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Smart Medicine Box

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ABSTRACT: Our project's primary objective is to develop a Smart Medicine Box tailored for individuals who require regular medication intake, particularly those with lengthy prescriptions or elderly patients prone to forgetfulness. We observed the challenges faced by patients, caregivers and Nurses in managing complex medication schedules, especially for chronic conditions such as diabetes, hypertension, respiratory ailments, heart diseases, and cancer. Our solution addresses these issues by incorporating features that ensure timely medication adherence and reminders. When it's time to take medication, the system emits a distinctive notification sound and illuminates the corresponding pill box with a bright light, making it easy for the patient to identify the medication to be taken. All medication compartments are pre-loaded into the system according to the prescribed schedule. One distinguishing feature of our system is its ability to detect whether the patient has retrieved the pills from the box or not, significantly enhancing medication adherence. Ultimately, our innovative system aims to expedite patient recovery and improve health outcomes by facilitating proper medication management.

KEYWORDS: Smart Medicine Box, Medication intake, prescriptions, patients, Reminders, Pill box.

I. INTRODUCTION

Medication adherence refers to the extent to which a patient correctly follows medical advice regarding their medication regimen. Conversely, medication non-adherence encompasses actions such as negligence and delays in taking prescribed medications, disregarding prescriptions, or skipping doses, often influenced by cultural and racial factors. Additionally, engaging in un-prescribed polypharmacy, altering prescriptions, or taking multiple medications without guidance are all examples of non-adherence.

Farmers, faced with the challenge of selecting the most suitable and financially viable crops for their soil, circumstances, and location often experience losses due to the variability in soil types across the country.

Factors contributing to medication non-adherence, particularly in rural areas of our country, include forgetfulness among elderly patients, difficulties in reading and understanding prescriptions and medication labels, as well as limited resources and knowledge to utilize various mobile-based medication reminder applications. Non-adherence to medication regimens can have serious health effects, potentially leading to negative outcomes.

The solutions can be categorized into hardware and software-based approaches. While numerous medication-reminder apps are available for different mobile platforms, these may not be accessible to elderly or illiterate individuals in rural India. The system in this study is hardware-based. It involves inputting the pharmaceutical tablets and their schedule into a device by a doctor, their assistant, or another literate family member (referred to as the "caregivers"). The smart medicine box then notifies the patient at the designated time.

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1.1 MOTIVATION

The prevalence of medication non-adherence poses significant risks to health, especially among older adults. To address this issue effectively, a system is needed that empowers patients to take their medications at the recommended times independently. However, studies reveal that people often forget to take their prescribed medications, leading to adverse health outcomes, hospitalizations, and increased medical costs. The proposed IoT-based smart medicine box aims to mitigate these challenges. By leveraging insightful data on medication usage and patient behaviour, healthcare professionals can tailor personalized care plans. This reliable and user-friendly device holds great promise for enhancing personal medication management, particularly for older individuals.

1.2 OBJECTIVE

The objectives of this project are:

1. Visual and Audible Alerts
2. Integration with Healthcare Systems (EHR)
3. Database Implementation for Patient Information
4. Appointment Management
5. Increased patient independence and autonomy
6. User-Friendly Interface

II. LITERATURE SURVEY

Iran Pak [1] conducted a study utilizing datasets from IoT devices connected to patients through wrist sensors, generating 10,000 data points per hour, each exceeding 1 terabyte in size. They employed a prioritization approach to handle sensitive IoT data and implemented LSTM deep neural networks on cloud computing platforms for remote monitoring of patients, which stands out as a novel contribution. The data transmission utilized 5th-generation Internet technology, with LSTM neural networks being central to the cloud computing architecture.

Archip [2] detailed the development of a low-cost modular monitoring system prototype. This system incorporated specially designed sensor arrays for EKG, SpO2, temperature, and movement, aiming to facilitate swift and effective medical responses in emergency scenarios. The IoT concept was employed in designing sensor interfaces, with a central control unit offering a RESTful-based Web interface for platform-independent operation and easy integration of additional components.

