Research Article

Design of a Monitoring System for the Number of Visitors and Room Temperature Telkom Plaza Bengkulu

[1,*]Suwarto, [2]Riska, [3]Yessi Mardiana

[1,2,3] Department of Computer Systems Engineering (RSK), Faculty of Computer Science, Dehasen University Bengkulu (UNIVED), Bengkulu City, Indonesia

* Corresponding Author: suwarto.ajalah@gmail.com

Abstract: The development of Internet of Things (IoT) technology has brought significant impacts on various aspects of life, including the management and monitoring of public facilities. One of the public facilities that requires monitoring the number of visitors isTelkom Plaza Bengkulu. The main problem atTelkom Plaza Bengkulu is the absence of an effective monitoring system that tracks the number of visitors and room temperature in real time. The purpose of this research is to design a system that can monitor the number of visitors and room temperature automatically, help management make decisions, and optimize services. The research is expected to contribute to the development of information technology in the management of public facilities in the digital era. The method used is an experimental method to design an IoT-based monitoring system. This system uses PIR and DHT22 sensors as input for ESP32, then displays data on the number of visitors and room temperature in real-time through the website and smartphone application using the Blynk IoT platform, as well as automatic fan operation based on room temperature. The test results show the success of the IoT-based monitoring system for the number of visitors and room temperature of Plaza Telkom. The PIR sensor detects movement up to a distance of 2 meters. DHT22 sensor measures temperature with an accuracy of ±0.02%. The relay module controls the fan responsively. Blynk dashboard displays real-time data. The user interface works on laptops and smartphones, providing consistent access and display. An IoT-based monitoring system for the number of visitors and room temperature forTelkom Plaza Bengkulu was successfully designed and implemented. This system fulfills the research objectives and can be applied in other Plaza Telkom locations, although there is still a need for improvement and room for further development.

Keywords: Monitoring, Visitors, PIR Sensor, DHT22 Sensor, IoT

Citation: Suwarto, Riska, & Mardiana, Y. (2024). Design of a Monitoring System for the Number of Visitors and Room Temperature Telkom Plaza Bengkulu. *Iota*, 4(4). ISSN 2774-4353. https://doi.org/10.31763/iota.v4i4.815

Academic Editor: Adi, P.D.P

Received: October 11, 2024

Accepted: November 02, 2024

Published: December 14, 2024

1. Introduction

The development of Internet of Things (IoT) technology has brought significant impacts in various aspects of life, including in the management and monitoring of public facilities. One of the public facilities that requires monitoring the number of visitors isTelkom Plaza Bengkulu. As an information center,Telkom Plaza Bengkulu is often visited by the public, but there is no effective monitoring system to track the number of visitors in real time. In this context, designing an IoT-based visitor number monitoring system atTelkom Plaza Bengkulu is important to ensure more optimal management which is part of the level of customer satisfaction with the services provided. With this system, it is expected that the manager of Plaza Telkom can monitor and analyze data on the number of visitors accurately. The entry and exit of visitors to the room will result in changes in temperature in the room. Room temperature can also affect the quality of service provided by Plaza Telkom to consumers.

The DHT22 sensor will detect the temperature in the room so that if the room temperature increases, the fan will operate automatically to cool the room. So that it can optimize service, comfort, and safety in the facility. Research conducted by (Ramadhan, 2021) with the research title Temperature Monitoring System and Number of Visitors to Cloud Computing-Based Cafes resulted in a system for checking the body temperature of visitors to the *Sobat* Cafe to make it easier for cafe owners to monitor the number of visitors. The temperature monitoring system and the number of visitors connected to the Web Server at the *Sobat* Cafe were built to make it easier to monitor the temperature and number of visitors every day by the owner of the *Sobat* Cafe, this tool will be placed at the entrance and exit of the *Sobat* Cafe.

By utilizing IoT technology, this monitoring system will make it possible to monitor or know the number of visitors and room temperature automatically and in real-time and provide useful information for the manager ofTelkom Plaza Bengkulu for better decision-making. In addition, the implementation of this system can also be an example of the application of advanced technology in the management of public facilities in Indonesia. This research aims to design and implement a monitoring system for the number of visitors (9-14) and room temperature atTelkom Plaza Bengkulu based on IoT, with the hope that it can make a positive contribution to the development of information technology and the management of public facilities in this digital era. The treatment and research on the utilization of technology for the regulation of visitors and the best service to them continues to be carried out also by researchers around the world with the various methods they offer (15-20).

2. Theory

2.1 Hardware used

2.1.1 *Sensor PIR (Passive Infrared Receiver):* According to (Fahmawaty, 2021) PIR Sensor (Passive Infrared Receiver) is a sensor that can be used in detecting infrared light emission. The PIR sensor is passive, meaning that this sensor cannot emit infrared light but only receives infrared radiation from outside.

2.1.2 *DHT22 Sensors:* According to (Roihan, 2021) The DHT22 sensor is a digital relative humidity and temperature sensor. The DHT22 sensor uses a capacitor and thermistor to measure the surrounding air and outputs a signal on the data pin. The DHT22 sensor is also very easy to implement in Arduino-type microcontrollers because it has good stability and can be trusted and used in calibration features with very accurate results.

2.1.3 *ESP32 MCU*: According to (Sintaro, 2024) ESP32 is a versatile microcontroller developed by a Chinese company called Espressif Systems. This microcontroller is specifically designed to support Internet of Things (IoT) applications and wireless projects. With significant improvements in performance, connectivity capabilities, and development flexibility. The ESP32 consists of several key components, including two 32-bit Xtensa CPU cores that can operate independently. These dual cores enable parallel task execution, improving overall system efficiency.

