

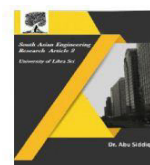
AN IOT BASED KEEN REMEDY DISPENSER MODEL FOR HEALTHCARE JUJAVARAPU SRAVANA¹, P. ANKITHA², V. NAGADEEPTHI³, V. KEERTHANA⁴

¹Assistant Professor, Department of ECE, Mallareddy College Of Engineering For Women

^{2,3,4}UG Scholar, Department of ECE, Mallareddy College Of Engineering For Women

ABSTRACT - Smart pill dispensers powered by Internet of Things (IoT) technology have revolutionized the way medications are delivered, providing significant advancements in healthcare. These dispensers integrate sensors and wireless connectivity to ensure accurate medication administration, improving patient adherence to prescribed treatment regimens. The IoT-enabled devices allow for real-time monitoring of medication usage, enabling healthcare professionals to remotely track a patient's adherence to their medication schedule. This connectivity ensures that any missed doses, incorrect medications, or other issues can be immediately detected, with notifications sent to both the patient and their healthcare provider. This seamless interaction between the pill dispensers and IoT devices helps reduce medication errors, which can often have serious health implications. One of the most important features of these smart dispensers is the incorporation of biometric verification methods, such as face recognition, to ensure that the correct medication is administered to the right patient. This technology eliminates the risk of errors caused by human oversight, providing a higher level of security for patients and increasing confidence in the medication management process. Additionally, these dispensers can be connected to the cloud, where data is securely stored and accessible for healthcare practitioners, allowing for ongoing monitoring and intervention when necessary. This cloud-based system ensures

that both patients and healthcare providers are always up-to-date with medication schedules, improving communication and reducing the likelihood of adverse events. By using IoT-enabled dispensers, the healthcare industry can optimize medication distribution, reducing the risk of hospital readmissions due to improper medication adherence. Real-time tracking and maintenance further contribute to the reliability and effectiveness of these systems, ensuring that patients are receiving the correct doses at the correct times. Furthermore, by automating medication management, these dispensers streamline the process for patients, especially those with chronic conditions who require complex medication schedules. The system's user-friendly interface allows patients to easily interact with their pill dispensers, and the automatic reminders and feedback ensure that they stay on track with their treatment plan. This level of automation and oversight leads to better health outcomes, as patients are more likely to follow prescribed regimens and experience fewer complications from missed doses. Overall, smart pill dispensers using IoT technology have the potential to drastically improve healthcare delivery by enhancing medication adherence, reducing medication mistakes, and providing better patient outcomes. The integration of biometric verification, remote monitoring, real-time data sharing, and cloud-based storage represents a significant advancement in healthcare automation, contributing to more efficient and reliable



medication management. This innovative approach can help address many challenges in modern healthcare, such as medication non-adherence, and may ultimately lead to lower healthcare costs, fewer hospital readmissions, and improved patient quality of life. The future of healthcare is undoubtedly intertwined with IoT, and smart pill dispensers stand as a testament to the transformative potential of this technology in the medical field.

I. INTRODUCTION The increasing availability of medicines globally has inadvertently led to a rising issue of noncompliance with medical treatments. Patients often struggle to manage multiple medications, forgetting which ones to take and when. To address this, low-cost home devices have been developed to assist patients in adhering to their prescribed medication regimens. These devices, which are particularly useful in home and long-term care settings, can automatically administer medications at specified times using Wi-Fi and cellular IoT connectivity. Additionally, they feature a user-friendly online interface that allows patients or caregivers to adjust dosages and schedules as recommended by healthcare professionals. While smartphone-based medication reminder applications exist, they primarily serve as alerts for patients without providing the full spectrum of medication management, such as storing detailed caregiver schedules or medical data. In contrast, the proposed smart pill boxes offer programmability, enabling medical professionals or patients to set the dose and timing of medications, ensuring that treatment is delivered precisely as prescribed. Moreover, these IoT-enabled devices are particularly beneficial for elderly individuals and those with visual

