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Smartpillar: A Smart Medication Reminder and Dispenser System

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***Abstract*—Health care is an important field to address when it comes to geriatrics. Old age people are suffering from various diseases and timely monitoring of supply of medicines is instrumental. A smart IoT based system is proposed here, which contains a medicine box associated with sensors. The box ensures that the medicines are supplied in its time. The proposed medical box helps patients not to bother about forgetting the intake of medicine at times. There are several expensive medicine dispensers available in the market now. In any case, a large portion of the older individuals all over the planet don't know about such items yet resort to putting away the medications in a crate. A few kinds of medication distributors are accessible monetarily around the world. These disadvantages can be settled utilizing a Programmed Medication Distributor that is solid, reasonable and can convey up to 2-3 weeks of prescriptions, so that, elderly folk's individuals won't have to rely upon another person. The item is intended to ensure that the amount and timing of the pills to be apportioned can be controlled.**

***Index Terms*— Internet of Things, Pill Dispenser, Easy Medication, Arduino, Smart Healthcare.**

I. INTRODUCTION

Population aging is a worldwide concern, because of the implications for systemic changes in health and social policy, economic viability, accessibility to public services, etc. For instance, The United Nations predicts that by 2050, elderly people would make up 36.81% of the population in Spain. [1], [2]. The elderly will make up 22.35% of the population of the United States of America by that time. But each year, life expectancy increases steadily. Life expectancy in Europe in 2018 ranged from 70.1 to 81.9 years old, with an average increment of 0.3 years every year, according to data released by the European Commission. In other words, by 2050, it might be between 80 and 92 years old [3]. People with chronic conditions typically need to take a variety of drugs on a regular basis. Nonetheless, elderly persons are more likely to take drugs incorrectly due to cognitive deterioration (e.g., more or less intakes than expected, at a different schedule, mix-up medications, etc.) [4]. In fact, 25% of the elderly population is thought to not take their medication as directed by a doctor. Incorrect pharmaceutical use can result in a variety of undesirable outcomes, including health deterioration, an increase in hospitalizations, or even a premature death. An IoT-based device called Meds-Spencer enables people to receive Real-Time Updates from doctors or other healthcare professionals regarding the medications they should take. The intelligent medicine box will assist a patient in taking their medicines at the appropriate time, which will depend on the patient's health [5] [6]. The proposed model considers the pros and cons of most dispensers and

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consists of a smart medication dispenser. It can remind the patient to take their medication and the dispenser makes a sound and turns on an LED, which can help the elderly person.

II. LITERATURE REVIEW

The automated pill dispenser provides a comforting sense of security, especially for individuals who have intricate medication requirements or are responsible for managing complex medication regimens. It effectively relieves anxiety and worry by ensuring accurate and timely dispensing of medications. This device offers peace of mind, as users can trust that their medications will be administered correctly according to their prescribed schedules. This is particularly beneficial for individuals with chronic conditions who rely on precise medication adherence for optimal health outcomes. Ultimately, the automated pill dispenser becomes a reliable ally in the pursuit of peace and reassurance in medication management.

The studies reviewed are moslty based on the requirement and their easiness to the individuals or patients. Abdul Aziz et. al provides a planned initiative which aims to make medicine administration simpler, particularly for senior individuals who regularly forget the proper dosage schedule. With the use of ThingSpeak, this study aims to build an automated medication dispenser that can notify carers via the Blynk app, inform elderly patients, and record drug drop statistics. This study uses an Arduino AT Mega 2560 as the device's microcontroller. It will be connected to a Wi-Fi module so that it may send information to the ThingSpeak platform and notify the carrier via the Blynk app [7]

