Smart Home Design and Fabrication Using the Internet of Things

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***Abstract*—Into this era of digitization and automation, human life is becoming simpler since most things are becoming automated, replacing traditional manually controlled systems. People's lives have become so reliant on the internet that its absence leaves them feeling helpless. The Internet of Things (IoT) is a platform which admits us for interacting with devices that can sense and control networked equipment. This model employs a Node MCU in conjunction with a relay module and a touch sensor to remotely control electrical appliances such as lights, fans, and air conditioners. The built web application gives users with an interface that includes buttons for operating the electrical equipment. This model's major goal is to provide a low-cost, simple-to-use, and adaptive solution. The seminar's goals are to discuss smart switchboard studies, including the components utilized in the project, the model's step-by-step execution, and certain benefits. 'Smart Switch Board is a touch sensor switchboard that is both safe and secure, as well as providing IoT functionality for managing all functioning devices from a single location. Smart Switchboard identifies whether or not your phone is present and activates accordingly.' As a result, component information and an introduction are mentioned in this paper.**

Keywords—Internet of Things, Smart home, ESP32S, Amazon Web Services, MIT

I. INTRODUCTION

With high-speed internet working in every day appliance, we plan to enhance the simplicity of utilizing everyday appliances at this time in the world. Physically handicapped folks find it challenging to operate these machines. Furthermore, if the person is not physically there, he will be unable to handle or monitor the appliance's status. This could result in an energy waste. As a result, we created a Smart switchboard that allows you to remotely control all of your household appliances. You can manage fans, lighting, and other appliances with this smart switchboard.

Using a web application, you can control tube lights, for example. The Internet of Things makes implementing this smart switchboard concept simple. The Node MCU sends information to the cloud.

A. Home Appliance Management

Provides a cloud platform for controlling consumer electronics that are cloud-hosted. The managing service allows the user to control the outcomes of digital devices interconnected to home equipment like lamps and fans. Smart actuators, such as valves and switches, perform tasks like as turning objects on or off or altering an operating system. On/off control services, proportion accessible position, regulating to control flow behavior, as well as abrupt shutting are all operations of actuator (ESD). To activate an actuator, a digital written message is sent to it.

B. Managing Home Access

Residential access technologies are generally utilized open access doors. In a conventional system, a directory with the biggest factor of authorized persons is used. When a user reaches the authentication protocol, their identifying features are immediately recorded and compared against the dataset. If the data in the dataset allows it, access is permitted; else, it is refused. For a big spread institute, cloud servers could be used to collect and process data centrally. Face detection technologies, biometrics, and RFID are used by used by some, whereas magnetism or acoustic identification documents are used by someone else.

II. RELATED WORK

Ref.	Controller Used	Focus Criteria	Wireless Interface	
[1]	Raspberry Pi	Indoor control Monitoring Smartphone	Bluetooth/Wi-Fi	No
[2]	Arduino Mega	Indoor Control Outdoor Control Safety Monitoring Energy Management Smartphone Web-based	Bluetooth/Wi-Fi	No
[3]	Node MCU	Indoor control Smartphone Web-based	Wi-Fi	No

[4]	Raspberry Pi	Indoor Control Outdoor Control Monitoring Energy Management Web-based	Fog-IoT	Yes
[5]	8051 microcontroller	Indoor control Outdoor control Web-based	GSM	No
[6]	PC Server	Security Energy Management	Wi-Fi	No
[7]	PC Server	Safety Monitoring Web-based	GSM/Wi-Fi	No
[8]	Arduino	Indoor Control Security Energy Management Smartphone	GSM	No
[9]	Arduino Mega	Indoor Control Monitoring Smartphone	Wi-Fi	No

