing personalized care, healthcare monitoring, enabling timely alerts, user friendly and compact design. Special attention will be given to the use of various IoT technology, integration of various sensors like temperature sensor, IR sensor and other with a microcontroller like ESP32 and the software dashboard where all data can be set or reset. The proposed paper explores the design, development and implementation of smart medical kit, along with the comparative analysis of existing work. In this, project ESP32 microcontroller acts as a brain of the system, processing sensor data and software section. The smart medical kit has RTC module that matches the current data with the input data trigger the further operation the are getting notification buzzer get on and LCD display shows block name and medication name. After taking medication buzzer get off. Overall this project showcases the potential of ESP32 and IoT in developing cost-effective and better way to improve and timely medication adherence.***

Keywords: Microcontroller ESP32, Internet of Things(IoT), smart healthcare, software dashboard, personalized care, healthcare monitoring

I. INTRODUCTION

The Internet of Thing (IoT) provides network of objects that includes gadgets, sensors, software tools and many more which all gather and share the information. Smart medical kit have emerged as integral component in medical industry, offering health monitoring. [1] People take a medication for a wide variety of reason, it may be due to some vitamin deficiency, chronic illness, old age, genetic disorder etc. The old as well as the young are getting affected by diseases. After consulting health professional they obtain the medication to relieve their symptoms that might be causing them nausea, pain, headache and many more.

Depending on the degree of the infection the patient would be advised to take the medication many times a day and for a prolonged period of time. But either due to the day today life or due to some other factor the patient sometimes fail to take their medication which in turn worsens their situation and affects their quality of living. For instance in the case of young child they wouldn't remember to take their medication as they tend to get distracted easily as such it's up to the child's parents to give the medication and in some cases even they do tend to forget due to their work, stress etc.

The smart medical kit can thus be used by the parents to set the time and alarm so as to remind their child to take their medication on time even when they aren't around as well as they can monitor the intake of medicine and other require medication. The same can be said even for the adults, teenagers who have to study, work to earn a living, this device can help them as it serves as a reminder to take their medication.

It is possible for them to set an alarm using their phone to take their medication but there is still a chance to ignore that reminder as they just simply have to slide it off it does serve its purpose to remind the person but there is no guarantee they would do it at that time maybe they would take it at a later time as they are busy at the moment and as a result they tend to forget to take. This box is especially useful for the elderly who tend to forget things as they age.

In the busy world, there is no time for everyone, mainly elders, to take care of their health by it is not always possible for us to remind them of their medicine's dosages every time. Shifting health care monitoring system to home can help many people to save their life. In order to track the health condition of the elderly people, the proposed model will be helpful[2].

Focusing on such issues, we purpose a smart medical kit that has a LCD display that indicates right compartment containing pill or syrup or other medication related stuff at that respective time. It contains various compartment for storage of all kind of medication. The status of intake taken by patient is sent to the care takers in form of massage. we have followed the following considerations:

1) Care with kit: Patients that are suffering from long term disorder that require the long-term health and medical management. The smart medical kit gives the track and remainder for all medication.
2) Assistance: The smart medical kit provides the remainder to all care takers, so they can assist the patient.

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3) Medical service: As the various development is happening day by day in field of medical, this kit is one of the problem solver for patient as well as doctors.

The adoption of a sophisticated smart medical kit response to the challenges inherent in the current days.

In conclusion the adoption of medical kit represents a judicious response to the challenges inherent in current available kit. Through it is compact structure, accurate timing, cost efficient, easy to use and overall management.

II. METHODOLOGY

The smart medical kit was developed through a clear and organized process that brings together hardware, software, and IoT technology to create a simple, reliable system for managing medications. The main idea is to make it easier for patients to remember and take their medicine on time, while also giving them and their caregivers a way to monitor everything in real time.

