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Internet of Things Based Home Automation System

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Abstract- The purpose of a home automation system is to computerize the majority of technological and electrical duties in the home. A combination of hardware and software is required to control and manage appliances and devices within a home. In today's society, the fundamental purpose of using the Internet of Things (IoT) to track electrical devices is to control them in accordance with situational demands. Because efficient monitoring enhances efficiency and lowers power and resource waste, there is a growing demand for it as technology advances. This technique can be used to prevent lights from being turned on throughout the day. Node MCU is a well-known name in the realm of home automation. It's great for IoT applications thanks to its Wi-Fi capabilities and Arduino IDE support. This article shows how to control home/office appliances from any location and at any time, even if the user is not at home or at work. This article includes a PHP web page with a few toggle buttons that allows you to remotely control the outputs (on/off) of your household appliances.

Keywords – Sensors, Micro-Controller, Micro servo motor, Buzzer.

I. Introduction

The home automation system of any smart house plays a significant role in today's environment; it not only makes life more comfortable and luxurious, but it also saves energy, lowering the demand for power generation. Because the demand for power generation is increasing in our rapidly changing world, home automation can assist in reducing and eliminating wasteful power consumption. Although the concept of home automation is still relatively new to the world, significant progress has already been made in this field. This effort reduces the cost and creates a more versatile home automation system, allowing the user to understand and apply IR and PIEZO sensors, which are efficient sensors for automation.

Because of its great sensitivity, straightforward design, and low cost, the smart window, which automated controls as well as a rain sensor, would be a fantastic breakthrough. Whenever rains start, a good smart window automation and control system closes the windows, keeping rain from entering and causing damage to the inside of the house. When rain falls on the rain sensor, it sends a signal to the microcontroller, telling it to command the servo motor to lower the window; when the rain sensor dries, the window raises.

This article also includes a manual method for controlling all of our household appliances via a Web application. All of the appliances were controlled by an ESP8266 microcontroller. You can control your appliances from anywhere in the globe using a Web application with some toggle buttons, even if you are not at home. The toggle buttons will send updates to the database server, which will subsequently send GPIO states to the microcontroller. The ESP8266 Wi-Fi Micro-Controller is always connected to the Internet via a Router.

II. Objectives

This project aims to overcome a problem where reduces the consumption of electricity and makes the home automation system low cost. The main objective of this project is to make a smart home where all the home appliances and things like window/door work automatically by the help of sensors or can be controlled remotely from anywhere whether the controller is at home or outside of its home by using the web application.

III. Literature Survey

P. Siva Nagendra Reddy Et.al [1] gave "Home Automation Using Android Application" (2016) In this setup, he explained how to use an Android application to control all of your household appliances. An Arduino Mega and a Wi-Fi Module were used to control all of the appliances. The Wi-Fi Module was used to receive commands from the phone, which were then processed by Arduino. The smartphone application is linked to the Wi-Fi module's IP address, and the text is transferred to the Arduino microcontroller via the Wi-Fi module. The characters in the code are assigned to the home appliances so that the intensity of the lights, fans, and rainfall scenario can be modified by sending those codes through the app. A rain sensor, a temperature sensor, a buzzer, and a servo motor were utilized in this experiment.

Usman Ali. Et. al [2] gave, "A Real-time Control System for Home/Office appliances automation, from mobile device through GPRS network " (2014) This article demonstrates how to control home and office appliances from anywhere and at any time, even while the user is not at home or in the office. The process moves from the mobile phone to the computer over the GPRS network, and then from the computer to hardwired virtual circuits via the computer adapter, in order to run home and office appliances. As a result, this article outlines a system that enables users to control their home and workplace equipment from anywhere using a cellular phone device. For communication over a GPRS network, a client/server architecture is utilized. For dealing with hardwired decoders in home and business devices, a high-level language was used to program a PC-parallel connector. A Java program was used to control all of the home and workplace equipment.

Satyendra K. Vishwakarma Et. Al [3] "Smart Energy Efficient Home Automation System Using IoT" designed a system that can be controlled with Google Assistant and a web application In this project's operational system, the Google Assistant was used to control and monitor a smart house, and in the event of a noisy environment, the system could be connected via a web-based service. This project included a security system that leverages the Google Assistant to authenticate users by asking for a user access code, preventing unauthorized access.

