Home Automation using IOT

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Abstract

This project presents the overall design of Home Automation System (HAS) with low cost and wireless system. It specifically focuses on the development of an IOT based home automation system that is able to control various components via internet or be automatically programmed to operate from ambient conditions. In this project, we design the development of a firmware for smart control which can successfully be automated minimizing human interaction to preserve the integrity within whole electrical devices in the home. We used Node MCU, a popular open source IOT platform, to execute the process of automation. Different components of the system will use different transmission mode that will be implemented to communicate the control of the devices by the user through Node MCU to the actual appliance. The main control system implements wireless technology to provide remote access from smart phone. We are using a cloud server-based communication that would add to the practicality of the project by enabling unrestricted access of the appliances to the user irrespective of the distance factor. We provided a data transmission network to create a stronger automation. The system intended to control electrical appliances and devices in house with relatively low cost design, user- friendly interface and ease of installation. The status of the appliance would be available, along with the control on an android platform. This system is designed to assist and provide support inorder to 1fulfil the needs of elderly and disabled in home. Also, the smart home concept in the system improves the standard living at home.

Keywords-HomeAutomation using IOT.

INTRODUCTION

In the rapidly evolving landscape of technology, the convergence of home automation and the Internet of Things (IoT) has revolutionized the way we interact with our living spaces. This project embarks on a journey to elevate traditional homes into intelligent abodes, leveraging the power of IoT cloud services to enhance control, accessibility, and efficiency.

At the heart of this endeavor lies the NODEMCU ESP8266, a versatile microcontroller renowned for its compatibility with IoT applications. Paired with a 4 Ch Relay Module, this setup forms the nucleus of our home automation system, bridging the gap between digital commands and physical devices. Complemented by essential tools such as the Breadboard, Jumpers, and everyday appliances like bulbs and sockets, our project is poised to transform the mundane into the extraordinary.

Central to our approach is the integration of IoT cloud services, which serve as the conduitthrough which commands are transmitted and executed. By harnessing the power of the cloud, users gain the ability to remotely monitor and control their homes from anywhere with an internet connection. Whether adjusting lighting preferences, managing

electrical appliances, or scheduling routines, the possibilities for customization are limited only by imagination.

This project report serves as a roadmap, guiding readers through the intricacies of implementing home automation using IoT cloud services. From the initial setup to the seamless integration of components, each step is meticulously documented to empower enthusiasts and beginners alike to embark on their own journey towards a smarter, more connected home.

The discussion delves into the significance of creating a smart living space, emphasizing the potential for real-time monitoring and remote control using Arduino devices connectedto the IoT Cloud. The Arduino IoT Cloud ESP8266 Home Automation System redefines modern living by seamlessly integrating Arduino boards, particularly the ESP8266 module, with the powerful Arduino IoT Cloud. This project envisions a smart home environment where devices intelligently respond to user preferences. Utilizing a comprehensive array of electronic components, the system enables real-time monitoring and remote control viathe IoT Cloud platform. Anticipated outcomes include heightened user convenience, energy efficiency, and improved security. With a clear focus on the future, the project explores potential expansions and advancements, laying the foundation for an intelligent and interconnected living space.

Phenomenon:- Highlighting the relevance and impact of the project in the context of home automation, this section addresses the increasing demand for intelligent and interconnected living spaces. It explores how the integration of Arduino and IoT technologies contributes to theenhancement of daily life through automation and smart control systems. As the demand for intelligent, interconnected homes rises, this project emerges as a pioneering solution. Itaddresses the growing need for seamless integration of technology into daily life, fosteringconvenience, efficiency, and security. By combining Arduino boards, specifically the ESP8266 module, with the Arduino IoT Cloud, the system empowers users to remotely monitor and control devices in real-time. This not only enhances the quality of living but also contributes to energy conservation and improved safety. The project's significance liesin its potential to revolutionize traditional living spaces, paving the way for a future wherehomes dynamically adapt to occupants' needs, heralding a new era of smart and responsiveenvironments.

