Project Report- ECE283

ON

"Smart Home hub: MicroPython-based home automation"

Submitted by

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Course Title: Introduction to embedded system with micro python

In partial fulfillment for requirements of the award of the degree of

“BCA”

Guide:-

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Content

Acknowledgment Page

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Abstract

A state-of-the-art home automation system, the Smart Home Hub is powered by ESP32 microcontrollers and developed on MicroPython. This cutting-edge platform easily connects all of the smart gadgets in a home, giving consumers convenient remote control and environment monitoring. The Smart Home Hub provides an adaptable and configurable solution for automating functions like temperature management, lighting, security, and more by utilizing MicroPython's adaptability. Its user-friendly interface and extensive connectivity options enable customers to customize automation processes to meet their unique requirements. The Smart Home Hub is the perfect option for anyone looking to improve the functionality and convenience of their living areas because of the combination of ESP32's performance and MicroPython's ease of use.

INTRODUCTION

The launch of the Smart Home Hub creates the framework for comprehending the importance and capabilities of this cutting-edge home automation system. It gives a summary of the main features of the platform and emphasizes how ESP32 microcontrollers and MicroPython are used as its fundamental building blocks. The introduction also outlines the main goal of the Smart Home Hub, which is to improve and expedite the administration of systems and devices in the home through intelligent automation. It may also discuss how popular smart home solutions are becoming and how important it is to have customized, user-friendly alternatives. In general, the introduction aims to pique the reader's curiosity and provide background information before delving deeper into the capabilities and advantages of the Smart Home Hub.

Literature Review

A. Automation

A low-cost home automation system with autonomous control features was developed by Eleyan and J. Fallon et al. [3] using an Android application and MQTT-broken communication. The suggested solution will allow customers to remotely manage household appliances using an Android smartphone. Relays and a embedded system (ESP32) microcontroller were suggested as a way to remotely control electrical switches from a Node server by H. K. Singh, S. Verma, S. Pal, et al. [7].

B. Energy efficient Home Automation

The primary focus should be on remotely activating andmanaging various smart home devices, according to a proposal made by B. R. K. Kodali and S. Yerroju et al. [4]. Utilizing energy more wisely is possible thanks to home automation technology. The ESP8266 board is very desirable and advantageous since it provides the IoT system with the requisite ultra-low power consumption capability at an inexpensive price.

C. View and performance of home automation

A technique for IoT-based wirelessly programmable smart home automation was proposed by K. Agarwal, A. Agarwal,

and colleagues. Home automation solutions leverage the IoT to remotely monitor and control household appliances [5]. This approach makes use of a specifically designed website connected to the internet or a local area network to manage standard home appliances from smartphones or desktop computers (LAN).

D. Home automation with cloud organizing

Y.Wenbo, W.Quanyu, and colleagues concluded that, because there are likely many undiscovered IoT apps and services, object resolution methodologies can also be defined by an IoT reference model [6]. From a public policy aspect, it is vital to confirm that IoT applications, such as those for aid, energy management, transportation, or other cutting-edge purposes, can have reasonable access to current infrastructure.

Hardware Requirements and Description

- ESP 32
- 1 channel relay module
- Dht 11(1)
- MQ 5 (Gas sensor)
- IR Sensor
- Buzzer
- Gear motor(1) (prototype)
- Jumper wires
- Power supply
- Complier : Thonny Python

Hardware description

ESP32: ESP32 is low cost and low power on chip micro-controller which is developed by Espress-if , it has wireless Bluetooth and wi-fi capabilities. It is dual core processor, comes with 2Xtensa 32-bit LX6 microprocessors: core 0 , core 1 running at 160 or 240 MHz. ROM 448 KB for booting and core functions , SRAM 512 KB for data and instructions. ESP 32 comes with 48

pins. All pins are not exposed in all ESP 32 developments boards only 36 pins are used. All boards have 3v3 ,Vin , GND pins for power supply and ground. One is reset button for resetting the code and boot button for installing firmware in micro python.

