



INTERNET OF THINGS (IOT) BASED SMART HEALTH CARE MEDICAL BOX FOR ELDERLY PEOPLE

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ABSTRACT

Despite the delayed adoption of IoT (Internet of Things) in the healthcare industry compared to other sectors, IoT in medicine is destined to keep the people safe and healthy, with the primary goal being to reduce the cost of health care in the next years. An intelligent medication box linked to sensors and a server for routine health monitoring is suggested as part of a smart Internet of Things-based healthcare system. With the aid of this internet-connected smart pill box, patients can stay on top of their medical regimens and easily communicate with their doctors even when they can't be in the same room at the same time. The suggested medication box has an alert that will remind the patient to take their medication at the prescribed time. Information about the doctor and patient, including medical history, medications, and upcoming appointments, is maintained on a laptop that also serves as a server. The doctor and the patient both have their own login credentials to use on the server. The server also stores the patient's prescription history and body temperature for the convenience of the attending physician. If the doctor decides to make a modification to the patient's prescription, they will be informed via the patient's mobile app. In addition, the doctor is in a position to act quickly in the event of a medical emergency.

Keywords: Health Care, Internet of Things (IoT), Body sensor network, LCD

I.INTRODUCTION

When combined with an alarm message, the suggested smart medicine box ensures patients take their medications as prescribed and at the appropriate times. It's an alarm-based medication reminder system that helps keep patients on schedule. A tablet's measurement of the drug slot level is sent to the cloud whenever the box is opened. Whether or not the patient must maintain the current medication dose is determined by the doctor based on the patient's ongoing difficulties. Whenever a significant change is detected in a patient's vital signs, an SMS message is sent to a designated caretaker. Changes like this are recorded in the cloud-based database and propagated to the user interfaces of both the pharmacy and the individual patient. As soon as the patient places an order, the new medications will be sent directly to their home. The use of IoT in a health monitoring and prediction framework depicts the collection and coordination of Patient data obtained through sensors, The information from the sensors is sent into the microcontroller Arduino board, where it is analysed, and from there it is transmitted via Wi-Fi to a remote server using an ESP8266 module.

An ARDUINO controller and many similar sensors are used in this setup. Here, we make use of temperature sensors, a heart rate monitor, a servomotor, an LCD, and an Internet of Things module. The heart of this project is a serial connection between an Arduino UNO and a Node MCU Wi-Fi module. Arduino primarily manages the three sections of the pill box, whereas Node MCU manages the temperature sensor, the heart rate sensor, the communication with the patient's mobile device, and the storage of medication time data and temperature

data on the server.

The smart medical box reminds the elderly to take their medications at the appropriate times by sounding an alert and checking the level of each medication slot on a regular basis. Once a new reading is taken, it is uploaded to the cloud. After that, the doctor and the pharmacy will be informed of the change. Everyone will be able to take their medicine at the proper moment thanks to the smart medical box. The solution allows real-time monitoring, so carers can keep tabs on a patient from afar and upload any new information about them to a central cloud database. The world is undergoing a technological transformation that has never been seen before, with previously unconnected networks giving way to ubiquitous internet "things" that generates and distributes vast amounts of valuable data.

The Internet of Things (IoT) is a widely known digital phenomena that alters our everyday lives, increases market efficiency, and promotes the effectiveness of legislation. In today's Internet of Things (IoT) era, commonplace objects have become more intelligent and play a pivotal part in the physical environment. From a simple street lamp to a complex metropolis, or from a simple production gadget to an elaborate intelligent factory, this flourishing integrated system is a promise to pursue a broad range of applications of technological, economic, and social potential. The healthcare sector is one important area where IoT has produced major benefits and has had significant repercussions.

The use of information and communication technology in healthcare has shown numerous positive outcomes in the area of continuous health surveillance, and the Internet of Things (IoT) model enables more responsive, supportive, and integrated treatment in which patients track and control their own wellbeing.

The Internet of Things (IoT) has the potential to advance a broad variety of medical applications, such as remote monitoring and control of patients' health, the treatment of chronic conditions, the promotion of individual health and wellness, and the care of children and the elderly. Due to the expected rapidity with which the world's population is expected to age, the field of Ambient Assisted Living (AAL)—which focuses on the healthcare of the elderly and the disabled—has taken on new significance in this wide variety of contexts.

