

# Design and Development of Smart IOT Enabled Pill Dispenser Real Time Alert System

**K. Jayavardhan<sup>1</sup>, M. Manoj Kumar<sup>2</sup>, C. Akhila<sup>3</sup>, K. Zubair<sup>4</sup>, T. Bharathi<sup>5</sup>**

<sup>1,2,3,4,5</sup>Department of ECE, Tadipatri Engineering College, Tadipatri.

## **ABSTRACT:**

The project titled Design and Development of Smart IoT Enabled Pill Dispenser with Real-Time Alert System focuses on improving medication adherence through an automated and user-friendly solution. The system is built around an ESP32 Arduino module, which acts as the central controller to manage all operations. It integrates push buttons for user input, an LCD for displaying medication schedules, and multiple servo motors to dispense pills at predefined times. A buzzer is incorporated to provide audible alerts, ensuring that users are reminded to take their medication on time. The device is designed to reduce human errors such as missed doses or incorrect medication intake, especially for elderly patients and individuals with chronic conditions. The IoT capability enables real-time monitoring and alert notifications, which can be extended to caregivers for better supervision. The system operates on a reliable power supply and is structured to be cost-effective and easy to use. Overall, this smart pill dispenser enhances healthcare management by combining automation, accuracy, and real-time alert mechanisms into a compact and efficient system.

**Keywords:** Smart Pill Dispenser, IoT, ESP32, Medication Management, Real-Time Alerts, Servo Motor, Healthcare Automation, Embedded System

## **INTRODUCTION**

To ensure their effectiveness and safety, medications must be transported and stored safely, especially those that may be heat-sensitive. Conventional approaches frequently lack safety features and real-time monitoring, which can lead to compromised situations or illegal access. This project provides an Internet of Things-based solution that enhances the monitoring and transportation technique by integrating various sensors and technologies. The system uses an Arduino Mega as its primary controller and has sensors such as a fingerprint sensor for legal access, a DHT11 for temperature and humidity, a MQ135 for gas detection, and a MEMS for chance detection. It also has a Peltier module to control the temperature, GPS to monitor the area in real time, and GSM to transmit indicators. IP digital camera video streaming provides extra security, and all records are transferred to Thing Speak for continuous tracking. This clever device makes it possible for real-time tracking, comfortable access, and continuous monitoring, which enhances the security and dependability of the transfer of essential medications. The transportation industry is undergoing a revolution because to the Internet of Things (IoT). Intelligent transportation systems enhance the movement of people and goods, promoting shared prosperity, average economic growth, environmental sustainability, and safety. Together, IoT and sensor networks are starting to have a significant influence on healthcare devices, providing solutions that make it easier to care for patients by continuously tracking physiological changes and physical Even if the patient is not physically present in

the doctor's office, these technologies allow vital information, such as blood pressure, heart rate, and blood sugar ranges, to be continuously recorded and delivered instantly to the appropriate medical personnel. In addition, the healthcare industry is not limited to urban areas; it also uses ships and airplanes to transfer medications across international borders quickly. Transportation by itself is not always enough to get to the desired location in the healthcare sector; drug safety while visiting is just as important. There are now compact, ingenious refrigerators and cooling bins that may be taken with medications even when traveling, in contrast to the large freezers and refrigerators that were once used in pharmacies to manage prescription treatments. GPS trackers are essential for monitoring delivery vehicles' movements. In order to achieve its objectives quickly and effectively, the quarter has been able to make use of such contemporary technologies, integrating them effortlessly. Nevertheless, there is a significant lack of thorough medication transport tracking and remote device temperature control. Due to the usage of outdated medications or vaccinations, this shortage has resulted in a significant increase in drug waste, which endangers human life. When buyers utilize expired medications or vaccines, there is a significant danger of death. Those who are concerned about the transfer of vaccines and medications are unaware of the state of those medications. Important elements in addition to temperature, humidity,

## LITERATURE SURVEY

One of the most crucial steps in the software improvement process is the literature assessment. Determining the enterprise's dependability, cost savings, and time factor is crucial when building a gadget. Selecting the machine and runtime language that can be used to enhance the tool comes next after those responsibilities are completed. Programmers may look for outside help after they begin building a device. You can get this guide from websites, books, or experienced programmers. To maximize the suggested system, the aforementioned issues are taken into account prior to device design.