impairments, helping them remember to take their pills on time and monitor their vitals continuously to optimize effectiveness. The medication dispenser system operates via a Bluetooth connection to a microcontroller, which manages the pill storage and distribution mechanism using a stepper motor. The device is designed to respond to spoken commands, sounding alarms on an LCD screen and speaker before dispensing the required medication. This feature ensures that even those with limited mobility or vision can independently manage their medication schedules. The automatic medication dispenser system integrates Wi-Fi, Bluetooth, and IoT technologies, enhancing its accuracy, mobility, and ease of use. It is capable of monitoring patient health information in real-time, providing caregivers with detailed updates about the patient's medication intake. In the context of the COVID-19 pandemic, such devices have proven essential in minimizing healthcare workers' physical contact with patients, reducing the risk of virus transmission while still ensuring that patients receive timely medication. The smart pillbox can also track pharmaceutical dosages over a month, providing a valuable solution for patients needing consistent health maintenance or immune-boosting medications. IoT-based pill dispensers alert caregivers when a patient misses a dose, ensuring better medication adherence and improving overall patient safety. These devices are also capable of counting remaining medications, notifying users when supplies are running low, thus preventing any interruptions in treatment. A mobile IoT-based medicine dispenser, designed specifically for geriatric patients, operates similarly, utilizing the NodeMCU

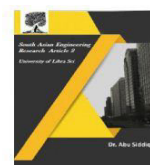
microcontroller to control the motorized dispensing mechanism. This system is designed for low-income seniors, offering an affordable solution to help them manage their medications more effectively. The device includes a mobile app that configures the dispensing time and uses Firebase to calculate the medication schedule. A more advanced system integrates a smart medicine box with IoT devices and services, offering real-time health data and remote monitoring by healthcare professionals. This system provides a comprehensive solution for patients, ensuring they receive customized medication, physiological parameter assessments, on-site diagnostics, and seamless communication with their doctors. The integration of IoT technologies allows for the continuous monitoring of patient health and medication adherence, making these devices a critical component of modern healthcare solutions aimed at improving patient outcomes and reducing medication errors.

II. LITERATURE SURVEY

A. K. Rajkumar, G. Rajkumar, and S. Gowriswari, "Advanced IoT-based anesthesia management system with remote monitoring and controlling," *International Journal of Advances in Signal and Image Sciences*, vol. 9, no. 2, pp. 46–54, 2023.

The paper by K. Rajkumar, G. Rajkumar, and S. Gowriswari, titled "Advanced IoT-based Anesthesia Management System with Remote Monitoring and Controlling," published in the *International Journal of Advances in Signal and Image Sciences* in 2023, explores the development of a state-of-the-art anesthesia management system

that leverages Internet of Things (IoT) technology for enhanced patient safety and clinical efficiency. The paper highlights the critical need for accurate monitoring and control of anesthesia during medical procedures, as improper administration of anesthetic agents can lead to serious complications, including overdose or insufficient sedation. The proposed IoT-based system integrates multiple sensors that track vital patient parameters such as heart rate, oxygen saturation, and respiration, which are essential for ensuring the safe and effective administration of anesthesia. These sensors continuously collect data, which is transmitted in real-time to a centralized system for monitoring by healthcare professionals.. The integration of IoT technologies helps automate several aspects of anesthesia management, reducing the potential for human error and improving the overall safety of patients undergoing surgery or other procedures requiring anesthesia. The authors focus on the system's potential for remote accessibility and real-time intervention. Using IoT connectivity, the anesthesia management system is capable of transmitting critical data to a cloud-based platform, allowing healthcare professionals to monitor patient conditions remotely, even from distant locations. This capability is particularly useful in settings where anesthesiologists may not be physically present in the operating room but can still provide oversight and make informed decisions based on real-time data. The remote monitoring aspect of the system offers significant advantages in enhancing patient care, especially in emergency situations or during complex surgeries where continuous observation of anesthesia levels is crucial. Additionally, the system



can automatically adjust anesthetic delivery based on real-time feedback from the sensors, ensuring optimal drug administration. This level of automation, combined with the ability to remotely monitor and control anesthesia, positions the IoT-based anesthesia management system as a promising solution for modern healthcare settings, ultimately improving patient outcomes and reducing the risks associated with anesthesia management.

B. L. R. D, B. M, M. M, H. D. Praveena and P. Geetha, "A Smart Medication Box with Regular Medications and In-Time Refilling," 2nd International Conference on Edge Computing and Applications, pp. 1066-1070, 2023.

