Indonesian Journal of Electrical and Electronics Engineering (INAJEEE), Vol 7, No 1, *2024, page* 6-11

Design and Build an IoT Based Reading Room Visitor Monitoring System for the Department of Electrical Engineering

Gita Masito Napitu[1*] , Lilik Anifah [2]
Bachelor of Electrical Engineering, Faculty of Engineering, Surabaya State University
[1]gita.21093@mhs.unesa.ac.id
[2]Lilikanifah@unesa.ac.id

Abstract - The reading room is one of the places frequented by students. Students can use this room for various activities such as reading books, looking for materials, independent study, and other activities. The increasing number of visitors in the room can affect the availability of space which can cause inconvenience between visitors and limited facilities that can hamper the activities to be carried out. Therefore, regular monitoring of the room is needed so that the room can be used optimally. In this study, researchers proposed a reading room visitor monitoring system tool majoring in IoT-based electrical engineering. This tool utilizes a single microcontroller, namely NodeMCU Esp8266 with the features offered, namely monitoring the number of visitors entering and leaving the room, the total number of visitors who are in the room, and the status of room availability. This tool is also equipped with red and green indicator lights as an indicator of room availability and a buzzer as an alarm if the room condition is full. The monitoring results are displayed on the LCD and utilize the IoT platform, namely in the application that displays monitoring results via a smartphone that can be accessed regularly. The sensors used in this study include Ultrasonic sensors and PIR sensors. The purpose of this research is to produce IoT-based reading room visitor monitoring tools and test the performance of the tools. In this study, the visitor monitoring tool that was made worked well with an average error of 0.031.
Keywords: IoT, Monitoring Visitors, Applications

PENDAHULUAN

Technology is the application of science in providing the necessary equipment to support human survival. The development of technology which is increasingly advanced in modern times today in various aspects, has an impact on the work done by humans. More and more innovations - innovations are being developed to make it easier for humans to complete various jobs. One form of technological development is the development of devices in the field of monitoring that have been integrated with the Internet of Things (IoT). The use of IoT technology in terms of monitoring has been widely used to obtain monitoring results that can be accessed regularly via smartphones.

The reading room of the faculty of electrical engineering is one of the places frequented by students. Students use this room for various activities, such as reading books, looking for materials, independent study, and other activities. The increasing number of visitors in the reading room can result in limitations on the available room capacity and the availability of facilities in the reading room, it can interfere with comfort between reading room visitors, and create an atmosphere that is not conducive that can interfere with concentration when carrying out activities in the reading room.

Based on the description of this background, the researcher proposed a tool that can monitor the number of visitors to the reading room of the IoT-based electrical engineering department. This tool utilizes a single microcontroller in the form of NodeMCU Esp8266 and Internet of Things (IoT) technology with the use of the Blynk application which will help librarians monitor visitors in the reading room and send notifications on the Blynk application when the room is full. This tool uses an Ultrasonic sensor to detect the distance of objects passing through the door and a PIR sensor to detect the presence of humans.

Several studies on visitor monitoring systems have been carried out including research conducted by [1] making a tool to calculate the number of visitors in the Adhelina store using the Atmega 16 Microcontroller. Research conducted by [2] which raised the title Design of a visitor count device at the Unis Tangerang library discussed the design of a visitor count tool at the Unis Tangerang library. Research conducted by [3] which raised the title of developing a tool to calculate the number of visitors to the Eremerasa bathing tour discussed the design of a tool for monitoring the number of visitors to the Eremerasa bathing tour. Research conducted by [4] entitled Design of a prototype monitoring system for school library visitors using RFID discusses the design of tools for school library visitors. Research conducted by [5] entitled "Internet of Things based automatic visitor counter" discusses the design of tools for monitoring the number of visitors on Mount Lampu Tapaktuan. Research conducted by [6] entitled Development of a Reading Room Counting System for the Electrical Engineering Department discusses the implementation of microcontroller technology to monitor reading room visitors.