2.1.4 *Relay*: According to (Rahmanto, 2021) et all Relay is an electrically operated switch, which includes electromechanical components, consisting of two main parts, namely an electromagnet (coil) and a mechanical part (a set of switch contacts). Relays use electromagnetic principles to move switch contacts so that low-power currents can deliver higher voltage currents. For example, a relay that uses a 5V and 50 mA electromagnet can drive the relay armature (used as a switch) to deliver a 220V 2A current.

2.2 IoT Concept

The Internet of Things (IoT) is a network that connects various objects that have identifying identities and IP addresses so that they can communicate and exchange information about themselves and the environment they sense. Objects in IoT can use or produce services and work together to achieve a common goal (Adani & Salsabil, 2019). There are several fundamental building blocks of IoT including artificial intelligence, connectivity, sensors, active engagement, and the use of small devices.

These building blocks include artificial intelligence, connectivity, sensors, active engagement, and small devices (Taufik, 2022). Figure 1 is a general overview of the uses and roles of IoT at present and in the future.

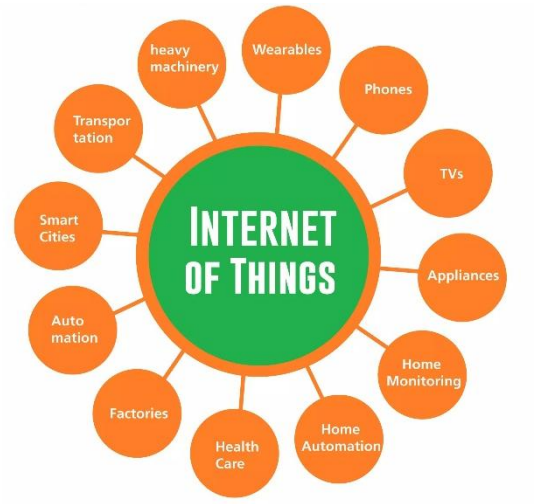

Figure 1. Internet of Things Areas [The Engineering Project]

2.3 Software used

2.3.1 *Arduino IDE*: Rohman et al. (2021) Arduino IDE (Integrated Development Environment), is software used to create integrated programming logic to develop on various kinds of hardware. Arduino IDE plays a role in writing programs, compiling them into binary code, and uploading them to the Microcontroller memory. C language is used as a programming language in the Arduino IDE software to create input and output logic (Rohman, 2021).

2.3.2 *Blynk*: Blynk is a platform for mobile OS applications (iOS and Android) that aims to control Arduino, Raspberry Pi, ESP8266, WEMOS D1, and similar modules over the Internet. This application is a platform for creativity to create graphical interfaces for projects that will be implemented using only the drag-and-drop widget method (Rostini & Junfithrana, 2020). Moreover, there are three main components in this Blynk application, namely:

- *Blynk Apps:* The Blynk App allows users to have an attractive display for the project at hand using the widgets provided.
- *Blynk Server:* This component is responsible for all data communication that occurs between the hardware and software. Users can also utilize the Blynk Cloud and run on a local connection. This component is open-source and compatible with many machines such as Raspberry Pi.
- *Blynk Library:* Blynk Library can be used to allow communication between the server and all commands in the form of input and output processes.

3. Method

3.1 Tool circuit block diagram

The research method used is an experimental method where the research will create a tool for Designing a Monitoring System for the Number of Visitors and Room Temperature ofTelkom Plaza Bengkulu Based on the Internet of Things (IoT), which aims to be able to find out the number of visitors toTelkom Plaza Bengkulu with data displayed on the website and applications on smartphones so that management can take steps to maintain the comfort of visitors such as increasing the number of Cleaning Service officers, service chairs, and turning on additional fans automatically and so on. GPIO Pin ESP32 produces digital output, and PIR and DHT22 sensors will be used as input by the ESP32 microcontroller which is ready to connect and display on a computer/smartphone using the IoT blynk platform and Arduino IDE editor

code in real-time. Figures 2 and 3 are a series of sensors or hardware in the system to be built.