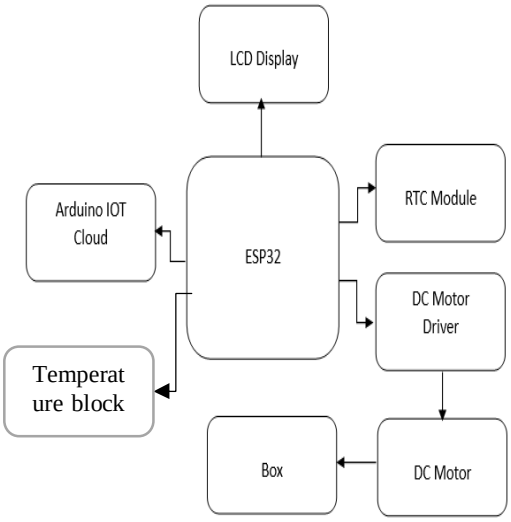
A. Hardware Section:

The process started by carefully picking out the right components—like the ESP32 microcontroller, IR sensors, a temperature sensor, a real-time clock (RTC), a buzzer, and an LCD screen—so they all work smoothly together. The caretaker or doctor should set the time and medication along with the compartment of box. The RTC module constantly checks the current time against the schedule time. When the scheduled time arrives, the ESP32 sends notification on smartphone and activates the LCD display, motor driver and the buzzer get on. The LCD display show the medication name, the motor driver actives the motor and it open the exact compartment of box. The motor is triggered to open the lid of the medication box, allowing access to the medication. The system resets after the lid closes and waits for the next scheduled time. If the current time is not matched with schedule time then RTC module constantly check for accurate timing. This kit have temperature block in which temperature can be maintain and monitor.

B. Software Section:

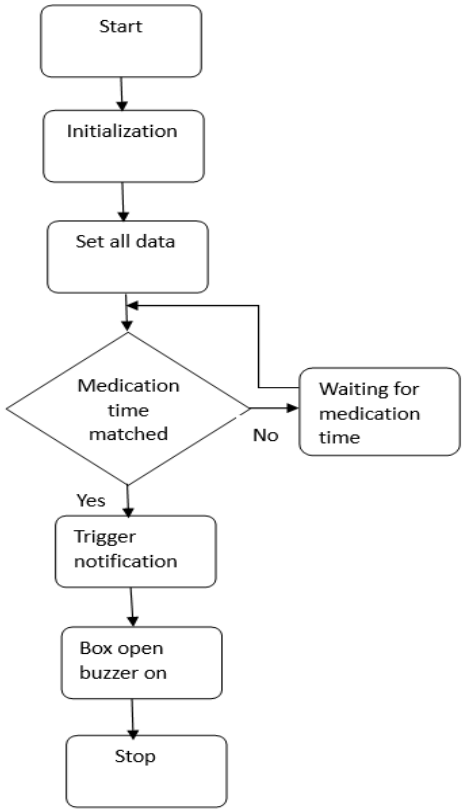
In this kit is connected with the software section where the data is going to set for the kit. It also shows the reading of temperature block. The compartment is selected by setting the Slot Select and medication time and name with the compartment is set using the Tablet Count. A caretaker will get all data and notification at this software part. A program was created that reads data from the sensors, keeps track of the time, and sends alerts when it's time for a dose. The system is also connected to the internet, so it can sync with a dashboard that users or caregivers can access through a phone or computer. This setup makes it easy to update or track schedules, helping people stick to their prescriptions and giving peace of mind to those who are caring for them.

Block Diagram:



The block diagram of smart medical kit with the microcontroller as the main control unit. The other components in the system includes LCD, RTC module, motor, motor driver, buzzer, power supply, IoT platform.

Flow Chart:



Flow chart shows the flow of operation of smart medical kit

III. EXPERIMENTAL RESULTS

Comparative analysis of smart medical kit:
An analysis conducted through the various kit designed for the patient's medication. Each one has only criteria for pills dispensing, manually adding and calculating the pills.

