IOT HOME AUTOMATION FOR AIR CONDITIONING AND HEATING SYSTEMS

Design your own IoT solution in any Domain (Smart City/Home automation)

Submitted to

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Abstract

We are currently experiencing an exciting era where everyday objects are becoming smarter and more interconnected. The Internet of Things (IoT) is revolutionizing the way we live, with sensors and communication capabilities being integrated into various items. This trend has led to the development of innovative gadgets that enrich our daily lives. The decreasing cost of microcontrollers with networking capabilities has made it more affordable for developers to create IoT devices. One example of an IoT application is a home automation project using a cost-effective custom-built ESP32 Wi-Fi module. This system allows basic home functions to be controlled through a mobile app from anywhere in the world, contributing to the concept of a smart home. The primary objectives of this project are to conserve electrical power and enhance security. What sets this home automation system apart is its ability to be operated remotely via the internet, offering convenience without compromising usability.

This project offers solutions for saving electricity in both residential and office environments by enabling dynamic control of power supply through the use of smart switches. Additionally, it includes a low-cost wireless surveillance system This project encompasses hardware and software development, with the hardware programmed in C language using the Arduino IDE and the mobile application utilizing the Blynk IoT app to connect to a cloud server.

Contents			
			Page No.
Abstract			ii
Chapter 1		**INTRODUCTION**	**4**
	1.1	Introduction	4
	1.2	Objectives of the Project	4
	1.3	Project focus	4
Chapter 2		**BACKGROUND MATERIAL**	**5**
	2.1	Conceptual Overview	5
	2.2	Technologies Involved	6
Chapter 3		**METHODOLOGY**	**9**
	3.1	Detailed methodology that will be adopted	9
Chapter 4		**IMPLEMENTATION**	**11**
	4.1	Modules	11
	4.2	Demonstration	12
Last Chapter		**CONCLUSION & FUTURE SCOPE**	13
	5.1	Conclusions	13
	5.2	Challenges and opportunities	13
	5.3	Future Scope of Work (at least 3 points)	14
REFERENCES			15

Chapter 1

INTRODUCTION

Introduction

Home automation has made it possible to have what is often referred to as a "Smart Home", a home that can detect and identify you, automatically adjust the lighting to your predefined taste, open doors automatically, play your favorite music, water your flower in the morning, switch on the security lights at night and switch them off in the morning, heat water for bathe and tea, stream to you anywhere in the world via internet a live video of what is happening in and around your premises. It makes it possible to link lighting, entertainment, security, telecommunications, heating, and air conditioning into one centrally controlled system. This allows you to your house an active partner in managing your busy life and assist you with efficient living. Nowadays, you can hardly find a house without a home automation system which can range from the remote for the television, burglar alarm and hi-tech security surveillance, to an automated air condition system that maintain the temperature at a predefined value.

Objectives of the Project

The objective of this project is to design and build new IoT hardware which can control mobile applications from anywhere around the world and that can be installed at every home and office at lowest possible cost.

Project Focus

Project has focus on two main area of home which are electricity and security, and come up with two hardware solution:-

I. Smart air conditioning and heating

Chapter 2

BACKGROUND MATERIAL

2.1 Conceptual Overview

Project developed two devices:-

- Smart air conditioning
- smart home heating

2.1 Conceptual view of Smart air conditioning

Using the ESP32 microcontroller, the smart home system is designed to control the air conditioner and heater virtually based on temperature conditions. When the temperature falls below 20 degrees Celsius, the heater is activated to warm the environment. Conversely, when the temperature exceeds 25 degrees Celsius, the system triggers the fan and air conditioner to maintain a comfortable temperature. This functionality is achieved through the automation capabilities of the ESP32, allowing for efficient and responsive control of the heating and cooling systems in the smart home environment.