ESP32 input / output peripheral include:

18 Analog To Digital Converter (ADC) Channels

3 Serial Peripheral Interfaces (SPI) Channels

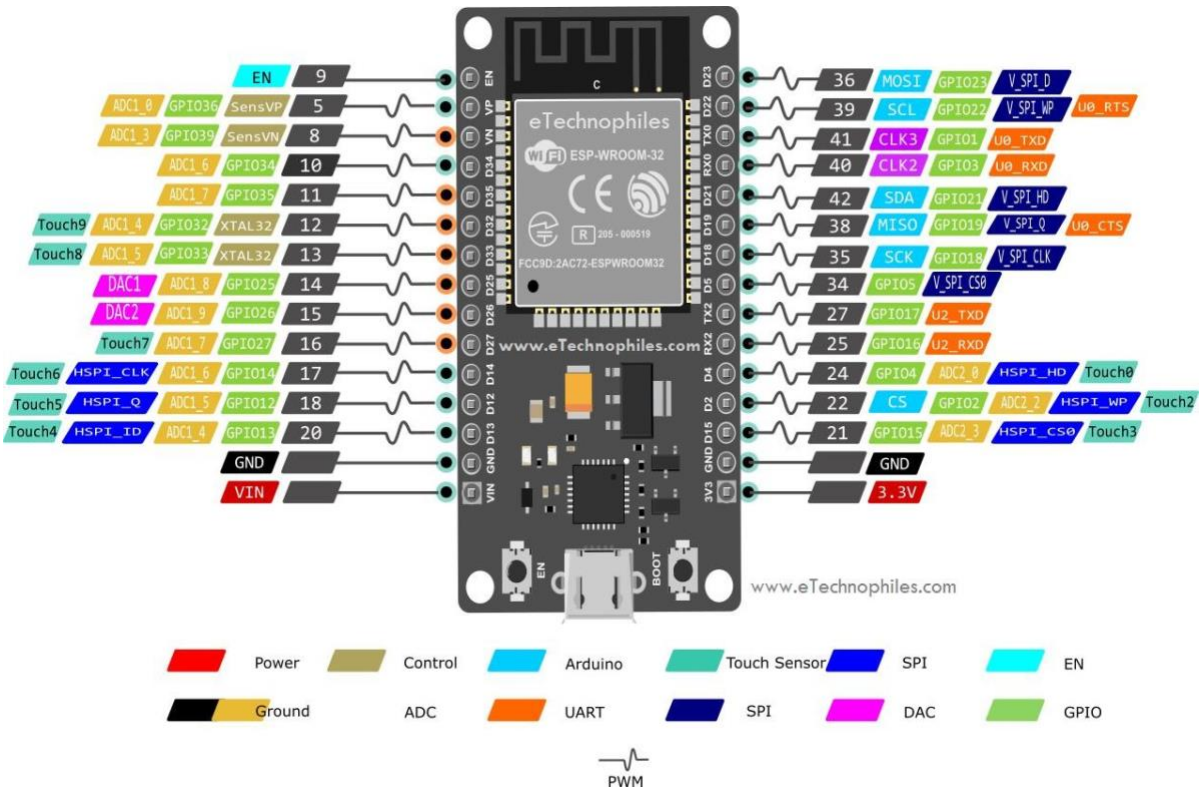
3 Universal Asynchronous Receiver Transmitter (UART)Channels

2 Inter Integrated Circuits (I2C) Channels

16 Pulse Width Modulation (PMW) Channels

2 Digital To Analog Converters (DAC) Channels

10 Capacitive Touch Sensor



Relay Module: A 5V relay module is an electronic device that acts as a switch, allowing low-voltage control signals to control high-voltage circuits. It is commonly used in various applications, including home automation, robotics, and industrial control systems.

The 5V relay module consists of a relay, which is an electromagnetic switch, and a control circuit powered by a 5V power supply. It has input and output pins, where the input pins receive the control signals from a microcontroller or other devices, and the output pins connect to the high-voltage circuit.

When the control signal is received, the relay module switches the high-voltage circuit on or off, providing isolation and protection for the control circuit. This allows for safe and efficient control of high power devices using low-power control signals.

Dht11: Dht 11 is a low cost sensor that senses temperature and humidity from environment and sends the signal to micro controller.to measure surrounding air sensor uses thermistor and capacitive humidity sensor. Three pins are used VCC, GND, and data pin.

Temperature measuring range of Dht 11 is 0 to 50 degree Celsius with 2 degree accuracy and humidity measuring range is 20% to 80% with 5% accuracy. This sensor is small in size and operating Voltage is 3V to 5V. maximum current is used 2.5mA. while measuring.

