IJARETY

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

INNO SPACE
SJIF Scientific Journal Impact Factor

doi crossref

निस्केयर NISCAIR

IOT-Enabled Smart Medication Reminder System for Heart Patients

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ABSTRACT: The Smart Medical Box for Monitoring represents a pioneering solution aimed at revolutionizing home health management through the integration of specialized sensors and Internet of Things (IoT) technology. This innovative project is designed to continuously monitor vital health indicators such as heart rate, temperature, and blood oxygen levels (SpO2) in real-time, offering users unprecedented insights into their health status. At the core of the system lies a compact and user-friendly device equipped with an array of sensors capable of capturing and transmitting crucial health data seamlessly. By leveraging IoT technology, the Smart Medical Box provides users with continuous access to their health metrics, enabling proactive health monitoring from the comfort of their homes. Complementing the sensor capabilities are intelligent computer programs that analyze the collected data in real-time. These programs employ sophisticated algorithms to detect deviations from normal health parameters, prompting timely intervention when abnormalities are identified. Leveraging historical data and predefined health profiles, the system suggests appropriate medications or interventions, empowering users to take proactive steps towards managing their health effectively. Furthermore, the Smart Medical Box incorporates GSM technology, enabling communication with users and caregivers regarding medication status. Through automated messages, users are alerted when their medications are running low, ensuring timely replenishment and uninterrupted treatment regimens. In summary, the Smart Medical Box for Monitoring represents a groundbreaking advancement in home health management. By seamlessly integrating sensor technology, IoT connectivity, and intelligent algorithms, the system offers a holistic approach to health monitoring and medication management. With its ability to provide real-time insights, proactive intervention, and medication reminders, the Smart Medical Box empowers users to take control of their health and well-being like never before.

KEYWORDS: Smart Medical Box, Monitoring, IoT technology, Sensors

I. INTRODUCTION

In an era defined by technological innovation and advancement, the realm of healthcare stands as a frontier ripe for transformation. Amidst the myriad challenges facing modern healthcare, the need for efficient, accessible, and proactive solutions for home health management is increasingly paramount. The Smart Medical Box for Monitoring emerges as a pioneering endeavour to address these pressing needs, offering a revolutionary approach to personalized health monitoring and medication management within the comfort of one's home. At its core, the Smart Medical Box represents a convergence of cutting-edge sensor technology and the Internet of Things (IoT). By harnessing the power of specialized sensors, this innovative device is capable of continuously monitoring vital health indicators, including heart rate, temperature, and blood oxygen levels (SpO2), in real-time. This continuous stream of data empowers users with invaluable insights into their health status, fostering a proactive approach to wellness. Complementing the sensor capabilities are intelligent computer programs imbued with advanced algorithms designed to analyse the collected health data. These programs serve as vigilant guardians, tirelessly scanning for deviations from normal health parameters. Upon detecting abnormalities, the system promptly alerts users and caregivers, facilitating timely intervention and ensuring that potential health concerns are addressed swiftly and effectively. Moreover, the Smart Medical Box is equipped with GSM technology, enabling seamless communication with users regarding medication status. Through automated messages, individuals are notified when their medication supply is running low, thereby averting the risk of treatment interruption and ensuring continuity of care. The significance of the Smart Medical Box extends far beyond its technological prowess. By placing the tools for health monitoring and medication management directly into the hands of individuals, this innovative system empowers users to take an active role in their own healthcare journey. By fostering a sense of ownership and agency, the Smart Medical Box not only enhances health

outcomes but also promotes autonomy and well-being. In essence, the Smart Medical Box for Monitoring heralds a new era in home health management. Through its seamless integration of sensor technology, IoT connectivity, and intelligent algorithms, this groundbreaking system represents a paradigm shift in how we approach healthcare. As we embark on this journey of innovation and empowerment, the Smart Medical Box stands as a beacon of hope, offering a glimpse into a future where personalized healthcare is not just a dream but a tangible reality.