Every sector of the industry has been impacted by the Internet of Things (IoT). He has so already ventured into the realm of science. IoT offers patients at-home hospital therapy, which has the potential to be incredibly dependable and user-friendly. It establishes a virtual sanatorium and helps the afflicted individual continue taking their medications in case of serious situations, notifying the physician and family members. The risk of delivering the wrong medication at the wrong time, overdosing, and underdoing has decreased because to smart medicine packaging. In order to implement some of these features, the icebox smart first aid box was developed. It specifically satisfies three requirements: caution, monitoring, and residual. It implements these features with the use of modern technology. To continually measure the patient's body temperature, blood pressure, ECG, and coronary heart charge, a smart bracelet is attached to their wrist. All of this information is sent to the icebox, which examines the statistics, forecasts likely anomalies, and shows the data on the box's LCD screen. Smart medication packing and recurring alarms are used to guarantee efficient remedy management. It alerts the doctor and members of the patient's own family if there are any deviations. The field is easy to use and has a continuous connection without signal loss. Biosensor research is accelerating to reduce biosensor length for remote region problems and enhance biosensor performance without causing consumer discomfort [1].

The Internet of Things (IoT) era has allowed people to develop a world full of intelligent solutions since it was first released ten years ago. Here, every physical device and item—referred to as "matters"—is connected to sensors via the Internet. In certain places, it is very traditional and casual to bring medications to patients or recipients at their holiday destination. When it comes to intelligent drug distribution, the drug must maintain its unique country while dealing with a few environmental conditions, such as

humidity, temperature changes, and many others. This study describes a successful IoT (Internet of Things) implementation for temperature tracking and medicine and vaccine transportation monitoring that is completed using sensor networks and cell applications. The gadget has a temperature sensor, uses a tiny portable cooling container, Arduino, MQTT (Message Queuing Telemetry Transport) for communication, and mobile apps as the user interface. Because CRC-32 is the gold standard error detection set of rules rather than complex hash capabilities like MD5 and SHA, it is designed for the routine shipping of medications and vaccines from sender to recipient, ensuring better performance, clean operation, and statistics integrity. Additionally, for pleasant record transfer, shared keys that are entirely based on elliptic curves are utilized. Finally, the validity and dependability of the suggested device are confirmed by its accuracy of 89.88% and F1 value of 0.686, which is higher than the initial cost of 0.5 [2].

Recent years have seen an unanticipated advancement in healthcare because to the application of engineering concepts and layout standards from biology and pharmaceuticals. One of the most often used intravenous (IV) treatments, saline, plays a crucial role in patient care. In conditions including dehydration, hypovolemia, hemorrhage, and sepsis, saline is crucial for replacing lost fluid and altering extracellular fluid. Nurses and other caregivers usually keep an eye on the salt level in the bottle. After a positive time, it is always necessary to check the salt level. There is a significant risk that your blood will return to the saline bottle if you are unable to accomplish this. Many times, due to carelessness or unforeseen circumstances, appropriate preparation for the removal of a needle from the affected person's vein is neglected, which can lead to significant losses or even death. A clever and useful brain stage reveal—a reliable, person-pleasing, and useful brain stage tracking machine—is provided to prevent such mishaps brought on by caregiver neglect. The Node MCU ESP8266 Wi-Fi module microcontroller was used to create this non-contact liquid stage sensor technology, which is a completely low-energy and low-cost sensor. The sensor's output is a positive voltage that is contingent upon the presence of saline solution. Based solely on the voltage obtained from the sensor, the ESP8266 Wi-Fi module built inside the Node MCU microcontroller creates and sends a specific message. In order to ship and purchase a settlement strolling at the TCP protocol, MQTT-S is utilized [3].

Rwanda has changed its fitness systems in a number of ways as a result of the outbreak. As a result, a wide variety of people have been exposed to pollution. Unexpected deaths result from a lack of infrastructure to handle a high volume of patients, which is caused by the overabundance of people seeking health services in developing nations and the lack of skilled doctors. The Rwandan government has approved the practice of keeping some patients in their homes while they are ill (domestic care). However, this leaves many people vulnerable to death in the absence of real-time information about the victims or the others residing in the residence. In order to develop a wearable hardware product that might be used to monitor the affected person's condition at home without the doctor and patient having to make physical contact, this article focuses on analysing the performance of wearable devices around the arena. Through a wireless communication environment, this portable device is meant to assist in continuously screening the affected person's fitness. In addition to a GPS sensor to track the patient's location, the suggested device uses body sensors, temperature, and coronary heart rate sensors to help remotely show the physical condition of patients living at home. The results show that the active product notifies a distant doctor via private email and SMS if an emergency or unusual condition is found within the human body [4].