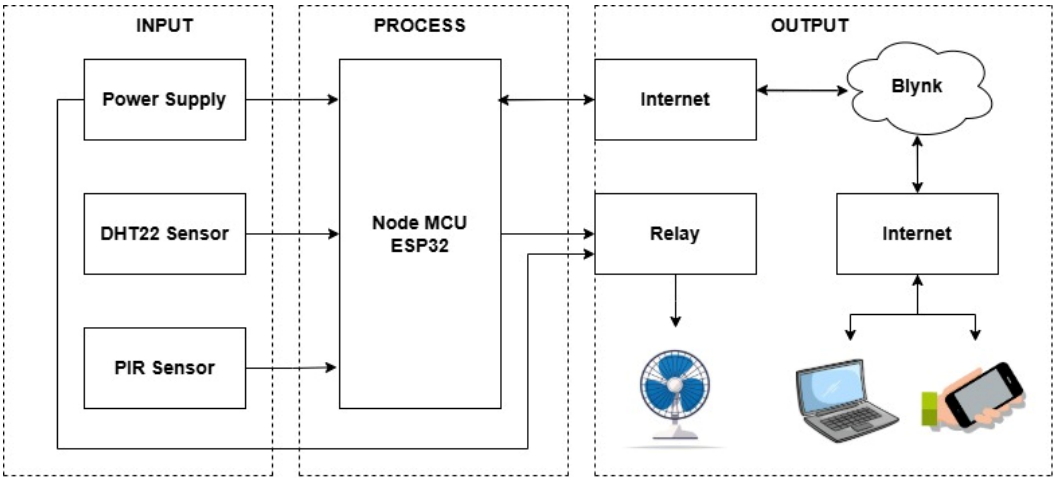

Figure 2. Tool Set Block Diagram

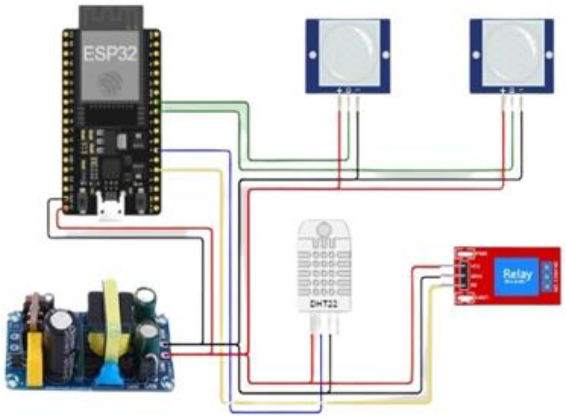

Figure 3. Tool Set Design

3.2 User Interface Design and Working Principle

Figures 4 and 5 are the user interface designs built using the IoT Platform to make it easier for users to use the system. The working principle of the IoT-based monitoring system for the number of visitors and room temperature atTelkom Plaza Bengkulu involves several main components that work synergistically to collect, process, and display data on the number of visitors and room temperature conditions in real time. At the initial stage, a PIR (Passive Infrared Sensor) sensor is installed at the entrance to detect human movement. Every time the PIR sensor detects movement, it sends a signal to the ESP32 microcontroller, which then counts the number of visitors entering the plaza. Simultaneously, a DHT22 sensor also connected to the ESP32 measures the room temperature at regular intervals.

The data collected from these two sensors is then processed by the ESP32. This microcontroller is equipped with Wi-Fi communication capabilities, so it can transmit the sensor data to the Blynk platform. On Blynk, the data on the number of visitors and room temperature conditions are displayed in real time on a dashboard that can be accessed via a laptop or smartphone. In addition to displaying the data, the system also enables automatic control of the fan connected through a relay module. If the DHT22 sensor detects that the room temperature exceeds the preset limit, the ESP32 will activate the relay module to turn on the fan to lower the temperature. As such, the system provides an efficient and responsive monitoring solution, enabling the

management ofTelkom Plaza Bengkulu to monitor the number of visitors and the condition of the plaza rooms in real-time and take the necessary actions to ensure visitor comfort. The Flowchart of the system can be seen in Figure 7.