II. LITERATURE REVIEW

Literature research is the most important step in the software development process. Before creating a tool, it is important to determine the time factor, profitability, and company strengths. With these in place, the next 10 steps are to decide which operating systems and languages you can use to develop your tools. Once programmers start building tools, they need a lot of external support. This support can come from experienced programmers, books, or websites. The above evaluations will be considered in the development of the proposed system before building the system.

Geng Yang, Kungliga Tekniska Hogskolan, Stockholm, Li Xie, Matti Mäntysalo, Xiaolin Zhou, Zhibo Pang "A Health-IoT Platform Based on the Integration of Intelligent Packaging, Unobtrusive Bio-Sensor, and Intelligent Medicine Box" 2020
In-home healthcare services based on the Internet-of-Things (IoT) have great business potential; however, a comprehensive platform is still missing. In this paper, an intelligent home-based platform, the iHome Health-IoT, is proposed and implemented. In particular, the platform involves an open-platform-based intelligent medicine box (iMedBox) with enhanced connectivity and interchangeability for the integration of devices and services; intelligent pharmaceutical packaging (iMedPack) with communication capability enabled by passive radio-frequency identification (RFID) and actuation capability enabled by functional materials; and a flexible and wearable bio-medical sensor device (Bio-Patch) enabled by the state-of-the-art inkjet printing technology and system-on-chip. The proposed platform seamlessly fuses IoT devices (e.g., wearable sensors and intelligent medicine packages) with in-home healthcare services (e.g., telemedicine) for an improved user experience and service efficiency. The feasibility of the implemented iHome Health-IoT platform has been proven in field trials.

S. Jaipriya, R. Aishwarya, N.B. Akash, Jeyadevi "An Intelligent Medical Box Remotely Controlled by Doctor" 2021
Now a day's, most of the people are encountered with some health-related problems and they need regular medications. From a survey, about 65% of people forget to take their medicines at right time. To avoid the medication non-adherence, a system has been proposed using an IOT Platform, sensors and with the medical box. An IMB model with wireless connectivity (Wi-Fi module) helps patients and doctors to be in closer communication. The model which has been developed has an intelligent medical setup that alerts the patients to take their medications at the right time. At the same time, the Doctor can check the patient's health condition using the sensors remotely. The sensors used will continuously monitor the patient's health. If there is any variation, then the doctor varies the number of pills to be taken. In case if the patient forgets to take the pills even after the alert, then the information of skipped dosages will be available in the server. The doctor can remotely update the medication details in the IOT server and timely updates about medicines are available to patients. This project is claimed to be the best solution for intimating the patient to take medicines regularly and continuous monitoring of the patient's health.

B. Ayshwarya, R. Velmurugan "Intelligent and Safe Medication Box in Health IoT Platform for Medication Monitoring System with Timely Remainders" 2021
The progress in IoT health care is considered to be a massive contribution to the elderly people. The elderly people and people who are suffering from chronic diseases need to intake tablets regularly on timely basis. Care takers with their busy daily routine may forget the instructions and time about pills which are prescribed for patient. Also care takers who are dealing increased number of patients may feel hectic to sort the medicine list for corresponding patients at proper time. Earlier much research have been carried in this area and different pill boxes have been proposed already. The intelligent medication box proposed in this work have specialized features including six sub boxes which helps to organize six different pills, provides timely remainders for the patient or caretaker in an android application like hand-held devices like smartphone. This intelligent medication box contains biosensor for monitoring of temperature and heartbeat. Overdosage and improper intake of medicines may lead to serious issues in health of elderly people to avoid mis usage of medicines a simple authentication process either by the caretaker or the patient himself is performed. The proposed medication is much safer as it clearly intimates about time, dosage, stock of medicine and sort out different pills in correct sub boxes during the next fill by caretaker.