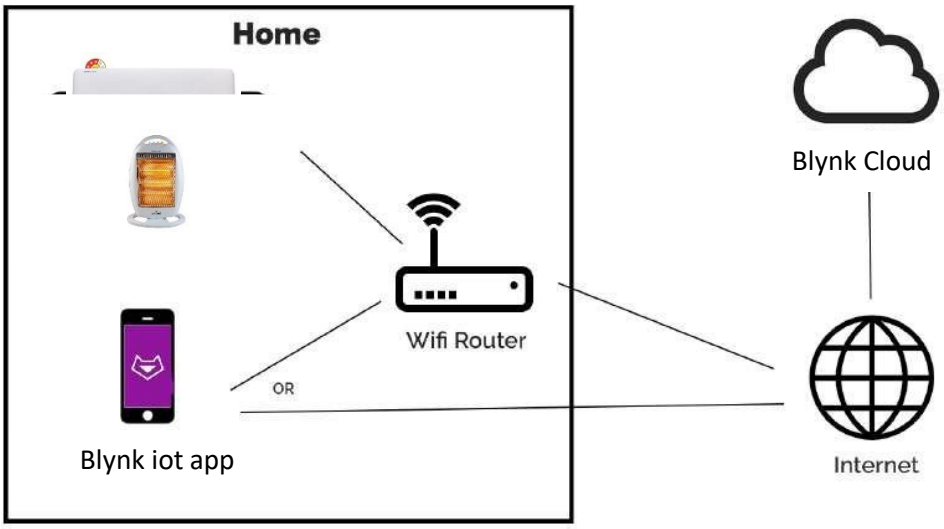


Fig 2.1 Smart-air conditioning and heating system overview

I. Air conditioner and heater is operated by ESP32 with Wi-Fi-module hardware which control and connect ac and heater to internet though local Wi-Fi network.
II. Mobile app can connect to ESP32 using local Wi-Fi network and also using GSMinternet or other Wi-Fi network.
III. Cloud provide accessible to control it though internet.
IV. This can be operated using manual switch and through mobile app. Livestatus of switch can be monitor from mobile app even if it gets used using manually.

2.2 Technology involved

2.2.1 Technology using for Smart air conditioning and heating

Hardware use to build smart air conditioning and heating

- NodeMCU ESP32
  - CPU: Xtensa dual-core 32-bit LX6 microprocessor
  - Wi-Fi: 802.11 b/g/n
  - Bluetooth: v4.2 BR/EDR and BLE
  - GPIO: 36 pins
  - Analog Input: 18 channels
  - SPI, I2C, UART, PWM, and more communication interfaces
  - Operating Voltage: 3.3V
- electromagnetic relay
- 220 volt to 5volt ac to dc converter
- Dt22 temperature and humidity sensor

Software used to program ESP32 microcontroller

- Arduino IDE using C language

Application use to perform

- Blynk iot

NodeMCU ESP32

The NodeMCU (Node Microcontroller Unit) is an open-source software and hardware development environment that is built around a very inexpensive System-on-a-Chip (SoC) called the ESP32. ESP32 is created and developed by Espressif Systems, a Chinese company based in Shanghai, and is manufactured by TSMC using their 40 nm process. It is a successor to the ESP8266 microcontroller.it contains all crucial elements of the modern computer: CPU, RAM, networking (Wi-Fi), and even a modern operating system and SDK. When purchased at bulk, the ESP8266 chip costs only $2 USD a piece. That makes it an excellent choice for this project.

fig :- nodmcu esp32

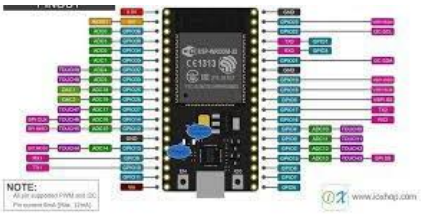


fig :- esp32 architecture

Dt22 temperature and humidity sensor

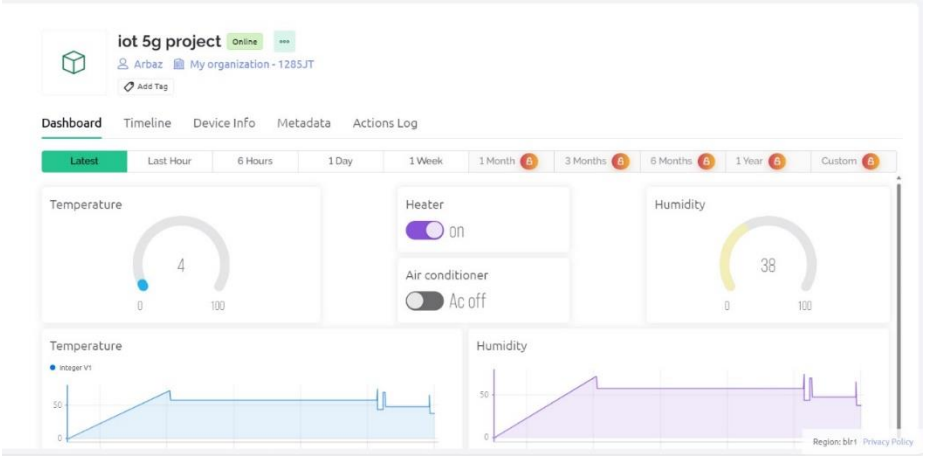
A temperature sensor is a device, typically a thermocouple or resistance temperature detector, that provides temperature measurement in a readable form through an electrical signal. A thermometer is the most basic form of a temperature meter that is used to measure the degree of hotness and coolness.