In rural locations, where quick response times are particularly important, these methods may be invaluable. During the last several years, significant progress has been made in healthcare IoT-based software, infrastructure, and technologies. Nonetheless, this was the original course taken by the pioneers of wireless sensor networks (WSN).

The system utilises real-time data from in-house sensors to notify family members or designated carers of significant changes in regular routines that may indicate an emergency. UnaliWear is an intelligent wearable designed specifically for the needs of the elderly. The Fall detection accelerometer and the constant voice for effective safety alarm make up for the lack of control over safety settings. As a means to better the lives of the elderly, we developed We-care, a wireless IoT-ready system that allows patients to monitor and collect vital information and makes them available to medical personnel and well-equipped carers. Accidents and the absence of crucial data are flagged thanks to the data collected by a medical wristwatch and sent to a central control network.

The presented gadget is the ideal home-use option because to its low-power and low-cost requirements. Our method is distinguished by its ease of integration with existing IoT-enabled networks and its reliance on a universally available, low-cost Platform that provides the bare minimum of functionality found in other systems of its kind.

II.RELATED WORK

The paper's findings are summarised as follows. When combined with an alarm message, the suggested smart medicine box ensures patients take their medications as prescribed and at the appropriate times. It's an alarm-based medication reminder system that helps keep patients on schedule. A tablet's measurement of the drug slot level is sent to the cloud whenever the box is opened. Whether or not the patient must maintain the current medication dose is determined by the doctor based on the patient's ongoing difficulties. Whenever a

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III. PROPOSED METHODOLOGY

The Wi-Fi module will use an IFTTT-created mail-transferring protocol to notify the patient through email when it is time to take their medication. If This Then That, often known as IFTTT, is an online service that allows users to construct "Applets" (chains of basic conditional statements) at no cost. Applets are little programmes designed to carry out a particular function inside a bigger application. Being a free web service, IFTTT allows us to automate some procedures. Users may set up events in programmes like Gmail, Facebook, Telegram, and more. Some applications are made possible by using a common kind of programming logic.

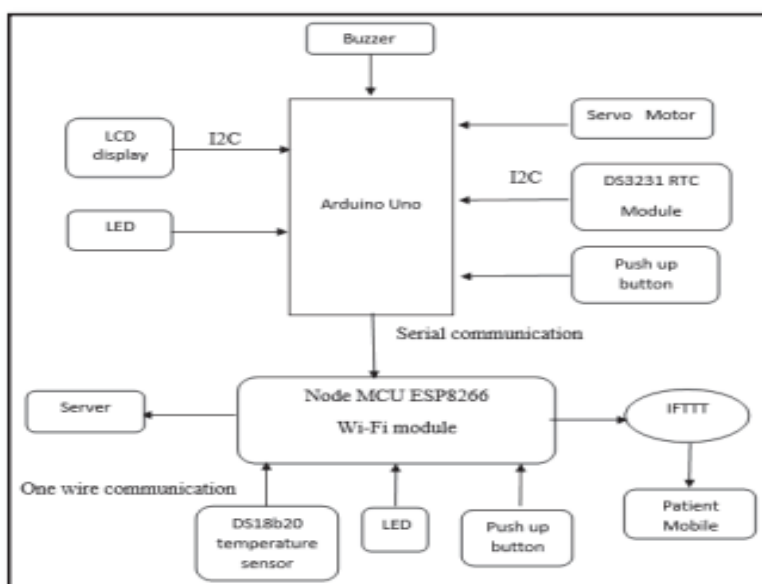


Figure1. Block Diagram of the smart medicine box

The smart pill box requires the user to enter their medical information and schedule for taking their medication. With its three sections, the user may store the three different medications required by their doctor. The control algorithm used in our system is shown graphically. The RTC module creates a real-time clock. This project's code is where you'll configure the alarm time and dosage for your prescription. If the produced real-time clock is within an hour of the medication time, an alarm will be set off, the Buzzer will sound, an email will be sent to the patient's mobile device, the corresponding compartment's LED light will illuminate, and the medicine's name will be shown on the screen. The patient's name will appear on the screen and the compartment's light will turn on if he or she fails to take their medication or respond to a notice. The light will go off automatically after you've removed the drug from the container.

