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An Smart Home Automation by Using IoT with Link Cloud

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ABSTRACT: The evolution of home automation has been revolutionized by the integration of cloud computing, offering scalable and accessible solutions for modern living. Link Cloud stands at the forefront, providing a unified platform that seamlessly connects and manages a variety of smart devices. The technical framework of Link Cloud, highlighting its ability to synchronize and control devices such as thermostats, lighting systems, and security cameras through intuitive web and mobile interfaces. Link Cloud's integration with cloud technology empowers users with remote monitoring and control capabilities, enhancing energy efficiency, security, and overall convenience. Real-world applications demonstrate its effectiveness in optimizing home environments, improving daily life, and reducing operational costs. As the demand for interconnected smart devices continues to grow, Link Cloud sets a new standard by overcoming compatibility challenges and simplifying device management. In summary, Link Cloud represents a significant advancement in home automation, offering homeowners unparalleled control and efficiency. By leveraging cloud capabilities, Link Cloud not only enhances the functionality of smart devices but also transforms living spaces into intelligent environments that adapt to modern lifestyles seamlessly.

KEYWORDS: Cloud Computing, Integration, Remote Monitoring Energy Efficiency, Security, Scalability, User Experience Analysis

I. INTRODUCTION

Home automation is become more beneficial because of its safety and security. Nowadays, home automation become more advance and precise to monitor all the home appliances.[2-3] Home automation system become energy efficient and highly approachable smart home technique. It involves basic feature to maintain the user satisfaction and comfort. Home automation is a unique system that can control and communication between nearly all aspects of your house. Home automation is a term used to describe the working together of all household amenities and appliances.[5] for example, a centrally microcontroller panel can have the capability to control everything from heating and overall electrical appliances. [1] Home automation can include controlling aspects of our home remotely through a computer or any mobile equipment, programming electronics devices to conditions or scenario or centralizing the control of a variety of appliances in us in to a single control center.[6-7] It is essential that the different controllable appliances be interconnected and communication with each other. The main purpose of home automation is to control or monitor signals from different appliances or basic services. A smart phone can be used to control or monitor the home automation system. Home Automation is a system that allows users to control various appliances of varying kinds and also makes controlling of home appliances easier and saves energy. Nowadays, home automation is used more and more. On the other hand, it provides increased comfort especially

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when everyone is busy with their work. Home automation installed in houses does not only increase comfort but also allows centralized control of heating, ventilation, air-condition, and lighting.[8-9-10] Hence, they contribute to an overall cost reduction and also useful in energy saving which is certainly the main problem today. In present years, wireless systems like Wi-Fi, Bluetooth have become more and more common in-home networking. Also in home automation, the use of wireless technologies gives several advantages that could not be achieved using a wired network only.[15] Home Automation Components: At the most initial level, home automation systems are made up of three elements- A smart device, A hub, A connected application.[16-17]

While some other home automation systems work with just two elements which include a single device that works with the help of an app on mobile or a tablet or a system that includes a hands-free hub that controls home automation system while most of the systems work using all the above three components.[14]

Smart Devices: These are the real powerhouse of any home automation system. These are the main parts that actually implement the whole system commands. Examples of the smart devices which can be added to any home automation to complete the whole system are as follows:

Access Control: Security Devices: This includes security cameras, smart locks.

Home Appliances: Smart refrigerators, washing machines, dishwashers, and ovens already exist. Smaller **Appliances:** As automatic coffee pots and electric kettle have been also around for a while too Climate Controls: Climate control system with energy management systems Smart Thermostats. Entertainment Pieces: Entertainment includes smart TVs, wireless speakers, and film projectors

Health Care Devices: Smart humidifiers and smart scales are two common examples of health care devices. Lighting Controls: They include dimmers, light bulbs, light strips, and switches, etc. A high-speed internet plays an important role in smooth connectivity and also plays an important reliable performance between Wi-Fi- enabled devices.