P. S. Akram [3] underscored the importance of IoT in various aspects of healthcare, including data collection, monitoring, analysis, and communication. Their research focused on monitoring patients' vital signs such as GPS location, body temperature, blood pressure, and pulse using sensors interfaced with an Arduino Board acting as a CPU. Data was transmitted over the internet for analysis, with immediate communication to doctors in case of critical situations.

Lakmini P. Malasinghe [4] provided an overview of advancements in both contact-based and contactless remote monitoring in healthcare. They discussed challenges prevalent in existing systems and offered suggestions for further research. These systems enable monitoring of daily activities with minimal user disruption, including sensor-based smart watches.

Tanmay Patil [5] aimed to develop a Remote Health Monitoring System using locally available sensors to minimize costs for potential mass production. They highlighted the adoption of technology in healthcare research, particularly in improving access to expensive healthcare services, especially in developing countries.

III. PROBLEM STATEMENT

Ensuring patients consistently adhere to their prescribed medication regimens is crucial for effective treatment and positive health outcomes. However, non-adherence is widespread, especially among older adults and those with complex chronic conditions, due to factors like forgetfulness, cognitive challenges, and complex medication schedules. The Smart Medicine Box project seeks to tackle this issue by improving medication adherence through innovative solutions.

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IV. BACKGROUND

This technology aims to empower patients to better manage their medication schedules and enable caregivers or nurses to monitor adherence remotely, thus improving overall treatment effectiveness and patient outcomes.

- Reminder System: It alerts patients (Visual and audible alerts) to take their medicines on time.
- Multiple Compartments: Smart medicine box has separate compartments for different medications (morning, afternoon, evening).
- Colour LED Lights: Above each compartment, colour LED lights indicate which medication to take when an alarm sound.

V. METHODOLOGY

5.1 BLOCK DIAGRAM

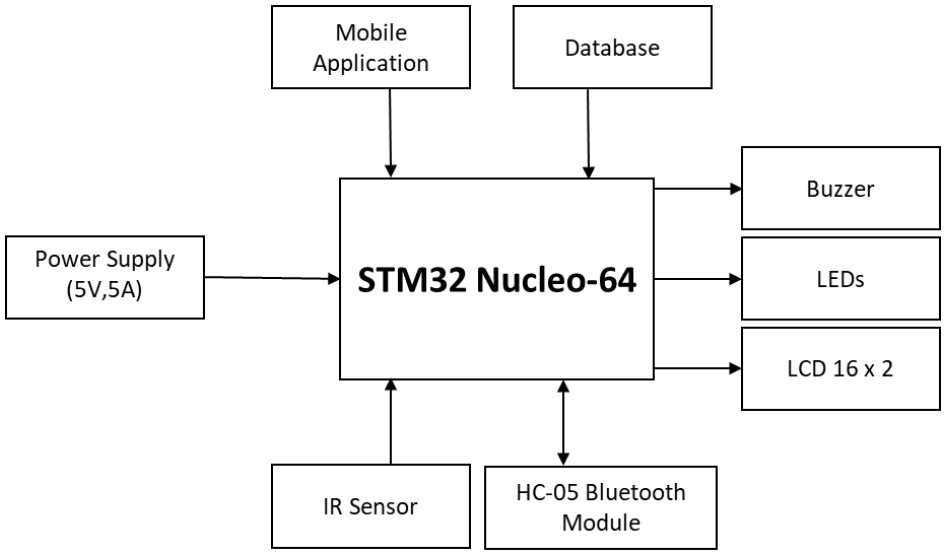

Figure: 1 Block Diagram of smart medicine box

1. STM32 Nucleo-64:

The STM32 Nucleo-64 board offers an economical and versatile solution for users to explore new ideas and create prototypes. By selecting from a range of performance and power consumption features provided by the STM32 microcontroller, users can tailor their designs. Additionally, for compatible boards, the external Switched-Mode Power Supply (SMPS) significantly reduces power usage during Run mode.
Furthermore, the ARDUINO Uno V3 compatibility and ST morpho headers make it easy to expand the functionality of the STM32 open development platform. Users have a wide selection of specialized shields to enhance their projects.

