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Voice Integration in Automatic Room Temperature Controlling System

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Abstract - *This study provides an innovative conceptualization and implementation of a model automatic room temperature management system that uses embedded technology to correctly monitor the appliances that depend on temperature. It enables the user to choose a preferred temperature and utilizes a temperature sensor to gauge the ambient temperature. When the temperature in the room exceeds the set temperature, the system activates the air conditioner to cool the space, and when the temperature falls below the set temperature, the system activates the heater to warm the space. The system is intended to reduce the need for human involvement and improve dependability in factories, storage facilities, and laboratories. A temperature sensor BMP280, a temperature display SS1D1306 OLED to show the state of the system, numerous drivers, and a microcontroller Arduino ESP32 serve as the main components.*

Key Words: Arduino ESP32, BMP280, SSD1306 OLED, microcontroller.

1. INTRODUCTION

Automation is a key component of this transformation as technology advances. We now rely on this automated system, which has transformed the way we communicate with these technologies. Users may effortlessly change the temperature of their room using speech recognition technology by giving instructions. This is especially helpful for those with disabilities who might struggle to utilize conventional control mechanisms like buttons or remote controllers. By using temperature BMP280, voice integration also enables users to manage their room temperature without having to physically contact the device. By doing so, users can adjust the device's temperature while using other applications or moving away from it. A microcontroller (Arduino ESP32) attached to a single chip, which produces precise results, allows the mechanization of the recommended system and controlling process. It could increase the system's overall effectiveness. Users may need to enter many instructions or browse through multiple menus when using conventional control techniques to achieve exact temperature adjustments. Users may speak their preferred temperature into the system via voice integration, and it will change as needed. Users may now control the temperature quickly and precisely without needing to enter any complicated information.

Additionally, new opportunities for automation and control have been made possible by the integration of voice control into automatic room temperature management systems. Users may design personalized temperature schedules and profiles that automatically alter the temperature based on their habits and preferences using voice commands. A schedule that automatically detects the temperature by the time of day or the number of occupants in the area may be created by users, for example. This can aid customers in energy conservation and help them pay less for their energy by making sure that the temperature is only altered when necessary. Overall, automatic room temperature management systems now offer a higher degree of comfort, effectiveness, and user experience thanks to the incorporation of voice control. Users may now alter the room's temperature with more ease and convenience, and new opportunities for automation and control have emerged as a result. Future automatic room temperature management systems with speech integration are anticipated to make even more creative use of voice integration as voice recognition technology develops.

2. Technology Used

Automation technology has advanced considerably in recent years. Additionally, a frequently utilised automated system is home automation. One of its components is an automatic system for adjusting room temperature. There have been several developments in this area. In the past, it was employed for certain reasons in fields or in industry, but today it is a part of our everyday life. The Arduino UNO R3 and DHT11 sensor are used by GURMU M. DEBELE and his partner in 2020 to build and construct an automatic room temperature management system. The heater and fan are turned on in accordance with the current room temperature [1].

Many industrial fields have been conquered by the necessity for precise temperature control. A Direct Current based Fan control system based on room temperature was proposed by Nur Afiqah Junizan and colleagues in 2019 utilising pulse width modulation technology, temperature sensor LM35, and Arduino Uno Microcontroller. This may be utilised for a variety of purposes in industries including farming and manufacturing [2]. In 2015, M. A. A. Mashud and his pals created an automated fan regulating system employing low-voltage power supplies, fixed voltage circuits, sensor & driver circuits, subtraction circuits, buffer circuits, and fan dimmer circuits. This was put through a series of experiments to see how well it would function as a controller device, and extremely positive findings were achieved [3]. Using the PIC16F887 microcontroller as the primary control unit, the LM35 digital temperature as a temperature generator, a 16x2 liquid crystal display (LCD) as an indicator to show organization can improve working classifications in addition to some drivers, and relays and light-emitting diodes (LED) as factors to show the corresponding working appliance driver, a system was created by Jabbar Shaati Jahlool in 2017. This technique is employed to automatically control the temperature for any special purpose [4].