Objectives:- In an era marked by technological advancement, the concept of home automation has emerged as a beacon of convenience and efficiency. Leveraging the power of the Internetof Things (IoT), this project endeavors to transform traditional households into smart homes, where every aspect of living is seamlessly interconnected and controllable at the touch of a button. The backbone of this project lies in the integration of NODEMCU ESP8266, a versatile microcontroller, with a 4 Ch Relay Module, which serves as the bridgebetween the digital realm and physical devices. Complemented by essential tools like Breadboard, Jumpers, and everyday appliances like bulbs and sockets, this setup forms thefoundation upon which the automation of various household tasks is built**.**

Purpose:- The future scope for the Arduino IoT Cloud-based home automation system using the ESP8266 NodeMCU is promising, with potential advancements and enhancements in several areas:

o Integration with Emerging Technologies: Incorporate emerging technologies such as artificial intelligence (AI), machine learning (ML), and edge computing to enablemore intelligent and autonomous decision-making within the home automation system. This could involve predictive analytics for energy management, personalized recommendations for user preferences, and adaptive automation basedon user behavior patterns.

o Enhanced Security Features: Implement advanced security measures such as end- to-end encryption, biometric authentication, and blockchain-based authentication to enhance the security and privacy of the home automation

system. This would address concerns regarding unauthorized access, data breaches, and privacy violations.

o Expansion of Device Compatibility: Expand compatibility with a wider range of IoT devices and protocols to support interoperability and seamless integration with third-party smart home devices and platforms. This would allow users to mix and match devices from different manufacturers and ecosystems, providing greater flexibility and choice.

o Augmented Reality (AR) and Virtual Reality (VR) Integration: Explore AR and VRtechnologies to create immersive interfaces for monitoring and controlling home automation systems. This could involve visualizing sensor data and device status in3D space, enabling users to interact with their smart home environment in new andintuitive ways.

TECHNOLOGY

1. NODEMCUESP8266 microcontroller

The NODEMCU ESP8266 is a popular and versatile microcontroller board based on the ESP8266 Wi-Fi module. It combines the capabilities of a microcontroller with built-in Wi-Fi connectivity, making it an ideal choice for Internet of Things (IoT) projects. Here are some key features and characteristics of the NODEMCU ESP8266:
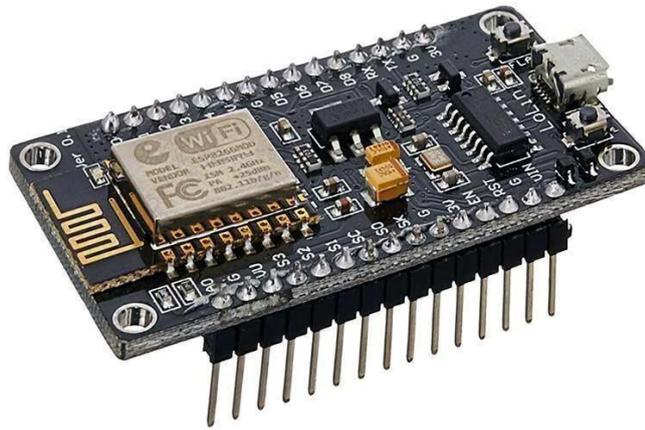
Fig: 4.1.1.1 NODEMCU ESP8266 board

The NODEMCU ESP8266 microcontroller board features several GPIO (GeneralPurpose Input/Output) pins that can be used for various purposes such as digital

input/output, analog input, PWM (Pulse Width Modulation) output, and communication interfaces. Here's a description of the commonly used pins on the NODEMCU ESP8266:

1. GPIO Pins (General Purpose Input/Output):

HARDWARE COMPONENTS

1. NODEMCU ESP8266 microcontroller

2. 4 Channel Relay Module

3. Jumper wires

4. LED bulbs and sockets

5. Push buttons

(Inter-Integrated Circuit) for interfacing with I2C devices.