Some previous studies have differences from this research including research conducted by [1] using the Atmega16 microcontroller and has not adopted IoT. The research conducted by [2] used a Wemos D1 microcontroller and PIR sensor and monitoring system using the thinkspeak website. Research conducted by [3] using Arduino microcontrollers and monitoring systems did not adopt IoT. Research conducted by [4] uses RFID in reading data with monitoring using websites, tools also do not use indicator and alarm light features. Research conducted by [5] the monitoring system uses the thinkspeak website and does not use the alarm feature. Research conducted by [6] using two microcontrollers namely Arduino and NodeMCU as well as monitoring using LCD and ubidots software.

The features offered by this tool are a monitoring system for the number of visitors entering and leaving the room, the total number of visitors who are in the room, and the status of room availability. This tool is also equipped with Red and green indicators as indicators of room availability and buzzers as alarms when the room is full. This research contribution is expected to help in monitoring visitors to the reading room of the electrical engineering department and can be one of the references that can be used in the development of visitor monitoring systems in future research.

METHOD

Research Flow

In this study, it is divided into 6 stages, the first is identifying problems through the results of observation, the second stage is looking for information about the research to be carried out such as the characteristics of the equipment to be used, the third stage is designing tools, the fourth stage is testing tools, the fifth stage is analyzing test results and the final stage is drawing conclusions. The Research Flow will be presented in Figure 1.

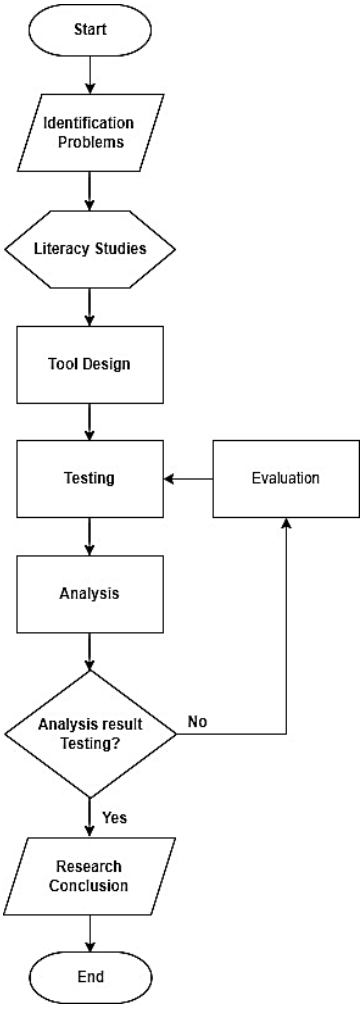


Figure 1. Research flowchart

Technical Drafting Design

Technical drafting design is a description of the design details of the components used by wiring or wiring. The tools and materials used in this study are shown in Table 1.

Table 1. Tools and Materials

No	Tools and Materials	Specifications
1	Laptop	Intel Core i3-6006U
2	Measuring instruments	Measure Tape 5M
3	Microcontroller	NodeMcu Esp8266
4	PIR Sensor	HC-SR501
5	Ultrasonic Sensor	HC-SR04
6	Buzzer	Passive Buzzer
7	Resistor	1 kΩ
8	LED	3mm
9	LCD	16x2 *with* I2C *Module*
10	Powerbank	20000mAh
11	Multimeter	DT9205A

The technical design is shown in Figure 2.