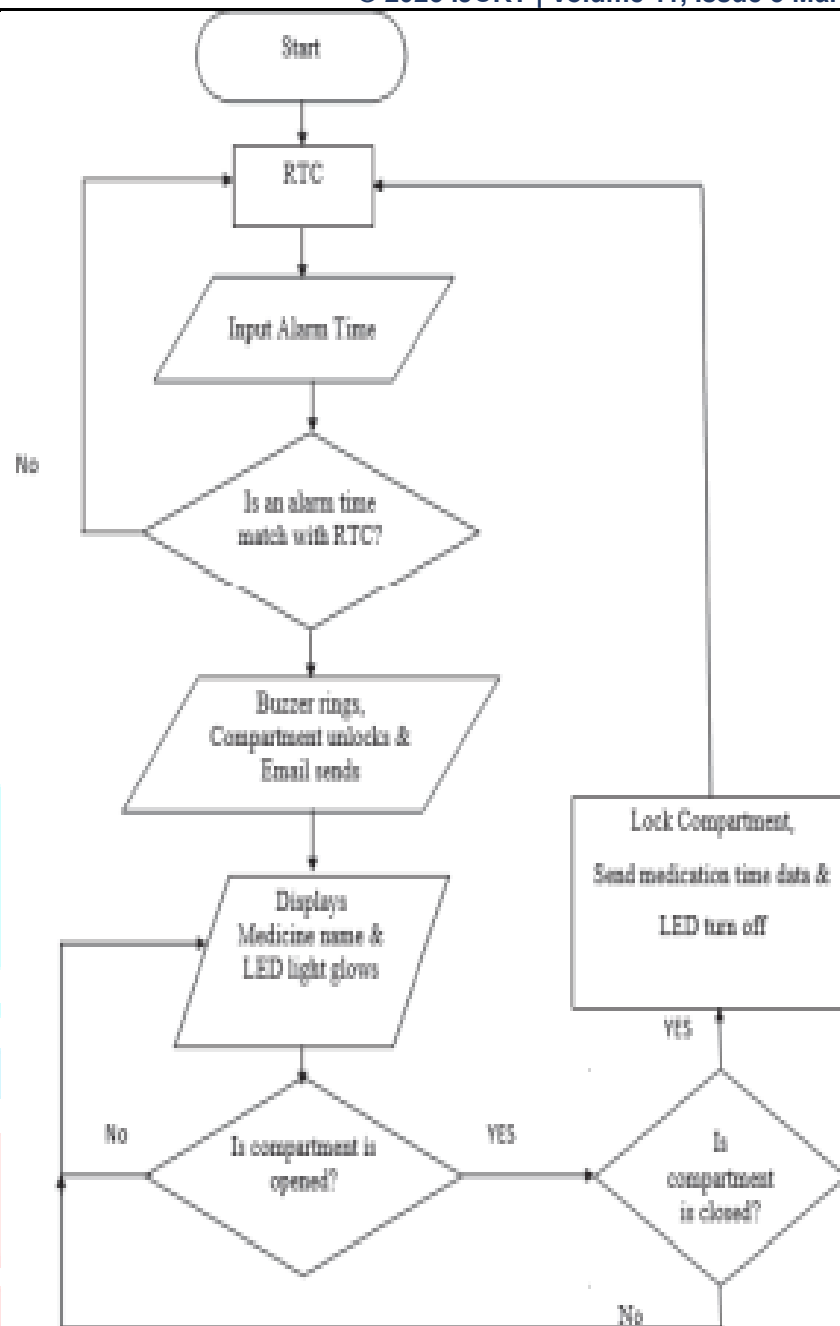


Figure2. Flow chart of medication process.