Smart Hubs: The hub is the controlling center of the home automation system. It is the piece that connects your individual devices and helps them talk to one another.

Mobile Apps: The mobile application provides an interface between the user and the system. It gives you the ability to control or monitor your smart devices remotely. They can be easily downloaded with the help of a provided application on mobile and provide access control of the system, power controls, timer access, and many more things.

(a) Proposed system: This is IoT project, it's to make a simple ESP32 IoT smart home automation using Blynk & IR remote to control 8 relays with and without the internet. With this ESP32 project, it can control 8 home

Appliances from the smartphone, IR remote, and manual switches. If there is no internet available still it can control the relay module from the IR remote and manual switches.

(b) Proposed system functions: In this project required following component for this ESP32 home automation system and smart relay module PCB. ESP32 DEV KIT V1, 8-channel 5v SPDT relay module, TSOP1838 IR receive (with metallic casing), Switches or Push Buttons, Any IR remote.

II. METHODOLOGY

In this ESP32 project, I have explained how to make the Tasmota ESP32 Alexa voice control home automation system to control 8 relays from the Amazon Alexa app and manual switches. You can also connect the DHT11 sensor with Tasmota and monitor the room temperature. This Tasmota ESP32 home automation system has the following features:

Control 8 appliances with Amazon Alexa voice control. Control 8 appliances manually with switches or pushbuttons. Control the ESP32 without internet.

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Get real-time feedback in the Amazon Alexa app.

Monitor room temperature with DHT11 sensor. All the tools used are FREE & open source.

1) ESP32 DEVKIT.

2) 8-channel 5V SPST Relay Module.

3) DHT11 Sensor.

4) Switches or Pushbuttons.

5) Amazon Echo Dot.

Project Planning:

1. Home automation is a network of hardware, communication, and electronic interfaces that work to integrate everyday devices with one another via the Internet. Each device has sensors and is connected through WIFI, so you can manage them from your smartphone or tablet whether you're at home, or miles away.

2. This allows you to turn on the lights, lock the front door, or even turn down the heat, no matter where you are.

3. There are three main elements of a home automation system: sensors, controllers, and actuators.

4. Sensors can monitor changes in daylight, temperature, or motion detection. Home automation systems can then adjust those settings (and more) to your preferences.

5. Controllers refer to the device's personal computers, tablets or smartphones used to send and receive messages about the status of automated features in your home.

6. Actuators may be light switches, motors, or motorized valves that control the actual mechanism, or function, of a home automation system. They are programmed to be activated by a remote command from a controller.

Brain storming:

As you probably know, smart home gadgets and home automation are getting a lot of attention these day by large companies like Samsung, Apple and Google. But there can be a wide gap between the ability to link DIY gadgets together across a wireless network and a true custom home automation system. Choosing the best smart home system takes time and research. The ability to manage your home's electronic systems from one main control system can make your household run smoother, feel better and save energy. The trick is to find a solution that will meet all the demands of your household, now and in the future. Most custom home automation systems can be tailored by a professional to provide all the benefits you desire, but there are some key features that will make the job easier and your interaction with your system more enjoyable.

Interoperability:

The beauty of an automation system is its ability to tie diverse electronic devices together so they can perform as one unified system. Getting these devices to work cohesively can be simple or complex, depending on the "openness" of the automation system. The more open a system is, the easier it will be for the lights, thermostats, audio/video equipment, security devices, motorized shades and other electronics to communicate with each other. A good example of interoperability is having the lights turn off, the thermostats set back when you press a "goodbye" button on a keypad or when a motion sensor notices that you have exited a room. To support

Interoperability between multiple electronic devices, manufacturers of home automation systems often form connectivity partnerships with other manufacturers. For example, Control4 has partnered with more than 60 other companies to ensure its line of automation products can communicate seamlessly with a wide variety of other systems— from architectural lighting and irrigation, to multi room audio. Another way automation manufacturers are fostering interoperability is through adherence to technology standards. For example, many manufacturers have embedded Z-Wave wireless control technology into their automation products so those products can network easily with other Z-Wave enabled products. The