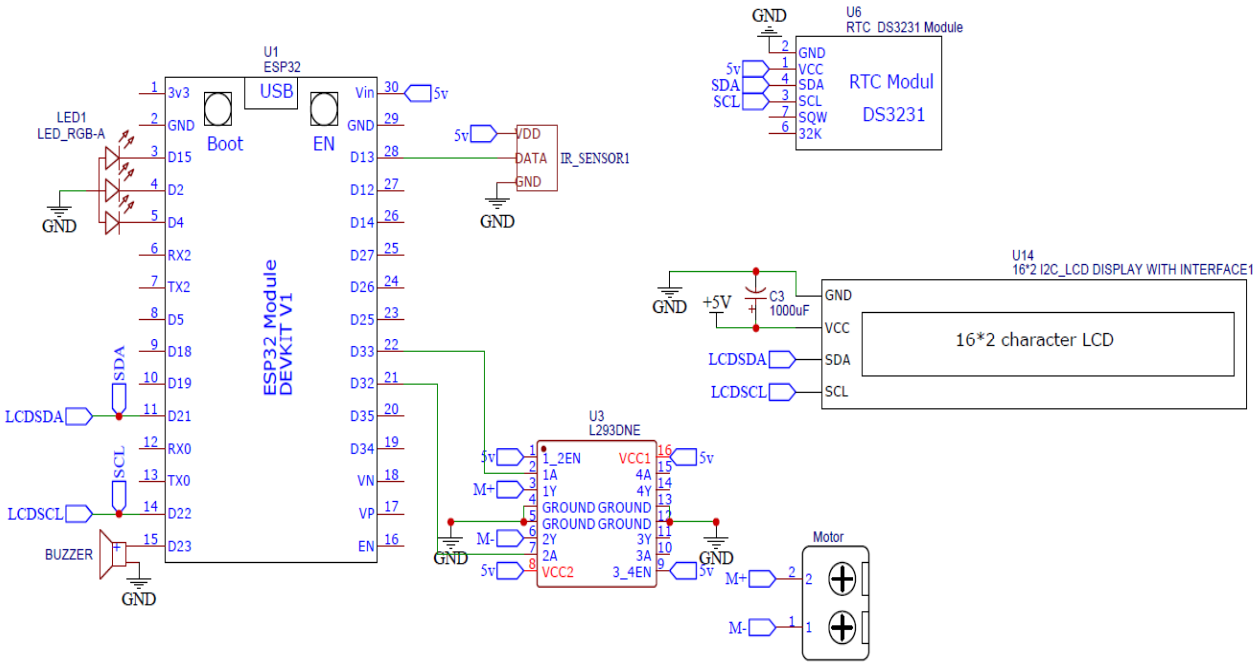
Statistical analysis:
The study and analysis of the methodologies, problem statement, implementations and in detail study of abstract helps to identified the strength and weaknesses of each system.

The main component of kit:
The main components are microcontroller ESP32 and IoT technology helps to implement the kit. This easier the interfacing with the different component and to manipulate with data in context with the smart medical kit.

Implementation and evaluation:
Implementation of the kit optimized on the strategies of building a user friendly, compact, easy to maintain and manage kit. The analysis of existing system helps for better view for kit.

Schematic of smart medical kit:
The schematic of smart medical shows the integration of various components with the core component that is ESP32 microcontroller, which acts as a main component of system. Multiple components are interconnected to monitor, trigger and perform operations. The below schematic clearly illustrates each component ensuring smooth communication and operation of the system with real time monitoring and alerts.

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Schematic of smart medical kit

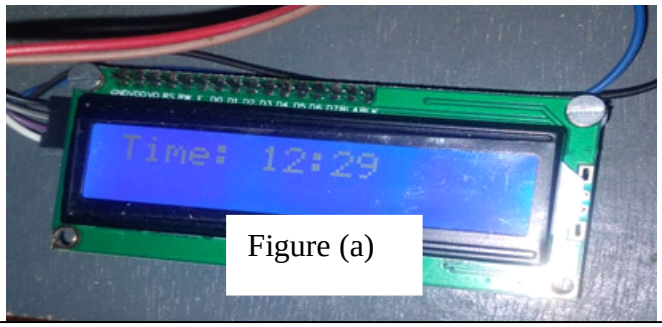


Figure (a)



Figure (b)

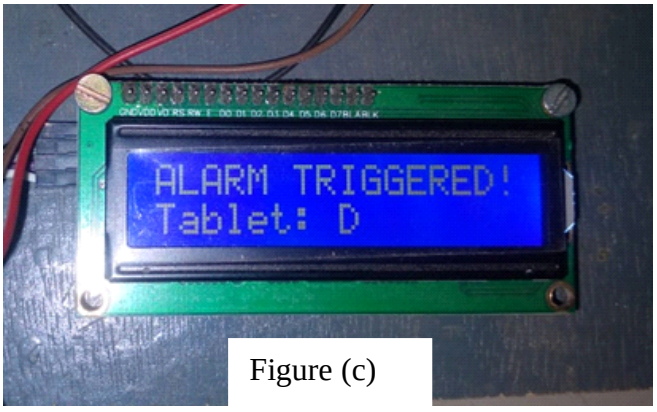


Figure (c)