III. METHODOLOGY PROPOSED

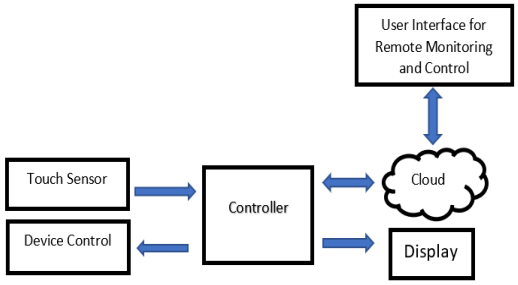

Fig.1. Proposed System Block Diagram

Smart cities require remote control and power monitoring of household appliances and business gadgets. The motive of this project is to design and make the smart switchboard for home automation. For remote control, this switchboard is Wi-Fi enabled and connects to the internet. Each switchboard will be mesh networked and connected to other switchboards in the house. Multiple device control and fan speed control will be available on the switchboard. With internet connectivity, a device can be managed from anywhere at any time with manual override. A controller (ESP32S), touch sensors, display, power management, and device system will be included in the hardware. A remote program for remote monitoring and device control will be integrated into the cloud. The smart switchboard prototype is being transformed into a solution for home and workplace automation.

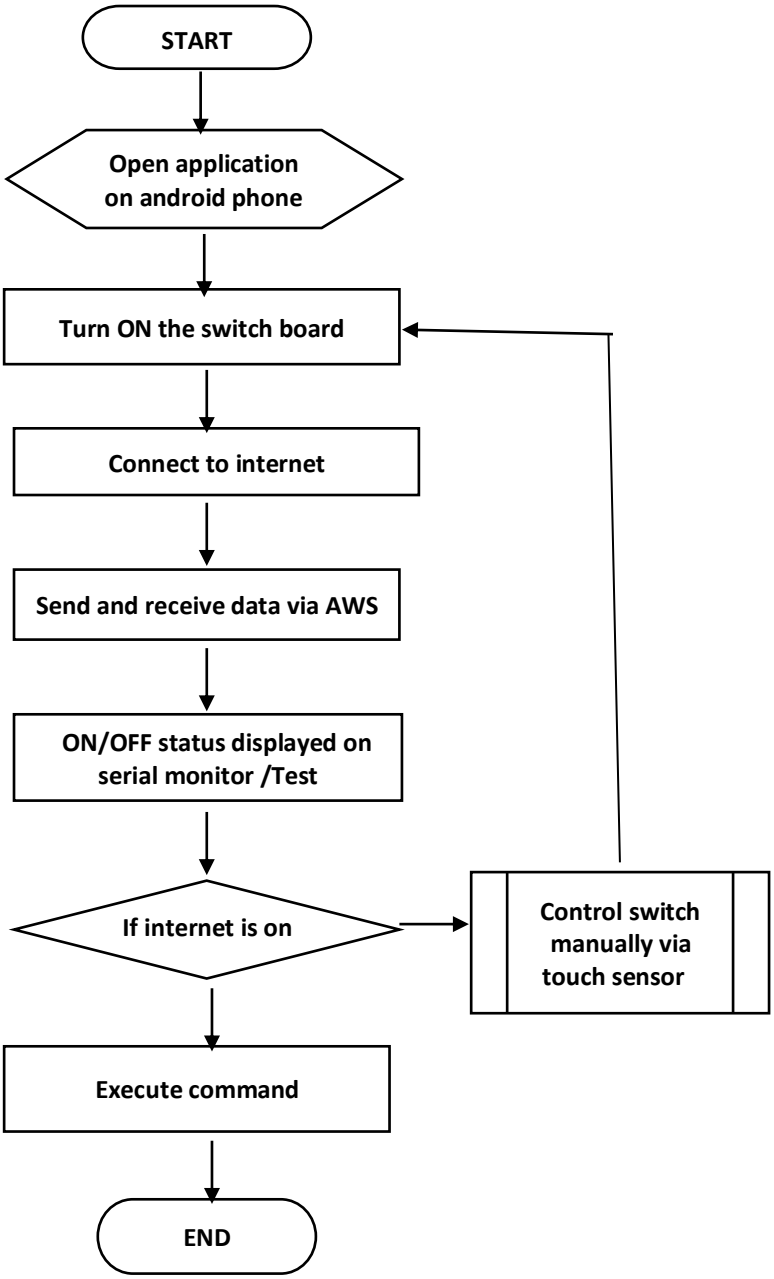

Fig.2. Flowchart for Proposed Methodology

A. Touch Sensor:

Here we've got a used touch sensor with IC TTP224. Which takes input and supplies that information to a controller. Operating voltage 2.4V~5.5V. For each touchpad, the capacitances outside can change the sensitivity. By using the pad, you may choose between Fast and Low Power modes. After powering on, wait around 0.5 seconds before touching the keypad; else, the feature will be disabled.