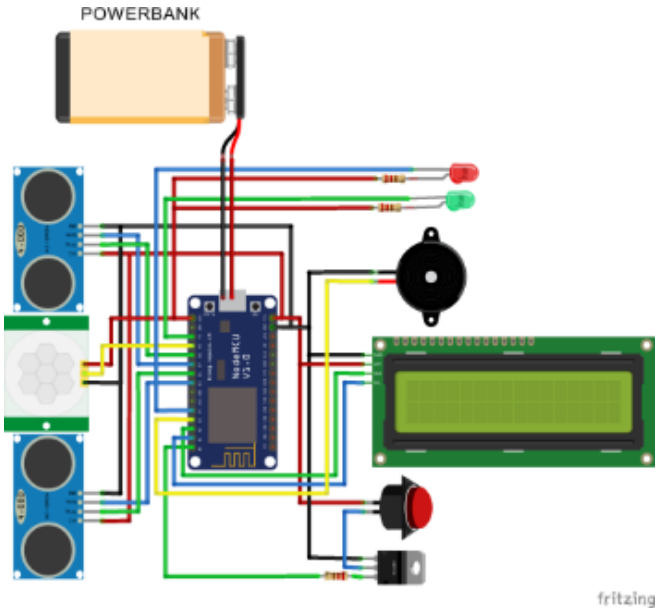


Figure 2. The technical design

Software Planning

Software design begins with making a system flow diagram, which aims to help researchers in program creation. The flowchart is shown in Figure 3.

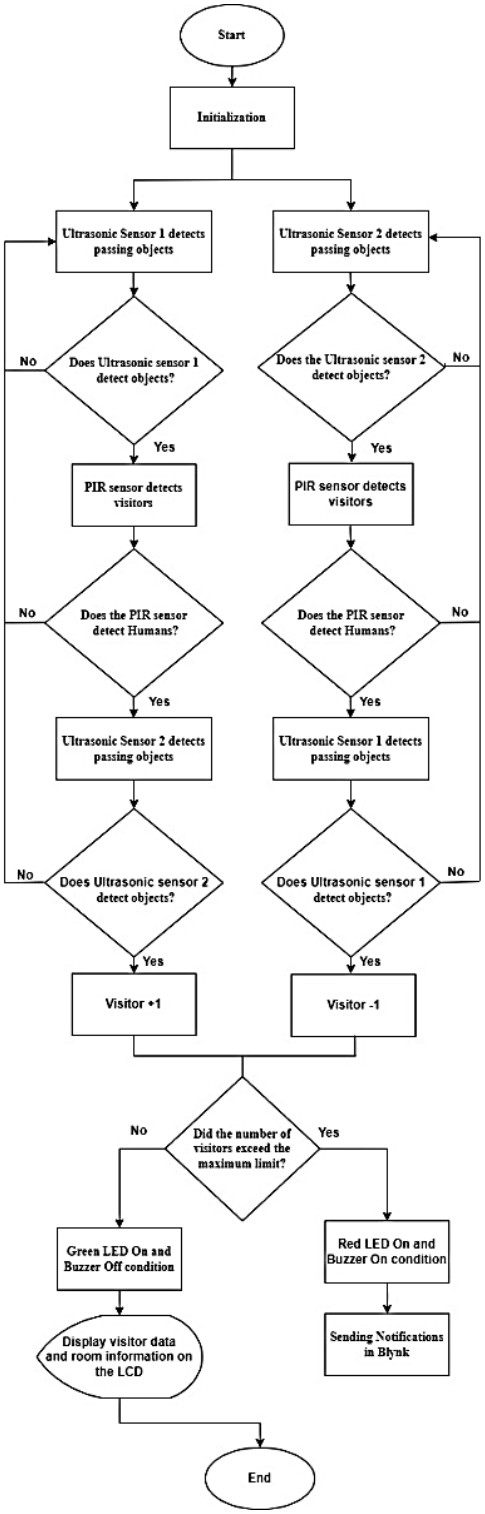


Figure 3. Flowchart

Block Diagram

The block diagram is a diagram that aims to illustrate the workflow and processes of a system. The block diagram in this study is shown in Figure 4.