S. Mukund et.al generated an Automatic Medication Dispenser with an alphanumeric keypad and microcontroller interfaced with an LED display. It also includes a motor controller, an alarm system which helps the delivery of multiple pills at certain time. The overall goal of the operation is to make it easier for the user to specify the timings for many pills to be administered at the appropriate times. [8] Jyothis et. al considers the easiness of patients and designed an automatic medicine dispenser that is dependable, inexpensive, and capable of holding up to 2-3 weeks' worth of medication can eliminate the drawbacks mainly seen in other dispensers. They utilized the advantages of IoT with microcontroller for the effective implementation and performs better when compared to similar ones. [9] Automated Medicine Dispenser is put forwarded by Rajeswar S et.al gained more appreciation among medical practitioners and patients. The idea driving this model is administering medication by staying. In this technique, the information of the solution of tablets to each patient is fed to the microcontroller's memory. By utilizing the idea of a line adherent robot, the distributor moves in the line put across the patient's bed, it stops at every bed. When the patient outputs their tag in the RFID per user, the pills endorsed for the patients fall into the holder.[10]

Online Medicine Reminder and Dispenser idea is designed by Shyla S et.al uses a mobile application for the real time monitoring. The mobile app interface for this device comprises two main components: the input interface and the output interface. The input interface facilitates the acceptance or modification of prescriptions. Users can conveniently enter or adjust their medication prescriptions through this interface. It provides a user-friendly platform for inputting crucial information related to dosage, frequency, and specific instructions prescribed by healthcare professionals. The app ensures that users have a seamless experience when managing their medication regimen. The output interface displays essential information and findings related to the medication management process. When it's time to take your medication, the Drove lights and signal will turn on, and the LCD will display the recommended treatment at the same time. [11]

An IoT Based Medicine Dispenser developed by Aditya P et.al is a medication Container that distributes medication based on the client's identification by using the client's name and the secret key that the machine's manager has provided to the client. This machine will distribute medication in accordance with the prescription that the patient was given by their doctor and in addition, the amount of medication that the user has left over [12]. Another approach is a programmed pill box that can be a decent decision to save time and to stay away from neglecting to take the drug with perfect timing, however it is more costly. The wellbeing recuperation interaction can be improved by utilizing a programmable drug gadget [13] The Programmed Medication Distributor, developed by Dhanu.S et.al, is designed with a unique feature that notifies the caregivers or attendants through an Android application when the patient has taken their medications. This innovative system ensures that once the medication reaches the patient, a signal is sent to the caregiver's mobile device via the accompanying Android app. [14].

The integration of the Android application with the Programmed Medication Distributor not only improves patient safety and medication management but also enhances the overall caregiver experience. It provides an efficient means of receiving updates on medication administration, allowing caregivers to fulfil their responsibilities effectively while ensuring the patient's well-being. The proposed model is also considering the

use of this functionality, which serves as a valuable monitoring and accountability tool, particularly for patients who require consistent supervision or have complex medication regimens. The Android app acts as a reliable channel of communication, enabling caregivers to stay informed about the patient's medication adherence and promptly address any concerns or issues that may arise.

III. Existing System

IoT-based pharmaceutical distributors are designed to precisely distribute and arrange prescription portions. They often feature a variety of compartments to contain different medications, and some structures significantly permit compartment modification for unique drug programmers. [15] IoT platforms enable continuous monitoring of medication adherence. Clients and guardians can screen and track medication admittance using related applications and cloud platforms; this is accepted as recommended to ensure dosages are given. This information can provide important insights into adherence examples and aid healthcare providers in making wise decisions. [16]

Many IoT-based platforms enable parents to remotely monitor prescription adherence and receive notifications if any dosages are missed. This feature is especially helpful for those who require assistance managing their prescriptions, such as the elderly or those with persistent conditions. To provide the board with beneficial medications, a system function in conjunction with drugstore administrations. This combination may include automatic ordering updates, medication tracking, and the ability to make top-off arrangements directly from the app. IoT-based medicine distributors routinely provide news highlights that result in reports and experiences about drug adherence. These findings can be shared with medical professionals as part of plans to have discussions and make any necessary adjustments to the treatment strategy. These frameworks' versatile apps have user-friendly interfaces that make it simple for individuals to create medication plans, receive updates, and access crucial information about their medications. Positive client experiences are enhanced by natural places of engagement. [17].