Divyanshu Tiwari, Devendra Prasad, Kalpna Guleria "Pinaki Ghosh IoT based Smart Healthcare Monitoring Systems" 2022

IoT devices are becoming very useful in today's world. In today's era IoT devices are increasing and it has a huge impact in healthcare. It can provide early detection of health problems and can reduce the cost of medical care. The healthcare monitoring system is required for a patient who needs to be monitored 24 X 7. The IoT based health monitoring system can monitor the vital health parameters of a person at all times. It can help patients in the case of emergency by providing immediate health consultation from the doctor available at a distant location. Further, IoT based smart systems enable remote monitoring of the patient by the guardian/ family member which is considered as one of the major advantages to save the precious human life. This paper provides an overview of various IoT based health monitoring systems. The comparison of various healthcare devices has also been presented by taking into consideration the important healthcare parameters.

Maheswari V Uma; A. Kalaiselvi, K. Priyanka, J. Haritha "Implementation of Patient E-Health Monitoring System using Mobile Applications" 2022

A faster pace of technological development makes life easier for people. Approximately 20,000 people die per month as they give less importance in monitoring their own body. Because of their heavy workload people forgot to monitor their health. Science and technology together make everything possible and makes the human lives more and more comfortable. The significance of proposing this system is to prevent diseases and avoid going to hospitals especially in this recent pandemic situation. Therefore, the proposed health monitoring device is designed to measure the patients' health parameters like temperature and heart rate (pulse rate), emotion detector using EMG electrode and blood pressure. Human body temperature and pulse rate are most important healthcare parameters which will conclude patient's condition. The parameters detected from the sensors are displayed on LCD and in mobile application through IoT web server which is used to compare the obtained values with the normal values. If the obtained data is greater than the normal values, then preventive measures can be followed. This proposed health care monitoring system, ensures good medical assistance to doctors, and improves proper maintenance of patient's health record which thereby reduces the risk of illness.

III. METHODOLOGY

The methodology for developing the IoT based smart medicine begins with a detailed requirements analysis, guiding the selection of appropriate technologies such as GSM for communication and Sensors for monitoring the patients. The sensor system used in our project is to create a smart IOT based medical box key parameter is to monitor. It is prescribed to patients who are ignorant of their medication or who miss medication due to work issues, negligence, or memory loss. People who have problems of remember when to take their medicines or quantity of medicines they should get benefit from our medicine box. The necessary sensors are used to collect the different vital measurements, such as heart rate and body temperature. When a finger is placed in the sensor, a bright light (LED) flashes on the finger, and a phototransistor on the opposite side monitors flow of blood. The system also has smart computer programs that can tell when something isn't normal. When it finds something unusual, it suggests the right medicine based on what's been set up before. This helps people get advice about their health quickly and can help manage health better.
A buzzer will notify you and remind you when it's time to take your prescription.

ARCHITECTURE DIAGRAM OF THE PROPOSED MODULE:

The architecture diagram depicts a comprehensive smart medicine box incorporating the sensors and GSM technologies. The physical enclosure of the smart medicine box to accommodate various medication types and sizes while ensuring ease of use and safety. This system for monitoring device performance and user adherence over time. The remote diagnostics and software updates to address any issues or add new features as necessary. It provides ongoing customer support to address user inquiries and ensure the continued success of the smart medical box solution. The system architecture that integrates selected hardware components with software modules for medication scheduling, dose monitoring, notification delivery, and user interface. The factors like power efficiency, scalability, and compatibility with existing healthcare systems or protocols. The sensors into the smart medical box to monitor medication levels, lid status (open/closed), and environmental conditions such as heart rate, oxygen level, temperature etc.
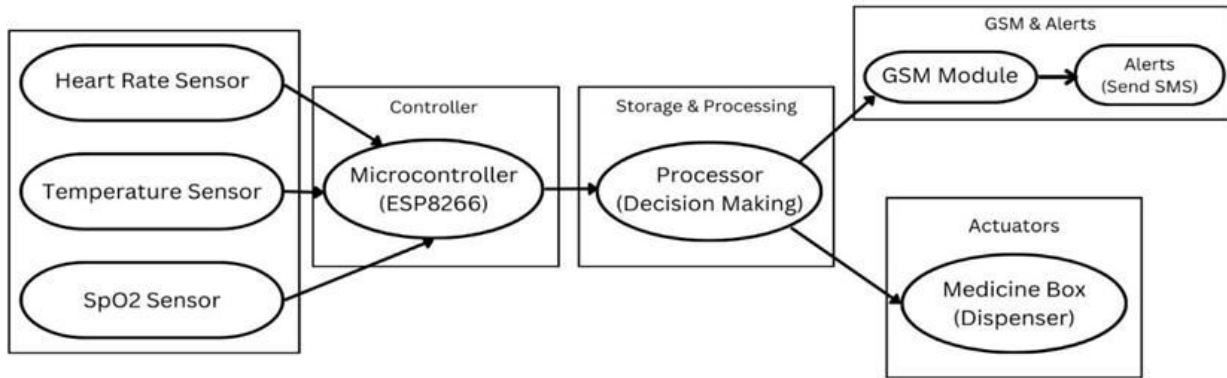
## IV. RESULTS AND DISCUSSION