These pins can be configured and controlled programmatically using software development environments like Arduino IDE, Lua scripting language, MicroPython, etc., allowing developers to interface with various sensors, actuators, and communication devices to build IoT applications. It's essential to consult the NODEMCU ESP8266 pinout diagram specific to your board version for accurate pin assignments and functionalities.
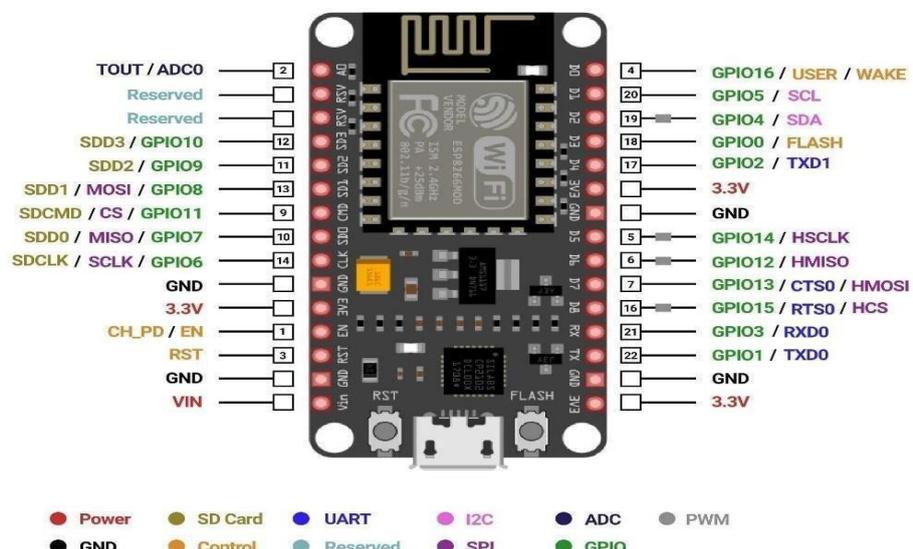

Fig:4.1.1.2 Pinout diagram of NODEMCU ESP8266

WORKING:

In this Arduino IoT cloud project, I have explained how to make Arduino IoT Cloud ESP8266 NodeMCU Alexa Home Automation system. With this NodeMCU ESP8266 project, you can control **4 home appliances** with **Arduino IoT Cloud dashboard, Alexa**, and **manual switches**. You can also control the relays from **Amazon Alexa App** from anywhere in the world. You can control the appliances from the manual switches if there is no internet available.

The circuit is very simple, I have used **D1, D2, D5 & D6** GPIO pins to control the 4- channel relay module. And the GPIO **SD3, D3,**

D7 & **RX** connected with the pushbuttons to control the relay module manually.

I have used the **INPUT_PULLUP** function in Arduino IDE instead of using the pull-up resistors with eachswitch.

As per the source code, when the control pins of the relay module receive the **LOW** signal the respective relay will **turn on** and the relay will **turn off** forthe **HIGH** signal in the control pin.

I have used a 5V 2Amp mobile charger to supply the circuit.
In the Arduino Cloud tutorial video, I have covered the following steps in detail.

- Create an account and add things in **Arduino IoT Cloud**.
- How to set up Arduino IoT Cloud Dashboard.
- How to set up **Arduino IoT Cloud** for **ESP8266.**
- **Programming** the NodeMCU with Arduino IDE
- Connect **Arduino IoT Cloud** with **Amazon Alexa App**.

APPLICATION

While the Arduino IoT Cloud-based home automation system using the ESP8266 NodeMCU offers various benefits, it also has some shortcomings:

Dependence on Internet Connectivity: Since the system relies on the internet to communicate with the Arduino IoT Cloud, it may encounter limitations or disruptions in functionality during internet outages or network issues.

1.Limited Scalability: The project may face limitations in scalability, especially if a large number of devices or complex automation scenarios are involved. Managingmultiple devices and automations through the Arduino IoT Cloud may become cumbersome as the system grows.

2.

3.Security Concerns: IoT devices, including the ESP8266 NodeMCU, may be susceptible to security vulnerabilities if not properly configured or secured. Withoutadequate security measures, there is a risk of unauthorized access or control of thehome automation system.

4.Reliability of Cloud Services: The reliability and availability of the Arduino IoT Cloud service may impact the overall reliability of the home automation system. Downtimes or service disruptions could affect the system's responsiveness and functionality.

RESULT AND CONCLUSION

The result of the above project is a fully functional Arduino IoT Cloud-based home automation system using the ESP8266 NodeMCU. This system allows users to remotely control their appliances via the Arduino IoT Cloud dashboard, providing convenience andflexibility in managing household devices. By following the project assembly points, including setting up the Arduino IoT Cloud, programming the ESP8266, and assembling the hardware, you can successfully implement a smart home system tailored to your specific needs.