Android mobile application

About half of the population around the world prefers Android over another operating systems or devices. IoT is one of the biggest areas where Android app development technology is continuously contributing with its enormous benefits. Internet of Things is generally recognized as the interconnectedness of different smart devices over the Internet. The devices make use of sensors and internet connectivity, which helps them receive, collect, and transmit information.so for this project I use blynk iot app which is an open-source platform which allow you to connect your iot device over internet, it is customizable, and we can develop buttons and configure it according to our requirement

List of support used on android devices to run mobile applications.

- Wi-Fi.
- Internet GSM
- Location.



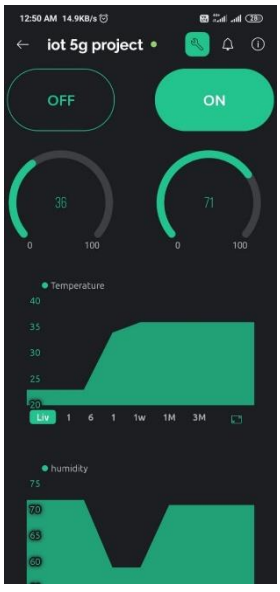


Fig android mobile application

2.2.2 Programming Language used during project

In this Project we have use only single programming language for programming which is:-
C: For embedded programming of NodeMCU for smart control using Arduino IDE. it is a non-object-oriented high-level programming language.

for the development of app we use direct online build app which have no need to program it is easy to use it work on drag and drop function that is blynk iot app

Blynk is an IoT (Internet of Things) platform that provides a simple and intuitive way to build mobile applications to control and monitor connected devices. It offers a drag-and-drop interface to create custom user interfaces for IoT projects without needing to write any code. Blynk supports a wide range of hardware platforms, including Arduino, Raspberry Pi, ESP8266, ESP32, and many others, making it a versatile choice for IoT enthusiasts and developers.

Blynk offers a customizable user interface with widgets like buttons, sliders, and graphs for controlling and visualizing device data. It ensures secure connectivity for remote IoT project monitoring and control. The platform integrates with cloud services for data storage, visualization, notifications, and automated actions. Blynk uses an energy-efficient protocol, ideal for low-power IoT applications, and provides a library supporting diverse hardware platforms, easing the implementation of supported devices and microcontrollers. These features make Blynk a versatile and user-friendly platform for creating IoT applications, catering to both hobbyists and professional developers.

Chapter 3

METHODOLOGY

3.1Detailed methodology that will be adopted

To create an IoT-based air conditioning and heating system using the NodeMCU ESP32 microcontroller with DHT22 temperature and humidity sensor for temperature control, along with Blynk cloud app for remote access, the following methodology can be adopted.

1. Hardware Setup:
    - Connect the DHT22 temperature and humidity sensor to the NodeMCU ESP32 microcontroller to measure the ambient temperature and humidity.
    - Connect the heating and cooling systems (heater and air conditioner) to the NodeMCU ESP32 microcontroller, using appropriate relays or switches to control their operations.

2. Programming the NodeMCU ESP32:
    - Write a program in Arduino IDE or any suitable IDE for the NodeMCU ESP32 to read data from the DHT22 sensor and control the heating and cooling systems based on the temperature readings.
    - Utilize the Blynk library to establish a connection between the NodeMCU ESP32 and the Blynk cloud app for remote monitoring and control.

3. Blynk App Setup:
    - Create a Blynk project and design a user interface with virtual buttons or sliders to set the desired temperature limits for activating the heating and cooling systems.
    - Map the virtual buttons or sliders to the corresponding functions in the NodeMCU ESP32 program for temperature control.

4. Control Logic:

    - Implement control logic in the NodeMCU ESP32 program to monitor the temperature readings from the DHT22 sensor and compare them with the set limits received from the Blynk app.
    - If the temperature falls below the set limit, activate the heater through the NodeMCU ESP32. Conversely, if the temperature exceeds the set limit, activate the air conditioner.

5. Testing and Deployment:

    - Test the system to ensure that the NodeMCU ESP32 effectively controls the heating and cooling systems based on the temperature inputs from the DHT22 sensor and the Blynk app.
    - Deploy the IoT-based air conditioning and heating system in the desired location, ensuring a stable internet connection for remote access via the Blynk app.

Chapter 4

IMPLEMENTATIONS

4.1Modules

Project is divided into two development modules :-

4.1.1 Circuit development

the circuit diagram is developed using wokwi simulator

The circuit diagram shows the connections ac and heater are replaced by led bulb for indication. Esp32 is connected to relay module and also to Dt22 temperature and humidity sensor ,lcd display shows real-time temperature and humidity according to the sensor value the microcontroller will work and it will on and off system.