MODULES IDENTIFIED:
GSM Module, Microcontroller Module, Sensors Module (Heartrate Sensor, Oxygen Level Sensor, Temperature Sensor), Medicine Dispenser Module

GLOBAL SYSTEM FOR MOBILE COMMUNICATION (GSM):

The GSM module, specifically the SIM800L GSM module, is utilized in this project for:

• GSM connectivity enables bidirectional communication between the smart medical box and users or caregivers, allowing for interactive features such as medication reminders, dosage confirmations, and alerts during the abnormal condition of the patient.
• It enables the transmission of location coordinates and emergency alerts via SMS.
• GSM communication allows the smart medical box to transmit adherence data to a central server or cloud platform, facilitating comprehensive tracking and analysis of patient medication adherence over time.
• In case of emergencies or critical events, such as missed doses or medication errors, the smart medical box can send immediate alerts to designated caregivers or emergency contacts via SMS.
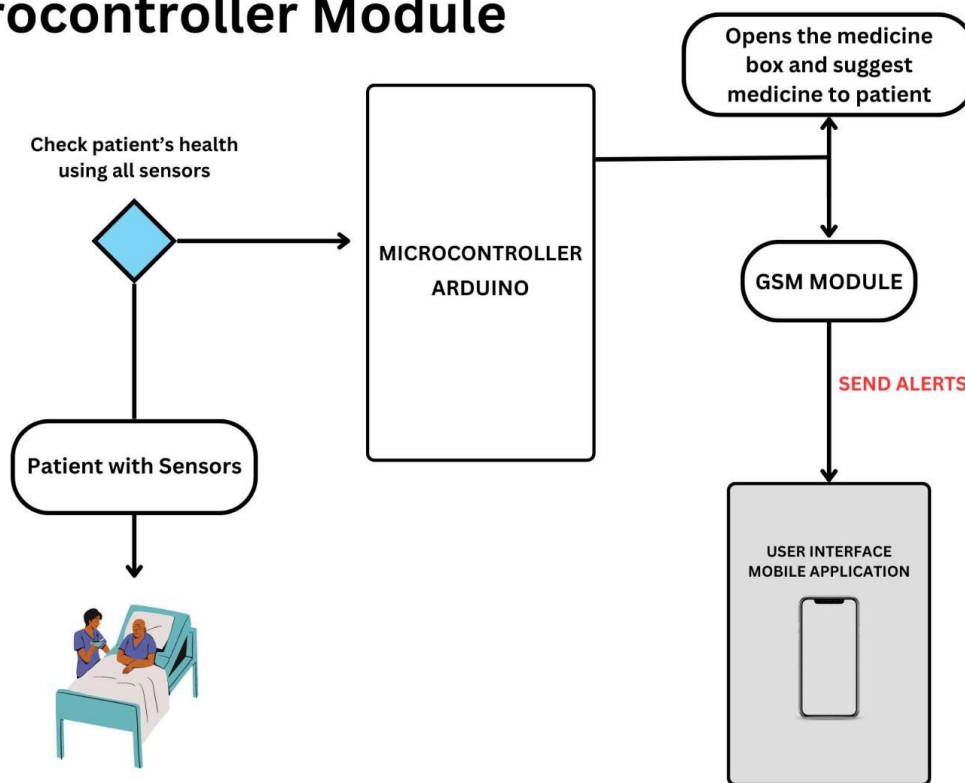
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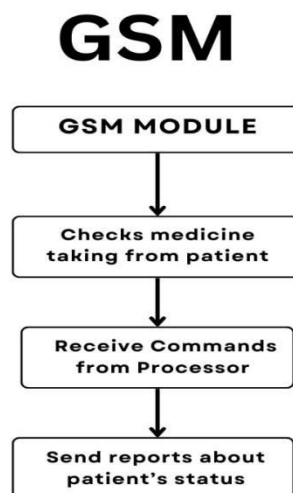
MICROCONTROLLER:

The microcontroller ESP8266 serves as the central processing unit of the system, responsible for data acquisition, processing, and decision-making.

- The ESP8266 microcontroller features built-in Wi-Fi connectivity, allowing the smart medical box to connect to local Wi-Fi networks.
- Wi-Fi connectivity enables seamless communication between the medical box and external servers, cloud platforms, or mobile devices for data transmission, remote monitoring, and control.
- The ESP8266 can be programmed to collect sensor data, such as medication usage, lid status, and environmental conditions, and transmit this data to a central server for analysis.
- Real-time data logging facilitates comprehensive medication adherence tracking, enabling healthcare providers to monitor patient behavior and intervene when necessary.

DIAGRAM:

SENSORS:
Sensors play a crucial role in monitoring medication usage, ensuring dosage accuracy, and providing real-time feedback to patients.

HEART RATE SENSOR:
- Continuously monitor the user's heart rate in real-time using the heart rate sensor.
- Track changes in heart rate patterns over time and detect abnormalities that may indicate cardiac issues or adverse reactions to medication.
- Heart rate sensors typically work by detecting the electrical signals generated by your heart as it beats.

TEMPERATURE SENSOR:
- The LM35 sensor is a precision integrated-circuit temperature sensor whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.
- Incorporating the LM35 sensor enables continuous, real-time monitoring of the patient's ambient temperature.
- Monitoring ambient temperature with the LM35 sensor allows for early detection of changes in the patient's body temperature, which may indicate fever or other health conditions.

OXYGEN LEVEL SENSOR:
- The SPO2 can provide valuable insights into the user's oxygen saturation levels, especially for patients with respiratory conditions or those requiring oxygen therapy.
- Continuously monitor the user's oxygen saturation levels using the SpO2 sensor.
- Use SpO2 measurements to assess the user's respiratory health and monitor the effectiveness of respiratory treatments or interventions.

DIAGRAM:
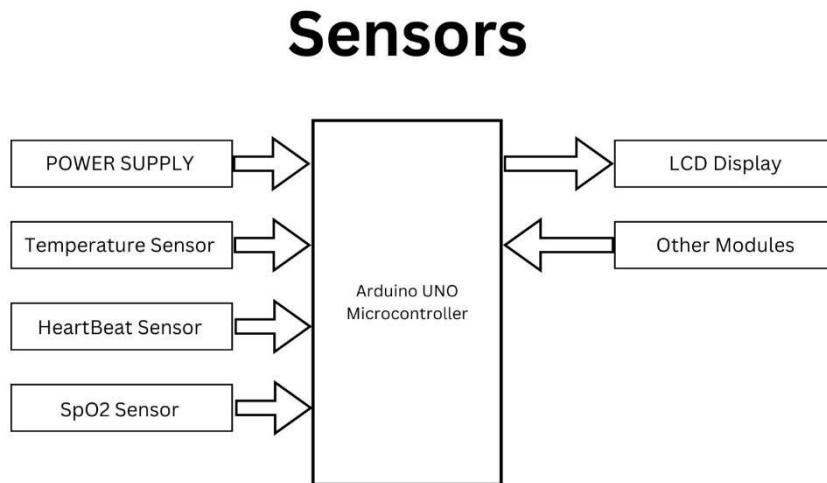
MEDICINE DISPENSER:
- The medicine dispenser adds automation and convenience to medication management for patients.
- Programmed the dispenser to automatically dispense medications according to scheduled doses set by the user or healthcare provider.
- Ensuring timely and accurate medication delivery, reducing the risk of missed doses and improving medication adherence.
- Monitor medication levels in the dispenser and send refill reminders or notifications to users when medication supplies are running low.