IV. Proposed System

The proposed strategy plans to create an upgraded automatic medicine dispenser that improves the medication administering routine for clients, especially those with complex medication regimens, a simple process. The system combines hardware components and clever programming to automate the association and distribution of medications, promoting accuracy, adherence, and sound judgement. Clients or carers enter solution data into the system, including names, estimates, repeats, and any unique headers.

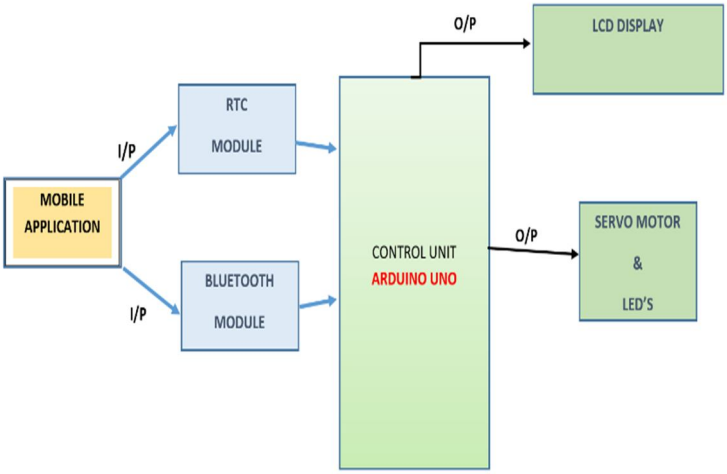

Fig. 1. System Diagram

Every prescription is given a revised plan by the structure that shows the extensive stretches of guidance taking the drug information into account. The expected prescriptions are consequently apportioned from the legitimate compartments as per the timetable by the framework. It ensures that the right drugs are managed in the right amounts. At the point when now is the ideal time to take their medicine, the framework informs clients outwardly, perceptibly, or electronically, guaranteeing opportune and precise organization. At the point when a

top off is required, the framework checks medication levels and informs the client. For the accommodation of requesting and conveying prescriptions, it can likewise incorporate with on the web or pharmacy stages. By dealing with their medications freely and helpfully, clients become less subject to other people. The network of the framework empowers clinical experts or carers to remotely check prescription adherence and make a fitting move. The proposed medication dispenser framework offers an inventive answer for work taking drugs the board, upgrading adherence, and work on tolerant results. By joining equipment, programming, and network, the framework soothes out medicine association, administering, and observing, helping people with complex prescription regimens and giving inward feeling of harmony to clients and parental figures the same. Through the app the user can set the time and dosage of a particular medicine in the format ”HH:MM -Dosage”. User can set time and dosage for up to 4 sets of medicines. The user can also set the local time of an area through the app. The prototype UI built in Bluetooth Electronics is shown in Fig 4.2.