Subacute ruminal acidosis (SARA) can develop in high-yielding dairy cows fed under extensive production conditions. In this research, we describe a prototype long-term cyber-physical reticula-rumen diagnostic system that monitors cow rumen parameters via the Internet of Things (IoT). A reticula-rumen

bolus equipped with temperature and pH sensors, a microcontroller, a radio transmitter, and a power supply module are all part of the diagnostic device's novel architecture. The device consists of a database, an internet server, a Message Queuing Telemetry Transport (MQTT) broker, and gateways for fact series from the bolus. If you wish to assess the health of the cow and take further action, this prototype diagnostic device gives consumers the most recent cow fitness statistics. As a result, using a diagnostic system can boost cow productivity, lengthen their life expectancy, and reduce the need to preserve dairy farms. This page presents the findings from the first stage of the investigation [5].

Internet of Things (IoT) visitor shipping is one of the main use cases that 5G infrastructure are anticipated to serve in the future. Processing the enormous volume of records that gadgets produce is a key issue that arises with their exponential expansion. For this, terrestrial networks might not be sufficient or always accessible. This is where satellites are useful and can deliver the constant security that 5G aims to provide. Aggregation, on the other hand, might be a helpful tactic to lower the number of site visitors and appropriately utilize network resources. The architecture of a hybrid IoT satellite network for Message Queuing Telemetry (MQTT) traffic series is not overlooked in this article. Before sending the records via satellite television for computer communications, we are developing a sophisticated filter called MQTT Message Filter Aggregator (MQTT-MFA), which gathers MQTT subjects near MQTT publishers. The created MQTT-MFA implementation works well with the open source MQTT broker Mosquito and makes use of a MQTT bridge. Extensive simulation studies have demonstrated that, when records payload compression is also enabled, MQTT-MFA requires the best 10% of the TCP/IP overhead generated inside the baseline structure (without a bridge configured) and 1/4 of the bytes to transport the same amount of information [6].

In many applications, remote tracking is essential, but it is especially important when it comes to health concerns. Parkinson's disease and other neurodegenerative disorders necessitate continuous monitoring in order to track the progression of the condition and modify medication treatment for people affected. Therefore, keeping track of their daily health reputation is helpful to prevent unexpected health problems and to intervene promptly in certain situations. In light of this, this research suggests a continuous monitoring system for Parkinson's disease patients that uses portable IMU devices and a dedicated community device to provide real-time records to the doctor via a cloud platform. In order for professionals to make quick and accurate decisions, the suggested device can pre-process the collected data and offer an easy-to-examine designated observer. The Raspberry PI 4 device serves as the gateway between the wearable sensors and the cloud platform, and the statistics alternate uses the MQTT paradigm [7].

This article's goal is to outline a platform that facilitates communication between patients and physicians, their own families, clinical labs, and hospitals. In other words, a platform that supports patients and the entire healthcare system during the last mile. As a result, confidential information gathered through facet devices is not only readily available to the patient but is also widely disseminated to assist patients at any time or place. This research paper specifically outlines, from a technical standpoint, how to implement the last mile for COVID monitoring and manipulation using existing cyber-bodily structures (CPS), such as Internet of Things (IoT) devices with communication and computing capabilities, unfastened domestic manipulation systems, and associated low-cost internet offerings that are currently available on the market. Our project's key component is the use of a tiny BLE/MQTT gateway or the development of handmade MQTT sensors, which enables us to send fitness data collected by the devices to a remote automated control system overseen by a doctor [8].

The Internet of Things (IoT) is a well-known concept that is utilized in a variety of industries, including commercial networks and medicine. Connecting thousands and thousands of everyday objects to the Internet is its goal. Proposing algorithms and protocols that satisfy the requirements of safety, tool interoperability, quality of provider, and power efficiency are significant challenging situations in this discipline. In order to facilitate green application layer communication for the Internet of Things, the Message Queue Telemetry Transport (MQTT) protocol being investigated. Presenting the fundamentals, resources, and instructions for the future of the MQTT protocol and its sensor network-specific variant, MQTT-SN, is the aim of this evaluation. The Controlled Application Protocol (CoAP) is one of the contemporary IoT software layer protocols that we discuss and compare with those protocols. We also provide equipment to support simulations and experiments. Specifically, we use logical tests to expose the delay of speech exchanges between MQTT and CoAP. Lastly, the region's problems and unanswered concerns are examined [9].

