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MODEL OF AUTOMATIC FIRE FIGHTING SIMULATION AND SECURITY SYSTEM BASED ON INTERNET OF THINGS (IOT) AND CLOUD COMPUTING IN CISCO PACKET TRACER

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Abstract: Fires often become disasters that can cause significant losses, both material and human lives. Fires can occur anywhere, including buildings, homes, and industries. During a fire, the risk of death or serious injury is also very high for people trapped inside a room, due to limited access to exit from the room where the fire occurs. Security is one of the most important aspects of life; everyone needs greater safety assurance regarding their home. In this research, the author employs system development and simulation methods, which allow researchers to reproduce complex environments and test system performance under various conditions without building actual physical infrastructure. Researchers have an idea to create a model and simulation of an automatic fire extinguisher and a security system based on IoT and cloud computing using Cisco Packet Tracer. The use of Cisco Packet Tracer as a simulator allows for the creation of IoT-based network simulation models to analyze the results of the simulations on the developed system, ensuring that the simulation results are accurate. The automatic fire extinguisher and security system simulation model yields positive results. When a fire is detected, the sprinkler system, alarm, and LCD provide information indicating a fire, while exit access such as doors and windows yield good simulation results. Additionally, the simulations for security systems for entrance security and rooms containing valuable items produce favorable simulation outcomes.

Keywords : Model Simulation, Automatic Fire Extinguisher, Security System, Internet Of Things (Iot), Cloud Computing, Cisco Packet Tracer.

1. Introduction

The development of technology, especially based on IoT, needs to be applied in everyday life. This study aims to create a model and simulation of an automatic fire extinguishing system

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and a security system based on IoT and cloud computing using Cisco Packet Tracer. Cisco Packet Tracer facilitates the simulation of smart systems [1].

In this research, the modeling involved fire sensors connected to an IoT network, with a control system that activates automatic extinguishers and automatically opens doors and windows when a fire is detected. The security system employs RFID, motion detectors, and CCTV, enabling remote monitoring and control.

This study focuses on developing and simulating an IoT-based automatic fire extinguishing and security system using cloud computing in Cisco Packet Tracer. The use of Cisco Packet Tracer allows for effective system development, testing, and validation before real-world implementation, saving both time and cost. This study presents an efficient solution for fire protection and home security, enabling rapid emergency response as well as remote monitoring and control.

2. Literature Review

1.1 Model

Model is a very useful tool for analyzing and designing systems. A model is defined as a logical description of how a system works or how components interact with each other. By creating a system model, it is expected to facilitate analysis [2]. The system model that will be built in this study contains three main components, namely a fire extinguishing system, a security system and a cloud computing network topology.

1.2 Simulation

Simulation software is a technology that allows someone to design and analyze a training process that imitates something through simulation without having to do it in real life. Simulation software is often used in equipment design to achieve a product or end result that is close to the original design specifications without buying expensive equipment or fearing damage [1]. The advantages of simulation in addition to being able to create designs to make the best decisions, simulation can also reduce costs because it does not take long compared to making something directly. And the disadvantages of simulation lie in the process that is still not in accordance with actual conditions, therefore the best possible design is needed so that no mistakes occur.

2.3 Automatic Fire Extinguisher

In general, automatic fire extinguishers are systems that automatically detect fires using sensors connected to the Internet. When the sensor detects a fire, the system automatically activates fire extinguishing equipment such as sprinklers or other extinguishing systems to extinguish the fire without direct human intervention. In this study, the author will create a model of a fire extinguishing system that automatically activates sprinklers, sirens, opens doors and windows automatically when a fire is detected and the simulation process uses Cisco Packet Tracer.

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2.4 Security System

A security system is also a collection of devices, sensors, software, and related infrastructure designed to protect an area, property, or person from threats or harm. This can include technologies such as surveillance cameras, motion sensors, smart door locks, alarms, and access control, often connected to the internet to allow remote monitoring and control via smart devices or computer systems.