DIAGRAM:
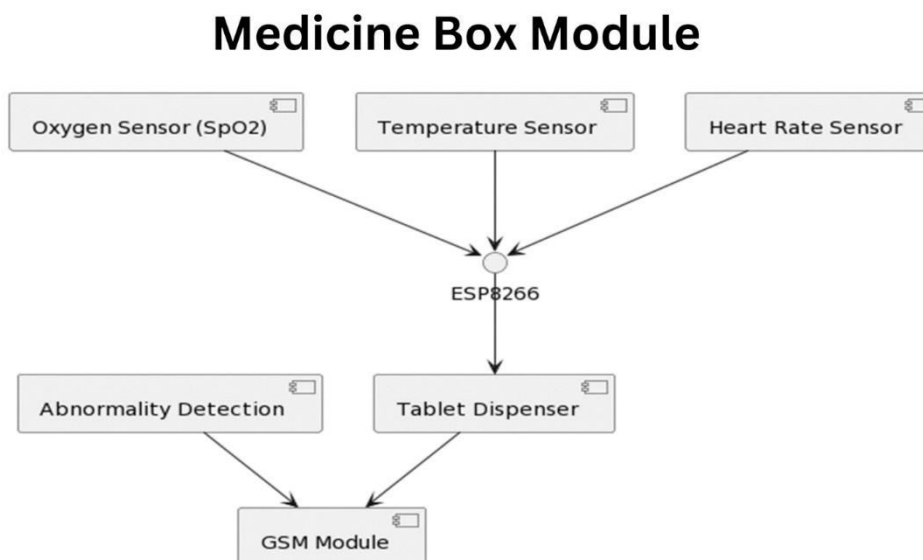
V. CONCLUSION

In this paper, we introduce an innovative solution to address the healthcare challenges faced by the elderly population through the development of IoT-based smart medicine suggestion boxes. Our system integrates state-of-the-art sensors, sophisticated algorithms, and user-friendly interfaces to redefine medication adherence and health monitoring for elderly individuals living independently. The core objective of our solution is to empower elderly users to manage their medication regimens effectively while promoting autonomy and independence in their daily lives. Central to the success of our system is its meticulously designed architecture, which places a strong emphasis on user privacy and data security. By leveraging advanced encryption mechanisms and a distributed storage approach, we ensure the confidentiality and integrity of sensitive health information while optimizing storage efficiency. This robust architecture not only safeguards users' privacy but also facilitates seamless data synchronization and backup, enhancing the reliability and accessibility of health records.

The effectiveness of our system has been validated through extensive clinical trials and pilot studies, which have demonstrated its ability to improve medication adherence rates and enhance overall health outcomes for elderly users. By providing personalized medication reminders and timely health status updates, our system empowers users to take control of their health and well-being, leading to improved quality of life and reduced healthcare costs. Moving forward, our research and development efforts will focus on further refining the algorithms powering our system, enhancing interoperability with existing healthcare infrastructure, and expanding accessibility to a wider audience of elderly individuals. With a commitment to innovation and collaboration, we aim to continue pushing the boundaries of healthcare technology, ultimately empowering elderly individuals to age gracefully and independently in place while receiving the support and care they need.

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