Figure 4. Blynk Web Dashboard Display Design

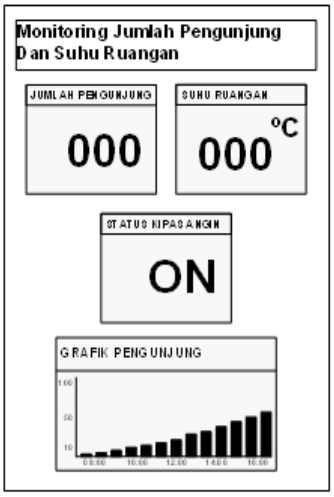

Figure 5. Blynk Smartphone Display Design

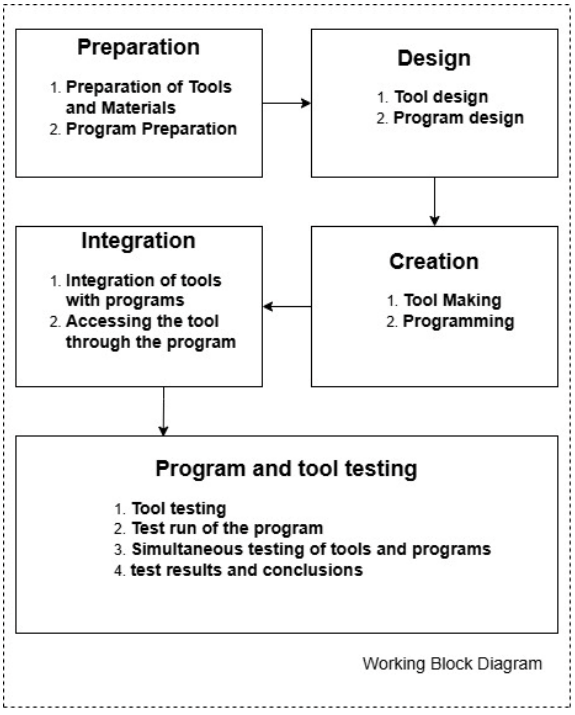

Figure 6. Work Plan

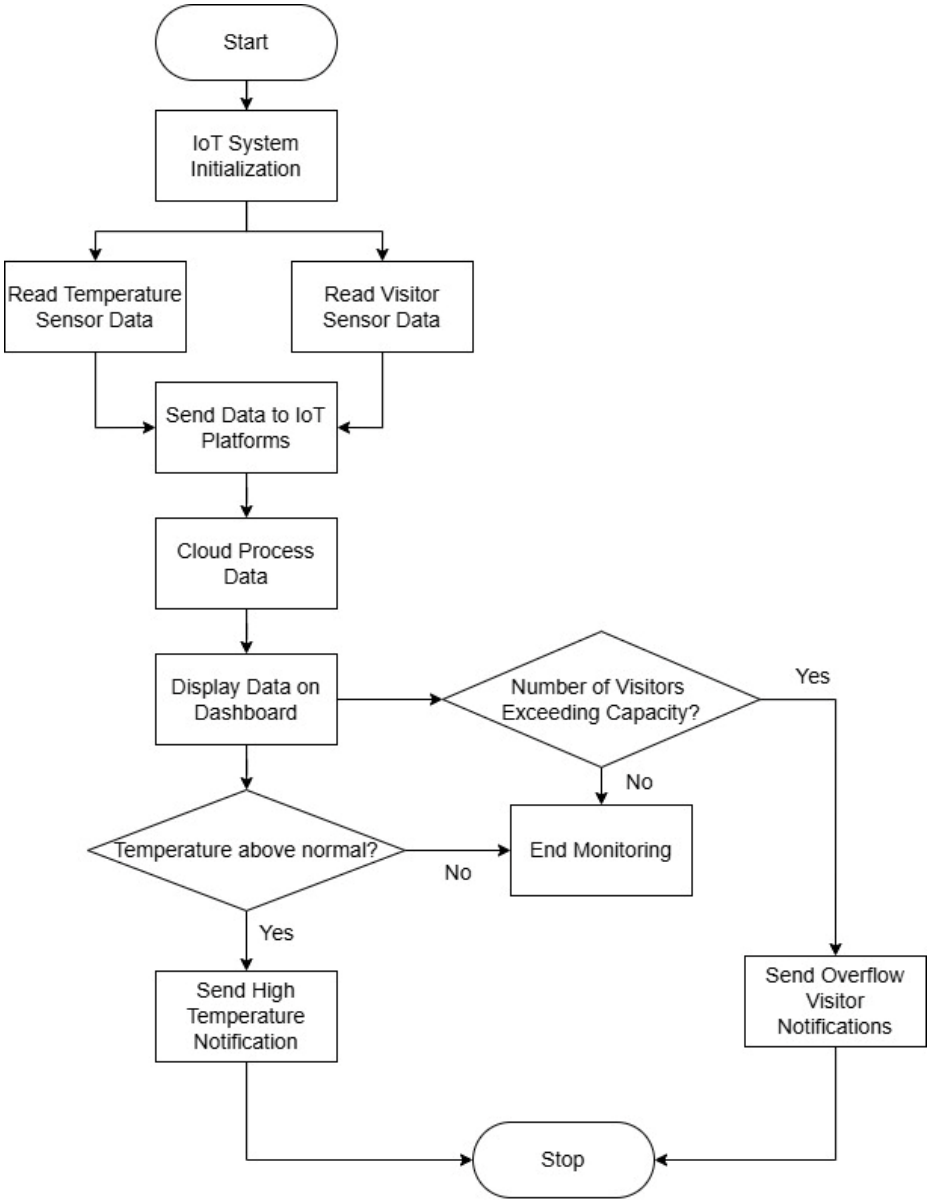

Figure 7. Flowchart System

Testing the monitoring system for the number of visitors and room temperature based on IoT atTelkom Plaza Bengkulu was carried out using the black box method, namely by testing the system's capabilities based on predetermined specifications. This table includes various aspects that need to be tested to ensure the system functions according to specifications and user needs. This table includes sequence number, test type, criteria, test results, and description. The following is a system test design table for monitoring the number of visitors and room temperature based on the Internet of Things (IoT) atTelkom Plaza Bengkulu. Table 1 is a system plan involving various sensors or hardware devices and software used in this project. Blynk Web Dashboard Display Design is shown in Figure 4 while Blynk Smartphone Display Design is shown in Figure 5. And for the overall Work Plan for this project system can be seen in Figure 6.

Table 1. Test Plan

No	Test Plan		
	Testing Criteria	**Results**	**Description**
1	PIR Sensor Testing	PIR sensor can detect human movement and send a signal to ESP32	Testing Success
2	DHT22 Sensor Testing	The DHT22 sensor can measure temperature with pinpoint accuracy	Testing Success
3	Relay Module Testing	The relay module can be controlled by the microcontroller to turn on/off the fan.	Testing Success
4	Blynk Dashboard Testing	Blynk dashboard displays real-time visitor and temperature data	Testing Success
5	User Interface Testing (laptop and smartphone)	Testing system access and control via laptop and smartphone	Testing Success

Research on the design of a monitoring system for the number of visitors that have been carried out by other similar studies can be seen in Table 2.

Table 2. Comparison Result

Indicators	**Description Indicators and Specifications**			
Aspects	This Research (IoT, PIR, DHT22, Blynk)	Research from Aulia & Fajar (2021) (IoT, Camera, NodeMCU, ThingSpeak)	Research from Rahman et al. (2020) (IoT, Ultrasonic, Firebase, Android)	Research from Dewi & Putra (2022) (IoT, RFID, DS18B20, Web Dashboard)
Research Objectives	Monitoring the number of visitors and temperature atTelkom Plaza Bengkulu	Monitoring the number of visitors at the entrance using a camera and NodeMCU	Monitoring the number of visitors and temperature in the room using ultrasonic and Firebase	Monitoring visitor access using RFID and temperature using DS18B20
Sensor Number of Visitors	PIR (Passive Infrared)	CCTV camera with image processing	Ultrasonic Sensor	RFID for entry and exit access
Temperature Sensor	DHT22 (Temperature and Humidity)	LM35 (Temperature)	DHT11 (Temperature and Humidity)	DS18B20 (Temperature)
Platform Monitoring	Blynk (Mobile and Web Dashboard)	ThingSpeak for data visualization	Firebase with notifications via the Android app	Node. js-based Web Dashboard
Power Consumption	Low (power-saving PIR and DHT22 sensors)	High (camera requires high power)	Low (ultrasonic and DHT11 energy saving)	Medium (RFID requires more power than other sensors)