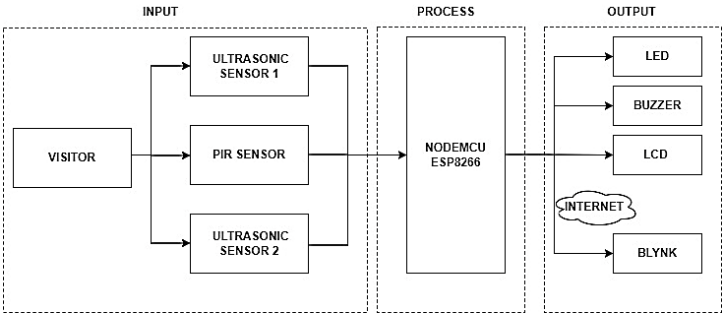


Figure 4. Block diagram

RESULTS AND DISCUSSION

Hardware Implementation

Hardware implementation is the result of the realization of hardware that has been designed, the circuit is placed in 3 panel boxes and placed on a pole tray. Box panel 1 consists of ultrasonic sensor 1 connected to a microcontroller located in box panel 2, consisting of a PIR sensor and ultrasonic sensor 2. Box panel 3 consists of an LCD, buzzer, indicator light, and buzzer. The results of hardware implementation are presented in Figure 5.

Figure 5. Hardware Implementation

Software implementation

Software implementation is the result of the appearance of the blynk application that has been created. The application can display the number of visitors who enter, the number of visitors who leave, the total number of visitors in the room, the status of the room, and send notifications if the condition of the room is full. The results of the realization of the blynk display are presented in Figure 6.

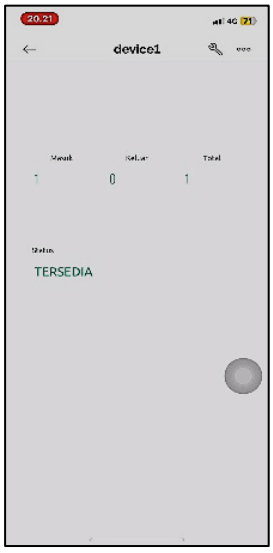
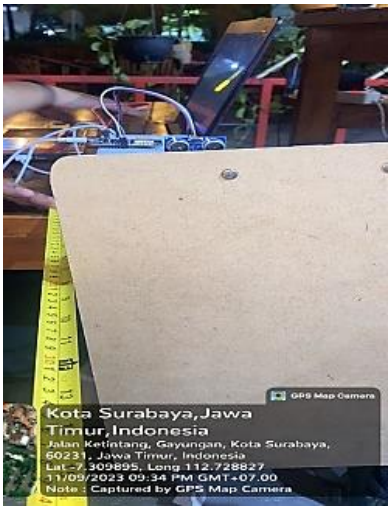


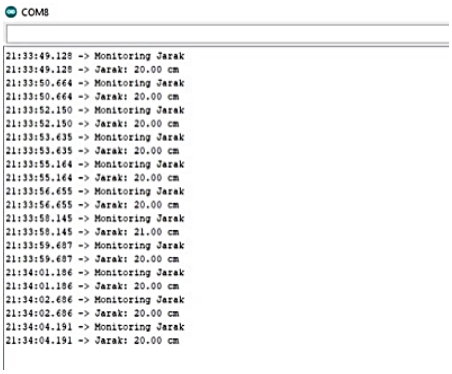
Figure 6. Application view

Ultrasonic sensor testing

This test is performed to prove the accuracy of the distance measured by the ultrasonic sensor to the actual distance. The results obtained are presented in Table 2 and Table 3.



(a)



(b)

Figure 7. Ultrasonic Sensor Testing (a) actual distance, (b) object distance on serial monitor

Table 2. Ultrasonic sensor 1 test results

esting To -	Actual Distance (cm)	ensor Distance (cm)	rror (%)
1	20	20	0
3	40	39	2,5
3	60	60	0
4	80	80	0
5	100	100	0
6	120	120	0
7	140	139	2,5
8	160	160	0
Average error			.625

Table 3. Ultrasonic sensor 2 test results

sting To -	Actual Distance (cm)	ensor Distance (cm)	rror (%)
1	20	21	2,5
3	40	40	0
3	60	60	0
4	80	80	0
5	100	100	0
6	120	120	0
7	140	140	0
8	160	160	0
Average error			.312

Table 2 and Table 3 present the results of testing Ultrasonic sensor 1 and Ultrasonic sensor 2, by comparing the distance measured by the sensor with the actual distance. The average percentage of error obtained on ultrasonic sensor 1 is 0.625 and the average error on ultrasonic sensor 2 is 0.312.