The International Agency for Research on Cancer stated in a 2012 declaration that since radon in the air poses a threat to human lifestyles, it is an important parameter that has to be monitored. Combining temperature and humidity measurements is typically helpful for a proper evaluation of radon measurements because it provides a comprehensive picture of the environmental conditions and, more importantly, enables the repayment of the raw measurements using experimentally derived correction elements, particularly with regard to humidity consequences. This led to the development and characterization of an integrated platform that was able to record all of the aforementioned measures. The radon awareness values were compared to a fully professionally measured website online, even though the temperature and humidity readings were taken using a reference climatic chamber. The cutting-edge system is community-related and offers common IoT facts and alternate capabilities, such as mobile hardware infrastructures and the MQTT protocol over Wi-Fi. [10].

## **EXISTING SYSTEM**

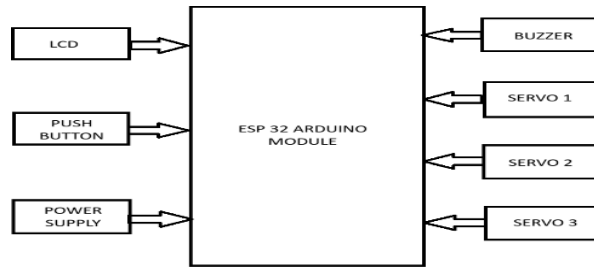
Traditional techniques of transporting touchy clinical materials rely upon insulated packaging and manual temperature tests to make certain secure garage situations. However, those approaches do now not permit for real-time tracking, making it difficult to detect environmental fluctuations or manipulate emergencies such as exposure to excessive heat, humidity, or contamination. The frequent lack of GPS tracking and relaxed tracking increases the hazard of delays and mishandling during transportation. Without automated indicators and facts recording, traditional structures offer confined transparency and inadequate response talents, compromising drug nice and safety.

## **PROPOSED SYSTEM:**

The proposed system presents a Smart IoT Enabled Pill Dispenser designed to ensure accurate and timely medication intake through automation and real-time alert mechanisms. The system is centred on the ESP32 Arduino module, which controls and coordinates all components efficiently. It is programmed to dispense pills at scheduled intervals based on predefined timings set by the user. Push buttons are provided for user interaction, allowing easy setup and modification of medication schedules. The LCD displays important information such as time, dosage, and system status, making it simple for users to understand and operate. At the scheduled time, the respective servo motor is activated to release the required pills from designated compartments. To enhance reliability, a buzzer is used to alert the user when medication is due. If the user does not respond within a certain time, the system can be extended to send real-time alerts through IoT

features to caregivers or family members. The entire system operates on a stable power supply and is designed to be compact, cost-effective, and user-friendly. This proposed system overcomes the limitations of manual medication management by providing automation, reducing human errors, and ensuring better health monitoring and adherence.

**BLOCK DIAGRAM:**



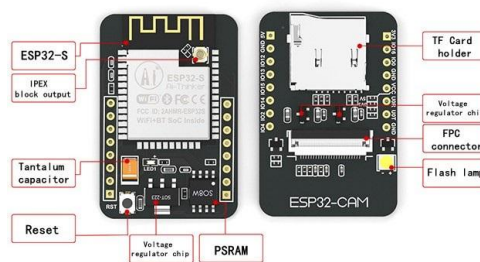
**FIG.1. BLOCK DIAGRAM**

**ADVANTAGES:**

- Ensures users take medicines on time by providing scheduled dispensing and timely alerts.
- Minimizes chances of missed doses, overdosing, or wrong medication intake.
- Buzzer alerts notify users instantly, and IoT support can inform caregivers if doses are missed.
- Simple interface using push buttons and clear information display on the LCD makes it easy to use, especially for elderly people.
- Servo motors automatically release pills, eliminating the need for manual handling.
- Uses commonly available components like ESP32, making the system affordable.

**HARDWARE WORK FLOW:**

**ESP32 (MICROCONTROLLER):**



**FIG.2.ESP32 (MICROCONTROLLER)**

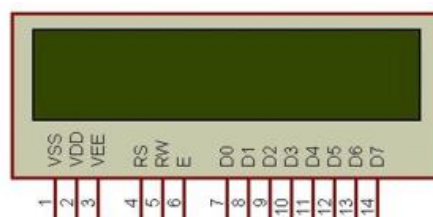
The ESP32 is the main controller of the system and handles all operations. It runs the program that stores the medication schedule and checks the time continuously. Based on the inputs from the push buttons, it updates the timing and controls the overall flow of the system. It sends signals to the servo motors to dispense pills and activates the buzzer when required. It also updates the LCD with the latest information. The built-in Wi-Fi feature can be used later to send alerts or monitor the system remotely, making it more useful in real-world applications.

