Internet-Based Smart Door Design of Things (IOT) with Visitor Access Controller Indoor

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Abstract

In the era of digital technology, the Internet of Things (IoT) has become an innovative solution in various sectors, including in access management and room security. This research aims to design and implement an IoT-based smart door system that is able to control visitor access using NodeMCU ESP8266 and send notifications through the Telegram application. The system uses PIR sensors to detect the presence of visitors and servo motors to operate the door automatically. When the number of visitors reaches the maximum set capacity, the system will automatically close the door and send a warning notification to the Telegram bot and activate the buzzer as a warning sign. Thus, this system not only improves the safety and comfort of visitors, but also helps prevent the spread of diseases by limiting the number of visitors according to a safe capacity. The test results show that this smart door system can function well in controlling visitor access and providing real-time notifications when the room capacity is exceeded. The implementation of this system is expected to be applied in various public places to improve security management and visitor capacity effectively.

Keywords: *Visitor Capacity, Smart Door, IoT, Telegram, NodeMCU Esp8266*

1. Introduction

The rapid development of technology, especially with the modernization of society, encourages humans to continue to create innovation. One of the innovations that is increasingly being used is the Internet of Things (IoT). In today's era of digital technology, electronic devices connected to the Internet of Things (IoT) are a top priority in various fields. IoT integration in the home includes visitor access controllers as well as the arrangement of electronic devices such as lights, TVs, fans, air conditioners, and door security systems. In this context, such home devices can be connected via NodeMCU ESP8266, which is necessary for connectivity with the internet network.

Home security is a key aspect that continues to receive increasing attention, especially with the rapid growth of technology and the complexity of security challenges. In particular, the management of door access in the room has a very critical role in maintaining the security of a property. The increasing crime rate and security threats make it important to have a smart and connected security solution online. In some places, the maximum capacity of the room has been set to maintain the safety and comfort of visitors. Excess visitors to a room not only creates discomfort and an unpleasant experience, but can also increase health risks, especially related to the potential spread of diseases due to crowds. Thus, the design of smart doors with telegram notifications not only meets the need for innovative technology, but also provides a practical solution to improve room security, with visitor restrictions as an effective measure in reducing risks and ensuring a positive experience for every visitor who comes.

2. Review the Library

2.1. Planning

Planning is a visual form that results from creative forms that have been planned. The first step in designing a design starts from irregular things in the form of ideas or ideas, then through the process of cultivation and management, it will produce orderly things, so that things that are already organized can fulfill their functions and uses properly. Design is the drawing, planning, and sketching of several separate elements into a whole and functional whole.

2.2. Internet of Things (IOT)

The Internet of Things (IoT) is a concept where an inanimate object has the ability to receive and transmit data over a network connection. One example of IoT is human interaction with a device, where the device is used to control an environment or monitor the condition of an

environment. In addition to needing devices such as sensors and actuators, to implement the IoT concept, the participation of other technologies, such as computer technology and network technology, is needed to achieve the desired goals.

2.3. Internet Network

The Internet or Internetworking is generally defined as the largest computer network in the world that connects all existing computer networks (Intranet, Wide Area Network, Metropolitan Area Network, Personal Area Network, etc.). Along with all computers, connected devices (smartphones, tablets, computers, switches, routers, hubs, and other connecting devices), as well as the computer users themselves, into a world computer network container.

The rapid development of technology has an impact on the increase in the number of network protocols, especially network protocols for client communication with a device. The emergence of these various types of protocols poses one problem, which is to make system development complicated. To overcome these problems, a simple network protocol is needed that is often used by most people. Hyper Text Transfer Protocol (HTTP) is one of the most widely used protocols in the internet, with HTTP working on the TCP layer making HTTP a protocol capable of sending news, video, and serving many web applications.

2.4. NodeMCU ESP8266

The term NodeMCU refers more to the firmware used than the hardware development kit. NodeMCU can be analogized to the Arduino board ESP8266. NodeMCU has integrated ESP8266 into a compact board with various functions similar to a microcontroller, as well as added access to WiFi and USB to Serial communication chips. To perform programming, only a USB micro data cable is required. In general, there are three NodeMCU manufacturers whose products are available on the market, namely Amica, DOIT, and Lolin/WeMos, with several board variants produced such as V1, V2, and V3.