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more connectivity partners a manufacturer has formed and standards it has adopted, the more choices you'll have as a consumer. More importantly, says CE pro Bill Charney of Advanced Home Audio, Shelton, Conn., "It allows installers to select the best suite products for their clients

Remote Access:

"Automation is all about being able to control things in your home," says Jay McClellan, president of Leviton Security & Automation, "and part of that is being able to change the settings quickly and easily if your plans change." More often than not, plans change when you're not at home, so being able to communicate those changes to your home automation system remotely is one of the most revered features of an automation system. Remote access capabilities allow you to monitor your home's environment and alter the settings of the lights, thermostats and other gear, if necessary, all from your laptop, cell phone or touch. McClellan believes that remote monitoring should be a service manufacturers and installers provide free of charge. "Why should you pay $30 a month to access your automation system when you're already paying for broadband access?" he suggests. Remote access also allows your installer to tweak your system without having to make a house call, which is always cheaper and more convenient.

Expandability:

The way you live in your home five years from now will probably be much different than the way you live in your home today. Moreover, technology will continue to evolve, introducing a completely new generation of products to the marketplace. In the future, you may also want to add new rooms like a recently finished basement or an addition off the back to your automation network. Or, you may simply want to start out with just a few features when you first put in your system then add new capabilities later as you have the money. For these reasons, it's important that a home automation system can be easily expanded vertically to incorporate additional products and horizontally to support additional rooms. Manufacturers can support vertical and horizontal expandability by designing their systems to speak a common network language, like IP (Internet Protocol), and by offering wireless retrofit table products that can communicate via a home's existing network of wired products.

Constrains & Assumptions:

In the beginning of the design process, we faced certain constrains and made some assumptions. Some of constrains are:

1. Due to the limited time constraints and also due to hardware inaccessibility and cost restrictions, it was assumed that readily available sensors are used on all the devices and no special programmer design is followed for the same. Also, this project would be implemented in phases so that it would be easier to track and make- changes. The scope of this project would remain at just controlling the system internally; the hardware aspects of this would be dealt with in the next phase. According to the devices, the assumptions are categorized as below.
2. Next phase. According to the devices, the assumptions are categorized as below.
3. The following are the assumptions for operating the front and the rear doors: Sensor on the door, which is a magnetic sensor, is always indicating the door is always closed. There are 2 doors and each has a different magnetic sensor attached to it. When the sensor detects a HI, the magnetic sensor automatically closes the door. This is achieved since a magnetic sensor is used
4. The following are the assumptions for operating the window: The system covers all the windows. A +5V power is supplied to the system. Only the status of the window is checked for and if the window is open then the system.

Buzzes until it is manually turned off. The default state of the window is LO. The sensor on the window, which is same as the sensor on the door, a magnetic sensor, is always on low indicating the window is closed always.

III. MODELING AND ANALYSIS

The 8-channel relay board is connected to GPIO (General purpose input output) pins of the ESP 32 Dev kit 1 by the jumper wire. We make sure that all the soldered pin are properly fixed nit and tight. After the part of soldering, we connected the 5-

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volt dc supply to the power input pins of the ESP 32 aboard and tested the circuit for any damage or loose connections we need to connect to the serial programming interface of the ESP chip. This is done by connecting our serial-to-USB converter TX and RX pins to the ESP RX and TX pins and powering the chip with the 3.3V and GND pins. In most cases those pins are available on the PCB in the form of pin holes or solder pads but pin headers or jumper wires need to be soldered or otherwise applied. In some cases, you will need to solder wires directly on the chip's pins which requires some experience and good soldering equipment.