**PUSH BUTTONS:****FIG.3. PUSH BUTTONS**

Push buttons are provided to make the system easy to operate. They are used to set the time, adjust the medication schedule, and control basic functions. When a button is pressed, the signal is sent to the ESP32, which processes the input and updates the settings. Each button has a simple function, so users can quickly understand how to use it without confusion. This makes the system more practical, especially for elderly people who may not be comfortable using complex digital interfaces.

**SERVO MOTORS:****FIG.4.SERVO MOTOR**

Servo motors are responsible for dispensing the pills from the compartments. Each motor is connected to a specific section where the tablets are stored. When the set time is reached, the ESP32 sends a signal to the required servo motor. The motor rotates to open the compartment and allows the pills to fall out. After that, it returns to its original position. This controlled movement helps in giving the correct quantity of medicine and avoids unnecessary spillage or errors during dispensing.

**LCD DISPLAY:****FIG.5. LCD DISPLAY**

The LCD is used to show all the important details of the system. It displays the current time, upcoming medication times, and system status. This helps the user know what is happening at any moment. The information is updated continuously by the ESP32. The display is simple and clear, so users can easily read and understand it without difficulty. It plays an important role in making the system user-friendly and reliable for daily use.

**BUZZER:****FIG.6. BUZZER**

The buzzer gives an alert when it is time to take the medicine. Once the scheduled time is reached, the ESP32 turns on the buzzer to produce a sound. This alert makes sure the user notices the reminder even if they are not near the device. The sound continues for a short time to grab attention. It is a simple but effective way to remind users and helps in avoiding missed doses.

**POWER SUPPLY:****FIG.7. POWER SUPPLY**

The power supply is responsible for providing energy to all the components in the system. It ensures that the ESP32, servo motors, LCD, and buzzer work properly without interruption. A stable power source is important for smooth operation, especially for accurate timing and motor movement. The system can be powered using an adapter or a battery, depending on the design. Proper power management helps in maintaining the reliability and long-term performance of the device.

**RESULT AND DISCUSSIONS:**

The developed smart IoT pill dispenser was tested under different conditions to check its performance and reliability. The system was able to dispense pills at the correct time based on the schedule set by the user. The servo motors responded accurately to control signals and released the tablets without delay. The buzzer alert was clearly audible and helped in reminding the user at the right moment. The LCD display showed the time and status continuously, which made it easy to track upcoming doses. During testing, the system worked smoothly with minimal errors. The response of push buttons was consistent, allowing users to update settings without difficulty. The overall operation was stable when a proper power supply was provided. In some cases, slight delays were noticed due to mechanical movement of the servo, but it did not affect the overall functionality. The system can be further improved by adding backup power and mobile notifications for better reliability. Overall, the results show that the system is effective in managing medication schedules and reducing the chances of missed doses.

**CONCLUSION:**

The smart pill dispenser works effectively by providing medicines at the correct time and helps in reducing

missed doses. It is simple to operate and suitable for everyday use, especially for elderly users. The system performs reliably with proper timing and clear alert indications. In the future, it can be enhanced by adding mobile app support to notify caregivers. It can also be improved further by including sensors and a backup power supply for better safety and uninterrupted operation.