2.5. Motor Servo

Servo motors are electrical devices used in intelligent modern machines, which are capable of pushing or rotating objects with high-precision control in terms of position, speed, and acceleration. This capability is not possessed by conventional machines. If there is a need to rotate and direct objects at a certain point or distance, the use of servo motors is very necessary. This is possible thanks to the combination of a regular motor with additional sensors, such as an encoder, for position feedback. The servo motor regulator, otherwise known as the servo drive, is the most important and advanced component of the servo motor, as it is designed to achieve a very high level of accuracy. In modern machines, when precision or precision is the most important aspect, the selection of servo motors is the main thing. The level of precision or accuracy of the placement of the servo motor is the main distinguishing feature. In the production process of machines, such as in CNC machines, the use of more than one servo motor unit on a single machine is often necessary, so it takes a PLC, such as the Modicon M262, to simultaneously give commands to each servo motor. The communication protocol used must be open to allow cooperation between PLCs and servo motors from various vendors. Servo motors are electrical devices that operate on the principle of closed loops.

2.6. Sensor PIR

The Passive Infrared Sensor (PIR) is a sensor used to detect the presence of infrared light emissions from an object. Passive Infrared Reciter (PIR) is an infrared-based sensor, but PIR sensors are different from IR LEDs and phototransistors. PIR sensors can work to react on the human body, because PIR sensors use IR filters on which are useful as passive infrared light wavelength filters . IR Filter PIR sensors can filter passive infrared light wavelengths with a distance of between 8 and 14 micrometers, only waves in humans can be accepted, because humans have waves between 9 and 10 micrometers.

2.7. Buzzer

A buzzer is an electronic component that functions to convert electrical signals into sound vibrations. Buzzers are used as notifiers or notifications in the form of sounds if there are conditions that occur according to what has been programmed.

2.8. LCD

LCD 16×2 (Liquid Crystal Display) is a data viewing module that uses liquid crystals to display data in the form of writing, images, symbols, and graphs. The 16 x 2 LCD has a small size so it is very suitable for pairing with a microcontroller. The LCD is available in the form of a module that has a data pin, power supply control, and contrast control. The 16x2 LCD display can be seen in figure II.4. With the I2C module, the 16x2 LCD only needs two pins to transmit data and two pins to the voltage supplier. So it only requires four pins that need to be connected to the NodeMCU, namely:
   a)   GND: Connected to ground
   b)   VCC: Connected with 5V
   c)   SDA: As I2C data and connected to pin D2
   d)   SCL: As I2C data and connected to pin D1

The I2C module is a two-way serial interaction standard using two specially designed channels for transmitting and retrieving data. I2C systems include SCL (Serial Clock) and SDA (Serial Data) lines which are responsible for transmitting data information between I2C and its controller. Devices connected to the I2C bus can be operated as Master and Slave.

2.9. LED

LED (Light Emitting Diode) lamps, a part of electronics that can emit a shimmering light, commonly called monochromatic, have an advanced voltage. This part of the device includes the connection with other diodes, although they have various shapes, but they use a semiconductor material. In the long run, LED parts have different types ranging from shape, variety, to function and work. LED lights are widely used in daily life, for example in public appliances at home, it can be from flashlights, bicycle lights, cellphone spotlights, or others. LED (Light Emitting Diode) is an electronic part that converts electrical energy into light energy.

2.10. Breadboard

Breadboard is a board used to place and arrange electronic devices/components into electronic circuits without soldering. The connection between one device/component and another electronic component on the breadboard is carried out through wires/cables. This circuit board is made of plastic and inside there are connectors that can clamp the legs of the device/component as well as the ends of the cable.

The holes in the breadboard function to clamp the legs of the components/devices and cables/wires to be assembled. Connectors are indicated by a line that connects the clamps to each other. On the left and right sides, respectively, there are two connector lines that serve as the positive (+) and negative (-) terminals of the power supply. Meanwhile, the connectors on the paths marked a-b-c-d-e and f-g-h-i-j are disconnected separated by a space used to place IC devices (integrated circuits) or components with dual-in-line package (DIP) packaging. Because the arrangement of the circuit using breadboard is carried out without soldering and the connection between components/devices is carried out through cables, it is necessary to provide qualified cables.