PIR sensor testing

This test is carried out to prove the accuracy of the PIR sensor in detecting objects passing through the reading room door. This test is carried out by comparing objects that pass through the PIR sensor, namely humans and objects. Table 4 displays the test results of PIR sensors.

Figure 8. PIR sensor testing

Table 4. PIR sensor Test Results

Room conditions	Display on LCD
Human	Human
Book	Not Human

Based on Table 4 of the test results of the PIR sensor, it can be seen that the PIR sensor can distinguish humans and objects passing through it.

Monitoring testing has integrated IoT

IoT-integrated monitoring testing is carried out by testing the performance of the Blynk application which is used to display visitor monitoring results when the system is running and send notifications when the room is full. The results of integrated IoT monitoring testing are presented in Table 5.

Table 5. Test results of indicator lights and buzzers

In	Out	Total	Display on the application and on the application
1	0	1	Successfully displayed
1	0	2	Successfully displayed
1	0	3	Successfully displayed
1	0	4	Successfully displayed
1	0	5	Successfully displayed
5	1	4	Successfully displayed
0	1	3	Successfully displayed
0	1	2	Successfully displayed
0	1	1	Successfully displayed
0	1	0	Successfully displayed
	0	3	Successfully displayed
0	2	1	Successfully displayed
2	0	3	Successfully displayed
0	1	2	Successfully displayed
1	0	3	Successfully displayed
0	2	1	Successfully displayed

Based on Table 5, the Blynk application successfully displayed the results of monitoring visitors who passed through the door during the test with an error percentage of 0. The next test is testing the performance of notifications on the Blynk application, this test is carried out when the room conditions are full, and the Blynk application will send notifications to the user. The full room notification view is presented in Figure 9.

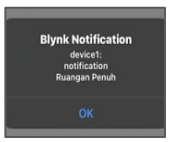


Figure 9. Notification results

In Figure 9, it can be seen that the application successfully sends a room notification to the user when the room is full. Indicators of achievement of Blynk applications are presented in Table 6.

Table 6. Blynk application achievement indicators

No	Testing activity	Indicators of Achievement	Testing Results	Conclusion
1	Testing the device connected to the application and displaying visitor monitoring results and sending full room notifications.	The tool can monitor visitors and display the status of the room and send full room notifications	The tool successfully displays the number of visitors entering and leaving the room, the total number of visitors in the room, and the status of the room, and sends a full room notification .	☑ appropriate ☐inappropriate

Overall testing of the tool (Offline)

Overall tool testing aims to ensure that the tool that has been designed works properly according to the design. In testing the tool as a whole, it will be tested whether the results of visitor monitoring displayed on the LCD match the actual data. The overall tool test results on the LCD are shown in Table 7 and the overall tool test results on LEDs and buzzers are presented in Table 8.

Table 7. The result of the overall testing of the tool

Visitor	In	Out	Total	Persentase error (%)
In (1)	Detected (1)	0	1	0
In (1)	Detected (1)	0	2	0
In (1)	Detected (1)	0	3	0
In (1)	Detected (1)	0	4	0
In (1)	Detected (1)	0	5	0
Out (1)	5	Detected (1)	4	0
Out (1)	0	Detected (1)	3	0
Out (1)	0	Detected (1)	2	0
Out (1)	0	Detected (1)	1	0
Out (1)	0	Detected (1)	0	0
In (3)	Detected (3)	0	3	0
Out (2)	0	Detected (2)	1	0
In (2)	Not Detected (1)	0	3	0.5
Out (1)	0	Detected (1)	2	0
In (1)	Detected (1)	0	3	0
Out (2)	0	Detected (2)	1	0
Average error				0.031

Table 8. The overall tool test results on LEDs and buzzers

In	Out	Total	Red LED	Green LED	Buzzer
1	0	1	Off	On	Off
1	0	2	Off	On	Off
1	0	3	Off	On	Off
1	0	4	Off	On	Off
1	0	5	On	Off	On
5	1	4	Off	On	Off
0	1	3	Off	On	Off
0	1	2	Off	On	Off
0	1	1	Off	On	Off
0	1	0	Off	On	Off
3	0	3	Off	On	Off
0	2	1	Off	On	Off
2	0	3	Off	On	Off
0	1	2	Off	On	Off
1	0	3	Off	On	Off
0	2	1	Off	On	Off

Based on Table 7 of the overall tool test results with monitoring results displayed on the LCD it can be seen that the tool can work properly, the tool can display data on the LCD by the monitoring results. Ultrasonic sensor 1, ultrasonic sensor 2, and PIR sensor can detect objects passing through the door with an average error of 0.031.