The paper titled "A Smart Medication Box with Regular Medications and In-Time Refilling," presented at the 2nd International Conference on Edge Computing and Applications in 2023, addresses the growing concern of medication non-compliance, particularly for individuals with chronic illnesses or those requiring multiple medications. The study introduces an innovative solution through a smart medication box that integrates Internet of Things (IoT) technology to provide real-time tracking and automated medication dispensing. The smart box is equipped with sensors that track medication usage and alert the user or caregiver when it is time for a refill or when medications are running low. The system can be accessed and controlled remotely via a mobile application, allowing healthcare providers and caregivers to monitor the patient's medication schedule and make adjustments as needed. Additionally, the paper discusses the use of edge computing to handle data processing close to the source, minimizing latency and ensuring

that the medication box operates efficiently, even in environments with limited internet connectivity. The authors explore the technical aspects and advantages of the proposed system. The smart medication box is designed to store and organize medications based on the patient's prescribed schedule, offering automated dispensing through a motorized mechanism. The system's connectivity to the cloud allows for seamless communication between the medication box, the patient, and healthcare providers, facilitating real-time updates and monitoring. The box is designed to send alerts for refills, ensuring that medications are always available when needed. Furthermore, the integration of edge computing ensures that data related to medication usage and refill alerts are processed quickly and efficiently, reducing reliance on centralized servers and improving system reliability. The paper also highlights the potential for future developments, such as integrating biometric authentication to ensure that medications are dispensed only to the correct individual, further enhancing the system's security. Overall, the smart medication box system presented in this study represents a significant step forward in improving medication adherence and patient care, particularly for those managing complex treatment regimens.

C. S. KB, and M. S. Majumdar, "Survey on Smart and Safe Medication Box for Medication System with Timely Reminders," vol. 6, no. 1, 2022.

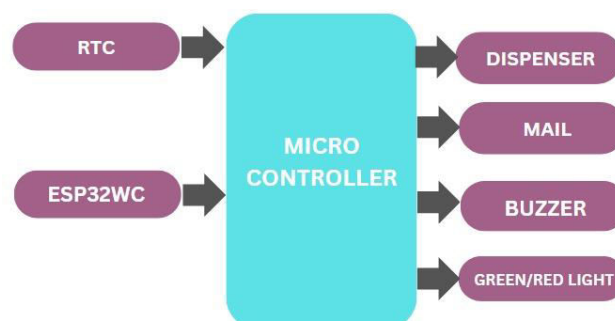
The paper titled "Survey on Smart and Safe Medication Box for Medication System with Timely Reminders," published in 2022, provides an in-depth review of smart

medication boxes designed to enhance medication adherence and safety. The study highlights the growing need for smart medication management systems, particularly for individuals with chronic illnesses or those taking multiple medications. The authors explore various features incorporated into smart medication boxes, such as automatic dispensing, timely reminders, and real-time monitoring. These devices aim to ensure that patients take their prescribed medications on time and in the correct dosage, thereby reducing the risk of medication errors and improving patient outcomes. This remote connectivity ensures that any missed doses, incorrect medication usage, or potential issues can be quickly addressed, providing a more comprehensive approach to patient care. The paper delves into the key technologies and methodologies employed in the development of smart medication boxes. The study examines different approaches to ensure the effectiveness of these systems, including the use of sensors, wireless communication, and cloud-based platforms. It also discusses how these devices use machine learning algorithms to optimize medication schedules, track usage patterns, and send alerts to patients or caregivers when it is time to refill medications or when medication errors occur. The paper further reviews the security features integrated into smart medication boxes to protect patient data and prevent misuse. It concludes by identifying the challenges faced in implementing such systems on a larger scale, including technical limitations, cost, and user adoption. Despite these challenges, the paper emphasizes the potential of smart medication boxes to improve patient safety, adherence, and overall healthcare

efficiency, making them an essential tool for modern healthcare systems.

III.IMPLEMENTATION

BLOCK DIAGRAM



DESCRIPTION

POWER SUPPLY

A **regulated power supply** transforms unregulated AC ([Alternating Current](#)) into a stable DC (Direct [Current](#)). It guarantees consistent output despite variations in input. A regulated DC power supply is also known as a linear power supply, it is an embedded circuit and consists of various blocks

- **Regulated Power Supply Definition:** A regulated power supply ensures a consistent DC output by converting fluctuating AC input.
- **Component Overview:** The primary components of a regulated power supply include a transformer, rectifier, filter, and regulator, each crucial for maintaining steady DC output.
- **Rectification Explained:** The process involves diodes converting AC to DC, typically using full wave rectification to enhance efficiency.