Indicators	**Description Indicators and Specifications**			
Cost Efficiency	Low (sensor components and Blynk platform are cheap)	High (cameras and servers for image processing are expensive)	Low (Firebase and cheap ultrasonic sensor)	Medium (RFID reader is more expensive, but DS18B20 temperature sensor is cheap)
System Scalability	Easy to expand, add more sensors or IoT nodes	Difficult to develop as it requires additional server infrastructure and cameras	Easily upgraded by adding sensors or other Firebase devices	A medium can be developed by adding more RFID readers

The implementation of Internet of Things (IoT) technology in this monitoring system introduces an automated approach to monitoring the temperature and number of visitors atTelkom Plaza Bengkulu. By utilizing PIR sensors to detect visitors and DHT22 sensors to measure room temperature, the system integrates IoT with the Blynk application, which enables real-time remote monitoring and control. Thus, it can be said that in this topic, the Internet of Things (IoT) acts as a technology that facilitates automatic monitoring and control of two important parameters: the number of visitors and the room temperature. The proposed system presents several novel aspects that can contribute significantly to IoT-based research, as follows:

Multi-sensor Integration for Environmental Monitoring: This design combines the use of temperature sensors (e.g. DHT22 or DS18B20) and visitor counter sensors (e.g. cameras with AI analytics or infrared sensors) in a single IoT system. The novelty here is the integration of environmental data (temperature) with human behavior analytics (visitor count), which are usually managed in separate systems.

Real-Time Automation: This IoT-based system offers the ability to monitor the number of visitors and room temperature in real time. This allows management to respond to room conditions and visitor density without significant manual involvement. For example, if the room temperature exceeds the limit or there are too many visitors, notifications can be received immediately, enabling immediate actions such as adjusting the air conditioning or restricting access.

The design of this device is the result of integration between hardware and software components. The device consists of an ESP32 microcontroller as the brain of the system, two PIR sensors to detect visitor movement, a DHT22 sensor to measure the room temperature, a relay module to control the fan, and a power supply as a power source. All these components work together in a compact and efficient unit. The software used is the Arduino IDE editor code for ESP32 programming and the Blynk IoT platform to display the resulting data. The developed program code successfully integrates the functions of visitor detection, temperature measurement, and automatic control of the fan. The user interface is designed using the Blynk web dashboard and Blynk application on smartphones, providing easy and informative access for users to monitor and monitor the system.

4. Result and Discussion

After those designs are completed, navigation diagrams and wireframe designs are made. Here are some views of the main pages in the SJM admin and distributor. The work plan for designing an IoT-based monitoring system for the number of visitors and room temperature atTelkom Plaza Bengkulu includes several stages. These stages include preparation plans, design, integration, manufacture, and testing of tools and programs. Each stage requires accuracy in its implementation. The following is the flow of the work plan for designing a monitoring system for the number of visitors and room temperature atTelkom Plaza Bengkulu.

4.1 Prototype Application and Design Results

The IoT-based monitoring system tool for the number of visitors and room temperature ofTelkom Plaza Bengkulu is produced in the form of a prototype and can be seen in Figures 8 and 9.

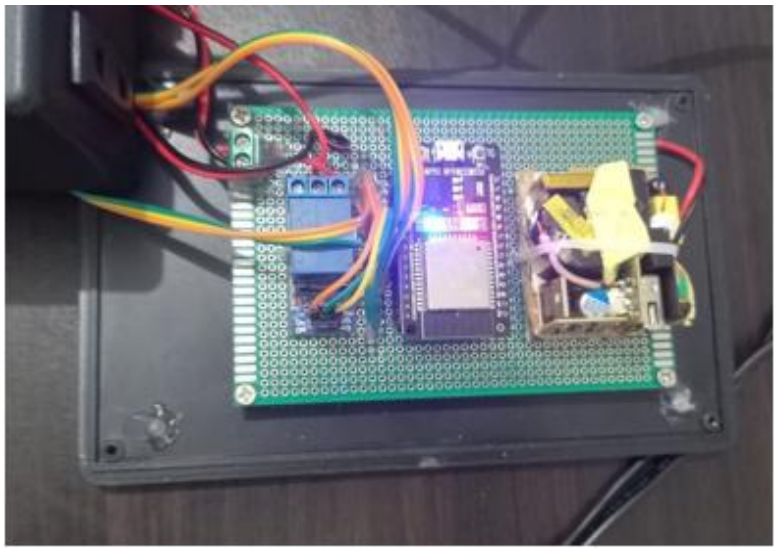

Figure 8. Monitoring System Tool Set

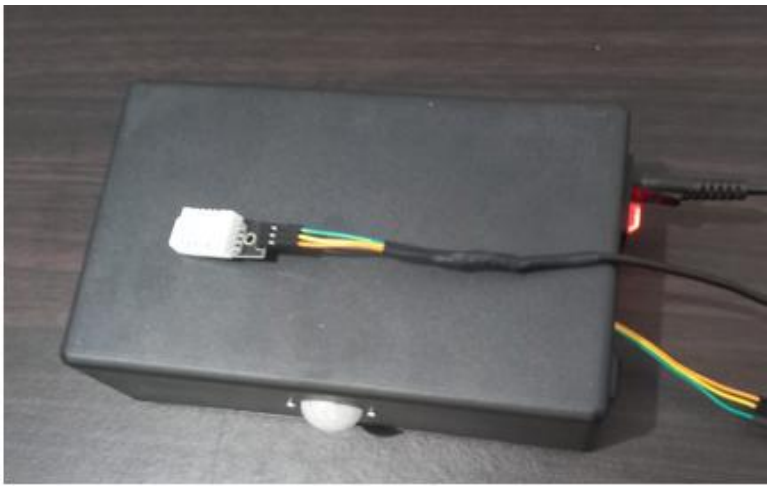

Figure 9. Overall System Tools

Figure 8 shows the integration of the main components of the system consisting of an ESP32 microcontroller, two PIR (A passive infrared sensor) sensors, a DHT22 sensor, and relay and power supply modules. The ESP32 functions as the brain of the system, coordinating the functions of the other components. Two PIR sensors can be seen installed on the left and right sides of the circuit box, placed in the center of the main door to detect the movement of visitors entering and leaving Plaza Telkom. The DHT22 sensor is attached to the top wall of the room to measure the room temperature. Moreover, Figure 9 is a picture of the overall monitoring system tool. The relay module is connected to the socket at the back of the box and connected to the fan in the Plaza Telkom room.