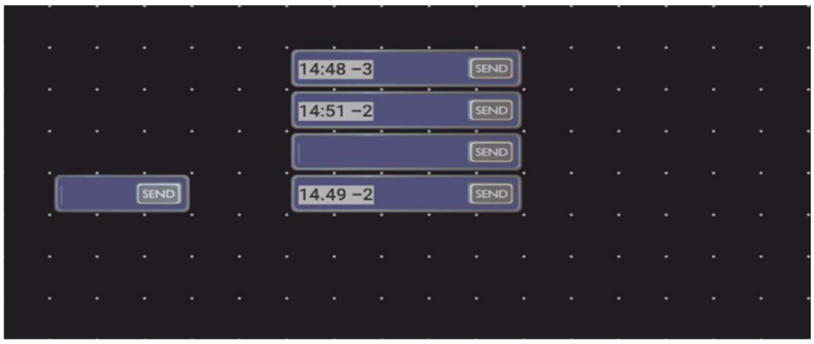

Fig. 2. Application Layout

A. Requirements

Arduino UNO: One of Arduino’s standard boards is the UNO. A well-known microcontroller board called the Arduino Uno is frequently used for hardware projects and prototyping. The Arduino Uno is crucial for the Arduino ecosystem, which provides a simple platform for creating intelligent electronic projects, and is dependent on the microcontroller. The ATmega328P microprocessor powers the Arduino Uno and operates at 16 MHz for storing code and data, it has 32KB of flash memory, 2KB of SRAM, and 1KB of EEPROM. Six of the board’s 14 computerized input/yield pins, or PWM (Heartbeat Width Adjustment) yields, are available for use. Additionally, it offers 6 straightforward information pins for viewing basic sensor results. The Arduino Uno features a built-in USB interface that enables it to connect to a PC for programming and communication. It functions as a virtual COM port, enabling straightforward code transfer and sequential communication with the PC. The Arduino IDE (Coordinated Improvement Climate), a free programming tool for coding and programmed development, is used by Arduino Uno. It supports a programming language based on C/C++ and has a robust library ecosystem, making it young and generally open. The Arduino Uno is compatible with a variety of protections, or add-on sheets, which increase its functionality. [18] RTC Module: A time tracking device that displays the current time and date is the DS3231.

RTC module. The phrase RTC means Real Time Clock. The RTC module uses a DS3231 clock chip. The time and date are typically provided by this module in computers, laptops, mobile devices, embedded system applications devices, etc. I2C is the protocol used by the RTC module. One more intriguing development: Either a 12 or a 24-hour configuration can be used to operate it. It can be applied to tasks like data logging, clock construction, time stamping, timers, and alarms [19].

Potentiometer: Allows the user to change the resistance and hence modify the output voltage, it functions as a variable voltage divider. It helps to set contrast for the LCD display.

Bluetooth Module: A Bluetooth module is a device that uses radio waves to wirelessly connect two or more electronic devices. Bluetooth modules are commonly used in devices such as headsets, keyboards, mice, and speakers. Bluetooth technology was originally developed as a way to replace cables used to connect electronic devices. The first Bluetooth module was released in 2001. Today, Bluetooth modules are commonly used in a variety of devices, including smartphones, tablets, and computers. Bluetooth modules typically have a range of up to 30 feet and can transfer data at speeds of up to 3 Mbps. Bluetooth modules typically use very little power, which makes them ideal for use in portable electronic devices. They are also relatively inexpensive and easy to use. Bluetooth modules can be used to create ad hoc networks, which do not require an access point. This type of network is often used in situations where it is not possible or convenient to set up a Wi-Fi network. Bluetooth

modules can also be used to connect electronic devices to the internet. For example, some printers and scanners come with built-in Bluetooth modules that allow them to be connected wirelessly to a computer.
LCD Screen: A liquid-crystal show (LCD) may be a flat-panel show or other electronically modulated optical gadget that uses the light-modulating properties of liquid crystals combined with polarizers. LCDs can either be regularly on (positive) or off (negative), depending on the polarizer arrangement. Optical channels are included to white on blue LCDs to give them their characteristic appearance. Servo Motor: The servo engine is an electrical gadget that can be utilized to precisely turn objects. The PWM flag is utilized to control the servo engine. The control circle of the servo contains a comparator that compares the control flag and creates the reference flag from the potentiometer. Therefore, the revolution proceeds until the comparator yield mistake flag gets to be zero and the DC engine stops. [20]
Bluetooth Electronics: The application controls the electronic project with an Android device. This application imparts utilizing Bluetooth to a HC-06 or HC-05 Bluetooth module in the project. This application accompanies a library containing 11 Bluetooth models for Arduino. It can likewise be utilized with Raspberry Pi or some other fast prototyping framework in which you have incorporated a reasonable Bluetooth module to your task.

