RoomSync Automation: An Android-based IoT Application for Room Control and Monitoring

Muhammad Brian Priambudi
Yogyakarta University of Technology
Yogyakarta, Indonesia

RR Hajar Puji Sejati
Yogyakarta University of Technology
Yogyakarta, Indonesia

ABSTRACT
With the continuous progress of science and technology, challenges often emerge, posing threats to the security of various premises. The issue begins with a security level that falls short of the established safety standards for homes. Numerous challenges jeopardize the security conditions of rooms, including the risk of fires resulting from unknown room temperatures and unregulated electronic devices, as well as potential dangers easily gaining access to the room. The prototype configuration of this room security system is programmed and managed by NodeMCU ESP-8266 to transmit comprehensive sensor data to the dashboard. In case the sensor detects any movement, NodeMCU ESP-8266 promptly responds and forwards the information to the Firebase database. The primary goal of this research is to develop an Android application for the purpose of controlling and monitoring room security. This system aims to create applications capable of detecting temperature, motion, and facilitating user-friendly monitoring. The implementation of this system has yielded outcomes wherein temperature, humidity, and movement are systematically monitored and regulated through the ESP-8266 microcontroller, with the results visible on the created dashboard..

General Terms
Android, Arduino, Firebase.

Keywords
Internet of things, Node MCU, Android, Monitoring, DHT-11

1. INTRODUCTION
Today, technological development is very rapid and has become a part of human life, there are many terms that mean smart home technology. In layman terms, smart phones are those embedded with sensors, actuators and systems that enable information and communication management which in turn enable remote control [1]. It is now feasible to remotely oversee these devices using smartphones, meaning their conditions are continuously monitored.

Residents often overlook the monitoring and control of their living spaces, even though these tasks could significantly simplify their lives. Humans usually inside their home interact with the environment settings like light, air, etc., and regulate accordingly [2]. With a smartphone, individuals can now manage tasks such as monitoring room temperature and activating devices like lights, all made possible through Internet of Things (IoT) technology.

The Internet of Things (IoT) is a networked system where devices, excluding those like smartphones, communicate and connect via the internet or private networks, each possessing a unique identifier for transmitting and receiving data over network connections, with recent advancements in technology enhancing this capability [3]. The growing popularity of IoT has extended significantly to basic household applications and routine activities [4]. The internet has evolved into a ubiquitous interface employed by numerous devices to streamline the daily lives of individuals [5]. As a result, with IoT, individuals have the ability to oversee their personal activities using wearables and intelligent medical devices, or they can manage vehicles through connected car solutions. [6].

2. PROPOSED MODEL

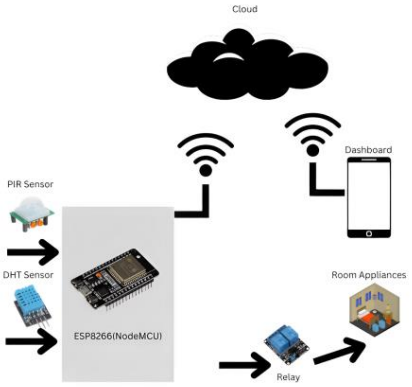

Figure 1. Block diagram of the model

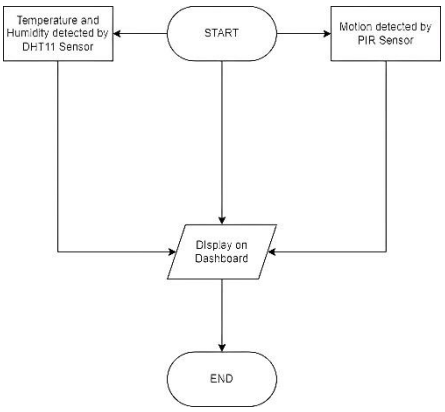

Figure 2. Flow Diagram

Figure 1 & 2 depicts the block diagram of the envisioned system. The goal of this system is to automate and monitor room appliances through various sensors, such as temperature and humidity sensors(DHT11) and PIR Motion Sensor. All the sensors are connected to the NodeMCU ESP8266 board and the sensor readings displayed on the dashboard.

Room temperature and humidity level are detected using DHT11 sensor. The motion of objects are sensed by PIR Sensor and use a relay to control the room appliances.

The ESP8266 module processes the data from those sensors, and will displayed on dashboard

2.1 Hardware Setup

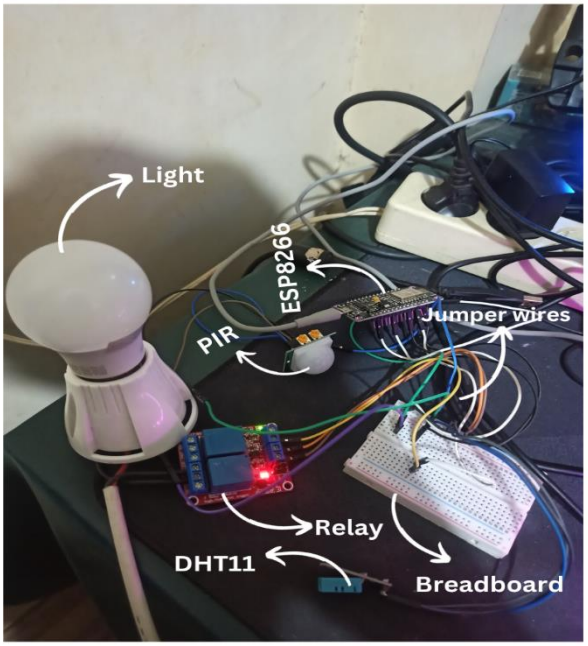

Figure 3. Hardware of the proposed model

2.1.1 DHT11 Sensor

This module includes a humidity and temperature sensor complex that produces a calibrated digital signal output, making the DHT11 sensor module a unified unit for detecting both humidity and temperature and providing a calibrated digital output signal [7].