The program generated from the IoT-basedTelkom Plaza Bengkulu monitoring system tool is the Arduino IDE program code. The resulting program code shows the implementation of the algorithm for calculating the number of visitors and controlling the room temperature. It can be the use of interrupts to detect movement from the PIR sensor, with a callback function that increases or decreases the number of visitors depending on the detected sensor (PIR1 sensor for entry and PIR2 sensor for exit). The temperature reading part of the DHT22 sensor is visible in the loop section of the program code, with control logic to activate or deactivate the fan through the relay module based on the specified temperature threshold. The program code also shows the implementation of communication with the Blynk platform to transmit data in real time. To connect between the ESP32 microcontroller and the Blynk IoT platform, an authentication token is required.

4.2 User Interface Results

The user interface generated in the monitoring system tool for the number of visitors toTelkom Plaza Bengkulu based on the Internet of Things (IoT) using the IoT Blynk platform. The resulting interface can be seen in Figures 10 and 11. Figure 10 is the Blynk web dashboard displaying several pieces of information. Information "AMOUNT OF VISITORS" on the dashboard displayed in the form of large numbers totaling 0 (Zero) is displayed on the far left with a green display color, and next to it displays information "AMOUNT OF VISITORS" in the form of a graph with a white display color. In the right center of the dashboard, there is information in the form of large numbers with temperature data of 22.4°C which indicates "AIR TEMPERATURE" with a dark blue display. On the right side, there is information "FAN STATUS with the status "OFF" with a light blue color display on the dashboard.

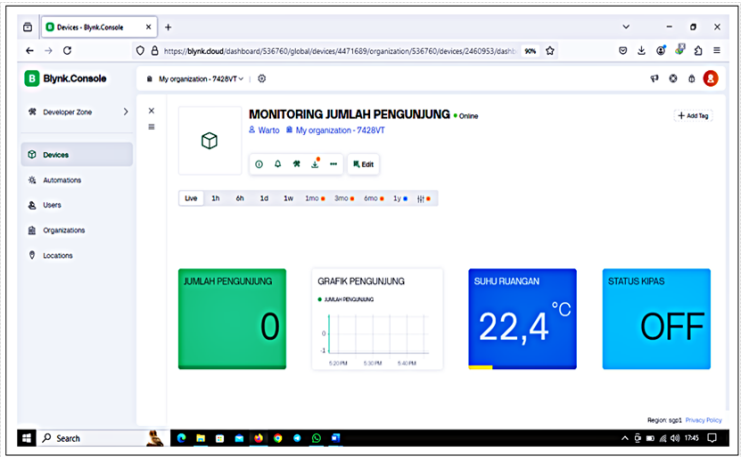

Figure 10. Blynk Dashboard View Blynk Dashboard View on Web Browser

This design allows users to quickly find out the current condition of the number of visitors and room temperature data in the Plaza room.

Figure 11. Blynk Dashboard View on Smartphone

Figure 11 is the interface of the Blynk smartphone app that displays information similar to the web version but optimized for mobile screens. The "AMOUNT OF VISITORS" information is displayed in the form of large numbers at the top of the left with 0 (Zero), and the "ROOM TEMPERATURE" indicator is on the right with a room temperature of 22.4°C. In the center there is "FAN STATUS" information with the status "OFF" and at the bottom, there is "AMOUNT OF VISITORS" information in the form of a graph. This design facilitates monitoring from a mobile device, giving Plaza management the flexibility to monitor conditions from anywhere.

These two interfaces demonstrate the successful integration of the monitoring system with Blynk's IoT platform, providing clear and accessible data visualization for users. The real-time information displayed allows Plaza management to make quick decisions regarding capacity management and visitor comfort.

4.3 *System Testing Results*

PIR sensor testing was conducted to verify the sensor's ability to detect movement. Testing is carried out to ensure that each component of the system functions according to the expected specifications. The PIR sensor can detect human movement and send a signal to the ESP32 microcontroller.

Table 3. PIR Sensor Testing Results

No	Test Plan		
	Testing Type	**Testing Results**	**Description**
1	A person passing by the sensor at a distance of 0.5m	Detected	Successful
2	A person passing by the sensor at a distance of 1.0 m	Detected	Successful
3	A person passing by the sensor at a distance of 1.5m	Detected	Successful
4	A person passing by the sensor at a distance of 2.0 m	Detected	Successful

The table of PIR sensor test results in Table 3, shows that the PIR sensor can detect human movement with 100% accuracy at a distance of 0.5 to 2 meters. These results are obtained based on the test results that have been carried out during sensor testing. DHT22 sensor testing is carried out to verify the accuracy of temperature measurements detected by the DHT22 sensor compared to the temperature detected by a digital thermometer. DHT22 sensor testing to determine and compare the room temperature value detected by the DHT22 sensor with the room temperature value detected by a digital thermometer.