V. IMPLEMENTATION

The Fig.3 shows the circuit diagram for the proposed model with the required components. Through the portable application, the user can specify the medication schedule and dosage instructions. This includes figuring out the drug's name, dosage frequency, and time. Through Bluetooth, the flexible application transmits the prescription schedule and dosage instructions to the medication allocator. Data on when and how much prescription should be distributed may be remembered by the guidelines.
The medicine container receives the instructions from the portable application and is equipped with a Bluetooth module and microcontroller. The gadget's microcontroller confirms the ongoing time against the drug plan got from the application. Assuming that now is the right time to administer drug, the interaction proceeds; in any case, it sits tight for the following planned time. The allocator gets ready for drug apportioning, which might include actuating the essential parts like engines or solenoids answerable for the physical administering instrument. When ready, the container administers the fitting drug measurements in light of the guidelines got from the application. This can be accomplished through components.
This affirmation might include checking the right amount of prescription apportioned or utilizing weight sensors to gauge the leftover medicine amount. The dispenser sends input or announcements to the versatile application, affirming that the drug has been administered effectively or informing any issues or blunders experienced during the cycle. The portable application gets the input from the container, refreshing the client on the drug administering status. This data can be shown to the client continuously or through notices.

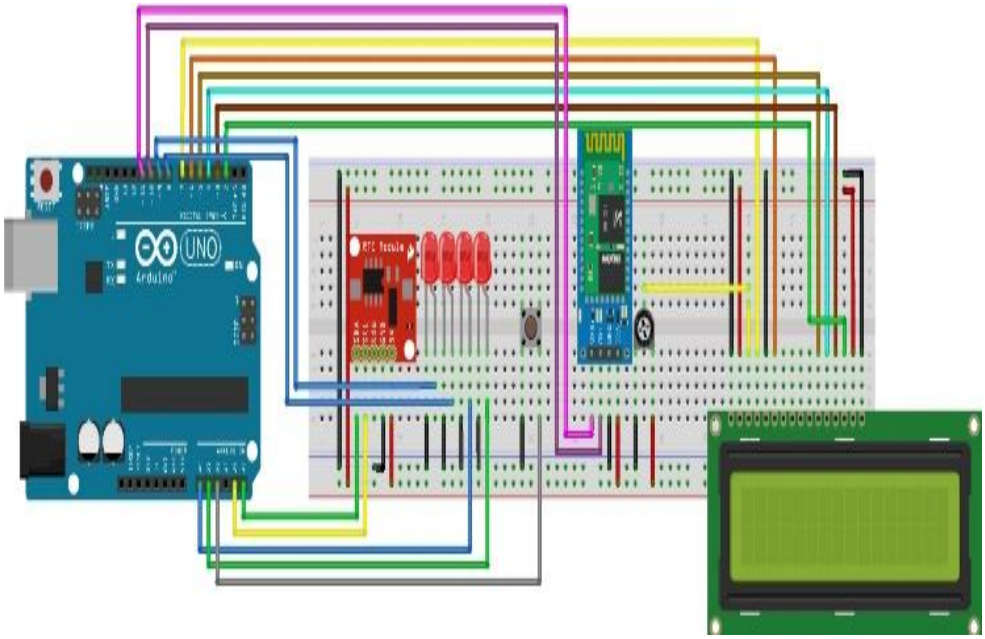

Fig. 3. Circuit Diagram

The versatile application can send updates or notices to the client's gadget, reminding them to take their drug at the booked times. These notices might incorporate insights concerning the medicine name, measurements, and any extra guidelines. In the meantime, the Bluetooth association between the application and the medication container works with consistent correspondence and synchronization of information and guidelines. The framework can be additionally improved by integrating extra highlights, for example, cloud availability for remote access, information investigation for experiences, and client confirmation for security.
Fig. 4 represents the interaction between the user, the app, the Arduino, the stepper motor, and the container. The user interacts with the app, which connects to the Arduino via Bluetooth. The app sends commands to the Arduino indicating which container and stepper motor should be rotated. The Arduino then rotates the specified stepper motor, which dispenses the pills from the corresponding container.