2.11. Kabel Jumper

A jumper cable is a cable that contains an electrical he has a pin that is connected to each wire, this jumper cable is used to connect the two components simultaneously which are connected to the Arduino tool without the need for an ordering tool. The main point of this jumper cable is to connect an electrical component in an electrical circuit. Then jumper cables are also commonly used on a breadboard or other test equipment, making it easier for beginners to learn and hone skills from an electronic assembly

2.12. Telegram

Telegram Messenger is a tool that is used to communicate with each other, exchange messages and can be used to send images, voice messages, document files. The Telegram Messenger app can also be connected to an Arduino, with a bot system available to act as a controller or command.
Bots are automated software applications that are able to execute various commands over the internet. Telegram is one of the applications that supports this bot. This bot feature began to be launched in 2015. Bot itself has the meaning of robots. Telegram provides Telegram Bot API to build telegram bot applications for developers. For data security, the developers don't need to know how MTProto encryption on the telegram server works because the intermediary server on telegram will handle all the encryption and communication with the Bot API. By using this bot, it makes it easier for us to create a special chat messaging application. In its use, Telegram Bot no longer requires an additional phone number as a special condition. This is because this feature is able to run on all platforms that have Telegram support.

3. Analysis and Planning

3.1. System Design

In the design entitled "Designing Smart Doors Based on the Internet of Things (IOT) with Indoor Visitor Access Controllers" which is made there are several problems that must be solved, including:
1. How to design a smart door with visitor access control using the Internet of Things?
   The problem in the design of smart doors based on the internet of things with visitor access controllers in the room is how to design a smart door with visitor access control using the Internet of Things.
2. How to implement smart door technology that can automatically close when visitors have met their capacity using the NodeMCU Microcontroller ESP8266?
   The problem in the design of smart doors based on the internet of things with visitor access controllers in the room is how to apply smart door technology that can be closed automatically when visitors have met their capacity using the NodeMCU Microcontroller ESP8266.
3. How do you implement a buzzer to output sound when visitors meet their capacity?
   Problems in the design of smart doors based on the internet of things with visitor access controllers in the room
   How to implement a buzzer to output sound when visitors meet their capacity.

3.2. Network Block Diagram

As for the block diagram of the designed system, as shown in the figure:
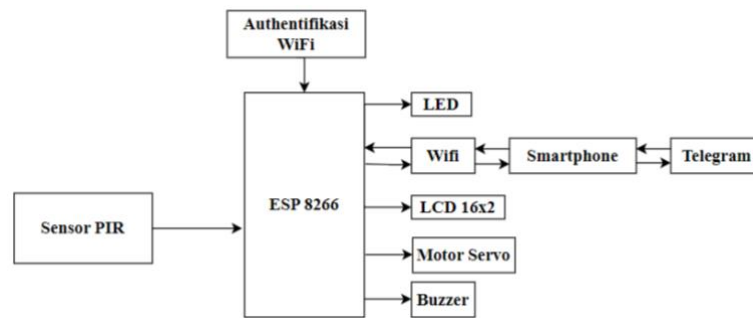
Fig. 1: System Block Diagram

The main components used in this system include PIR Sensors, Servo Motors, LCD, Buzzer, and LEDs. The PIR sensor serves as a detector for visitors entering the room, while the Servo Motor is used to move the door automatically. The buzzer is used as an indicator when there is an excess of visitors in the room, then the data will be displayed on the LCD that has been equipped with I2C.

3.3. Entire Range of Tools

This series functions to run the tool system so that the tool can work according to the program specifications that are entered.
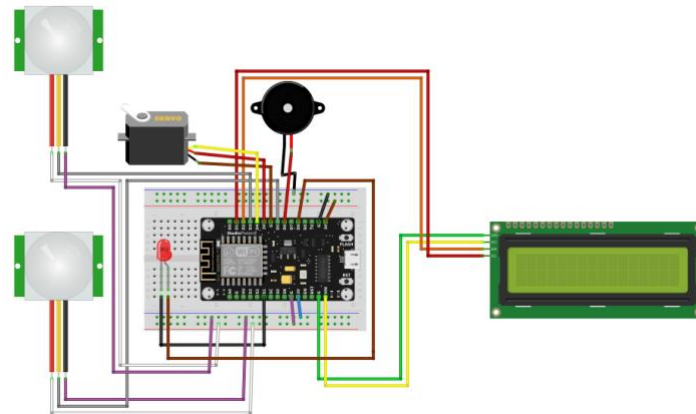