2.1.2 NodeMCU ESP8266 Module

NodeMCU firmware comes with ESP8266 Development board/kit [8]. ESP8266 is the most integrated Wi-Fi chips [9]. The ESP8266 possesses robust on-board processing capabilities and ample storage, facilitating integration with minimal upfront development and runtime loading. This is achieved by utilizing its GPIOs (Gene ral Purpose Input/Output) in conjunction with devices tailored for the respective sensors.

2.1.3 PIR Sensor

Pyroelectric Infrared Sensors (PIR) are compact and robust devices ideal for cost-effective surveillance, excelling in the detection of human or animal presence [10]. As a passive device, the PIR sensor operates discreetly and functions effectively even in low-light conditions [11].

2.1.4 Relay

A relay is an electrical switch that functions through electricity, serving as an electromechanical component comprising two primary elements: an electromagnet (coil) and a mechanical switch [12]. The relay operates by receiving a low current and voltage, activating the switch connected to a higher voltage [13]. The relay comprises a coil and a contact as its primary components. Upon receiving an electric current, the coil generates an electromagnetic field, inducing mechanical movement in the movable part. Consequently, this alters the position of the contact, leading to either the opening or closing of the electrical circuit. Relays find widespread application in various contexts, such as automatic control systems, the regulation of electrical equipment, and safeguarding circuits. Their utility lies in enabling feeble control signals to manage devices demanding higher power. Additionally, relays come in diverse types, including electromagnetic, solid-state, and thermal variants, each tailored for specific characteristics and purposes.

2.1.5 Breadboard

A breadboard is a platform or surface used for creating and testing simple electronic circuits. It provides a versatile space where electronic components can be arranged and connected to prototype various circuit designs. This essential tool is particularly useful for engineers and hobbyists during the early stages of electronic development, allowing them to experiment and design without the need for soldering.

3. RESULT AND DISCUSSION

Using the system proposed in this paper, all room appliances are monitored using a mobile phone. All of these components are connected via an Internet of Things (IoT) platform. The devices are all consistently monitored and displayed on the dashboard. The dashboard is based on Android Studio.

Figure 4. Dashboard

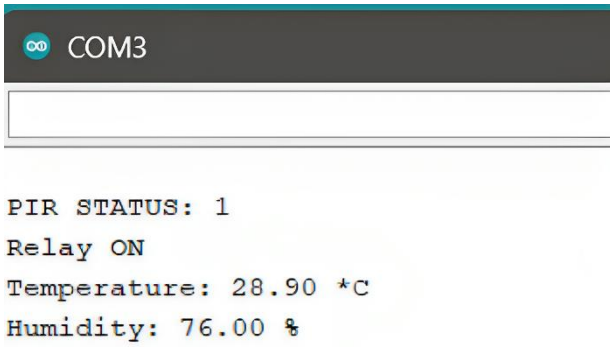

Figure 5. Serial Monitor

Figure 4 show the dashboard based on Android Studio that displays the temperature, humidity, and how many motions were detected. Sensors, linked to the NODE-MCU functioning as a client, are responsible for measuring these values. The dashboard serves as an output interface, displaying the real-time status of all connected devices.

Figure 5 shows the information presented on the serial monitor output, revealing data on temperature, humidity, and motion detected by the sensors.

Table 1. Dashboard Feature Testing Results

No	Feature	Condition	Status
1.	Temperature	Displays the temperature scanned by the DHT11 sensor	Success
2.	Humidity	Displays the humidity scanned by the DHT11 sensor	Success
3.	Relay	Used to turn on or turn off relay that leads to the light	Success
4.	Motion	Used to scan motion by the PIR sensor	Success

Table 1 shows the results information of the implementation of features in the dashboard.

The dashboard displays temperature 30.79°C and humidity 71% whereas the serial monitors display temperature 28.90°C and humidity 76%. This proves the system is working.

4. CONCLUSION

In this paper, the suggested system empowers users to commandingly manage room appliances via a centralized dashboard. This allows for universal control of all devices, providing a visual representation of their current statuses.

The process of monitoring the room will be facilitated by having a system that has been created with the real-time information obtained. The control and monitoring process will be easier because it uses the Android application and can be done remotely.

As the demand for smart home solutions continues to grow, the Android Application for Room Control and Monitoring IoT presents a forward-looking and scalable solution. Its emphasis on user control, device visualization, and interoperability positions it at the forefront of modern home automation, promising a more comfortable and efficient lifestyle.

In the future, Android apps designed for overseeing and managing rooms through the Internet of Things (IoT) will play a crucial role in daily life. Progress in IoT technology will empower users to efficiently control and supervise various elements within their rooms, introducing a higher level of automation.

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