2. LCD 16×2:

An LCD (liquid crystal display) is an electronic display module widely used in various applications, including mobile phones, calculators, computers, and TV sets. These displays are particularly favoured for their compatibility with multi-segment light-emitting diodes and seven-segment displays. The key advantages of using LCDs include affordability, programmability, support for animations, and the ability to display custom characters and special symbols.

3. HC-05 Bluetooth Module:

The HC-05 represents a Bluetooth module specifically crafted for wireless communication. It can operate in either a master or slave configuration. The module features a red LED that indicates the connection status - whether Bluetooth is currently connected or not. Prior to connecting to the HC-05 module, this red LED blinks continuously in a periodic manner. Once it establishes a connection with another Bluetooth device, the blinking rate slows down to two seconds.

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The HC-05 operates at 3.3V, but it can also be powered by a 5V supply voltage, thanks to the onboard 5V to 3.3V regulator.

4. IR Sensor:

An IR sensor is an electronic device that emits light to detect objects in its surroundings. It can measure an object's heat and detect motion. Although these radiations are invisible to our eyes, infrared sensors can perceive them.

The IR sensor consists of two main components:

- **Emitter**: This is an IR LED (Light Emitting Diode) that emits infrared light.
- **Detector**: The detector is an IR photodiode that is sensitive to the same wavelength of IR light emitted by the IR LED. When IR light falls on the photodiode, its resistance and output voltage change in proportion to the magnitude of the received IR light.

5. Buzzer:

A buzzer is a straightforward and widely employed electronic device. When an electrical signal is applied to it, the buzzer generates an audible sound or tone. These devices play a crucial role in electronic systems, offering auditory feedback or alerts to users. Due to their various types and features, buzzers find applications across diverse scenarios, signalling events or delivering user notifications.

6. LED:

An LED (light-emitting diode) is like a tiny electronic light bulb. When electricity flows through it, it produces light. The colour emitted by an LED is determined by the specific semiconductor material it contains. Aluminium gallium indium phosphide (AlGaInP) alloys result in LEDs that emit red, orange, or yellow light. On the other hand, indium gallium nitride (InGaN) alloys are responsible for LEDs producing green, blue, and white light. Even slight variations in the alloy composition can yield different vibrant colours.

5.2 FLOWCHART

The flowchart depicts the system where a reminder is set to prompt the patient to take their medicines at the designated time. The system, which includes a buzzer and LED notification, notifies the patient for medicine intake. This ensures that the patient is adhering to their medication schedule, thereby maintaining a consistent medication regimen. The process is cyclical, starting with setting the reminder and ending with the patient taking the medicine.