2.5 Internet Of Things (Iot)

The Internet of Things is a concept where an object or thing is embedded with technology such as sensors and software to communicate, control, connect and exchange information with other devices as long as it is connected to the Internet [3]. Internet of Things (IoT) is a technology that is currently being launched to automate communication by connecting various objects around us as part of the Internet. IoT devices are integrated with network technology for remote and local control [4]. Internet of Things (IoT) is a technology that integrates sensors and software into objects that allow them to communicate and exchange information over the Internet. The Internet of Things includes various electronic devices with different functions that are connected to automatic transmission and remote control.

2.6 Cloud Computing

Cloud computing is a transformation of client-based or server-based computer information and communication technology. Cloud services allow users to access software, storage, infrastructure, and technical capabilities over the Internet. Cloud computing technology offers benefits to consumers by eliminating the need for large investments in software and information applications and hardware maintenance. Three features that can be used by cloud computing [1]. The integration of IoT devices and cloud computing environments provides opportunities to enhance system utilization from both sides. On the other hand, IoT systems benefit from the use of storage and data processing resources provided by cloud entities. In addition, the characteristics of cloud computing are more stable than IoT devices of IoT systems, so they can guarantee the availability of IoT sensor data collected [5].

2.7 Cisco Packet Tracer

Cisco Packet Tracer is a software that allows us to create an experiment with network behavior. The devices contained in the packet tracer are exactly the same as those in the real world, starting from routers, hubs, switches, PCs, and also other smart home devices. Although by using packet tracer we do not need to buy such expensive devices, but it cannot represent the real world 100 percent [6]. Cisco Packet Tracer is a simulator software designed and developed by Cisco Systems that helps teachers and students understand the principles of computer networking and simulate computer networks before implementing them with real devices. Cisco Packet Tracer can be officially installed on Windows, Debian, and Linux operating systems [3].

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3. Analysis and Design

3.1. Research methodology

In this study, researchers used system development and simulation methods, which can allow researchers to reproduce complex environments and test system performance under various conditions without having to build actual physical infrastructure. Cisco Packet Tracer allows researchers to create accurate IoT simulation models as well as cloud-based automatic fire extinguishing and security systems. Simulation methods allow researchers to evaluate system performance, identify potential problems or deficiencies, and even test various scenarios without risk in real environments. This makes simulation methods very suitable for modeling and testing complex systems such as automatic fire extinguishing and security systems based on the Internet of Things and Cloud Computing.

Based on the methodology used in this study, the flow of research work methods is formed, namely as follows:

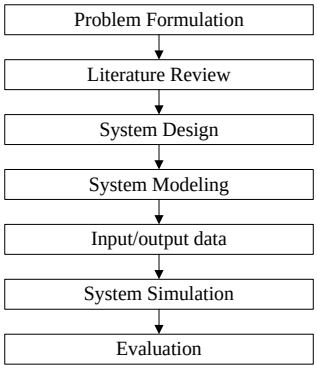

Fig.1 : Research Workflow

3.2. System design

The system design is carried out at the planning stage to create a simulation concept for automatic fire extinguishers and security systems based on the Internet of Things and cloud computing. The design of the system to be built includes:

1. Network topology: a network structure that connects all devices and systems involved.
2. Automatic Fire Extinguishing: An automatic system that detects and extinguishes fire effectively, and exits such as doors and windows open automatically when a fire is detected.
3. Security system: a system designed to detect, monitor, open doors using a card reader, and close exits such as doors and windows if the trip sensor is active.

3.3. System model

At this stage, modeling is carried out on the simulation by creating a network connection model from the Internet to connecting to the server network connected to the fire extinguisher

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and security system, as well as server configuration to ensure that the entire system can work very well. Therefore, this model aims to create a realistic and comprehensive simulation, so that reliability and efficiency can be tested and evaluated in real emergency situations. The following is a picture of the model created;

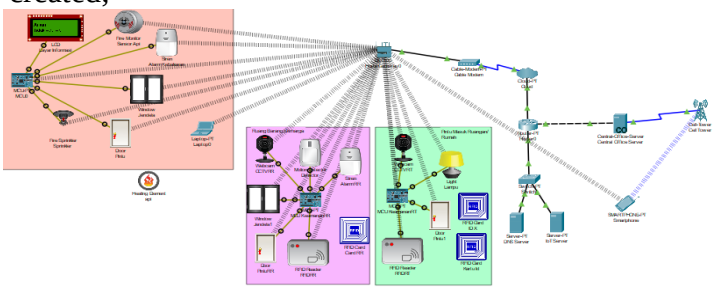

Fig.2 : System Model

Figure III.3 shows the flow of modeling the configuration of the network and IoT devices, from setting the router IP address and DHCP to registering and configuring IoT devices. This model includes key components such as Wireless Home Gateway configuration, connection to cloud providers, DNS settings, and IoT services to facilitate communication between devices and servers in the cloud ecosystem. This process ensures that the device is ready to be simulated on a well-structured network.