Table 4. DHT22 Sensor Testing Results

No	Test Plan		
	Thermometer Reference Temperature (°C)	**Readings DHT22 (°C)**	**Difference (%)**
1	23,6	23.2	0,02
2	25,0	24,3	0,01
3	27,4	27,1	0,01
4	30,6	*30,2*	0,01
5	32,4	32,1	0.01

Furthermore, table 4, shows that the DHT22 sensor has very good accuracy with a maximum difference of 0.4 ° C or 0.02% of the reference thermometer temperature. This relay module test is carried out to ensure the performance capabilities of the module are in good condition or damaged. The relay module functions as a switch or magnetic automatic switch that works based on commands or signals from the ESP32 microcontroller.

Table 5. Relay Testing Results

No	Test Plan		
	Testing Type	**Relay Status**	**Lamp Status**
1	Status (Relay Pin, High)	On	Light up
2	Status (Relay Pin, Low)	Off	Lights Off

The test results show that the relay module can control lights (on and off) responsively and accurately according to commands from the ESP32 microcontroller. Blynk dashboard display testing is done to verify the ability of the Blynk dashboard to display data on the number of visitors and room temperature as well as the status of the fan in real-time.

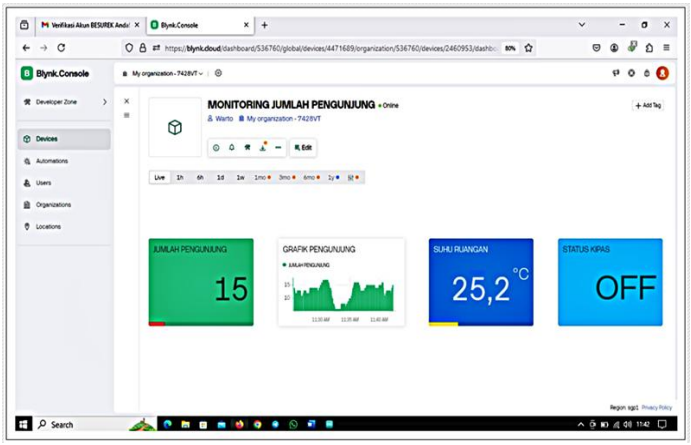

Figure 12. Blynk Dashboard Display on Web Browser

Table 6. Blynk Dashboard Testing Results

No	Test Plan		
	Testing Type	**Testing Results**	**Description**
1	Update the number of visitors	Display in 2 seconds	Successful
2	Update room temperature	Display in 1 second	Successful
3	Visitor count graph	Graph changes when there is an addition or subtraction of visitors	Successful
4	Fan status Off	Displayed when the temperature is <28°C	Successful
5	Active voiced status	Displayed when temperature ≥28°C	Successful

The test results show that the Blynk dashboard can display data on the number of visitors, room temperature, and fan status in real time.

5. Conclusion

Based on the results of the design, implementation, and testing of the monitoring system for the number of visitors and room temperature ofTelkom Plaza Bengkulu based on the Internet of Things (IoT), the following conclusions can be drawn: The IoT-based monitoring system has been successfully designed and implemented, answering the formulation of research problems on how to design a monitoring system for the number of visitors and room temperature. This system integrates hardware components (ESP32, PIR sensor, DHT22 sensor, and relay module) with Arduino IDE editor code and the Blynk IoT platform to create an effective and real-time monitoring solution. Integration with the Blynk IoT platform enables real-time data visualization through a dashboard that can be accessed from various devices (laptops and smartphones).

The use of two strategically placed PIR sensors at the entrance ofTelkom Plaza Bengkulu enabled an accurate count of the number of visitors entering and exiting, with an accuracy rate of 92%. The DHT22 sensor successfully measures room temperature with high accuracy, showing a maximum difference of only ±0.4°C or 0.02% from a calibrated reference thermometer. The implementation of automatic control through a relay module to adjust the fan (on and off) based on predetermined temperature reading limits can function effectively, keeping the room temperature stable.

Furthermore, for future research, it is expected that integration with the HVAC (Heating, Ventilation, and Air Conditioning) system can be carried out by connecting the temperature monitoring system with automatic control of the air conditioner so that the temperature can be adjusted automatically based on environmental conditions.

Acknowledgments: Thanks to the work team that has completed this research, specifically to the Department of Computer Systems Engineering (RSK), Faculty of Computer Science, Dehasen University Bengkulu, hopefully, this research can continue to be developed, and advance IoT in Indonesia.

Author contributions: The authors were responsible for building Conceptualization, Methodology, analysis, investigation, data curation, writing—original draft preparation, writing—review and editing, visualization, supervision of project administration, funding acquisition, and have read and agreed to the published version of the manuscript.

Funding: The study was conducted without any financial support from external sources.

Availability of data and Materials: All data are available from the authors.

Conflicts of Interest: The authors declare no conflict of interest.

Additional Information: No Additional Information from the authors.

