Volume 4 Number 2 (2026)
July-December 2026
Page: 920-937

Journal of Creative Power and Ambition (JCPA)
https://edujavare.com/index.php/jcpa
E-ISSN: 3031-4054
DOI: 10.70610/jcpa.1690

Design and Construction of a Bedroom Monitoring Device for the Elderly Using LoRa Communication and the Internet of Things

Muhammad Anshory Nurputra[1], Tamaji[2], Erwin Dhaniswara[3]

Universitas Widya Kartika, Indonesia
* Email correspondence; anshorynp@gmail.com

Article history Submitted: 2026/04/01; Revised: 2026/05/11; Accepted: 2026/07/20

Abstract

The elderly are a group of people experiencing declining physical health and mobility. According to various studies, they are at risk of health problems such as falls in their bedrooms, unstable body pressure, sleep disturbances, and even medical emergencies. The Internet of Things (IoT) implements a more responsive, accurate, and ubiquitous health monitoring system, such as LoRa (Long Range), a low-power, wide-range wireless communication system that can be used to efficiently transmit sensor data remotely. The design consists of two boxes: one as a transmitter and the other as a receiver. Both the receiver and transmitter use a Wemos D1 R32 and LoRA RA-02 with antennas. The transmitter sends data in the form of temperature and humidity, which are read by the DHT-11, and noise by the MAX4466 and a button. The data is sent and received by the receiver module, which displays it on the LCD and activates a buzzer with a telegram notification. Tests showed that the device could read temperature and humidity, detect noise, and send a panic button signal. It displays data on the LCD, activates a buzzer, and sends telegram notifications in the event of an alert. Wireless transmission utilizes the LoRa RA-02 module for communication between the transmitter and receiver modules.

Keywords Internet of Things, Elderly, LCD, LoRa, Telegram

INTRODUCTION

The global increase in the elderly population has created significant challenges in healthcare services, particularly in ensuring continuous monitoring and timely emergency response for older adults living independently or with limited supervision (Jane Osareme et al., 2024). Aging is commonly associated with declining physical function, reduced mobility, impaired sensory perception, and increased vulnerability to various health problems, including falls, sleep disorders, hypothermia, and other medical emergencies. These conditions frequently occur inside the bedroom, where elderly individuals spend most of their time resting. Unfortunately, many emergency situations remain unnoticed because older adults may be unable to call for assistance or caregivers are not physically present. Consequently, an intelligent monitoring system capable of providing continuous observation and immediate notification is becoming increasingly important to improve elderly safety and quality of care.

Among the environmental factors affecting elderly health, room temperature, humidity, and excessive noise are important indicators that can influence physical well-being (Engelen et al., 2022; Hernandez-Martin et al., 2025). Previous studies have reported that elderly individuals are more susceptible to hypothermia due to physiological changes in cardiovascular function and decreased thermoregulation. Body temperatures below 36°C may contribute to prolonged recovery from illness, increased risk of cardiac complications, wound infection, bleeding, and reduced drug metabolism. Likewise, excessive environmental noise may disturb sleep quality, increase stress levels, and negatively affect overall health (Hahad et al., 2025; Zaman et al., 2022). Therefore, continuous monitoring of these environmental parameters can provide valuable information for caregivers to prevent potential health risks before they develop into serious medical conditions.

Recent advances in the Internet of Things (IoT) have enabled the development of intelligent healthcare monitoring systems that integrate sensors, wireless communications, and cloud-based notification services (Greengard, 2021; Gulati et al., 2022; Rath et al., 2024). IoT technology allows physiological and environmental information to be collected automatically, processed in real time, and transmitted to caregivers via smartphones or internet-based platforms. However, many existing IoT monitoring systems rely primarily on conventional wireless technologies such as Wi-Fi or Bluetooth. Although widely available, these communication technologies present several limitations, including relatively high power consumption, limited communication range, and reduced reliability in environments where internet infrastructure is unstable or unavailable. Such limitations limit their effectiveness for continuous elderly monitoring, particularly in residential environments located far from wireless access points.