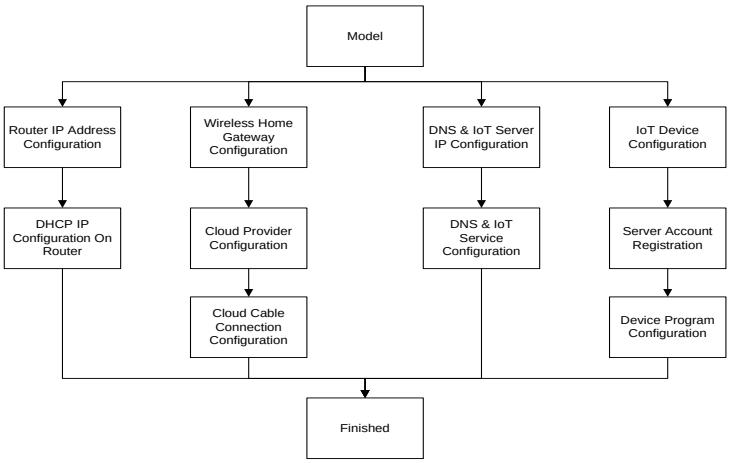

Fig.3 : Modeling Flow

3.4. Flowchart

This flowchart explains the implementation of a simulation model of an automatic fire extinguishing system and an IoT-based security system implemented using a cloud computing-enabled cisco packet tracer. The main purpose of creating a flowchart is to visualize the process, interactions between various system components. facilitate understanding, analysis and evaluation. This flowchart also helps simplify system design, documentation processes, and facilitates effective communication between researchers, developers and stakeholders.

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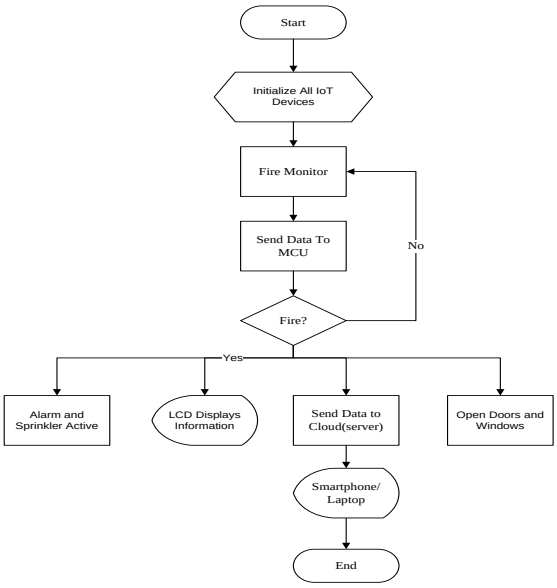

Fig.4 : Fire Fighting System Flowchart

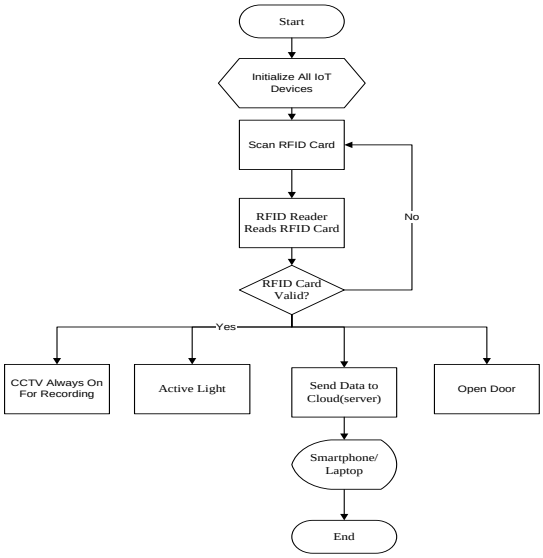

Fig.5 : Room Entrance Security System Flowchart

4. Results And Discussion

4.1. Discussion

Discussion of the results of the simulation model of automatic fire extinguishers and security systems based on IoT and cloud computing on Cisco Packet Tracer shows the effectiveness of technology in detecting and responding to fires in real-time. IoT sensors detect emergency