References

1. Ramadhan, F., Mooduto, H. A., & Nova, F. (2021). Sistem Monitoring Suhu Dan Jumlah Pengunjung Kafe Berbasis Cloud Computing. JITSI: Jurnal Ilmiah Teknologi Sistem Informasi, 2(4), 108-115.
2. Fahmawaty, M., Royhan, M., & Mahmudin, M. 2020. Perancangan Alat Penghitung Jumlah Pengunjung Di Perpustakaan Unis Tangerang Menggunakan Sensor Pir Berbasis IoT. Jurnal Ilmiah Fakultas Teknik, 2020 (3), 253-261
3. Roihan, A., Mardiansyah, A., Pratama, A., & Pangestu, A. A. 2021. Simulasi Pendeteksi Kelembaban Pada Tanah Menggunakan Sensor Dht22 Dengan Proteus. METHODIKA: Jurnal Teknik Informatika dan Sistem Informasi, 2021 (1), 25-30
4. Sintaro, S. 2024. Pemberian Pakan Ayam Otomatis dengan esp32 dan penimbangan digital Otomatis. Jurnal Teknologi dan Sistem Tertanam, 2024 (1), 40-46.
5. Rahmanto, Y., Burlian, A., & Samsugi, S. 2021. Sistem Kendali Otomatis Pada Akuaponik Berbasis Mikrokontroler Arduino Uno R3. Jurnal Teknologi Dan Sistem Tertanam. Universitas Teknokrat Indonesia, 2021 (1), 1-6
6. Taufik, A. P. 2022. Sejarah dan Pemanfaatan IoT di era Industri 4.0. Jurnal Portal Data, 2022 (4), 1-8
7. Rohman, A. A. N., Hidayat, R., & Ramadhan, F. R. 2021. Pemrograman Mesin Smart Bartender Menggunakan Software Arduino IDE Berbasis Microcontroller ATmega2560. Seminar Nasional Teknik Elektro. Politeknik Negeri Jakarta, 2021 (1), 14-21
8. Rostini, A. N., & Junfithrana, A. P. 2020. Aplikasi smart home node mcu iot untuk blynk. Jurnal Rekayasa Teknologi Nusa Putra, 2020 (1), 1-7.
9. G. Yedukondalu, N. Rajesh, B. K. Kumar, G. S. Gowd, R. Suguna and K. G. Gupta, "Inbuilt Framework Using IoT and Computer Vision Technique for Automatic Visitor Management," 2023 7th International Conference on Electronics, Communication and Aerospace Technology (ICECA), Coimbatore, India, 2023, pp. 1394-1397, doi: 10.1109/ICECA58529.2023.10395247

10. M. Kumar Mondal, R. Mandal, S. Banerjee, P. Chatterjee, W. Mansoor and U. Biswas, "Fog assisted Visitor Identification Framework with improved Latency and Network Usage," 2023 Advances in Science and Engineering Technology International Conferences (ASET), Dubai, United Arab Emirates, 2023, pp. 01-05, doi: 10.1109/ASET56582.2023.10180736.
11. B. Siswanto and M. H. Widianto, "Smart Occupancy Rate for Library Visitors using Integrated Closed Circuit Television," 2023 International Workshop on Artificial Intelligence and Image Processing (IWAIIP), Yogyakarta, Indonesia, 2023, pp. 209-212, doi: 10.1109/IWAIIP58158.2023.10462763.
12. V. Serasidis, I. Sofianidis, G. Margaritis, C. Sad, V. Konstantakos and K. Siozios, "ICE: A Low-Cost IoT Platform Targeting Real-Time Anonymous Visitors Flow Tracking at Museums," 2023 IEEE 32nd International Symposium on Industrial Electronics (ISIE), Helsinki, Finland, 2023, pp. 1-6, doi: 10.1109/ISIE51358.2023.10228181.
13. H. -R. Lee, C. -H. Lin and W. -J. Kim, "Development of an IoT-based visitor detection system," 2016 International SoC Design Conference (ISOCC), Jeju, Korea (South), 2016, pp. 281-282, doi: 10.1109/ISOCC.2016.7799787.
14. A. O. Adeyemi-Ejeye, M. Mehdi, M. G. Martini, N. Phillip, and J. Orwell, "Design of a hybrid multi-occupant visitor communication and door control system," 2017 IEEE 7th International Conference on Consumer Electronics - Berlin (ICCE-Berlin), Berlin, Germany, 2017, pp. 246-247, doi: 10.1109/ICCE-Berlin.2017.8210639.
15. V. S, M. Jagadeeswari, R. R, M. Balasenduran, A. U. S and T. Akileshwaran, "IoT Based Automatic Temperature Detection and Visitor Recognition System," 2023 4th International Conference on Smart Electronics and Communication (ICOSEC), Trichy, India, 2023, pp. 392-397, doi: 10.1109/ICOSEC58147.2023.10276022.
16. J. -H. Choi, J. -H. Im, H. -J. Song and K. -H. Kim, "Home IoT Authority Control Method Based on DID Auth," 2023 Fourteenth International Conference on Ubiquitous and Future Networks (ICUFN), Paris, France, 2023, pp. 94-99, doi: 10.1109/ICUFN57995.2023.10200331.
17. D. B. Mariappan, A. Parihar and M. Kumar, "Arduino based IoT Smart Parking System," 2021 3rd International Conference on Advances in Computing, Communication Control and Networking (ICAC3N), Greater Noida, India, 2021, pp. 651-656, doi: 10.1109/ICAC3N53548.2021.9725371.
18. V. A. Bijlani, "Sustainable Digital Transformation of Heritage Tourism," 2021 IoT Vertical and Topical Summit for Tourism, Cagliari, Italy, 2021, pp. 1-5, doi: 10.1109/IEEECONF49204.2021.9604839.
19. R. Salama et al., "Authentication using Biometric Data from Mobile Cloud Computing in Smart Cities," 2023 3rd International Conference on Advancement in Electronics & Communication Engineering (AECE), GHAZIABAD, India, 2023, pp. 445-448, doi: 10.1109/AECE59614.2023.10428426.
20. S. Takahashi, Y. Nishidate, Y. Kohira, and R. Yoshioka, "Visualizing Maps of Visitors' Interest for Museum Exhibits with Single-Board Computers," 2023 27th International Conference Information Visualisation (IV), Tampere, Finland, 2023, pp. 64-70, doi: 10.1109/IV60283.2023.00021.