Long Range (LoRa) communication technology has emerged as a promising alternative for low-power and long-distance wireless communication. As a Low Power Wide Area Network (LPWAN) technology, LoRa enables reliable transmission of sensor data over significantly greater distances while consuming significantly less energy than conventional wireless communication systems. These characteristics make LoRa particularly suitable for smart healthcare applications requiring continuous monitoring with minimal power consumption. Furthermore, integrating LoRa communication with IoT services enables sensor information to be transmitted efficiently to remote monitoring stations while simultaneously providing instant notifications through internet-based messaging applications.

Based on these considerations, this study proposes the design and development of an IoT-based elderly bedroom monitoring system using LoRa wireless communication. The proposed prototype employs a DHT-11 sensor to monitor room temperature and humidity, a MAX4466 sound sensor to measure environmental noise levels, and a panic button that allows elderly users to manually request immediate assistance during emergency situations. The sensing unit is implemented using a Wemos D1 R32 microcontroller functioning as the transmitter, while another Wemos D1 R32 functions as the receiver to process incoming data, display monitoring information on an LCD, activate a buzzer alarm when abnormal conditions are detected, and send real-time notifications through a Telegram Bot. The primary objective of this research is to develop a reliable monitoring system capable of measuring environmental conditions accurately, transmitting sensor data wirelessly using LoRa technology, and providing timely emergency notifications to caregivers. It is expected that the proposed system will contribute to improving elderly safety, enhancing remote healthcare monitoring, and supporting the implementation of intelligent smart-home technologies for aging populations.

METHODS

This study employed an engineering research approach, commonly referred to as Research and Development (R&D), to design, develop, implement, and evaluate an Internet of Things (IoT)-based bedroom monitoring system for elderly individuals using LoRa wireless communication technology (El-Guebaly, 2024; Wingate, 2025). The research focused on producing a functional prototype capable of monitoring environmental conditions in real time while providing emergency notifications to caregivers. The development process consists of five sequential stages. The first stage involved requirements analysis, where the hardware and software components necessary for the system were identified. The hardware included a Wemos D1 R32 microcontroller, a DHT-11 temperature and humidity sensor, a MAX4466 sound sensor, a panic button, LoRa RA-02 communication modules, an LCD display, and a buzzer, while the software platform consisted of Arduino IDE and Telegram Bot for remote monitoring. The second stage focuses on system design by developing block diagrams, flowcharts, communication architecture, and hardware schematics to define the interaction between transmitter and receiver nodes through LoRa technology and IoT connectivity. The third stage involved prototype implementation through hardware assembly and embedded software programming. During this phase, the transmitter collected environmental data from the sensors and transmitted the information via LoRa to the receiver, which processed the received data, displayed the monitoring results on the LCD, activated the buzzer when emergency thresholds were exceeded, and forwarded notifications through Telegram. The fourth stage consisted of system testing and evaluation, including verification of sensor performance, communication reliability, notification response time, and overall system functionality. Finally, the experimental data were analyzed to evaluate system performance, identify limitations, and determine potential improvements for future development.

Data collection was conducted using two complementary techniques. Direct observation was employed to monitor the behavior and performance of the prototype during experimental testing, while a literature review was carried out to obtain theoretical references and previous studies related to LoRa communication, IoT applications, elderly monitoring systems, environmental sensors, and wireless health monitoring technologies. These references provided the scientific foundation for system design and evaluation.

The study utilized quantitative experimental data obtained from repeated prototype testing. The measured variables included room temperature (°C), relative humidity (%), and environmental noise level (dB). These parameters were continuously recorded from the DHT-11 and MAX4466 sensors under different environmental conditions. Additional observations included LoRa communication performance, Telegram notification delay, LCD display functionality, buzzer activation, and panic button response. The collected numerical data were subsequently analyzed using descriptive quantitative methods to evaluate sensor accuracy, communication stability, system responsiveness, and overall operational reliability. The analysis also examined whether predefined threshold values successfully triggered warning notifications and local alarms according to the designed system logic.