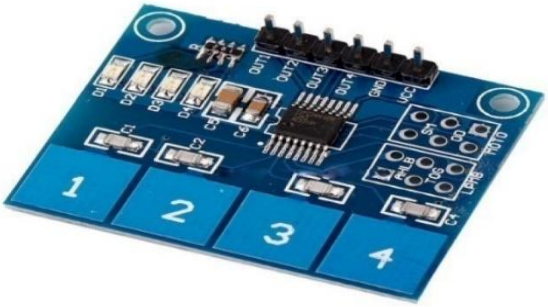

Fig.3. Touch Sensor Module

A touch sensor is a gadget or instrument that recognizes and analyses physical connection or embraces. Touch sensor admits a tool or object for sensing touch, generally through the usage or operator of an individual. Tactile sensors are touch sensors that are responsive to touch, force, or pressure.

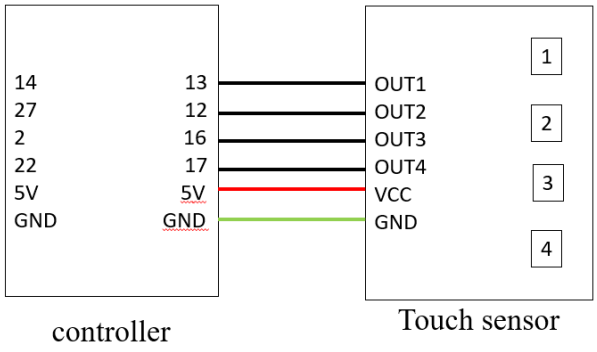

Fig.3. Circuit Diagram of Touch Sensor with Controller

A 6-channel capacitive touch sensor could be the item in question. The project is based on the TTP224 IC, which features six (4) separate capacitive touch sensor inputs with configurable sensitivity for use in fine-tuned sensor applications. Each sensor input is calibrated to compensate for parasitic capacitance in the system and automatically recalibrated to compensate for environmental changes. The TTP224 features Multiple Pattern Touch recognition that permits the user to pick a selected set of buttons to be touched simultaneously. If this pattern is detected, a standing bit is about and an interrupt is generated.

B. Controller

Controllers are the brain of an intelligent home automation system. they permit you to integrate and control security, heating, and air lighting. It has Multi- connections. Broadcast encryption, Authentication and encryption, Secure Simple-Pairing.