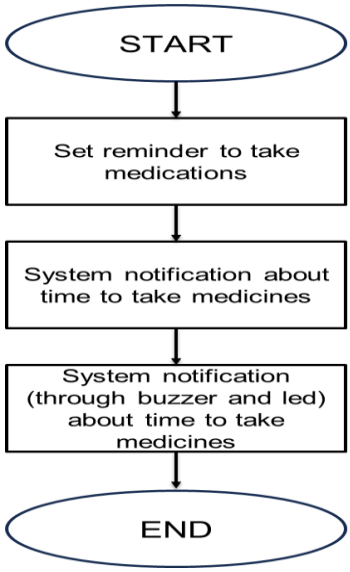

Figure: 2 Flow chart of smart medicine box

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VI. RESULT

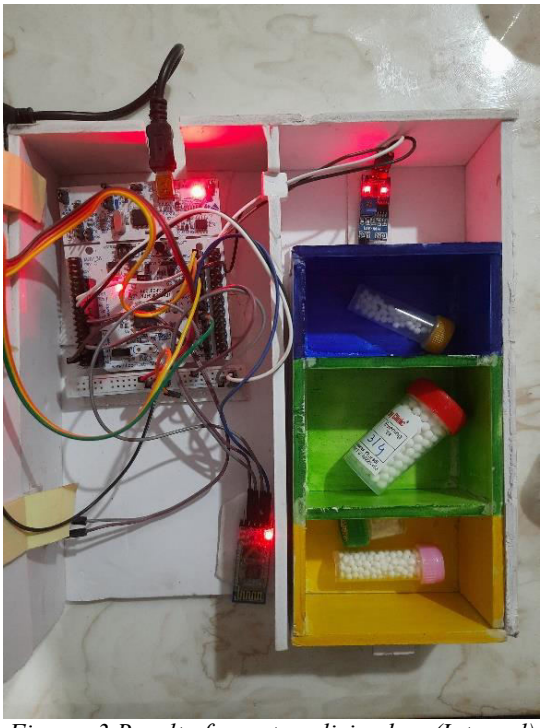

Figure: 3 Result of smart medicine box (Internal)

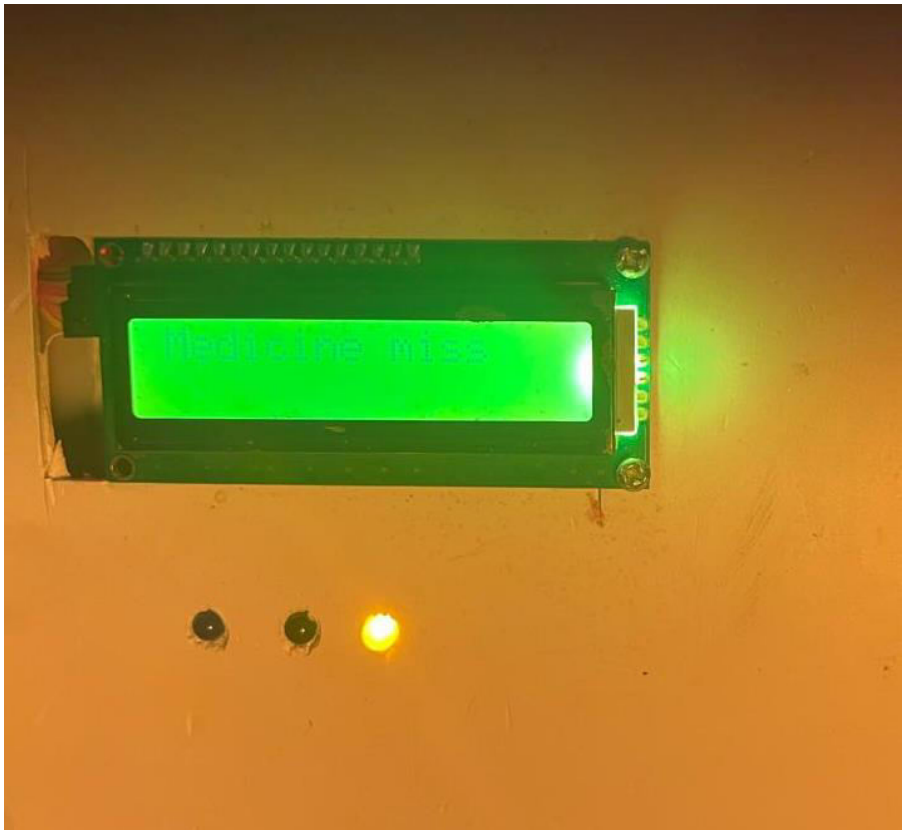

Figure: 4 Result of smart medicine box (External)

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We've developed a project that proves highly beneficial for patients. Our findings indicate that our solution is particularly valuable for individuals who take medication regularly. Managing lengthy and complex medication prescriptions can be challenging for these users. Our product effectively addresses this issue, ensuring that patients receive the right treatment without the burden of remembering intricate medication schedules. As a result, caregivers can rest assured about their patient's well-being, leading to healthier and stress-free lives.

VII. CONCLUSION

Our project delivers superior smart medicine box, designed with the needs of patients and the elderly in mind. It stands out for its functionality and quality. Considering the comprehensive nature of the package, the pricing is competitive and fair. The system's alarms are meticulously programmed to prompt at the correct times. The programming language used is user-friendly and adaptable. Our mission is to facilitate a healthy, worry-free lifestyle for regular medication users by offering an affordable product. Moreover, our project is sustainable, allowing for the replacement of less efficient or costly medicine boxes with our versatile and cost-effective solution.

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