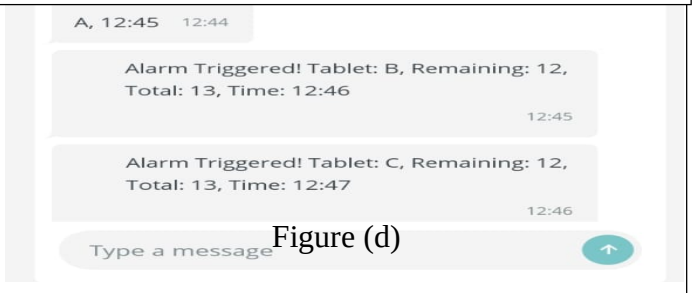


Figure (d)



Figure (e)

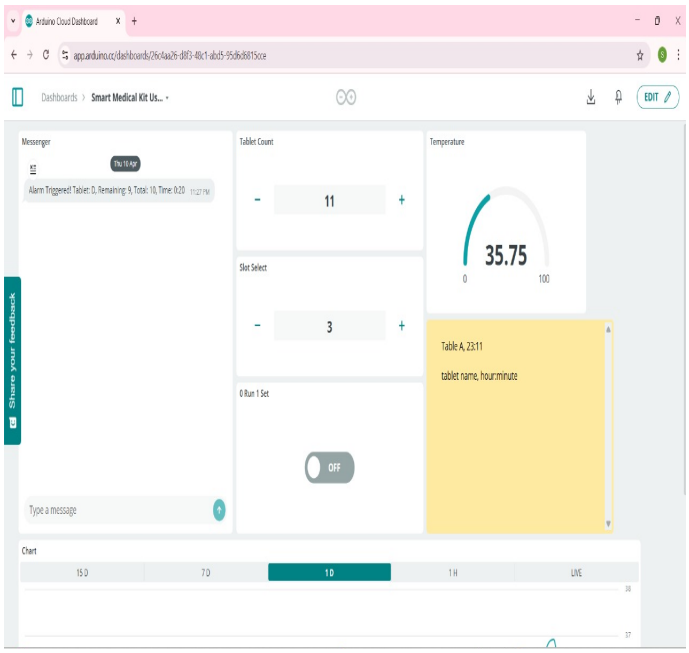


Figure (f)



Figure (g)

- Figure (a): LCD display shown in figure (a) gives current time on the system.
- Figure (b): In this figure an image shown which has three block first one is fo Tablet Count where number of tablet or any other medication data can be set, second one is of Slot Select where slot from the block can be selected and last one is of button for setting the data.
- Figure (c): It shows LCD display having a message of “ALARM TRIGGERED! Tablet : D”. This message is given by system at the time of medication as per input data.
- Figure(d): This image shows “A, 12:45” massage where Ais name of medication and 12:45 is time to take that medication. And last two massages shows the status of name of medication taken, time of medication and remaining number of medication.
- Figure (e): This image is of final hardware setup of the system which include medication kit which temperature block interconnectd as per the schematic of smart medical kit. This system builts with various sensors such as temperature sensor, IR sensor, RTC module, peltier plate, motor, motor driver, LCD display, buzzer and core component ESP32 microcontroller. There are two blocks first one is for all medication and second one is temperature block which can be used for specific medication that should kept in certain temperature.

- Figure (h): This image shows the software section of smart medical kit. It involves the message section where patient has to input and set all data, range of temperature of temperature block, format of input and option to set or reset kit.
- Figure (g): This graph shows the temperature readings. At the initial point of a graph the initial temperature of block can be measured and at the end of graph final temperature can be measured with time and date. This graph gives you 15days, 7days, 1day, 1hour and live temperature scale.