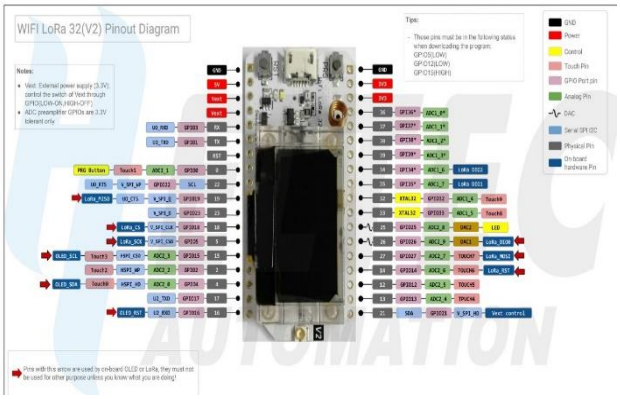

Fig.5. Pin Configuration of ESP32S

The ESP32S can work as a single application or as a slave module to a hosted MCU, freeing up the service feature CPU from protocol suite overhead. The ESP32 may provide Wi-Fi and Bluetooth functionality to other systems via its SPI / SDIO or I2C / UART interfaces. The ESP-32S can be used to build active products that accept inputs from various of switches or sensors and loads connected, actuators, and other output devices. Projects on the ESP-32S can be done on their own or in collaboration with source code on windows System. It is used for processing serial data from sensors, comparing data with predefined values, and controlling appliances and data from the cloud. It is also able to control data according to the input from the switch available on boards, providing feedback to indicate whether the home appliance is on or off.

- The Heltec Wi-Fi Lora 32 V2 is an ESP32S development kit of 8 MB of flash memory which uses the EPS32S microprocessor. It includes a Lora WAN module from Semtech (SX1276 or SX1278) and an SSD1306 0.96-inch 128x64 OLED display connected via I2C.
- The Node MCU IoT platform is free and open-source. It comprises both software and hardware for the ESP8266 Wi-Fi SoC and the ESP-12 module. The Node MCU is used to determine the module's internet connection to the cloud. It's a network layer-specific microcontroller. NodeMCU-32S is a Lua Wi-Fi IoT development board that is compatible with the Node MCU ESP-32S controller board. The event board maintains Node MCU's classic look.

C. Channel relay module

The relay module is an occasional Level 4- channel 5V relay board, and a 15- 20mA driver current is needed by every channel. Relay is wont for controlling several devices and equipment with a large current. It is furnished with high-current relays that job in AC250V 10A or DC30V 10A. it is a typical alliance which a microcontroller will control directly.

A relay works as a switch which has the capability of switching many circuits that can be either separate, concurrent, or in series. A relay is used by the exponents to accommodate 3 output devices. Node MCU's output pins are linked to every of the input pins of the module.

Characteristics:

- Rough, epoxy capsulated architecture
- Optical isolation – 4,000 volts
- In between encapsulating, exposed to maximum power testing and 6 times the average electrical surges
- Thermal mechanism is unique
- Guaranteed for life

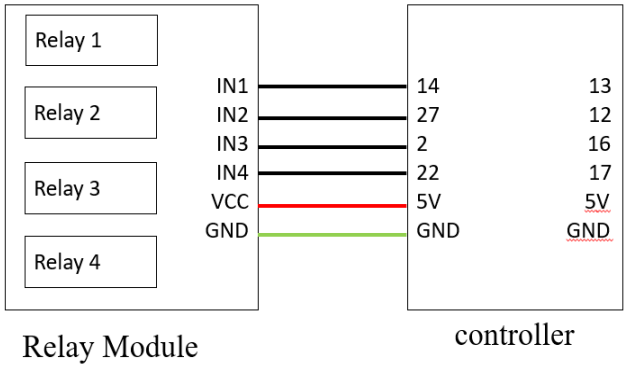

Fig.6. Circuit Diagram of Relay Module with ESP32S

D. Cloud

Data is frequently stored in the cloud. It provides data storage, servers, databases, networking, and software services over the internet. Cloud memory admits to avoid wasting folders on a distant dataset and access whenever you need them.

Browser sites, program and datasets which work on such web server, often referred to here as "server." Internet servers are located in cloud services all over the globe. Systems eliminate the need for individuals and organizations to manage data centers or execute operating systems upon their computers. Clouds computing is a decentralized virtual machine which offers clients liquidity computer solutions.