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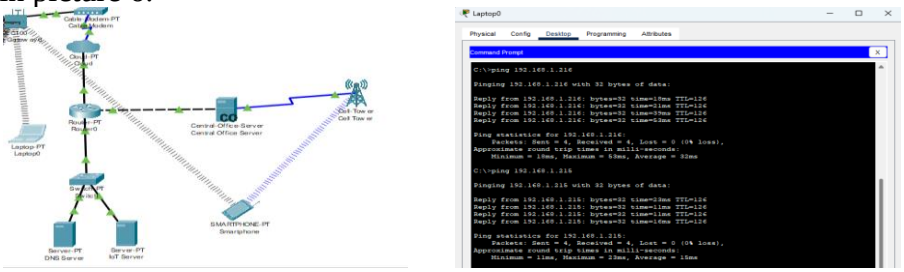
conditions, send data to the cloud, and automatically activate fire extinguishers, while security systems such as CCTV provide live visualization, motion detectors detect intruder movement, and RFID readers for entrance security.

4.2. Simulation Results

4.2.1. Network Topology Test Results in Cloud Computing

The results of network topology testing in cloud computing are carried out through ping testing from a laptop to a server, either a DNS server or an IoT server, testing is carried out to ensure that user devices are connected or can exchange messages. The ping test for network topology in cloud computing was successful, this indicates that network connectivity between components or nodes is functioning properly, ICMP (Internet Control Message Protocol) packets can be sent and received without any obstacles, and physical and logical networks are connected properly. This indicates that communication between various components in the cloud infrastructure is running smoothly, the IP address and routing configurations have been set correctly, and there are no firewalls or security rules that block ICMP traffic used by the ping command, as in picture 6.

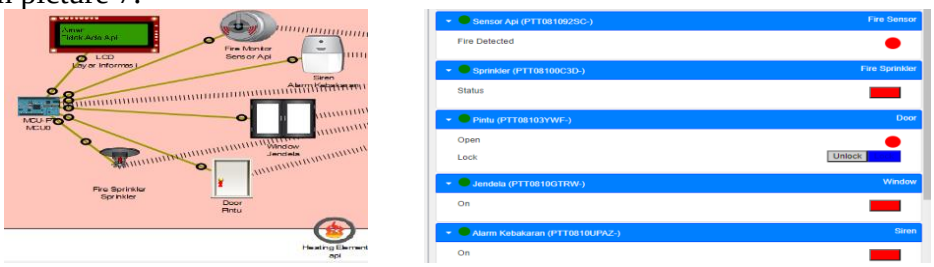


Cloud Computing Network Topology Laptop Ping Test Results To Server IP

Fig.6 : Network Topology Test Results in Cloud Computing

4.2.2. Automatic Fire Extinguisher Test Results

The initial Condition of the Device is the active fire sensor detects a fire, doors and windows are locked, the sprinkler status is off, the fire alarm status is off and the LCDs are safe/unsafe information. as in picture 7.



Device Does Not Detect Fire Smartphone Screen Display Does Not Detect Fire

Fig.7 : Device Does Not Detect Fire

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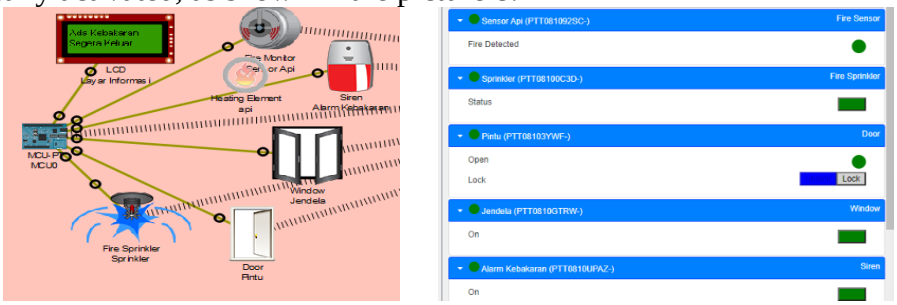
And the simulation results were successful, where when the sensor detected a fire, the locked door automatically opened and the window that was initially locked opened automatically, the fire alarm sounded and the LCD displayed fire information, and the sprinkler was automatically activated, as shown in the picture 8.