The proposed monitoring system was organized into three major functional components: input, processing, and output. The input subsystem consists of the DHT-11 sensor for temperature and humidity measurement, the MAX4466 sound sensor for environmental noise detection, and the panic button for manual emergency activation. The processing subsystem utilized Wemos D1 R32 microcontrollers at both the transmitter and receiver nodes, interconnected through LoRa RA-02 modules for long-range wireless communication. The output subsystem includes a 16×2 LCD for displaying monitoring information, a buzzer for local alarm indication, and a Telegram Bot for delivering remote notifications. System operation followed a predefined algorithm in which the transmitter continuously acquired sensor data and transmitted them via LoRa. The receiver compared incoming values against predetermined thresholds; if the temperature exceeded 38°C, the noise level exceeded 80 dB, or the panic button was pressed, the system activated the buzzer and transmitted an emergency notification via Telegram. Moderate conditions generated warning messages, while normal environmental conditions were displayed as safe. This integrated methodology enabled the development of a reliable, real-time monitoring system capable of improving elderly safety through long-range wireless communication and IoT-based remote supervision.

FINDINGSAND DISCUSSION

DHT-11 Testing

Testing the DHT-11 to detect temperature and humidity around the sensor. The DHT-11 is connected to pin D3 on the WEMOS D1 and receives a 3.3 V supply voltage.

Figure 1 DHT-11 Testing

On the serial monitor, set the baud rate to 9600. This will then display the temperature in Celsius. The following is a test of the DHT-11 as a temperature and humidity sensor, where the data is displayed via the serial monitor.

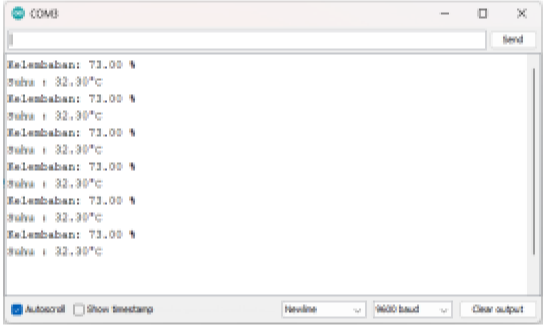

Figure 2 DHT-11 Testing

In testing the DHT-11 sensor to detect room temperature and humidity. The results obtained room temperature 32.30 OC and humidity 73%. Based on the test results, the DHT-11 sensor is able to read environmental conditions stably and display temperature and humidity data on the serial monitor without experiencing significant reading delays. A temperature value of 32.30°C indicates a relatively warm room condition, while a humidity of 73% RH indicates a fairly high water vapor content in the room. These values are still within the working range of the DHT-11 sensor, which is able to measure temperatures of 0–50°C and humidity of 20–90% RH so that the sensor can work according to its specifications.

In the designed system, temperature and humidity information is used not only as monitoring data but also as parameters for determining the condition of the elderly's bedroom. Sensor readings are sent via LoRa communication to the receiving node, then processed by the Wemos D1 R32, displayed on the LCD and sent to Telegram. This allows users to monitor the room's environmental conditions in real time without having to be present. Changes in temperature and humidity are influenced by several factors, such as room ventilation, sunlight intensity, number of occupants, and air circulation around the sensor. Therefore, measurement results may vary depending on environmental conditions at the time of testing. However, these changes can still be detected effectively by the sensor, ensuring that the information received by the user accurately reflects the room's condition.