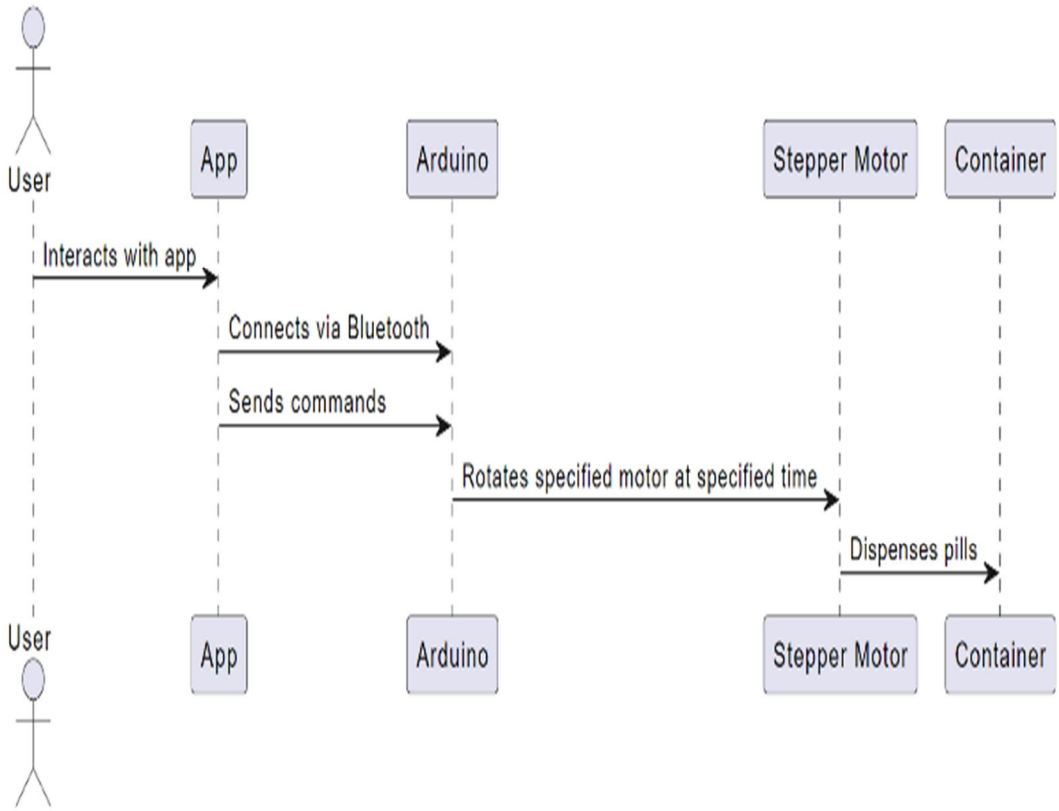

Fig. 4. System Diagram

VI. Conclusion

IoT-based systems enable precise association and administration of medication amounts, ensuring that patients receive the best medication at the perfect time. Portable applications connected through Bluetooth offer the best recommendations to users, lowering the risk of missed dosages and promoting medication adherence. These frameworks continuously monitor and track drug adherence, providing valuable information about prescription behavior and assisting healthcare providers in making well-informed decisions. The paper covers a medicine dispenser module which assist the elderly and unmindful persons in the intake of their medications regularly and to provide this product at affordable cost also. The final model of the proposed product using electronic components can dispense up to 4 different medicines (tablets or capsules) at various timings with an alarm system to alert the person. The system is useful for those persons who take pills regularly and whose course of prescription is very long and difficult to remember. The Bluetooth hardware-based IoT-based medicine device with an application interface offers more advantages for the administration of prescription drugs and adherence. Future enhancements for IoT-based medicine dispensers include incorporating AI and ML capabilities to personalize medication schedules and dosage amounts based on patient data, as well as adding voice recognition

and natural language processing to improve accessibility for patients. Additionally, improving remote monitoring and communication features would enable healthcare providers to monitor medication adherence and make adjustments to treatment plans remotely.

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