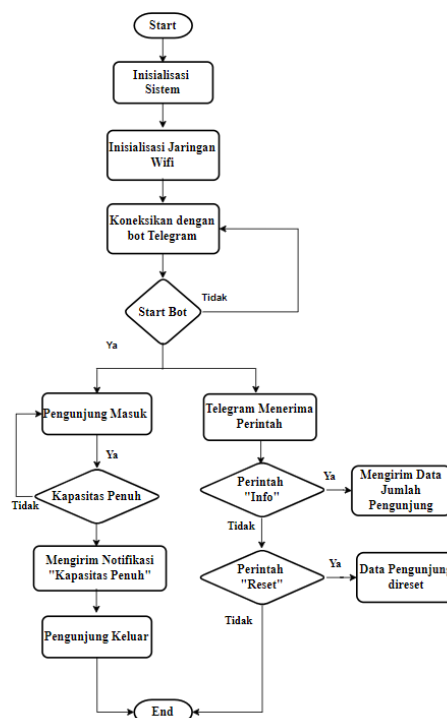**Fig. 2:** Overall Network

3.4. System Flowchart

Fig. 3: Flowchart of Door Planning System with Access Controller

Information:

From the flowchart above, it can be explained that the process starts by running the program and connecting the system to the internet. Once the internet connection is established, the system will connect it with the Telegram bot. The bot is then activated; If the bot cannot be run, the connection will be rechecked.

Once the bot is successfully executed, when a visitor enters the room, the system automatically monitors the number of visitors entering. If the number of visitors meets the predetermined capacity, the system will send a "full capacity" notification. If the capacity has not been met, the system will again monitor incoming visitors.

Furthermore, if the system receives the "info" command through Telegram, it will send data on the current number of visitors. In addition, if the system receives a "reset" command, it will reset the number of visitors to zero and send a "counter reset" message. This process ends after all of the above steps are executed successfully.

4. Discussion and Implementation

4.1. Discussion

In this chapter, the results of the test of the design of the tool made will be explained along with the discussion. The test results in a tool that is designed and programmed using an Arduino application. The tool will be used to improve room safety by providing controlled access, instant notifications via Telegram, and limiting the number of visitors to a safe capacity to reduce the risk of accidents or emergencies due to crowds.

4.2. Component Testing

Analysis To ensure that the NodeMCU Microcontroller circuit ESP8266 function properly on the device, tests are carried out by providing command programs to the Microcontroller. This testing process involves inputting data from a computer into a Microcontroller to verify the overall response and performance of the device.

To do the installation, first connect the computer with the downloader via a USB cable to the microcontroller circuit. Testing the tool using commands can be done through the following steps:
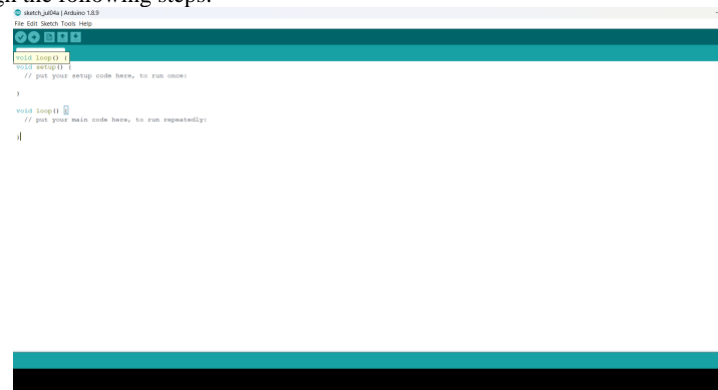
1. Arduino Software Display

To do the installation, first connect the computer with the downloader via a USB cable to the microcontroller circuit. Testing the tool using commands can be done through the following steps:

Fig. 4: Software display

2. Program Display

Next, to program the NodeMCU Microcontroller ESP8266, type in the program that suits the needs of the device.
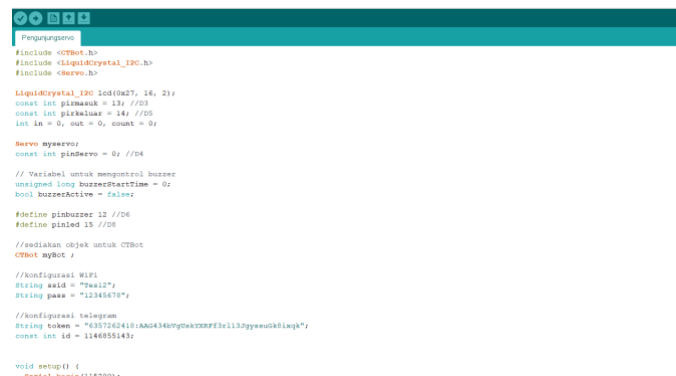