The DHT-11 sensor has a measurement accuracy of approximately ±2°C for temperature and ±5% RH for humidity. With these specifications, the sensor is still suitable for use as a monitoring system for elderly bedroom conditions because this research focuses more on monitoring changes in environmental conditions than laboratory measurements that require a very high level of precision. In addition, the DHT-11 sensor has the advantages of low power consumption, a simple digital interface, and easy integration with the Wemos D1 R32 microcontroller. Test results showed that sensor readings were continuous throughout the system's operation. No reading failures or data loss were observed during transmission to the receiving node. This demonstrates that the integration between the DHT-11 sensor, Wemos D1 R32, and LoRa communication has been successful, allowing environmental data to be reliably transmitted to the monitoring system.

Compared to previous studies that used DHT-11 and DHT22 sensors as temperature and humidity sensors, this study offers advantages because the measurement data is not only displayed locally but also sent via LoRa communication and forwarded to the Telegram application for remote monitoring. This integration enables the system to provide faster information on the condition of the elderly's bedroom, allowing users to take immediate action if changes in environmental conditions occur that could potentially disrupt the comfort or health of the elderly.

Button and Telegram Testing

The button functions as a Telegram notification sender. This is used in emergency situations. The button uses a common cathode configuration. The pin is connected to ground, so when pressed, it sends negative logic to the WeMos digital pin.

Table 1 Button Testing

No	Button	Notification delay (seconds)
1	Pressed	4
2	Pressed	5
3	Pressed	5
4	Pressed	4
5	Pressed	6

Table 1 shows the data collected in the form of Telegram notifications and their delays. When the button is pressed, the notification isn't received immediately; there is a delay. This is influenced by several factors, including the connection, program delay, and the Telegram bot server.

Figure 3 Telegram Notifications

The Telegram notification shows that when the device is turned on, it will send a bot started up message. An alert status is displayed when the temperature is between 34°C and 38°C and the noise level is between 60 and 80 dB. Based on the test results, the panic button functioned as designed. When the button was pressed, the Wemos D1 R32 detected a logic change on the digital pin and then processed the data as an emergency. The data was then sent via LoRa communication to the receiving node for further processing. This process proceeded smoothly without any failures in reading the button status during the test.

Once the receiving node receives information from the sending node, the system automatically activates a buzzer as a local alarm and sends a notification via the Telegram app. Notifications are sent using the internet network connected to the Wemos D1 R32, allowing users to receive information in real time, even if they are in a different location from the device. This mechanism is one of the system's advantages, as it can provide a quick alert when an elderly person needs assistance. Notification delivery delay is influenced by several factors, including Wi-Fi network quality, internet connection stability, and data processing time on the microcontroller. During testing, Telegram notifications were received in a relatively short timeframe, still meeting the monitoring system's requirements. Thus, communication between the hardware and the Telegram application ran synchronously without any significant issues.

Using Telegram as a notification medium has several advantages over other notification platforms. It's lightweight, free, and easy to use, and supports instant messaging through the Bot API. Furthermore, Telegram can be accessed from various devices, including smartphones, tablets, and computers, making it easy for family members or healthcare professionals to monitor the elderly's condition anytime, anywhere. The implementation of the panic button in this study serves as a one-way communication tool between the elderly and their supervisors when conditions requiring immediate assistance arise. For example, when the elderly experience dizziness, fall, difficulty breathing, or other emergencies that still require the press of a button. This feature allows for faster information dissemination compared to when the elderly have to manually contact their family by phone.

Compared with previous studies that solely utilized environmental sensors as information sources, this research adds value by integrating a panic button with LoRa communication and the Internet of Things. This combination enables the system to not only monitor bedroom conditions but also provide a direct assistance request facility via Telegram notifications. Thus, the developed system improves security while expediting response to emergencies experienced by the elderly.

Table 2 Notification Testing

No	Notification	Condition
1	Watch out	1. Button pressed 2. temperature >38 C 3. Noise < 80dB
2	Alert	4. Humidity >70% 5. Temperature >34C 6. Noise >60dB
3	Safe	7. Button not pressed 8. temperature 20 – 34 C 9. Humidity < 70% 10. Noise < 60dB

From the test in table 2, it was found that the conditions are safe, alert, and caution. Safe conditions are when the button is not pressed, the temperature is between 20°C and 34°C, humidity is below 70%, and noise is below 60 dB. Alert when humidity is above 70%, temperature is above 34°C, and noise is above 60dB. Caution when the button is pressed, temperature is above 38°C, and noise is above 80dB.