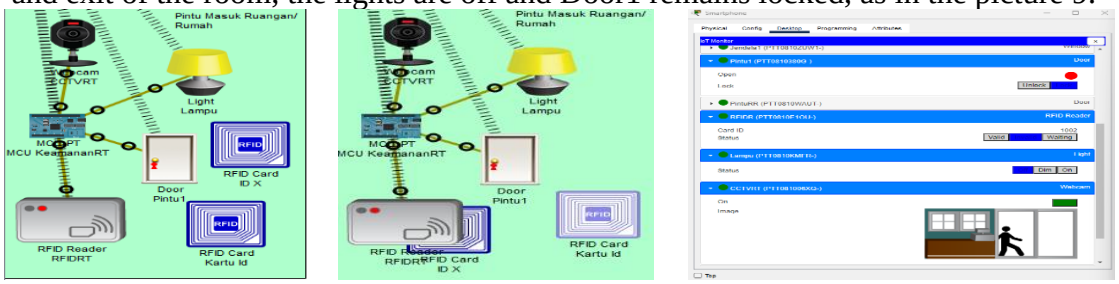
Fire Detection Device Smartphone Display Device Detects Fire

Fig.8 : Fire Detection Device

4.2.3. Security System Simulation Test Results

4.2.3.1. Entrance Security System Simulation Test Results

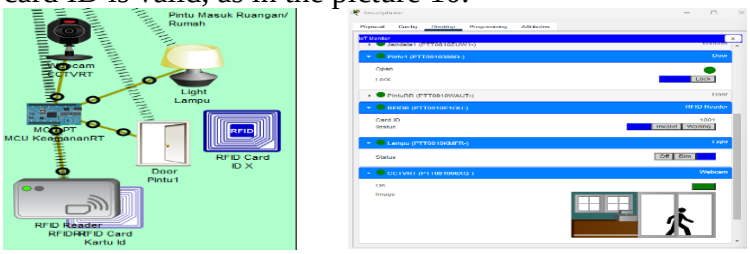
The initial and invalid conditions on the RFID Reader are the same, where the RFID Reader is said to be invalid if the RFID Card ID/ = 1001 (not 1001), CCTVRT is always active to record entry and exit of the room, the lights are off and Door1 remains locked, as in the picture 9.



Initial Condition of RFIDR Invalid RFIDR Condition Smartphone View On RFIDR Invalid

Fig.9 : Initial and invalid RFID conditions

RFID Reader is said to be valid if RFID Card ID = 1001, CCTVRT is always active to record entry and exit of the room, the lights are active when RFID is valid and, Door1 opens automatically if RFID card ID is valid, as in the picture 10.



Valid RFIDR Conditions Smartphone View On RFIDR Valid

Fig.10 : Valid RFIDR Conditions

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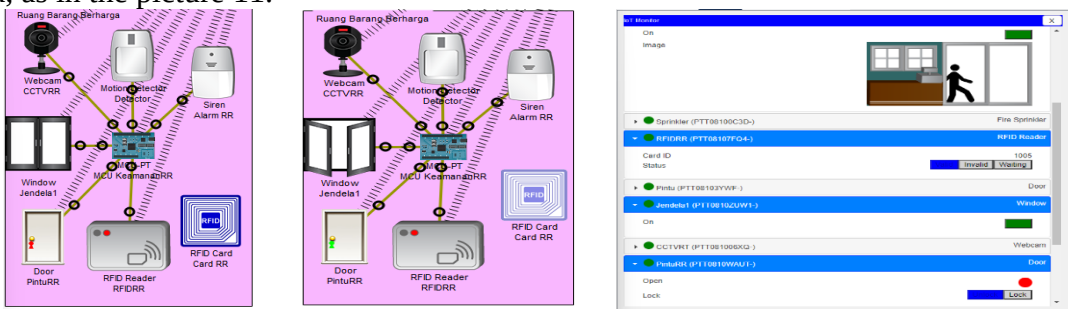
4.2.3.2. Security System Simulation Test Results On Motion Detector