1. Uploading Tasmota firmware to ESP 8266 NodeMCu:

Flashing Tool - o Tasmota Web Installer - flash Tasmota using a Chrome based browser for ESP82XX and ESP32 o Traumatizer - flashing and firmware download tool for ESP82XX only. (Windows, Linux or Mac) o ESP-Flasher
- GUI flasher for Tasmota based on esptool.py for ESP82XX and ESP32. (Windows, Linux or Mac) o Esptool.py - the official flashing tool from Expressive for ESP82XX and ESP32. (Requires Python)

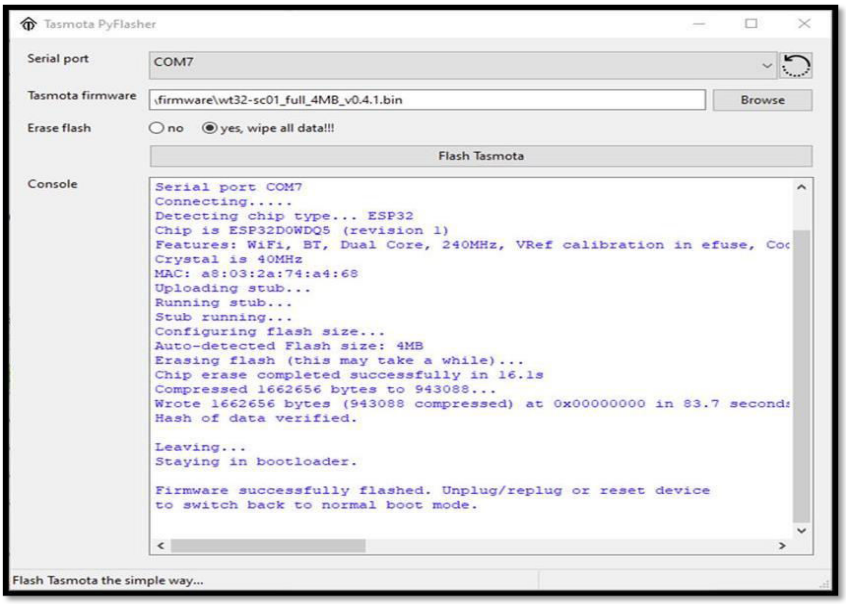

Figure 1: Uploading software to ESP 32

To show the ESP board on the desktop we need to update the driver of the system by installing proper driver for ESP 32 board the chip will be shown as name of port (COM-3) then select the port for upload the code, by selecting the port 3 browse the “Tasmota32bin” file in the desktop files. Select the file and hit flash button on the flasher tool then press the boot button on the esp32 board. After all this the code will start to upload slowly, the uploading time of the code will be taken around 1 - 2 min. after the code completion the flasher toll will show done !!, so our programmed is successfully uploaded.

To put the ESP into Programming Mode:

1. Disconnect serial-to-USB adapter and power
2. Bridge GPIO0 and GND (by pressing the on-board button or connection with a wire)
3. Connect the serial-to-USB adapter to your computer
4. After a few seconds disconnect GPIO0 from GND (release button or remove the wire connection). On devices that do not provide the GPIO0 connected button, it may be easier to leave the wired bridge in place throughout

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The entire flashing process (erase & upload). Doing so will not create any problems. After the firmware is uploaded successfully, remove the bridge. This allows the device to boot normally.