Sound Sensor Testing

The sound sensor detects noise. The reading is in dB for the noise scale. The sound sensor has three pins: VCC to 5V, GND to ground, and the OUT pin connected to pin A0 on the Wemos D1 R32.

Figure 4 Sound Sensor Testing

Based on the block diagram, the components used will be explained based on their characteristics. The following is a sound sensor test:

Table 1 Sound Sensor Testing

No	Source	dB value
1	TV	64
2	Motor	68
3	Conversation sound	57
4	Washing machine	54
5	Grinding machine	85
6	Lonely	48

Table 3 shows data taken from various noise sources. The reading range is 48–85 dB. In a quiet environment with no noise sources, the reading is 48 dB. The highest reading was obtained from the grinding machine, at 85 dB.

LCD Testing

Testing a 16x2 LCD equipped with I2C requires a 5V supply from the Wemos D1 R32. With I2C, the LCD only requires two pins to display data: SDA and SCL. The test results on the LCD will display data from the device. This data includes temperature, humidity, noise level, and system condition status. This LCD is only available on the receiver side of the LoRa.

Figure 5 LCD display

The LCD successfully displays characters based on the program. The LCD will then display data such as temperature and humidity. The noise level in dB is indicated, along with the condition: safe, alert, or caution.

Buzzer Testing

BuzzerAs an alarm indication in case of a warning condition. If the temperature is above 38°C, the noise level is above 80%, and the button is pressed, the buzzer will be activated, accompanied by a Telegram notification.

Table 4 Buzzer Testing

No	Condition	Buzzer
1	Button pressed	On
2	Temperature 38.4 C	On
3	Humidity 81%	On

Based on the testing in Table 4, the readings are obtained when the buzzer sounds when the button is pressed. This button functions as a panic button in emergency situations. Temperatures above 38°C indicate hot conditions in the room, and high humidity indicates excessive humidity.

Figure 6 Buzzer Testing

Figure 6 shows the alert condition when the button is pressed. This also sends a Telegram message.

Lora Testing

LoraThe module consists of a transmitter and receiver module, each equipped with an antenna. On the transmitter side, there is a Wemos D1 R32 with a DHT-11 sensor, a MAX4466 as a noise sensor, and a button. On the receiver side, there is a Wemos D1 R32 with an LCD display and a buzzer.

Figure 7 Receiver and Transmitter

LoRa testing confirmed that the data on the transmitter side included temperature, humidity, noise, and button status. Based on the test results, data communication using LoRa successfully transmitted temperature, humidity, noise, and panic button status data from the transmitter to the receiver without any transmission failures during the test process. The received data can be displayed on the LCD and used to activate the buzzer and Telegram notifications according to predetermined conditions. LoRa communication testing was conducted to determine the system's ability to transmit data from the transmitter node to the receiver node. The transmitted data included temperature, humidity, noise levels, and panic button status. During the testing process, communication took place wirelessly using a LoRa module operating at 433 MHz, eliminating the need for an internet connection for data exchange between devices.

Test results showed that all data sent from the transmitter node was successfully received by the receiver node without any loss of information. The received data was then processed by the Wemos D1 R32 to be displayed on the LCD, activate a buzzer if certain conditions are met, and then forwarded to the Telegram application via an internet connection. This indicates that communication between the two nodes is proceeding smoothly and in accordance with the system design. The success of LoRa communication is influenced by several important parameters, namely the Received Signal Strength Indicator (RSSI), Signal-to-Noise Ratio (SNR), and Packet Loss. The RSSI value indicates the strength of the signal received by the LoRa module. The closer it is to zero, the better the received signal quality. Conversely, a smaller (more negative) RSSI value indicates that the received signal is weakening due to increasing distance or the presence of obstacles between the two devices.