## REFERENCES

1. A. K. S, N. V, P. S, S. P and R. R, "AI Health – IoT based Smart Medicine Box," 2023 2nd International Conference on Advancements in Electrical, Electronics, Communication, Computing and Automation (ICAECA), Coimbatore, India, 2023, pp. 1-5, doi: 10.1109/ICAECA56562.2023.10200103.
2. D. S. Bhatti, M. M. Hussain, B. Suh, Z. Ali, I. Akobir and K. -I. Kim, "IoT-Enhanced Transport and Monitoring of Medicine Using Sensors, MQTT, and Secure Short Message Service," in IEEE Access, vol. 12, pp. 46690-46703, 2024, doi: 10.1109/ACCESS.2024.3382508.
3. S. Kishore, K. P. Abarnaa, S. Priyanka, S. Sri Atchaya, P. L. Priyanka and J. J. N. Amala, "Smart Saline Level Monitoring System using Liquid Level Switch Contactless Sensor, NodeMCU and MQTT-S," 2022 International Conference on Applied Artificial Intelligence and Computing (ICAAIC), Salem, India, 2022, pp. 1611-1614, doi: 10.1109/ICAAIC53929.2022.9792849.
4. N. Janvier, N. Arcade, N. Eric, M. A. Rwanda and T. J. B. Rwanda, "Internet of Things Based Patient and Doctor Virtual Interaction During Pandemic in Rwanda," 2021 3rd International Conference on Advances in Computing, Communication Control and Networking (ICAC3N), Greater Noida, India, 2021, pp. 1997-2002, doi: 10.1109/ICAC3N53548.2021.9725745.
5. A. Zabasta, N. Kunicina, U. Grunde, J. Judvaitis and I. Sematovica, "Implementation of IoT Concept for Early Diagnostic of Subacute Rumen Acidosis in Cows," 2020 9th Mediterranean Conference on Embedded Computing (MECO), Budva, Montenegro, 2020, pp. 1-4, doi: 10.1109/MECO49872.2020.9134092.
6. R. Soua, M. R. Palattella, A. Stemper and T. Engel, "MQTT-MFA: A Message Filter Aggregator to Support Massive IoT Traffic Over Satellite," in IEEE Internet of Things Journal, vol. 9, no. 16, pp. 14928-14937, 15 Aug.15, 2022, doi: 10.1109/JIOT.2021.3129058.
7. C. Carissimo, G. Cerro, T. Di Libero, L. Ferrigno and G. Miele, "An Ad-Hoc Networked Measurement Framework to Real-Time Monitoring of Neurodegenerative Diseases," 2024 IEEE International Symposium on Measurements & Networking (M&N), Rome, Italy, 2024, pp. 1-6, doi: 10.1109/MN60932.2024.10615473.
8. A. Faro, D. Giordano and M. Venticinque, "The Last Mile of M-Connected-Healthcare in the Covid Age: Data Sharing at Large Scale," 2020 IEEE International Conference on Internet of Things and Intelligence System (IoTaIS), BALI, Indonesia, 2021, pp. 149-154, doi: 10.1109/IoTaIS50849.2021.9359706.
9. S. Quincozes, T. Emilio and J. Kazienko, "MQTT Protocol: Fundamentals, Tools and Future Directions," in IEEE Latin America Transactions, vol. 17, no. 09, pp. 1439-1448, September 2019, doi: 10.1109/TLA.2019.8931137.
10. C. Bourelly, L. Ferrigno, G. Miele and G. Cerro, "Environmental hazards for human health: a radon measurement IoT-enabled platform," 2022 IEEE International Symposium on Medical Measurements and Applications (MeMeA), Messina, Italy, 2022, pp. 1-6, doi: 10.1109/MeMeA54994.2022.9856573.



11. M. Majid, S. Habib, A. R. Javed, M. Rizwan, G. Srivastava, T. R. Gadekallu, and J. C.-W. Lin, “Applications of wireless sensor networks and Internet of Things frameworks in the industry revolution 4.0: A systematic literature review,” *Sensors*, vol. 22, no. 6, p. 2087, Mar. 2022.
12. V. S. Naresh, S. S. Pericherla, P. S. R. Murty, and S. Reddi, “Internet of Things in healthcare: Architecture, applications, challenges, and solutions,” *Comput. Syst. Sci. Eng.*, vol. 35, no. 6, pp. 411–421, 2020
13. D. Oladimeji, K. Gupta, N. A. Kose, K. Gundogan, L. Ge, and F. Liang, “Smart transportation: An overview of technologies and applications,” *Sensors*, vol. 23, no. 8, p. 3880, Apr. 2023.
14. S. Chakraborty, T. Chakravorty, and V. Bhatt, “IoT and AI driven sustainable practices in airlines as enabler of passenger confidence, satisfaction and positive WOM : AI and IoT driven sustainable practice in airline,” in *Proc. Int. Conf. Artif. Intell. Smart Syst. (ICAIS)*, Mar. 2021, pp. 1421–1425.
15. G. Mao, Y. Hui, X. Ren, C. Li, and Y. Shao, “The Internet of Things for smart roads: A road map from present to future road infrastructure,” *IEEE Intell. Transp. Syst. Mag.*, vol. 14, no. 6, pp. 66–76, Nov. 2022.