- **Filter Function:** Filters, such as capacitor and LC types, smooth the DC output to reduce ripple and provide a stable voltage.
- **Regulation Mechanism:** Regulators adjust and stabilize output voltage to protect against input changes or load variations, essential for reliable power supply

RTC DS1307

What are Real Time Clocks?

Real time clocks (RTC), as the name recommends are clock modules. [The DS1307 real time clock](#) (RTC) IC is an 8 pin device using an I2C interface. The DS1307 is a low-power clock/calendar with 56 bytes of battery backup SRAM. The clock/calendar provides seconds, minutes, hours, day, date, month and year qualified data. The end date of each month is automatically adjusted, especially for months with less than 31 days. They are available as integrated circuits (ICs) and supervise timing like a clock and also operate date like a calendar. The main advantage of RTC is that they have an arrangement of battery backup which keeps the clock/calendar running even if there is power failure. An exceptionally little current is required for keeping the RTC animated. We can find these RTCs in many applications like embedded systems and computer mother boards, etc. In this article we are going to see about one of the real time clock (RTC), i.e. DS1307.

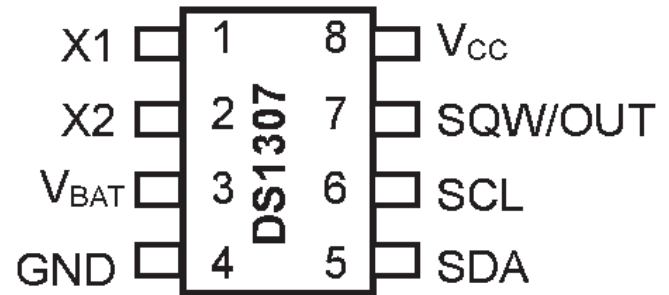


Fig: DS1307 PINOUT

NODEMCU:

NodeMCU is an open source LUA based firmware developed for ESP8266 wifi chip. By exploring functionality with ESP8266 chip, NodeMCU firmware comes with ESP8266 Development board/kit i.e. NodeMCU Development board. Since NodeMCU is open source platform, their hardware design is open for edit/modify/build. NodeMCU Dev Kit/board consist of ESP8266 wifi enabled chip. The ESP8266 is a low-cost Wi-Fi chip developed by Espressif Systems with TCP/IP protocol. For more information about ESP8266, you can refer ESP8266 WiFi Module. There is Version2 (V2) available for NodeMCU Dev Kit i.e. NodeMCU Development Board v1.0 (Version2), which usually comes in black colored PCB. NodeMCU Development Kit/Board consist of ESP8266 wifi chip. ESP8266 chip has GPIO pins, serial communication protocol, etc. features on it.

ESP8266 is a low-cost [Wi-Fi](#) chip developed by Espressif Systems with TCP/IP protocol. For more information about ESP8266, you can refer [ESP8266 WiFi Module](#). The features of ESP8266 are extracted on NodeMCU Development board. NodeMCU ([LUA](#) based firmware) with Development board/kit that consist of

ESP8266 (wifi enabled chip) chip combines NodeMCU Development board which make it stand-alone device in IoT applications. Let's see 1st version of NodeMCU Dev Kit and its pinout as shown in below images.

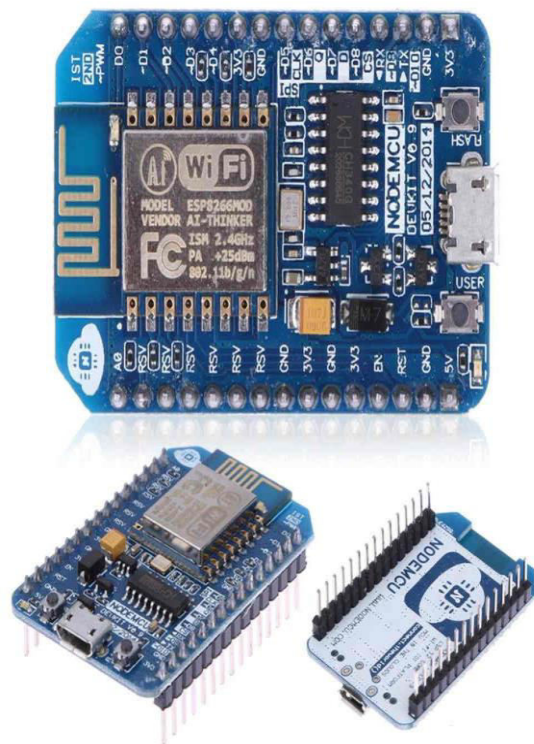
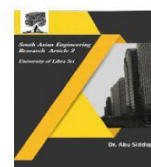