Fig. 5: Program display

3. File Storage Process

Before proceeding with the installation of the microcontroller, be sure to save the completed program before compiling.
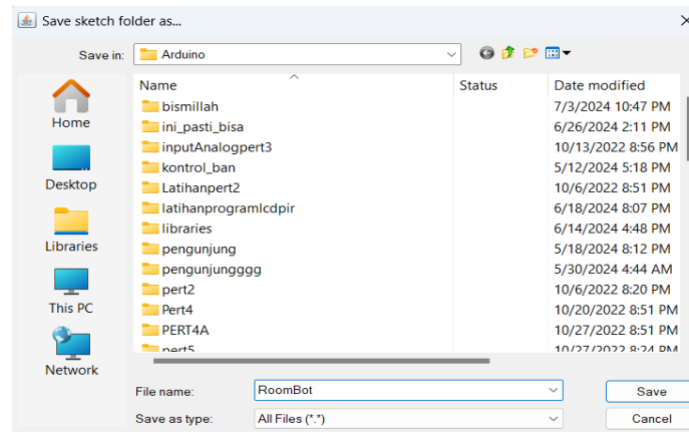

Fig. 6: Storage Proses

4. Compile Results

Before proceeding with the microcontroller installation, the program should be checked by clicking the "Compile" button to set the program into the Microcontroller Chip. This process checks whether the program is created contains errors or not, if it succeeds, a "Done Compiling" message will appear.
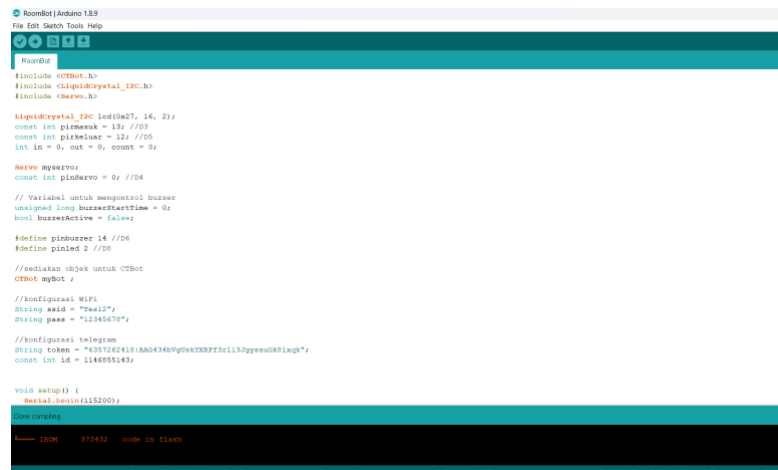

Fig. 7: Compile

5. Overall of Hardware

Fig. 8: Hardware

6. Tool Network System

Fig. 9: Network System

7. Test Results on The Door

The test results on the door can be seen in the image below, which shows that the LED will light up when the door is opened.

Fig. 10: Door Test result

8. Indoor Test Results

The test results in the room show that the LCD will display the number of visitors entering and exiting the room. 'M' indicates the number of visitors, 'K' indicates the number of exits, and 'T' indicates the total number of visitors, as seen in the image below.

Fig. 11: In Door Test result

Notifications will be received if the number of visitors in the room has exceeded capacity. The system also allows sending commands to find out information related to the number of visitors and reset it, as seen in the image below.

Fig. 12: Vzsitzz

5. Conclusion

In After completizg the design and manufacturing stage of the system, tze process continues with the testing and analysis stage. Based on the results of all these stages, conclusions can be drawn as follows:

1. The working principle of Wi-Fi in this tool system serves as the main communication medium that allows interaction between the device and the Android smartphone. By utilizing a Wi-Fi connection, the device can send and receive data wirelessly, allowing users to control and monitor the device through an app installed on their smartphone.
2. Android smartphones can be used as a medium to send and receive notifications and information in the form of notifications on the system of tools designed, using the Telegram application.
3. NodeMCUs ESP8266 serve as the main controller, receiving and processing data, and acting as a receiver for Wi-Fi signals. With its ability to connect with Android devices, NodeMCU ESP8266 enables efficient communication and control between the device system and applications on smartphones.
4. The design on the door cannot open automatically, because it is only dedicated to providing notifications when the door is opened. The test results show that this system works well in detecting and counting the number of visitors, displaying the number on the LCD, and sending notifications when the capacity is reached. However, there are obstacles in the PIR sensor that sometimes detects movement even though there is no real movement, causing visitor calculations to be unstable.

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