In addition to RSSI, the SNR parameter is also used to determine signal quality against noise. A higher SNR value indicates that the information signal can be clearly distinguished from noise, resulting in more stable communication. In this study, communication was maintained because the signal quality remained acceptable to the LoRa module, preventing data reading errors on the receiving end. Another parameter observed was packet loss. Based on the test results, the transmitted data was received completely, resulting in a very low packet loss rate, even approaching zero. This indicates that LoRa communication offers a high level of reliability for monitoring. The low packet loss also indicates that the data transmission mechanism between nodes operated stably throughout the testing process.

The advantage of using LoRa over other wireless communication systems is its relatively long range and low power consumption. In this system, the transmitted data, including sensor values and button statuses, is only a few bytes in size, making it a perfect fit for LoRa, which is designed to efficiently transmit small data. Therefore, LoRa is a suitable choice for elderly bedroom monitoring systems that require long-distance communication with low energy consumption. However, LoRa communication quality is still affected by environmental conditions. Obstacles such as concrete walls, building structures, metal equipment, and radio wave interference can cause signal degradation. Furthermore, the greater the distance between the transmitter and receiver nodes, the lower the RSSI value, resulting in slightly longer transmission times. Therefore, antenna placement and device positioning are crucial factors for optimal system performance.

Overall, the test results demonstrated that LoRa communication effectively supports the monitoring of elderly people's bedrooms. Sensor data can be transmitted in real time to the receiving node, displayed on the LCD, and then forwarded to Telegram for remote monitoring. This demonstrates that the integration of LoRa and the Internet of Things technology was successfully implemented, meeting the research objectives. The test objective is to measure distances and obstacles between the LoRa transmitter and receiver. The following is a map of the LoRa test data.

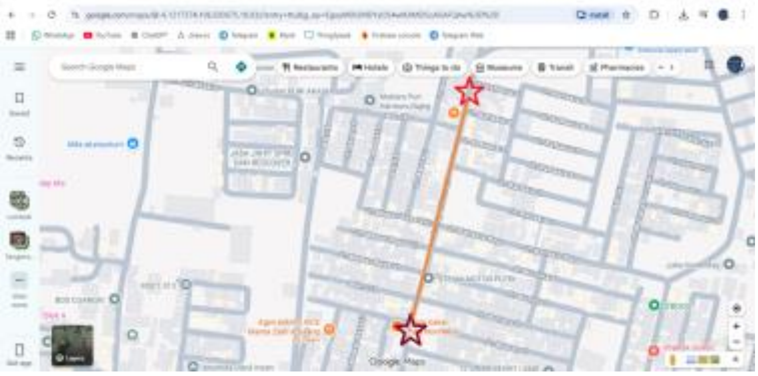

Figure 8 lora test map

Figure 4.9 shows LoRa testing over various terrains and distances. The following details the distances and obstacles encountered in the LoRa testing.

Table 5 Lora Distance Testing

No	Distance (m)	Obstacle	Status	Accuracy (%)
1	5	No	Connected	100
2	50	No	Connected	100
3	90	No	Connected	100
4	136	No	Connected	100
5	168	No	Connected	100
6	352	No	Connected	100
7	451	No	Connected	100
8	654	No	Not Connected	0
9	687	No	Not Connected	0

In the LoRa distance test, the following details are based on obstacles, status, and accuracy. When the distance between the LoRa receiver and transmitter is less than 600 m, the status is ready and connected. However, if the distance is greater than that, the LoRa connection cannot be established, and accuracy is 0%.

Figure 9 LoRa Testing between Distance and Accuracy

The test in Figure 9 shows LoRa testing based on distance. Accuracy refers to the device's connection to the system between the receiver and transmitter. When the distance is below 500m, the system is connected and can communicate data with 100% accuracy. However, when the distance is above 500m, the system is disconnected with 0% accuracy.