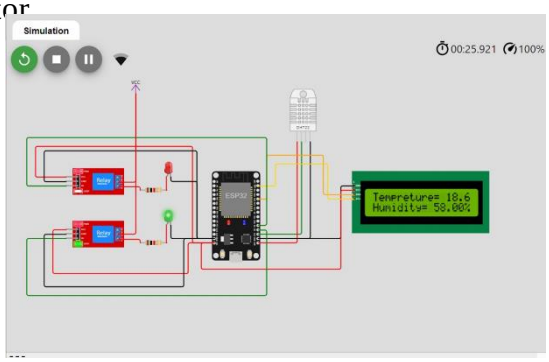


Fig : circuit diagram

4.1.2 Simulation

For simulation we use wokwi simulator The Wokwi Simulator is an online platform that allows you to simulate and test IoT (Internet of Things) and embedded systems. It supports various microcontrollers such as ESP32, Arduino, and the Raspberry Pi Pico. With Wokwi Simulator, we can simulate the behavior of these devices, including displays, sensors, motors, and Wi-Fi connectivity. The reason behind Choosing this platform it is open-source platform and user-friendly interface which give a interactive view to user.

4.1.3 Demonstration

Esp32 is connected to local area network and get connected to internet the online status starts getting show on the blynk app and it ready to control virtually

Different case study

- When temperature above 25 degrees
  If the temperature increase above 25 degree the sensor is sense temperature it send the request to microcontroller to turn on air

conditioner for the cooling live status will shows to app in the form of graph value ,user can observe the condition for precise control.

- When temperature below 20 degrees
  When temperature goes below set value microcontroller read the value and turn on the heater to normalize temperature
  The below link give details demonstrating video
  https://drive.google.com/file/d/1wgRrmLAVsqoojeZMmINmGzkn6fgFow_b/view?usp=sharing

Chapter 5

Conclusion and future scope

5.1 conclusion

In conclusion, the IoT-based air conditioning and heating system utilizing the NodeMCU ESP32 microcontroller, DHT22 temperature and humidity sensor, and Blynk cloud app offers a versatile and efficient solution for remotely controlling temperature in various environments. The integration of the NodeMCU ESP32 with the DHT22 sensor allows for accurate temperature monitoring, while the Blynk cloud app facilitates seamless remote access from anywhere. The system's ability to automatically activate the heater when the temperature falls below the set limit and switch on the air conditioner when the temperature rises provides convenient and responsive climate control. This IoT solution not only enhances user comfort and convenience but also demonstrates the practical application of connected devices in managing environmental conditions effectively.

5.2 Challenges and opportunities in integrating heaters and air conditioners with smart home technology

The challenges include security and privacy concerns, data collection and sharing, data analytics, and latency . Another challenge is the uncertainty in sensor selection, which can be addressed by using data-driven activity recognition approaches

5.3 future scope

The future scope of the IoT-based air conditioning and heating system using the NodeMCU ESP32 microcontroller, DHT22 temperature and humidity sensor, and Blynk cloud app holds significant potential for further advancements and applications. Some of the future prospects include:

1. Energy Optimization: Implementing advanced machine learning algorithms or predictive analytics to analyze temperature data and user patterns can lead to more efficient energy consumption, ultimately reducing operational costs and environmental impact.
2. Integration with Smart Homes: Integrating the IoT-based system with other smart home devices and platforms can enable seamless automation and synchronization, providing a more comprehensive and interconnected home environment.
3. Enhanced User Interface: Developing a more intuitive and interactive user interface on the Blynk app, incorporating features such as scheduling, historical data analysis, and personalized settings, can further improve user experience and customization.
4. Environmental Monitoring: Expanding the system to incorporate additional environmental sensors for air quality, carbon dioxide levels, and sunlight intensity can contribute to creating a healthier and more comfortable indoor environment.
5. Remote Diagnostics and Maintenance: Implementing remote diagnostics and predictive maintenance capabilities can enhance system reliability and reduce downtime by proactively identifying and addressing potential issues.
6. Scalability and Interoperability: Designing the system to be easily scalable and interoperable with other IoT devices and platforms can enable its integration into broader smart city initiatives and industrial applications.
7. Data Security and Privacy: Emphasizing the development of robust data security measures and privacy protocols to protect sensitive information transmitted and stored within the IoT ecosystem.

REFERENCES

Conference Papers

- , “Home Automation”, Energy Efficient Smart
  Home Automation Systemvolume no 1, publication
  year 2015, Total pages 11.
- Internet of Things (IoT)-Based System for Smart Home Heating and Cooling Control
  Published in: 2022 IEEE International Conference on Environment and Electrical Engineering and 2022 IEEE Industrial and Commercial Power Systems Europe (EEEIC / I&CPS Europe)

Web

- About ESP 32, www.espressif.com
- NodeMCU,www.nodemcu.com
- Cloud web, www.blynk.io
- Simulation, www.wokwi.com

For ppt and project video visit
(https://drive.google.com/drive/folders/1vAGVw0RMIoyxeg38u8w4jMh6aRBqlAa6?usp=sharing)