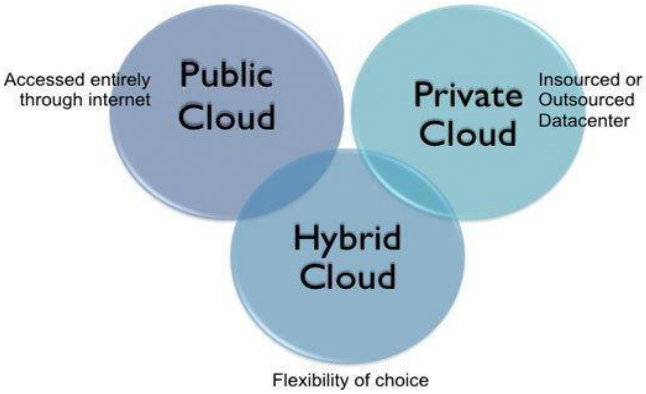

Fig.7. Types of Cloud

Users of the cloud can give more consistent, available, and updated services to their customers. Physical devices placed in cloud providers' data centers make up the cloud. These services are accessible via the internet everywhere in the globe, with the server functioning as a single contact for all consumers. Cloud computing is divided into four types:

Personal clouds: Personal cloud is kept within a business and is only utilized for internal purposes. HP Data Centers, Microsoft, and Ubuntu, for example.

Public clouds: In public clouds, a company rents cloud services from cloud providers on an as-needed basis. The utility computing model is used to provide services to users. Amazon EC2, Google, and Azure, for example.

Hybrid clouds: Clouds that are hybrids are made up of various internal or exterior clouds. When a company switches from its own private cloud to the public cloud, this is a possible scenario. Amazon Web Services and Microsoft Azure, for example.

Multi clouds: This type of cloud is made up of multiple cloud vendors, either public or private. Multi-clouds are hybrid clouds, however not all hybrid clouds are multi-clouds. When various clouds are connected by some type of integration, they become hybrid clouds. Two public Infrastructure as a Service (IaaS) providers and a public Platform as a Service provider are included (PaaS).

E. MIT App

MIT App Inventor could be a Google-developed web application integrated development environment. An App Inventor is a tool that allows you to create Android apps using an application. Your work is saved on the App Inventor servers, which makes it easier to maintain track of your projects. The MIT app inventor assists in the remote control of home appliances.

App Inventor allows you to create Android applications using a web browser and either a connected phone or an emulator. Your work is saved on the App Inventor servers, which makes it easier to maintain track of your projects. The App Inventor Blocks Editor is where you put together programmer blocks that tell the components how to work together.

The Massachusetts Institute of Technology may manage MIT App Inventor, a web application integrated development environment that was previously offered by Google and is now maintained by the Massachusetts Institute of Technology (MIT). It enables novice programmers to create application software (apps) for two operating systems.

(OS): Android and iOS, both of which are in final beta testing as of July 8, 2019. It's free and open-source software with two licenses: an ingenious Commons Attribution Share Alike 3.0 Unported license for the ASCII text file, and an Apache License 2.0 for the rest. It employs a graphical user interface (GUI) similar to that of the programming languages Scratch (programming language) and Star Logo, which allows users to drag and drop visual objects to create an app that runs on Android devices, while an App-Inventor Companion (the program that allows the app to run and debug on iOS devices) is still in development. Google drew on extensive earlier research in educational computing as well as internal Google work on online development environments to create App Inventor. Constructionist learning theories, which highlight that programming can be a vehicle for engaging powerful ideas through active learning, are supported and guided by App Inventor and hence the other initiatives. As such, it's a part of an ongoing movement in computers and education that began with the work of Seymour Paper and therefore the MIT Logo Group within the 1960s and has also manifested itself with Mitchel Resnick's work on Lego Mind storms and Star Logo. App Inventor also supports the utilization of cloud data via an experimental Firebase #Firebase Real Time Database component.

IV. HARDWARE IMPLEMENTATION

The system's hardware architecture consists of a USB-powered Node MCU that is connected to a four-channel relay module through a 230V power supply. The relay can be used to link a variety of home equipment. The internet address 80 has been put into the Node MCU. The client can use it to upload data and change the status of the GPIO pins. As a result, the relay linked to the relevant GPIO pin can be controlled.