In Table 8 which displays the overall tool test results on LED and buzzer indicators, the red and green indicator lights used also work well in displaying room availability indicators. The buzzer connected to the device as an alarm when the room is full also functions properly during the device test.

In this overall tool trial, the tool has been set with a maximum number of visitors, which is 5 people, so that when visitors are less than 5 people, the green indicator light will light up as an indicator of the room available, and the buzzer is not lit, but if visitors Having reached 5 people, the red-light indicator and the buzzer will light up as a marker of the condition of the full room. Figure 10 presents the view LED indicator light when room conditions are available and full.

(a) (b)

Figure 10. LCD Indicator Testing (a) Room conditions are available (b) Full room conditions

In Figure 10, the success rate of the indicator light that lights up according to the working function of the tool. When the room condition is available, the green indicator light is on, while in full room conditions, the red indicator light will light up. As for the conclusion, the overall testing of the tool was successful.

CONCLUSION

The research design of the IoT based reading room visitor system, has succeeded in making a reading room visitor monitoring system tool with system performance that can monitor the number of visitors entering the room, leaving the room, and the total number of visitors in the room equipped with LED indicators used as room status markers and Buzzers as warning alarms when the room conditions are full and the performance of the tools in this study are can display visitor information based on monitoring results displayed through the LCD and Blynk application and provide warnings by notifications to users when the room is full in the Blynk application with an average error of 0.031.

The advice given for further development is that the tool can be modified to have a database and the design of the box on the tool can be made even simpler with a better layout so that it does not interfere with cable wiring and is safer.

REFERENCES

[1] D. Intan Surya Saputra, "Rancang Bangun Alat Penghitung Jumlah Pengunjung di Toko Adhelina Berbasis Mikrokontroler Atmega 16," *J. Sisfokom (Sistem Inf. dan Komputer)*, vol. 4, no. 1, pp. 16–21, 2015.

[2] M. Fahmawaty and M. Royhan, "Perancangan Alat Penghitung Jumlah Pengunjung Di Perpustakaan Unis Tangerang Menggunakan Sensor Pir Berbasis IoT," *JIMTEK J. Ilm. Fak. Tek.*, vol. 1, no. 3, p. 253, 2020.

[3] S. Jupri, D. Hendryadi, N. Syam, S. Komputer, and S. Bina Adinata, "Pengembangan Alat Penghitung Jumlah Pengunjung Wisata Permandian Eremesa Berbasis Arduino," *Jtriste*, vol. 8, no. 2, pp. 23–31, 2021.

[4] Sofyan, Muh Imam Quraisy, Mardewi, and Siti Nur Asia, "Design of a Prototype Monitoring System for School Library Visitors Using Rfid and Nodemcu Based on the Internet of Things," *Int. J. Soc. Sci.*, vol. 1, no. 4, pp. 333–340, 2021, doi: 10.53625/ijss.v1i4.711.

[5] D. Afriani, D. N. Ilham, K. Khairuman, M. S. Talib, and M. K. Harahap, "Internet of Things Based Automatic Visitor Counter," *Int. J. Multidiscip. Sci. Arts*, vol. 1, no. 1, pp. 35–40, 2022, doi: 10.47709/ijmdsa.v1i1.1615.

[6] A. Murdhiani, "Pengembangan Sistem Penghitung Pengunjung Ruang Baca Departemen Teknik Elektro Menggunakan Teknologi Mikrokontroler," vol. 4, no. 2, pp. 609–618, 2023.