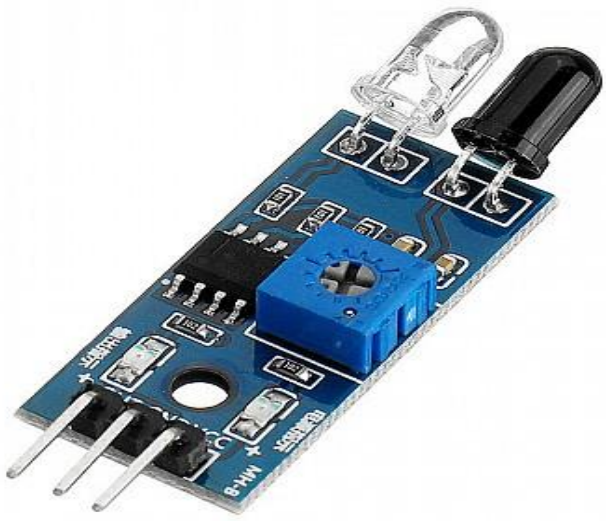
Gear motor: gear motor is electrical motor coupled with gear train. It is a combination of DC motor and gear box.it uses direct current power. gear box is used to limit the speed of motor shaft. The speed of motor is counted in terms of rotations of the shaft per minutes and it is termed as RPM. The gear assembly helps in increasing the torque and reducing the speed.

MQ 5 (Gas sensor)

- The Grove - Gas Sensor(MQ5) module is **useful for gas leakage detection (in home and industry)**.
- It is suitable for detecting H2, LPG, CH4, CO, Alcohol. Due to its high sensitivity and fast response time, measurements can be taken as soon as possible.

IR sensor

- The IR transmitter continuously emits the IR light and the IR receiver keeps on checking for the reflected light.
- If the light gets reflected back by hitting any object in front it, the IR receiver receives this light. This way the object is detected in the case of the IR sensor



Jumper Wires:

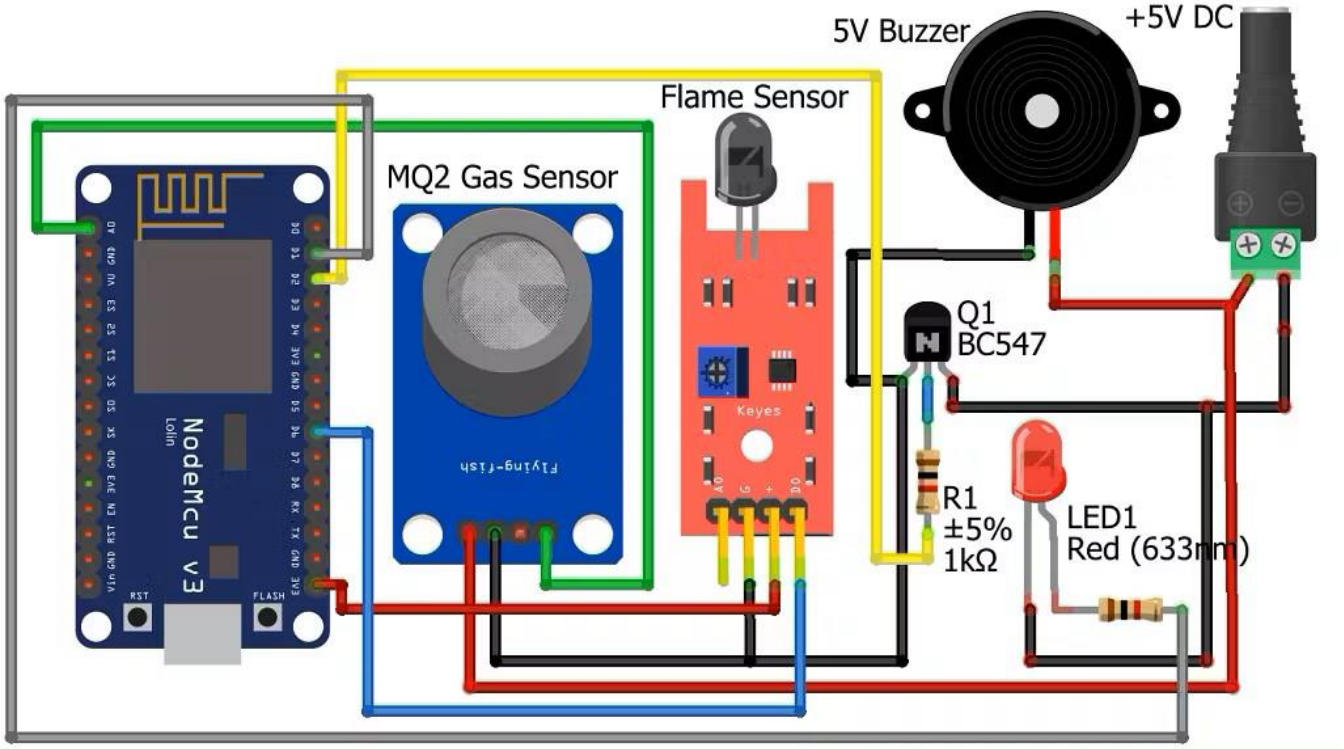
WORKING

- To configure your ESP32 using MicroPython, first install the Micro Python firmware on the board. The ESP32 can be flashed with MicroPython firmware using programs.
- After installing the firmware, We use a serial terminal like Thonny Python to connect to the ESP32.
- Link ESP32 to WiFi: To link the ESP32 to your Wi-Fi network, write code in Micro Python. As a result, the ESP32 can speak with other gadgets connected to your network and the internet.
- Making APIs (Application programming interface)
- Create Micro Python APIs on the ESP32 to process requests from your mobile application. With the help of these APIs, your phone app will be able to instruct the ESP32 to control appliances and submit requests for status information.

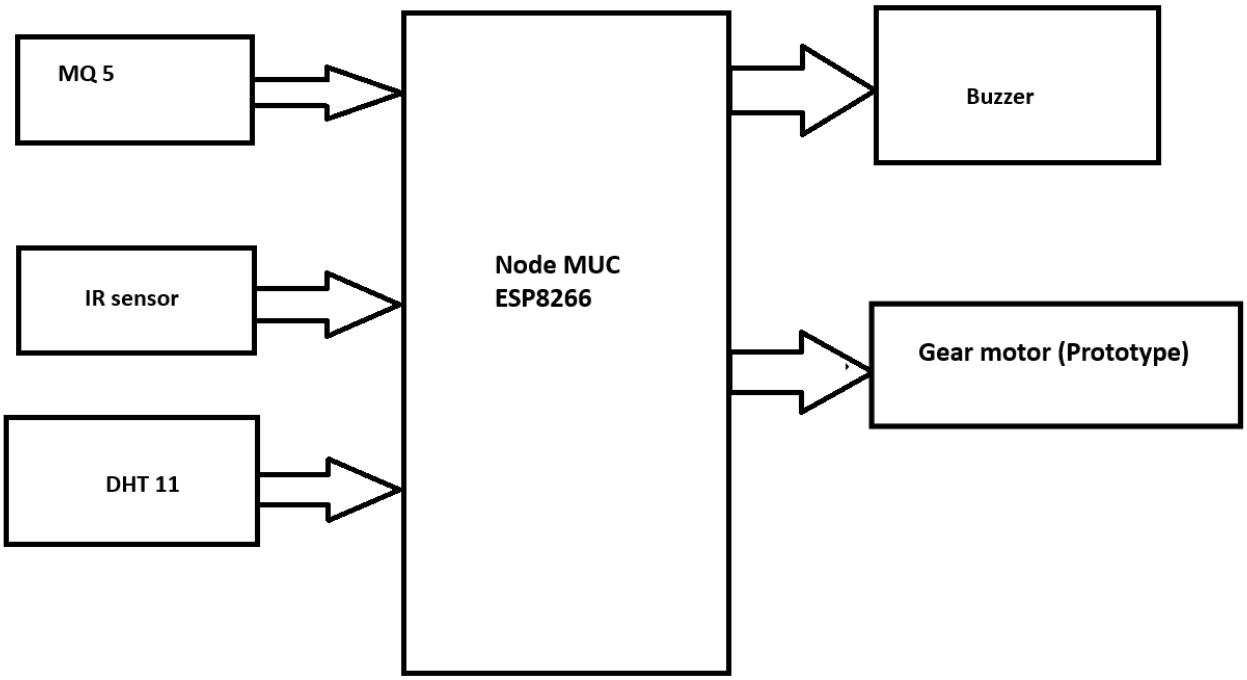
- Development of Phone Apps: Create an iOS or Android mobile application with a framework such as React Native, Flutter, or native development.
- To communicate with the ESP32's APIs, use HTTP requests. The app sends an HTTP request to the ESP32, which controls the appropriate appliance, when the user interacts with the app (e.g., turns on a light).
- Control and Monitoring of Appliances:
- To interface with relays, sensors, or other parts attached to your household appliances, write Micro Python code to control the ESP32's GPIO pins.
- Use sensors that are linked to the ESP32 to provide functionality for monitoring the state of appliances (such as temperature and power consumption).