Fig: Node Mcu

IV.DESCRPTION

The paper "Smart Pill Dispensers and IoT: Advancements in Medication Administration" explores the transformative role of Internet of Things (IoT) technology in enhancing medication delivery through smart pill dispensers. It highlights how IoT-enabled smart pill dispensers are revolutionizing the healthcare industry by improving medication adherence, minimizing errors, and optimizing patient outcomes. The paper outlines the integration of sensors and cloud connectivity within these devices, allowing for real-time monitoring and control of

medication intake. These dispensers utilize IoT to ensure that patients take the right dose of medicine at the prescribed times by notifying patients of any missed doses or errors in medication. The interaction between the smart pill dispenser and IoT technology facilitates remote monitoring by healthcare professionals, who can track patient adherence to prescribed medication regimens and intervene if necessary. Furthermore, the paper emphasizes the use of advanced biometric technologies, such as face recognition and fingerprint verification, ensuring that the correct patient receives the medication. This prevents medication administration errors that could result from misidentification or confusion, especially in settings like hospitals or nursing homes. By providing accurate and timely medication, these devices aim to reduce hospital readmissions, prevent adverse events, and improve patient health outcomes, all while offering a cost-effective solution to the challenges of medication management. Additionally, the research discusses how IoT connectivity enables cloud-based data storage and sharing, ensuring that both healthcare providers and patients have access to real-time information. This feature not only facilitates the tracking of medication adherence but also provides an efficient way to manage and refill medications. The paper also delves into the use of smart pill dispensers in personalized healthcare, as they can be tailored to the specific needs of the patient, including adjusting dosage schedules and integrating multiple medications into a single dispensing schedule. Moreover, these devices can be connected to mobile applications that allow users to receive notifications and reminders, enhancing



patient engagement and participation in their own healthcare. As the paper discusses the future of smart pill dispensers, it suggests further integration with other health monitoring systems, such as wearable devices and electronic health records (EHRs), to create a more comprehensive and efficient healthcare ecosystem. The potential for smart pill dispensers to address medication non-adherence, reduce human errors, and improve patient safety is vast, making them an invaluable tool in the future of healthcare. The paper concludes by acknowledging the need for further research to refine the technology, overcome potential security and privacy concerns, and ensure the widespread adoption of smart pill dispensers in both clinical and home settings, ultimately advancing medication administration practices.

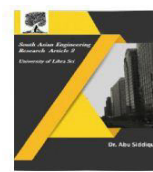
CONCLUSION The smart pill dispenser system incorporating IoT technology represents a significant advancement in healthcare, offering a transformative approach to managing medication and patient care. This innovative system brings numerous benefits, including improved medication adherence, real-time remote monitoring, and the potential for cost savings. By automating the dispensing of medications, providing timely reminders, and enabling seamless communication between patients, healthcare professionals, and caregivers, the smart pill dispenser system holds the promise of revolutionizing patient treatment and improving health outcomes. Its ability to ensure that patients take the correct dosage at the prescribed times reduces the risks of medication errors, while also offering a user-friendly interface for patients to interact with the

system. Additionally, the system's remote monitoring capabilities allow healthcare providers to track patient adherence from a distance, offering timely interventions when necessary. This becomes especially valuable in chronic disease management and for patients with complex medication regimens. The system also offers significant potential in the broader healthcare industry, including clinical research, where it can provide insights into patient behavior, treatment effectiveness, and adherence trends. By contributing valuable data, it has the capacity to enhance medical research and improve treatment strategies. Moreover, the integration of IoT technology makes it possible to track patients' medication intake in real-time, ensuring that healthcare providers and caregivers can quickly detect and address any issues related to adherence or potential medication errors. The system's role in enhancing patient safety and satisfaction is also noteworthy, as it minimizes the chances of missed doses or incorrect medication, both of which are common causes of hospital readmissions and adverse drug events. In the future, the development of machine learning algorithms for better identification and personalization of medication regimens will enhance the system's accuracy and effectiveness. Additionally, integrating the smart pill dispenser with other health monitoring devices, such as wearable sensors or electronic health records (EHRs), could further streamline patient care and offer a more comprehensive approach to healthcare management. These potential advancements will allow the system to become even more personalized, adjusting medication schedules and dosages in real-time based on a patient's evolving health