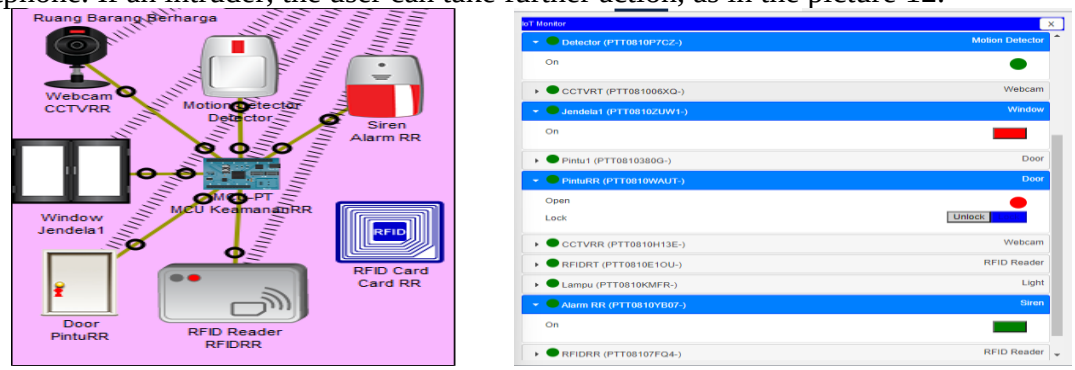
RFID Reader is said to be valid if RFID Card ID = 1005, CCTVRT is always active to record entry and exit of the room, DoorRR and windows open automatically if the RFID card ID is valid, as in the picture 11.



Initial Room Conditions | Valid RFIDR Conditions | Valid RFIDRR Smartphone View

Fig.11 : Room Condition When RFIDRR is Valid

When the motion detector is active, the DoorRR and windows are automatically locked and the alarm is active, then, CCTVRT is always active to record the room, so that users can verify whether the person entering the room is an intruder or not. If not, the user can open the door via smartphone. If an intruder, the user can take further action, as in the picture 12.



Motion Detector Active Room Condition | Smartphone Motion Detector Active Display

Fig.12 : Motion Detector Active Room Condition

5. Conclusion

The following are the conclusions from the simulation model of the automatic fire extinguishing system and security system based on the Internet of Things (IoT) and cloud computing in Cisco Packet Tracer:

1. Cisco Packet Tracer 8.2.1 used in this study proved effective for simulation as it provided all the required devices. With the availability of these devices, the simulation could be conducted successfully, and the final results met expectations. The ability of Cisco Packet Tracer 8.2.1 to accommodate specific device needs allowed this research to achieve its goals with high accuracy and efficiency.

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2. The fire extinguishing simulation model works such that when the sensor detects fire, locked doors automatically unlock, although they may not fully open. However, if the door is closed, it will automatically open. Windows that were previously locked open automatically, the fire alarm sounds indicating a fire, the LCD displays fire information, and the sprinkler activates automatically.

3. The security system simulation model at the entrance of a room opens the door when the RFID Reader validates an RFID Card with ID = 1001. The CCTVRT is always active to record room entries and exits. The lights turn on when the RFID is valid, and Door1 opens automatically if the RFID card ID is valid.

4. The security system simulation model in the valuable items room unlocks the door and opens the window automatically when the RFID Reader validates an RFID Card with ID = 1005. When the motion detector is active, the alarm activates, the door and windows automatically lock, and the CCTVRT is always active to record the room, allowing the user to verify whether the person entering the room is an intruder. If not, the user can open the door via smartphone. If it is an intruder, the user can take further action.

5. This simulation demonstrates effectiveness in testing various scenarios in cloud computing and IoT systems, such as ping tests and IoT device connectivity, ensuring that devices and networks function properly. Although the simulation ran well in the virtual environment, these results may not fully reflect real-world conditions.

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