Analysis

Based on the design and testing results, a LoRa and Internet of Things-based elderly bedroom monitoring device was successfully realized in accordance with the research objectives. The system consists of two main parts, namely a transmitter and a receiver that communicate with each other using the LoRa RA-02 module. On the transmitter side, a DHT-11 sensor is used to read the room temperature and humidity, a MAX4466 sound sensor to detect noise levels, and a panic button as an emergency button. The obtained data is then sent wirelessly to the receiver to be displayed on the LCD, activate the buzzer, and send notifications via Telegram.

Testing the DHT-11 sensor yielded a temperature reading of 32.3°C and a humidity reading of 73%. These results demonstrate the sensor's ability to monitor room conditions in real time. Temperature and humidity information is crucial because environments that are too hot or too humid can impact the comfort and health of the elderly. However, the DHT-11 sensor has limited accuracy, so further research could require calibration using standard measuring instruments to improve the accuracy of the measurements.

Testing the panic button and Telegram showed that the system was capable of sending notifications when the emergency button was pressed. The test results showed a notification delivery delay of between 4 and 6 seconds. This delay is influenced by internet connection quality, data processing on the microcontroller, and Telegram server response time. Despite the delay of several seconds, the system can still be used as an early warning system because emergency information can still be received in a relatively short time.

In sound sensor testing, readings ranged from 48 dB to 85 dB. The lowest value, 48 dB, was achieved in relatively quiet conditions. This indicates that the sensor still detects ambient sounds and internal noise from electronic circuits. The highest value, 85 dB, was achieved when the sensor detected the sound of a grinding machine. Based on these results, it can be concluded that the sensor is capable of distinguishing environmental noise levels and can be used as an indicator of conditions that could potentially disrupt the comfort of room occupants.

Data communication using the LoRa RA-02 successfully connected the transmitter and receiver nodes. Data such as temperature, humidity, noise, and panic button status were received well by the receiver. LoRa was chosen due to its low power consumption and its ability to support wireless communication in the monitoring system. LoRa communication makes the system installation process more flexible because it eliminates the need for a cable connection between the transmitter and receiver devices. LCD testing showed that all data received from the transmitter could be displayed properly. Furthermore, the buzzer also successfully functioned as a warning alarm when the system detected an alert condition or when the panic button was pressed. Overall, the device successfully performed its primary function as a monitoring system for elderly bedroom conditions. The system was able to read environmental parameters such as temperature, humidity, and noise, then transmit this information wirelessly using LoRa and provide notifications via Telegram. Thus, the device can assist in the process of monitoring elderly bedroom conditions remotely and in real-time.

The developed system offers several advantages that support its practical implementation for elderly bedroom monitoring. It is capable of monitoring temperature, humidity, and noise levels in real time while providing an emergency notification feature via a panic button. The use of LoRa communication enables reliable long-range wireless data transmission, and Telegram notifications facilitate remote monitoring by caregivers, allowing timely responses to abnormal conditions. In addition, the integrated buzzer functions as a local warning indicator to enhance user safety. Despite these strengths, the system has several limitations. It is not yet equipped with a fall detection sensor, which could improve emergency detection capabilities. The system also lacks a backup power supply, such as a battery, to ensure continuous operation during power outages. Furthermore, the accuracy of the DHT-11 and MAX4466 sensors could be improved through calibration procedures, and the Telegram notification service remains dependent on a stable internet connection, which may affect system performance in areas with limited network availability. These limitations provide opportunities for future development to enhance the reliability, accuracy, and robustness of the proposed monitoring system. In the research results, there are 3 conditions, namely safe, alert and watchful. All three conditions send a Telegram notification and display it on the LCD. Here are the conditions for testing these three conditions:

Table 6 Tool Testing

No	Button	Temperature (C)	Humidity (%)	Noise (dB)	Status

1	pressed	32	65	56	Watch out
2	Not pressed	38	75	46	Watch out
3	Not pressed	35	65	51	Alert
4	Not pressed	31	76	65	Alert
5	Not pressed	28	57	58	Safe

From the test in table 6, it was found that the conditions are safe, alert, and caution. The safe condition is when the button is not pressed, the temperature is above 20°C and below 34°C, the humidity is below 70%, and the noise is below 60 dB. The alert condition is when the temperature is between 34-38°C, the noise is between 60-80 dB, and the humidity is above 70%. The alert condition is when the button is pressed, the temperature is below 20°C and above 38°C, and the noise is above 80 dB.