needs. The continued improvement of the smart pill dispenser system will enable a more patient-centered approach to healthcare, where individuals are empowered to manage their medications more effectively, and healthcare providers are better equipped to monitor and intervene when necessary. This technology holds the potential to address the long-standing issue of poor medication adherence, which is responsible for a significant portion of adverse health outcomes and healthcare costs. As technology evolves, the smart pill dispenser system will likely become an essential tool in enhancing the efficiency, safety, and overall quality of healthcare. The integration of such systems into healthcare ecosystems will not only benefit patients but also streamline healthcare processes, leading to a more connected and efficient healthcare environment. The future of healthcare management is undoubtedly moving toward greater connectivity, personalization, and proactive care, with the smart pill dispenser system playing a central role in shaping this future.

REFERENCES

- [1] C. Bandara, Y. Kodithuwakku, A. Sandanayake, R. A. R. Wijesinghe, and V. Logeeshan, Design and Implementation of an Automated Medicinal-Pill Dispenser with Wireless and Cellular Connectivity," *Advances in Science, Technology and Engineering Systems Journal* Vol. 8, no. 3, pp. 161-169, 2023.
- [2] K. Padmanaban, A. M. Senthil Kumar, H. Azath, A. K. Velmurugan, and Murugan Subbiah , "Hybrid data mining technique based breast cancer prediction," *AIP Conference Proceedings*, vol.2523, no. 1, pp. 1-7, 2023.
- [3] B. M. Kannan, P. Solainayagi, H. Azath, S. Murugan and C. Srinivasan, "Secure Communication in IoT-enabled Embedded Systems for Military Applications using Encryption," *2nd International Conference on Edge Computing and Applications*, pp. 1385-1389, 2023.
- [4] S. P. Vimal, M. Vadivel, V. V. Baskar, V. G. Sivakumar and C. Srinivasan, "Integrating IoT and Machine Learning for Real-Time Patient Health Monitoring with Sensor Networks," *4th International Conference on Smart Electronics and Communication* , pp. 574-578, 2023.
- [5] M. Senthil Kumar, H. Azath, A. K. Velmurugan, K. Padmanaban, and Murugan Subbiah, "Prediction of Alzheimer's disease using hybrid machine learning technique," *AIP Conference Proceedings*, vol. 2523, pp. 1-6, 2023.
- [6] M. S. Shahriar Haque, M. R. Khan Hamim, M. T. Ehsan and M. H. Ali, "Design and Implementation of an IoT-based Smart Pillbox for Improving Medical Adherence," *17th International Conference on Electronics Computer and Computation*, pp. 1-5, 2023.
- [7] P. Arul, M. Meenakumari, N. Revathi, S. Jayaprakash, and S. Murugan, "Intelligent Power Control Models for the IOT Wearable Devices in BAN Networks," *2023 International Conference on Intelligent and Innovative Technologies in Computing, Electrical and Electronics*, pp. 820-824, 2023.



- [8] M. Sarjare, P. Ghutke and R. Ghosh, "Development of Smart Medicine Box using IoT Environment," 11th International Conference on Emerging Trends in Engineering & Technology - Signal and Information Processing, pp. 1-5, 2023.
- [9] A. Joy, A. D, K. Ramaraj and T. M, "Smart Drug Delivering System in Hospitals Using RFID," 5th International Conference on Inventive Research in Computing Applications, pp. 1645-1649, 2023.
- [10] S. D and K. C, "Machine Learning based Automatic Tablet Dispenser," 2nd International Conference on Applied Artificial Intelligence and Computing, pp. 1-6, 2023.
- [11] B.R. Babu, M.A. Haile, D.T. Haile, and D. Zerihun, "Real-time sensor data analytics and visualization in cloud-based systems for forest environment monitoring," International Journal of Advances in Signal and Image Sciences, vol. 9, no. 1, pp. 29-39, 2023.
- [12] C. H. Patil, N. Lightwala, M. Sherdiwala, A. D. Vibhute, S. A. Naik, and S. M. Mali, "An IoT based Smart Medicine Dispenser Model for Healthcare," In IEEE World Conference on Applied Intelligence and Computing, pp. 391-395, 2022.