IV. CONCLUSION

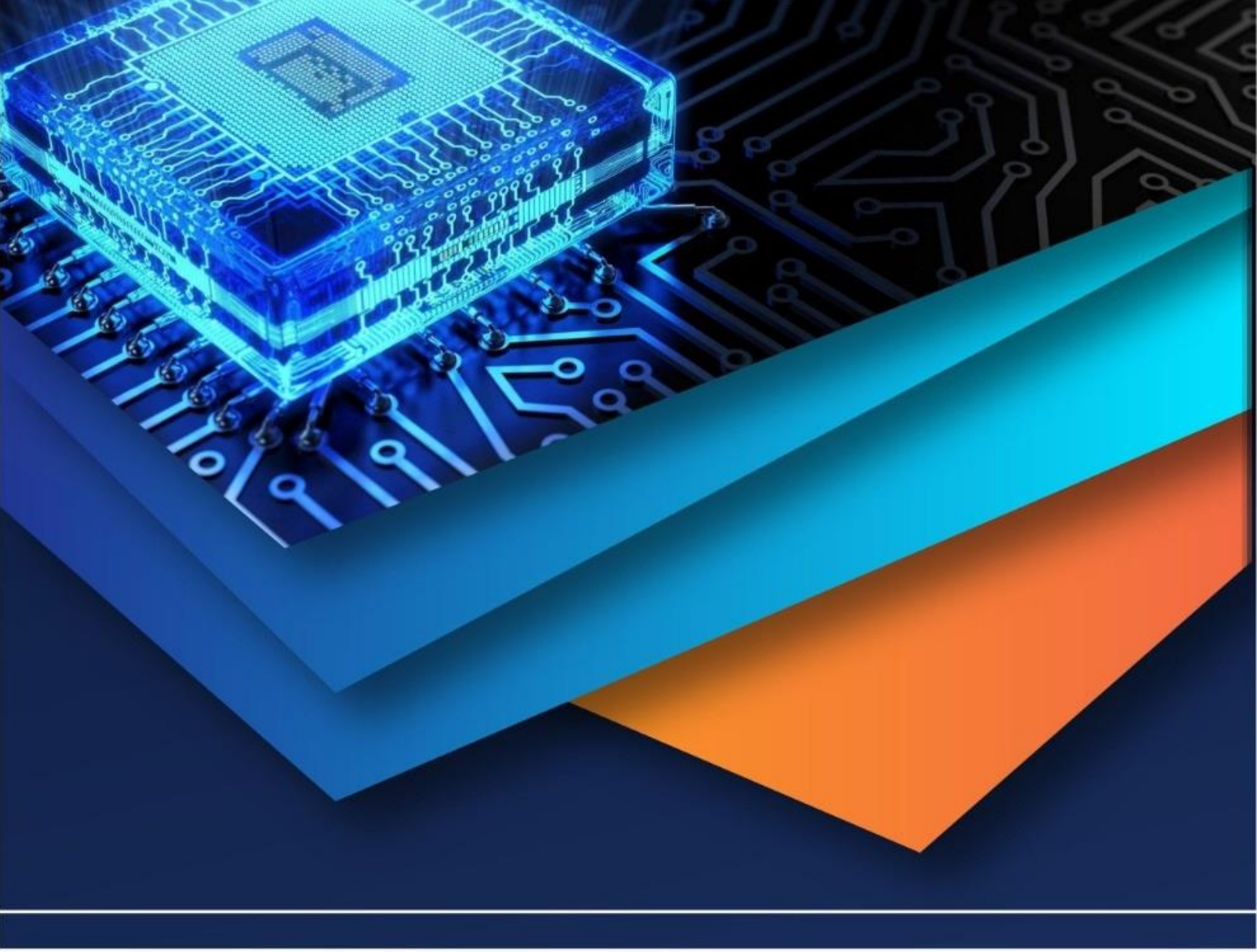
In conclusion, this paper demonstrates the smart medical kit capable of managing and maintaining the patient's medication, medical dispensing and remote data transmission. The challenges of remote monitoring and data acquisition are overcome using the IoT technology. Also provides the incorporating temperature section. This proposed system addresses key limitations of existing solutions.

The development of smart medical kit having features like temperature control, data acquisition, real time data monitoring, embedded with IoT technology contributes to the advancement of smart healthcare technologies. The ability to collect and transmit medical data in real time can greatly enhance personalized treatment plans

The developed system stands as a significant advancement in smart healthcare, notably contributing to user friendly, compactness, focusing on the problem of forgetting the dose of medication which affect on patient's health. This proposed system emerges as a sophisticated solution that addresses multiple challenges.

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