- Security Points to Remember: To prevent unauthorized access to your home automation system, use security methods like HTTPS for communication between the ESP32 and the phone app.

CIRCUIT DIAGRAM



Block Diagram



CODE

```
from machine import Pin

import network

import time

from BlynkLib import Blynk

import dht


BLYNK_AUTH_TOKEN
="jAbXoDxteTHTSIM1L0Fj_q3XhIEpFW7t"


relay_pin = 2  # Change this pin according to your setup

dht_pin = 4      # Change this pin according to your setup
(GPIO4 on ESP8266)


relay = Pin(relay_pin, Pin.OUT)

dht_sensor = dht.DHT22(Pin(dht_pin))


wifi= network.WLAN(network.STA_IF)

wifi.active(True)

wifi.connect("12 pro +", "321321321")
```

```
while not wifi.isconnected():
    pass
print("Wifi Connected Successfully")

blynk= Blynk(BLYNK_AUTH_TOKEN)

def read_dht():
    dht_sensor.measure()
    temp_c = dht_sensor.temperature()
    humidity = dht_sensor.humidity()
    return temp_c, humidity

def update_blynk_with_dht():
    temp, hum = read_dht()
    blynk.virtual_write(1, temp) # Assuming you have Virtual Pins 1 and 2 set up on Blynk app for temp and hum respectively
    blynk.virtual_write(2, hum)
```

```
def control_relay_based_on_temp_hum():
    temp, hum = read_dht()
    if temp > 25 and hum > 60:  # Example conditions, change as per your requirement
        relay.on()
    else:
        relay.off()

blynk.set_user_task(update_blynk_with_dht, 10000)  # Update Blynk every 10 seconds
blynk.set_user_task(control_relay_based_on_temp_hum, 10000)  # Control relay every 10 seconds

while True:
    blynk.run()
    time.sleep(0.1)
```

Experimental Results:

Device control: using smart home hub, user can control the functioning of various devices like AC and led with his smart phone and wireless wifi and Bluetooth technologies of esp32.

Sensor integration: smart home hub Implementing latest IOT technology and using various sensors like microcontroller esp32, power sensors gear motor ,devices like dht, relay module.

Remote control: with remote access capabilities , home owners can control and monitor their homes from anywhere with their smart phone and internet connected devices.

Improve convenience: it lead to the increased convenience for users by making their life more comfortable by automating basic routines like on/off off of electronic devices.

Customization and personalization: system can be customizable according to user needs. Customizable settings for temperature, lighting, entertainment and other features allow users to create customizable environment.

User friendly: system is easy to use and working is easy to understand. Customizability make the system to fit in environment according to user's life style.

Enhanced security: security feature of this system such as motion sensor/window sensor, cameras provide home security and prevent unauthorized access.

APPLICATIONS:

Home automations: using smart home hub, users can automate their home like turning on/off lights, adjusting thermostats, locking doors, controlling appliances remotely with voice assistance or smart phones commands.

Energy management: Thermostats can learn and adjust household settings, monitor and analyse when rooms are unoccupied automatically manage heat/cooling turn off/on lights, optimize energy usages, reducing utility bills.

Security: smart home security systems include features like security cameras, smart locks, window and door sensors. These systems allows users to monitor their property in real time , receives alerts and instructions and control remotely access to their systems.

Health monitoring: smart home devices can **monitor** health parameters of users like heart rate , blood pressures, sleeping patterns.

Appliances control: users can smartly make the control switches and plugs and home appliances like coffee makers, washing machines, ovens, AC s , heaters.

Water management: It can adjust watering schedules in irrigation. It can take real time decision for watering based on weather, forecast, soil moisture level, conserving water while making healthy landscaping. Leak detecting sensor can also make the owner alert about water leakage and prevent from other damages.

Voice assistance and AI: virtual voice assistance like apple , amazon alexa , google assistant can serve as central hub for controlling smart home appliances.

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conclusion and future scope

implementation of smart home hub project offers numerous benefits such as enhanced experience, security, automation, customization, remote control, health monitoring, water management and energy efficient etc.

furthermore, the future scope of home automation are:

integrating emerging technologies like AI (artificial intelligence), machine learning with smart home automation can enhance further functionalities, automation and user experience.

Extending smart home automation capabilities into broader urban environments can create inter connected ecosystems, that will enhance efficiency, mobility, safety and quality of life of humans and residents.

Further advancements can come in energy saving technologies, renewable energy integration, can help user to reduce carbon footprint, and continue more sustainable future.