Michael Horn, et al. [4] is "Single-element weather sensor for automatic windows", created a system, in the event of heavy wind, rain, or snow, a simple weather sensor fastened to a window provides information for the automated opening and closing function of windows in companies and private houses. When sufficient high voltages and currents are applied to an ohmic electrical device, the device warms up and changes its resistance value.

Abhilash Reddy, et.al [5] "Automatic rain sensing car wiper ", In this article, an automatic automobile wiper system senses rain and begins to work on its own. When rains fall on the sensor, the sensor detects their intensity and adjusts the wiper speed automatically. The more rain that falls, the faster the spinning speed is. It will no longer be necessary to use your hands to operate the wipers. This project includes an Arduino, a rain sensor, a 16x2 LCD module, and a servo motor. The analogue output pins of the rain sensor are used to monitor moisture levels, and when a moisture threshold is exceeded, the wiper rotates. This module is the only one that uses the LM393 op-amp. The data collected by the rain sensor is sent to Arduino. The Arduino is an Atemga8-based microcontroller board. Arduino is a platform for developing the functionality of electrical devices that can be used to create interactive electronic devices. It comes with a built-in power supply and a USB port for connecting to a computer. Arduino analyses the input from the rain sensor and then utilises the processed data to control the servo motor. The rain sensor is situated to the side of the windscreen on the outside of the vehicle. The rain sensor is connected to the servo motor.

IV. Proposed System

This proposed work can be implemented in a home or any other type of structure. It lowers the cost of hardware and the time it takes to install it. This module is simple to install and use, thus no technical knowledge is required. The main goal of this project is to lower a building's electricity consumption. Increased electricity use necessitates an increase in electricity generation. Because it produces a large amount of carbon monoxide and is a source of harmful gases, it pollutes the environment severely. Make it expandable so that future add-ons can be added. This research offered a system in which the microcontroller (ESP8266) can be operated remotely via a web application using certain toggle buttons from anywhere.

Figure 1. Architecture diagram of proposed system

The figure 1 illustrates the working of the system NodeMCU micro-controller where home appliances and the window work automatically by the help of sensor and appliances can be manually controlled by using web application.

A. Hardware Components

NodeMCU: All of the objects in this project will be controlled by the microcontroller NodeMCU (ESP8266). The NodeMCU (Node Microcontroller Unit) is an open-source software and hardware development environment based on the ESP8266, a low-cost System-on-a-Chip. The Embedded Systems ESP8266 features all of the essential components of a computer, including a CPU, RAM, networking (Wi-Fi), and even a current operating system and SDK. As a result, it's a great fit for a variety of Internet of Things (IoT) projects. For the most basic functions, like as turning it on or sending a keystroke to the chip's "computer," you must solder wires with the necessary analogue voltage to its pins. You must also program it in low-level machine instructions that the chip hardware can understand.

Figure 2. NodeMCU (ESP8266) Micro-controller

Relay Board: Computer boards with a variety of relays and switches are referred as relay boards. They are used to regulate the voltage supply and have input and output terminals. For each of the onboard relay channels, relay boards allow separately programmable, real-time control. The number of channels, physical dimensions, input range, and output range are all part of the relay requirements. Isolation between control signals and output controls is provided by relay boards with opto-isolators. The majority of relay boards have two, four, eight, or ten channels. Each channel features a relay switch with a maximum output rating of 250 VAC / 5 amps. A power pack connection connector is available on some relay boards.

Figure 3. Relay Board

Motion Sensor: In this project, a IR motion sensor is utilised to control home automation since it detects motion and is reliable indoors and out, day or night, as illustrated in figure2. It uses less energy than microwave sensors and is far less expensive than microwave sensors. IR sensors are ideal for electrical applications in tiny and compact spaces.