2. Configure the tasmota interface:

Figure 2: User interference of tasmota

Figure 3: Setting interference of tasmota

After uploading the program the ESP 32 showed hotspot connectivity option then we connected one of the mobile to the hotspot of ESP 32 by this the user interference of the esp. board showed on the mobile screen then we connected the ESP board to WIFI of the home , so the esp. board is connected to WIFI successfully then the board shows default IP address of the device which is (192.168.1.106) after putting this IP address in the other mobile the device shows the user interference of the tasmota software .(Figure 2) Then we configured the module as per the 8-channel relay below diagram shows how we configure the module. (Figure 3)

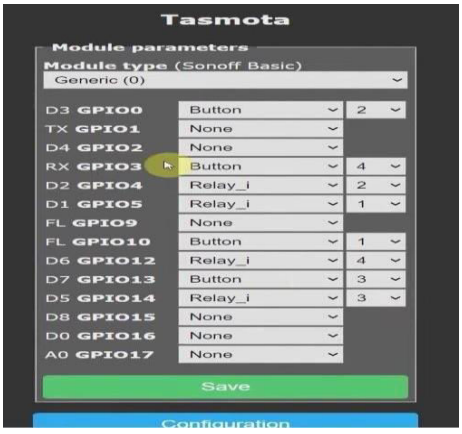

Figure 4: Setup of relay.

By using tasmota software we gave the output function (Relay) to the required GPIO (General purpose input output) pins , then we named those GPIO pins as relay 1 , relay 2 , relay 3 till relay 8 After giving the relay names to respective

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relays we completed the device setup. (Figure 4)

3. Connecting the Alexa to ESP device:

For connecting the Alexa to ESP 32 board we need to connect both devices to the same network or WIFI this enable the MQTT protocol to access the device communication this enables the Alexa to control the appliances by voice command and by app in Mobil e phone.

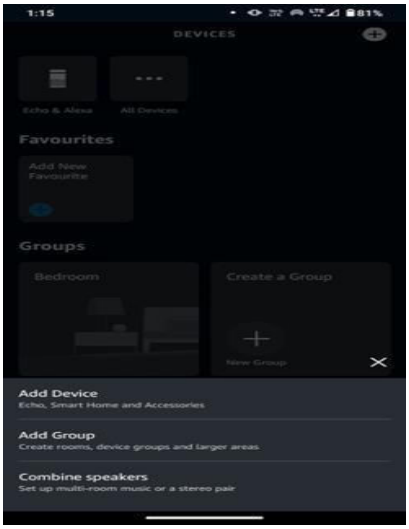

Figure 5: Add device option

Figure 6: PCB with electronic components

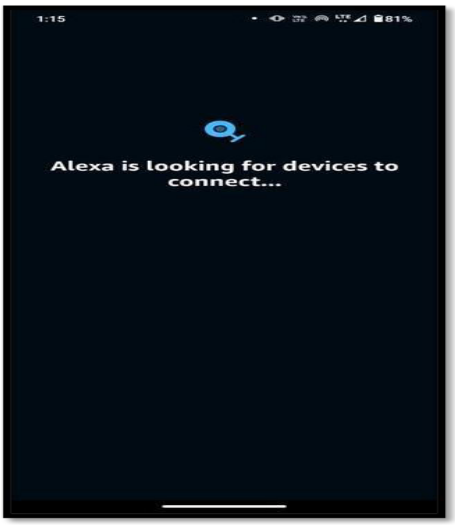

Figure 7: Discovering devices

To connect the ESP board to Alexa echo dot, open Alexa app and tap on the devices then tap on add devices the app will open next menu on the screen(Figure 5)

Above screenshot shows the option of 'Discover new devices' Click on that. Alexa will start to discover the devices after 45 sec. Alexa will show 8 devices added then we have to quickly add the devices to Alexa app. Now the automation part is completed circuit board Model and Material which are used is presented in this section. Table and model should be in prescribed format. (Figure 7)

IV. RESULTS AND DISCUSSION

1. **Testing Result and application**

Sr.No.	Description	Input data	Expected Results	Actual Result	Status
1.	Is Wi-Fi device start?	Search in mobile.	Should find in the mobile device in Wi-Fi Section.	It's found and get ready to pair	Pass.
2.	Allow to pair with password?	Input the password	It accepts password and pair with each other.	Mobile and circuits are connected to each Other via Wi-Fi.	Pass.