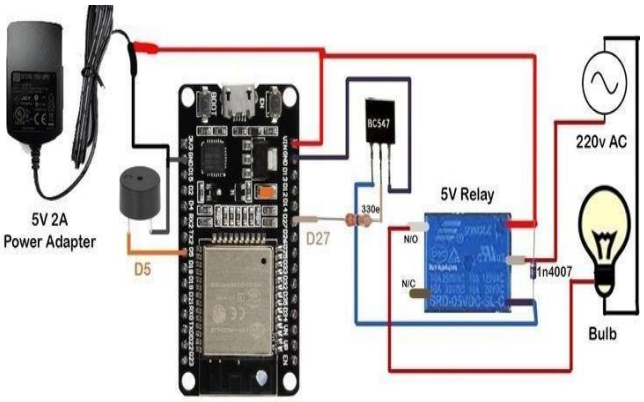

Fig.8. Hardware Architecture

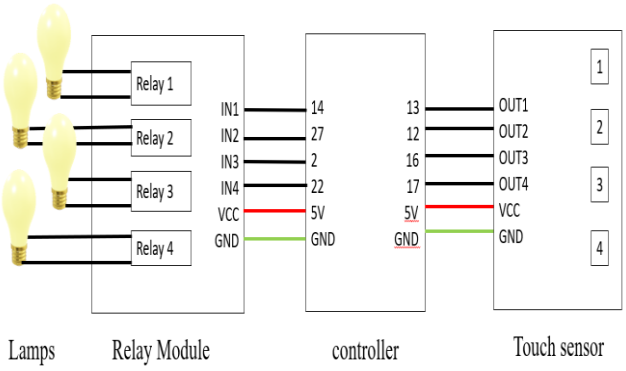

Fig.9. Circuit Diagram of Switch Board

V. RESULT

We have successfully controlled home appliances via controller ESP32S Heltec, the size of switch board was reduced by the use of touch sensors. Data sending and receiving was implemented easily and securely through AWS. The users are able to operate switch board remotely.

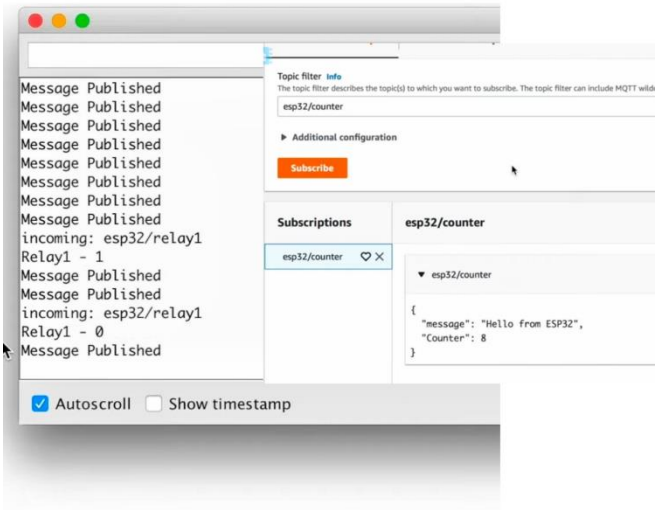

Fig.10. Serial monitor and AWS MQTT output

VI. CONCLUSION

Users can control home appliances with the Smart Switch Board based on IoT. The online application provides a framework for controlling home appliances. The Node MCU is used by the smartboard to be controlled all components inside the smartboard. The Node MCU is equipped with a low-cost, high-power board. This system has the following qualities when compared to other home automation systems: Other home automation systems are more expensive. It is a small, portable board that can operate basic household equipment such as fans and tube lights. The smartboard examines the use of electrical frameworks and generates a report on electricity usage. The smartboard is controlled by a web app that can be modified.

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