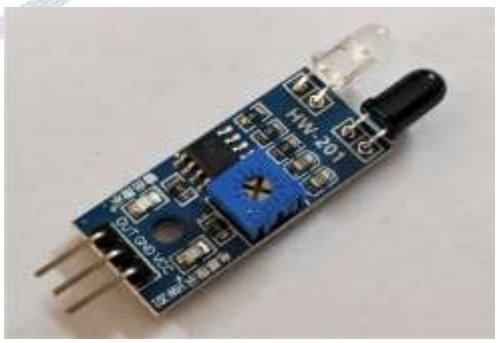

Figure 4: IR (Motion Sensor)

Pressure Sensor: Along with the IR sensor, which is a motion sensor, this project also includes a piezo sensor, which is a type of pressure sensor, as seen in Figure 3. It will provide the best output for the Wi-Fi NodeMCU, as the piezo sensor will have a very high frequency response. It indicates that parameter changes at very

high rates may be easily sensed, and it has high transducers that can detect microsecond events and provide linear output.

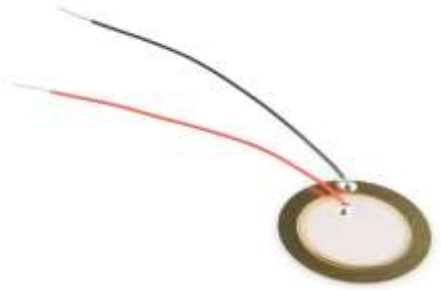

Figure 5: Piezo-electric (Pressure Sensor)

Rain Sensor: Rain sensors are most commonly used to detect raindrops. Every rain sensor has a preset threshold limit. The rain sensor delivers information to the one who takes the necessary action when the droplets or humidity level reaches a certain level. The humidity can be measured by the digital analogue pins on the rain sensor. The intended action is carried out when the measured humidity exceeds the threshold level. When wet, the rain sensor acts as a variable resistor, changing from 100000 to 2M ohms. As a result, the more the board is wet, the more current conducts. Analog output, digital output, Ground, and positive voltage are all represented by A0, D0, GND, and VCC, respectively. Rain sensors come with two + and - loop pins, which correspond to sensor board connect up A and B, respectively.

Figure 6: Rain Sensor

Servo Motor: A servo motor usually has an electric generator through which the shaft can be rotated to a specific angle using a coded signal given by the servo. Servo motors are extremely useful in everyday life and are used in a variety of equipment. Servo motors are extremely efficient and cost-effective. Servo motors are small and can be used in appliances to execute a certain task more efficiently. Servo motors are energy-efficient and low-power motors. Pulse width modulation is utilised to drive these servo motors, and electrical pulses are sent via a control cable. The three types of pulse width modulations are minimum, maximum, and repetition rate. A servo motor can turn 90 degrees in either direction and has a total movement of 180 degrees. The servo motor may revolve in both a clockwise and counterclockwise direction.

Figure 7. Servo Motor

B. Software Components

Arduino IDE: The Arduino IDE (Integrated Development Environment) is a software application that assists programmers in writing code. There are numerous toolbar and menu options for sketching the required system's codes. This software enables the newly sketched programme to be uploaded to the Arduino board.

Figure 8. Arduino IDE

000webhost: The 000webhost is used in this project to deploy a web application on the server to control and operate the microcontroller via the server. In short, 000webhost is a free web hosting service that enables users to host their own websites on the server.

Figure 9. 000Webhost (Website Hosting Platform)

Visual Studio: On Windows, this is the best all-in-one IDE for.NET and C++ developers. It comes with a number of tools and features that will help you improve and elevate your software development process at every stage. A 64-bit IDE makes it easier to work on projects of any size or complexity. A new Razor editor allows you to change code across several files. Visualize async processes and use automatic analyzers to solve problems.

Figure 10. Visual Studio Code

V. Working of the System

NodeMCU: In this working system, there is a web application that updates the GPIO states in the database, and then the database server sends the output to the NodeMCU (microcontroller) via HTTP Get Request from the Arduino IDE, allowing the user to control the NodeMCU (microcontroller) states from anywhere in the world. To perform operations on the NodeMCU, the NodeMCU always be connected to the Internet (Router) by the in-built Wi-Fi feature in the NodeMCU.