Key features of the project include:

- Remote control of appliances: Users can turn appliances on or off remotely using the Arduino IoT Clouddashboard.

- Manual control with push buttons: Integration of push buttons enables manual control of appliances, providing an alternative to remote or automated control.

- Seamless interaction between hardware and cloud services: The system demonstrates the smooth interaction between physical components (ESP8266 NodeMCU, relays, push buttons) and cloud-based services (Arduino IoT Cloud), enabling efficient management of connected devices.

Overall, the result is a functional and efficient home automation system that enhances convenience, energy efficiency, and overall control over household appliances.

CONCLUSION

Creating an Arduino IoT Cloud-based home automation system using the ESP8266 NodeMCU provides a robust and versatile solution for modern smart homes. This project demonstrates the powerful capabilities of IoT technology,

enabling users to control their appliances remotely via the Arduino IoT Cloud dashboard, enhancing convenience and
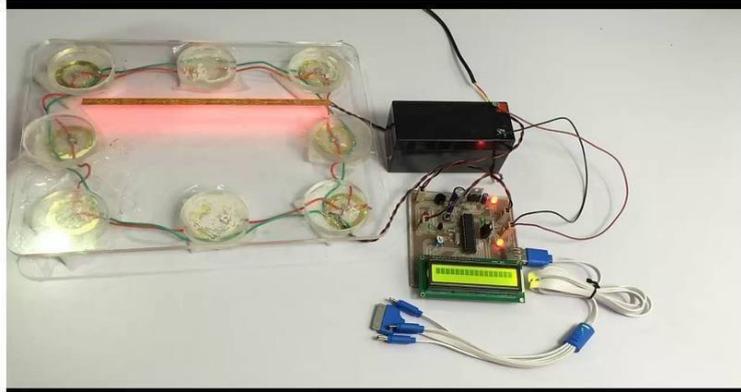
efficiency. By following the outlined steps—gathering components

FUTURESCOPE

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REFERENCE

➤https://dl.espressif.com/dl/package_esp32_index.json

➤https://iotcircuithub.com/arduino-iot-cloud-esp8266-alexa-home-automation/

➤Marshiana D, Sherine EM, Sunitha N, Vinothkumar C (2016) Footstep power production using piezoelectric sensors. Asian J Res Chem 9: 831.

➤Suresh M, Pal M, Sarkar D, Majumdar K (2022) Generation of electricity using piezoelectric material: Study on asphalt pavement structure on rural road. J Mater Civil Eng 34: 4021418.

➤DeVita P, Helseth J, Hortobagyi T (2007) Muscles do more positive than negative work in human locomotion. J Experim Biol 210: 3361-3373.

➤Nia EM, Zawawi NAWA, Singh BSM (2017) A review of walking energy harvesting using piezoelectric materials. Mater Sci Eng 291: 12026.

➤Su WS, Chen YF, Hsiao CL, Tu LW (2007) Generation of electricity in GaN nanorods induced by piezoelectric effect.

Appl Phys Lett 90: 63110.

➢Mahmud I (2018) Electrical power generation using footsteps. Eur Sci J 14: 318.

➢Asry AMM, Mustafa F, Sim SY, Ishak M, Mohamad A (2019) Study on footstep power generation using piezoelectric tile. Indonesian J Electr Eng Compu Sci 15: 593-599.

➢Ang CK, Al-Talib AA, Tai SM, Lim WH (2019) Development of a footstep power generator in converting kinetic energy to electricity. E3S Web Confer 80: 02001.

➢Aman MA, Afridi HU, Abbasi MZ, Khan A, Salman M (2018) Power generation from piezoelectric footstep technique. J Mech Cont Math Sci 13: 67-72.

➢Electronic devices and circuit theory by Robert L.Boylestad and Louis Nashlsky

➢Knight, Jones, & Field, "College Physics" (2007) p. 815

➢"Energy harvesting" http://www.scribd.com/footstep-power-generation-system.html 3/7/2013

➢How it works: Science and technology (third edition) volume 13 by Marshall Caven Dish.

➢https://youtu.be/2R7sBhx1R_k?si=DQPghyy4wJ6jqFPG