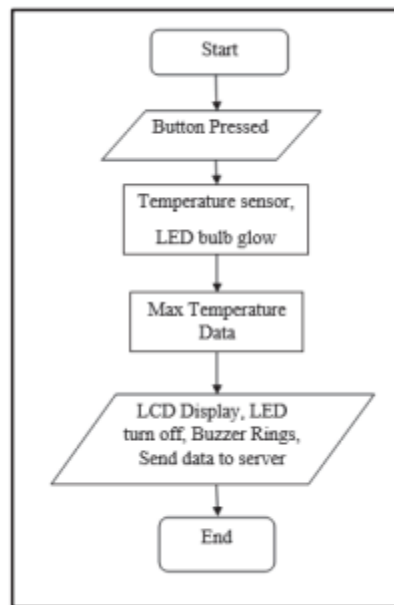


Figure3. Flow Chart of measuring and storing temperature

This project also includes functionality for taking the patient's temperature and saving that information for the doctor to review. This project incorporates a temperature sensor for monitoring the patient's core temperature. These readings are recorded and saved to the server. Measured information will be stored on a server for medical research. The doctor may learn anything about the patient by taking his or her temperature. Once the patient inserts the thermometer-like sensor into his body and presses a button, the LED light will illuminate to show that the sensor is collecting data for 60 seconds. Wi-Fi module took the highest possible reading and displayed it on the screen. In order to enable the doctor keep tabs on the patient remotely, the system will send the most relevant data retrieved every 60 seconds to the server.

IV SYSTEM DESIGN

Here, an intelligent medicine box will serve as a helpful reminder for a patient to take their medicines at the appropriate times. If a patient has to take their medication at 6 a.m., for instance, they will need to be reminded of this fact the night before. The alarm will go off and the box will make a noise in the morning to remind him. A servo motor ensures that the medicine box remains locked in the event that he forgets the prescribed time and tries to take his medication at an inconvenient moment. When it's time to take the pills, the box will beep and vibrate until the user either opens the drawer to get the pills or remembers that it's time to take them.

In addition, the Wi-Fi module enables the medication box to notify the user at a predetermined email address even while the user is away from home. Since a patient's temperature may be an important indicator of their health, the device also includes a sensor to take its own reading. Both the patient and the doctor will have access to the data on the patient's temperature and medication intake, which will be kept in a server. In addition, it will be useful for physicians to have up-to-date information regarding the patient's physical health.

The following components were used: DC jack, Header pins, RMC pins, Hard Foam Sheet, Solder lead, Servo sg90 micro, ESP32-WROOM-32, Buzzers, Switch DIP X01, Hall Effect sensor, IC 7805, Capacitors, OLED, DS18B20(sensor), and Solder.

The Software We Use: Software development environments (IDEs): Arduino, VS Code, and Firebase. The primary objective of this project is to aid the elderly and patients who depend on medicine by sending them postal services and alerting systems to remind them at precise intervals of medication time. This removes the potential for harm associated with either the patient forgetting to take their

medication or taking the incorrect medication at the wrong time. We've put together streamlined and straightforward parts to make this possible.

We built the Smart medical box around an ESP32 microcontroller, which serves as the system's "brain," and into which we have fitted a number of other components. 1 A 0.9-inch OLED coupled to an ESP32 dual-core that combines wifi and Bluetooth wireless capabilities displays medicine information and the appropriate time for taking it. Vin, GND, SCL, and SDA are the four pins that an OLED module will have.

1. Its graphical, user-guiding module is fitted on top of the medication box and can be seen from a specific distance. The ESP32 is linked to a set of Hall effect sensors, which may be used to determine how close or far away an object is. This function aids in monitoring the drawer's opening and shutting. Two hall effect sensors are utilised for each drawer, for a total of six.
2. Each drawer's locking and unlocking mechanism is managed by a servo motor that is connected to an ESP32. Power, ground, and signal are the three pins available.
3. Servos may be directed and controlled by sending Pulse Width Modulation (PWM) signals to the motor, which in turn determines the position of the shaft. In order to determine the inside temperature of the patient, DS18B20, a one-wire digital temperature sensor, is linked to the ESP32. To interact with ESP32, just one data line and GND are needed.
4. The measured temperature is automatically recorded in the home base. During medicine time, the patient will be notified by the buzzer. When the correct drawer is opened, the system stops beeping, assuming that the patient has finished taking their medication.
5. This box's outside is created from a firm foam sheet, making it strong, insulating, and simple to handle. An email will be sent to the patient's specified address at the prescribed time with an alert message and the pill consumption times and the date.
6. We have utilised IFTTT, a free web-based service that integrates nicely with iot components, to send emails to patients' addresses when a specific value is detected by a sensor.
7. Medicine taken or skipped is recorded as 1 or 0 in the firebase, together with the time the medication was taken and the patient's temperature. 7. The patient will receive the reminder message at the time of medication. These three pieces of information are kept in the firebase account and are retrieved by the doctor and patient websites, where they are visually presented to aid the doctor in understanding the patient's medication condition. Depending on the patient's temperature or the decline in a graph tracking the patient's history of missed pills, the doctor may decide to adjust the patient's dosage or make other observations.