Table 1: Troubleshoot chart of ESP 32 V1

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Sr.No.	Description	Input data	Expected Result	Actual Result	Status
1.	Check whether circuit start or not	5V D.C. supply are plug.	Circuit gives a LED signal	It starts working	Pass
2.	Is there device connected and works?	Ex: - fan, light	It's working when we give voice command on Alexa.	Light working properly with 230V	Pass
3.	Is there device connected and also stop the working Devices?	Ex: - fan, light	Its working we give voice command on Alexa which already started its must be Off.	Light working properly with 230Vit gets stop	Pass

Table 2: Test case for Circuits

Figure 8: Working Kit

Figure 8 shows a basic setup for a home automation system using an ESP8266 microcontroller and a relay module. Here's a detailed explanation of the components and their connections:

1. ESP8266 Node MCU - This is a microcontroller with built-in Wi-Fi capability, often used for IoT (Internet of Things) projects. It can be programmed using the Arduino IDE or other programming environments.
2. Relay Module - This module contains multiple relays, which are electrically operated switches. Each relay can control a high-voltage device like a light bulb. The relays are connected to the ESP8266 to receive control signals.
3. AC Input - The AC power source is connected to the relay module to provide power to the light bulbs.
4. Light Bulbs- These are the output devices controlled by the relays. Each bulb is connected to a relay which, in turn, is controlled by the ESP8266.
5. Switches- Manual switches are connected to the relay module, allowing for physical control of the light bulbs. Each

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switch is likely wired in parallel with the relay control, so either the manual switch or the ESP8266 can control the light.

How It Works

The ESP8266 can be programmed to connect to a cloud server or a local network, allowing remote control of the light bulbs through a smartphone app or a web interface. When a control signal is sent from the cloud to the ESP8266, it triggers the appropriate relay, turning the corresponding light bulb on or off. The manual switches provide an alternative way to control the light bulbs directly, without needing to use the cloud interface.

Using Linked Cloud

The term "linked cloud" refers to integrating the home automation system with cloud services. This could involve:

Real-time control- Sending commands from a cloud-based app to the ESP8266 to control the relays.

Monitoring and Analytics-Collecting data from the ESP8266 (such as the status of the relays) and storing it in the cloud for monitoring or analysis.

Automation Scripts-Running cloud-based scripts that automatically control the relays based on predefined conditions (e.g., turning on lights at sunset).

V. CONCLUSION

In this paper we present a setup of home automation using IoT and Node MCU (ESP8266) along with a live monitoring system by the ESP32 CAM module. This system has a vast scope and limitless applications. When implemented its full potential, it can help minimize energy consumption. Using the IoT connectivity, we can monitor and access our smart home easily from anywhere, which will definitely will prove to be energy efficient. It acts as helping hand for the old age and physically impaired person. For future work we would like to add up more controlling units that can make our smart home more intelligent. With the knowledge of new techniques in 'Electronics' we are able to make our life more comfortable. One such application of electronics is used in "Industrial Automation using Android Mobile via Wi-Fi" The approach we followed and which is explained in this project report is novel and has achieved the target of "Home Appliances Controlling using Android Mobile via Wi-Fi" satisfying user needs and requirements. Home Appliances Controlling using Android Mobile via Wi-Fi is automatic versatile system. It can be implemented in industry, home, agricultural field, remote and hazardous applications. It provides the flexibility & system reliability with low cost as well as less maintenance. It provides remote access to the system to deliver service at any time of the day. With this System, we can control as well as monitor the devices at remote location.

The development of this project has shown how much hard work goes into the creation of a system. "Home Appliances Controlling using Android Mobile via Wi-Fi" was a project based on microcontroller, due to which hardware requirement is reduced. Embarking of this project has helped us in developing a team spirit, patience and time management necessary for today's technical professionals. This project has built in us confidence that any problem can be solved with sheer determination, hard work and optimism.

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