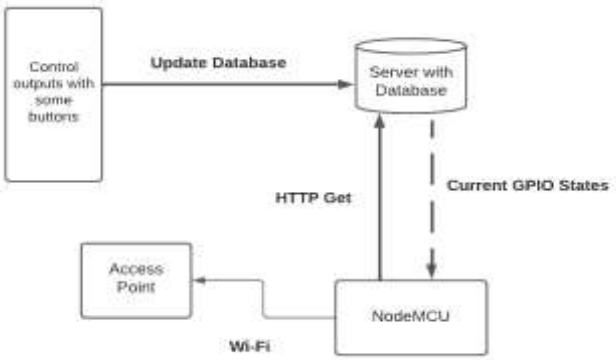

Figure 11. Controlling outputs of NodeMCU

Motion Sensor and Pressure: If both motion and pressure are sensed at the same time, i.e., if the IR sensor detects motion and the pressure detected by the piezo sensor is more than and equal to 100, the lights will switch on. Figure 5 shows how to feed this approach to the NodeMCU using the Arduino IDE program. This software makes use of the embedded C programming language, which is used to program hardware components for IoT use.

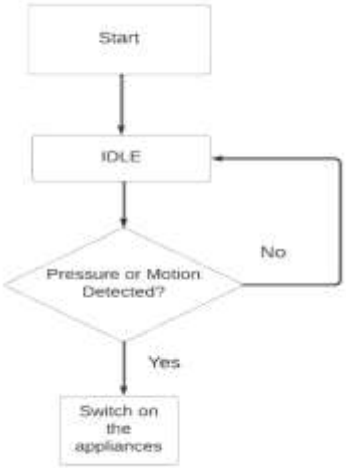

Figure 12. Pressure and Motion Sensor working flowchart

Rain Sensor: Rain Sensor, Servo motor, and NodeMCU are used to build the rain sensing window shutting and opening system. When raindrops fall on the rain sensor, it detects the rain and provides the necessary information to NodeMCU to continue the operation. The NodeMCU is a microcontroller board based on the ESP8266 module. The rain sensor sends information to the NodeMCU, which processes it and regulates the servo motor based on the results. The rain sensor, which detects rainfall, is installed in the side corner of the home's window. The window is coupled with the servo motor and are powered by it. When the rain stops and the rain sensor dries, the sensor senses it and sends the data to the NodeMCU board, and controls the servo motor to open the window.

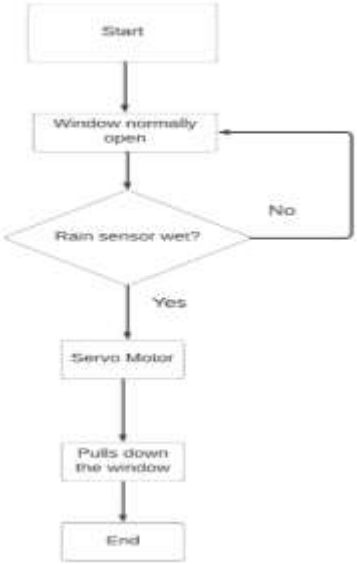

Figure 13. Working flowchart of Rain Sensor and Servo Moto

VI. Methodology

Step 1: To begin, there are few toggle buttons that update the database with the GPIO values.

Step 2: The ESP8266 will then use the Arduino IDE to make an HTTP Get request to the server.

Step 3: If H1 (IR Sensor), H2 (Rain Sensor), and H3 (Piezo Sensor) equal or above high, the sensor data are evaluated.

Step 4: The light turns on and the window closes after the values are checked.

Step 5: If any of the sensors' values are low, the lights will remain off and window remain open.

Step 6: In the case of rain sensor, when the raindrops fall on the sensor, it senses the some wet and sends the information to micro-controller and instructs the servo motor to pull down the window.

Step 7: When the rain sensor dries out, the window opens.

VII. Results

The web application which controls the outputs in on and off state by some toggle buttons which is shown in figure 14.