V. EXPERIMENTAL RESULTS

➤ The outlook of Smart Medical Box



Figure4. SMART Medical Box

It uses servo motors to control the movement of its three separate storage spaces for pharmaceuticals. This container is small, simple, convenient, and straightforward.

➤ Display of LCD

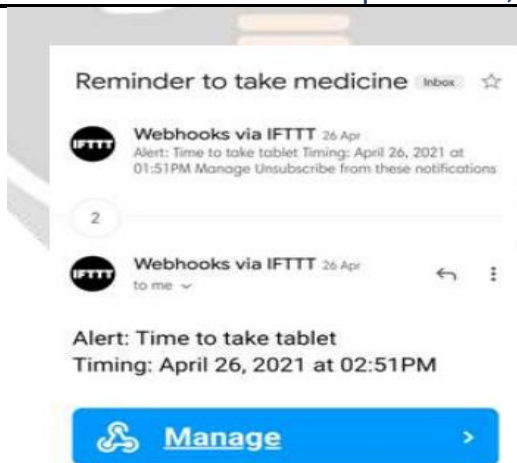


Figure 5. LCD

The ESP32 controls the monochrome display of this module, thus it is always on. The names of the medications and when they should be taken are shown, which is useful so that the patient may take this information into consideration.

➤ Reminder to take the medicine

This message serves as a reminder to take the prescription at the prescribed time. As the value detected by the component changes, IFTTT sends a notification to the patient's email address.



➤ **Websites for doctor and patient**



A patient's own webpage. Users (patients) need credentials to access the site. Visitor information about the doctor, including name, speciality, and contact information, will be readily available by clicking on their name on the website. The patient's medication status and temperature readings will also be shown as visual aids for keeping tabs on their health.



A physician's official webpage. After the doctor has logged in, he or she may see a list of patients and choose the appropriate one. In addition to the two graphs depicting the status of the patient's medicine and body temperature, selected patient data such as name, age, condition, and mail id will be presented. If the doctor notices anything out of the ordinary during the observation, he or she may consult with the patient personally and make any necessary adjustments to the treatment plan.

VI.CONCLUSION FUTURE ENHANCEMENT

Internet of Things applications that capture the spirit of emerging technologies usher in a new social norm by facilitating routine health monitoring for individuals. This clever medical box is the solution to the issue of insufficient doctor-patient communication. The clever design of this pill box means that the elderly no longer require help from a carer to take their medication as prescribed. All patients, regardless of age, income, or health, may benefit from this project because of the additional features supplied by this box, such as servers to store the drug data, a temperature sensor, and basic health monitoring. Because of its perfect characteristics, the box can be used by the average person with ease.

The global technological shift towards connecting thousands of devices is unprecedented. The Internet of Things is a game-changing idea that improves our everyday lives and has the potential to have a profound effect on the quality of healthcare in the United States by creating a more individualised, effective, and interconnected system. In this piece, we presented We-Care, a framework for Internet of Things healthcare that aims to monitor and gather vital data from the elderly. The system is designed to send alerts in the event of an emergency by picking up on things like falls and the absence of vital signs. The greatest solution for all senior individuals living at home is the wearable system, which is combined into a simple, separable, and easy band. The developed software programme collects all the information the wristband transmits to the server and may remotely warn carers or medical professionals in the event of an emergency. Research using the acquired data will then be utilised to monitor patients' health. Under the WE-Care framework, the IoT programme will coexist with existing technologies since it uses a standardised set of protocols.

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