CONCLUSION

This study successfully designed, implemented, and evaluated a bedroom monitoring system for elderly individuals based on LoRa and Internet of Things (IoT) technology. The proposed system integrates a DHT-11 temperature and humidity sensor, a MAX4466 sound sensor, a panic button, LoRa RA-02 communication modules, an LCD display, a buzzer alarm, and a Telegram Bot to provide comprehensive environmental monitoring and emergency notification services. Experimental results demonstrate that the system is capable of continuously monitoring temperature, humidity, and noise levels in real time while transmitting sensor data reliably between the transmitter and receiver nodes using LoRa communication. The monitoring information is displayed on the LCD and simultaneously processed to activate an audible buzzer alarm when predefined threshold values are exceeded. In addition, the Telegram Bot successfully delivers warning notifications and emergency alerts, including panic button activation, with an average transmission delay of approximately 4–6 seconds, indicating satisfactory responsiveness for practical applications. The integration of long-range wireless communication and IoT connectivity enables remote monitoring of elderly bedroom conditions, thus enhancing caregiver awareness and supporting timely responses to potential emergency situations. Overall, the developed system demonstrates reliable performance, cost-effective implementation, and practical feasibility as an intelligent monitoring solution that contributes to improving the safety, comfort, and quality of elderly care in residential environments.

REFERENCES

El-Guebaly, L. (2024). *Fusion Energy Technology R&D Priorities*. Elsevier.

Engelen, L., Rahmann, M., & de Jong, E. (2022). Design for healthy ageing–the relationship between design, well-being, and quality of life: a review. *Building Research & Information*, *50*(1–2), 19–35.

Greengard, S. (2021). *The internet of things*. MIT press.

Gulati, K., Boddu, R. S. K., Kapila, D., Bangare, S. L., Chandnani, N., & Saravanan, G. (2022). A review paper on wireless sensor network techniques in Internet of Things (IoT). *Materials Today: Proceedings*, *51*, 161–165.

Hahad, O., Kuntic, M., Al-Kindi, S., Kuntic, I., Gilan, D., Petrowski, K., Daiber, A., & Münzel, T. (2025). Noise and mental health: evidence, mechanisms, and consequences. *Journal of Exposure Science & Environmental Epidemiology*, *35*(1), 16–23.

Hernandez-Martin, M., Del Ama Gonzalo, F., & González-Lezcano, R. A. (2025). Indoor environmental quality to ensure the health and wellbeing of vulnerable people in residential buildings: a systematic review. *Frontiers in Built Environment*, *11*, 1652527.

Jane Osareme, O., Muonde, M., Maduka, C. P., Olorunsogo, T. O., & Omotayo, O. (2024). Demographic shifts and healthcare: A review of aging populations and systemic challenges. *Int J Sci Res Arch*, *11*(1), 383–395.

Rath, K. C., Khang, A., & Roy, D. (2024). The role of Internet of Things (IoT) technology in Industry 4.0 economy. In *Advanced IoT technologies and applications in the industry 4.0 digital economy* (pp. 1–28). CRC Press.

Wingate, L. M. (2025). *Project management for research and development: Guiding innovation for positive R&D outcomes*. Auerbach Publications.

Zaman, M., Muslim, M., & Jehangir, A. (2022). Environmental noise-induced cardiovascular, metabolic and mental health disorders: a brief review. *Environmental Science and Pollution Research*, *29*(51), 76485–76500.