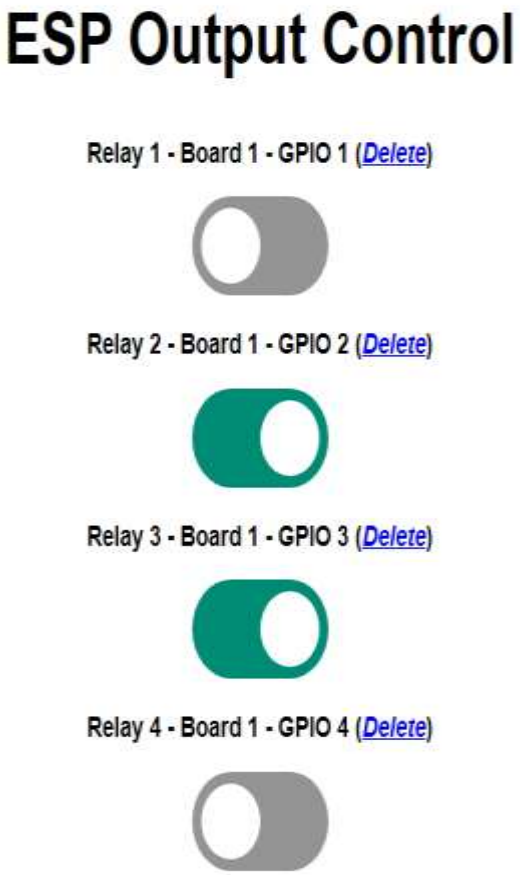

Figure 14. Screenshot of Web page with toggle buttons to control outputs

The below **figure 15** shows the database where output states are update in the database in 0 and 1 output when the switch the buttons in on state it updates the state in 1 and in off state it updates 0 which can be seen in figure 15.

Figure 15. Screenshot of GPIO States Database Page

Figure 16 illustrates the completed implementation, in which all IoT devices, such as an infrared sensor, a rain sensor, a buzzer, and a micro servo motor, are connected to the NodeMCU ESP8266 microcontroller and relays through jumping wires. This device is powered via USB when it is connected to a power source (adapter) or a laptop.

Relays, mini servo motors, sensors, and buzzers are connected to the microcontroller NodeMCU (ESP8266) through a power source to keep this system working efficiently. In addition to controlling microcontroller functions like as turning on/off lights attached to relays,

a web application is created using visual studio to control your micro-controller from anywhere, where you are in the range or not of the micro-controller

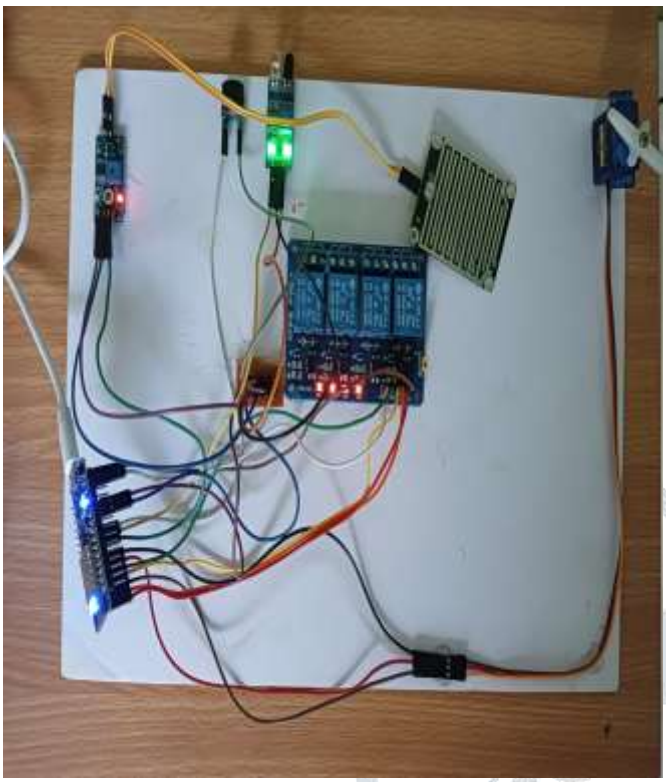

Figure 16. Final Implementation

VIII. Conclusion

The goal of this project is to create a low-cost, secure, remotely operated system that can be accessed by anyone anywhere. This project is also very customizable; you can control many outputs easily and even connect boards to your server through your web application. An ESP8266 microcontroller controls a motion sensor and a pressure sensor. You may control your household appliances and turn on and off lights and fan from anywhere using a hosted PHP web application.

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