Using a PIC 16F877 microcontroller and temperature sensor, KHAIRURRIJAL and his collaborators created a thermal plant system in 2011 for learning autonomous control. They created a method for closed-loop temperature regulation [5]. A creative prototype design for an automated ventilation fan is shown in 2017 by N. N. S. N. Dzulkefli and colleagues. To automatically manage the ventilation fan and reduce the heat that increases the risk of global warming, a temperature sensor LM35 and microcontroller PIC16F887 circuit is employed [6]. A Smart Home System (SHS) was developed in 2014 by Mohamed Abd El-Latif Mowad and others. It serves as an interface between a remote control for a home reliever and the remote control for a mobile device. Microcontroller utilised is PIC16F877. Through Bluetooth, it uses Android to control the entire house [7]. In 2014, Sani Mohammed Lawal and his co-workers suggested an autonomous temperature control system designed specifically for egg incubators to automatically adjust and monitor the needed temperature utilising nonlinear sensors with potential for linearization. Even when there is a power outage, this design continues to function well with little to no difficulty [12]. In 2022, Manitha Samath and her team created a low-cost system that requires no microprocessor and reduces the amount of human interaction regardless of changes in the environment. They employ the transistor there. Their primary goal is to create a system that is simple to use [15]. In 2017, J. Chandramohan and his companions launched the Intelligent Smart Home Automation and Security System Using Arduino and Wi-fi project.

With the great assistance of an installed micro-web server and internet protocol (IP) interconnection, this home control and monitoring system is both reasonably priced and customizable. It allows users to access and control equipment and devices remotely using an Android-based mobile application that is supported by a wireless transceiver and IBOARD [16]. In 2018, M. Danita and collaborators suggested a system based on the Internet of Things (IoT) that uses a DHT11 (Temperature & Humidity sensor) and a YL69 moisture sensor to monitor greenhouse conditions. In a cloud database (ThingSpeak), the temperature and humidity readings are kept, and the results are displayed on a webpage [17]. A real-time humidity and temperature monitoring system based on the Internet of Things was created in 2021 by Md. Zahidul Islam and his buddies with the aid of a DHT-11 temperature sensor and ESP-8266 Wi-Fi module. In order to look at the surroundings of the room on a website, an IOT application was utilised in the COVID-19 pandemic [21]. A single chip microprocessor and a temperature and humidity sensor based on a greenhouse were presented in 2017 by Yi Liu and his associates as an autonomous control system. With the integration of computers and agriculture, this initiative contributed to the development of modern agriculture. The device can fully satisfy the needs of indoor farmers and indoor growers and manage fluctuations up to 3% [22].

3. Design and Implementation

Hardware Used

A) Arduino ESP32

An extensive combination of Wi-Fi and Bluetooth communication is found on the Arduino ESP32 microcontroller (MCU) board, which is low powered and inexpensive. Along with faster Wi-Fi, it has 48 I/O pins. Additionally. The number of GPIO pins has been increased. It has a built-in Hall effect sensor and all of its pins are touch sensitive, which may be used to bring up the microcontroller from deep sleep mode. Additionally, an 8-centimeter display screen is included with the ESP32-WROVER board with Espressif Systems.

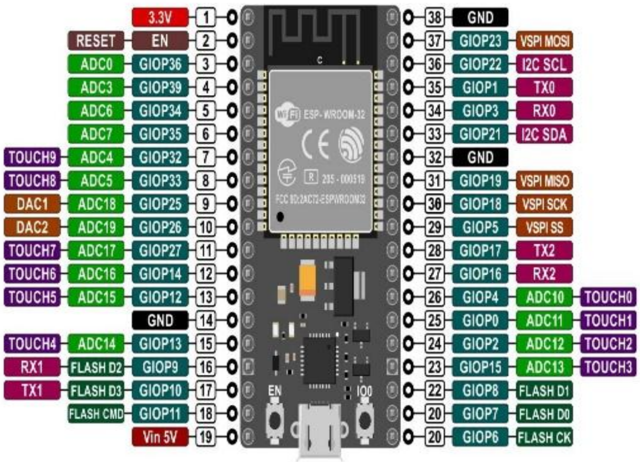

Figure 1. Arduino ESP32 pinout diagram

A) BMP280

The innovative technology used by BMP280's temperature sensor allows for highly accurate measurements of both ambient temperature and humidity. The temperature, pressure, and humidity are all being measured by this sensor as soon as the power is turned on. It gives us digital information instantly. Both SPI and 12C interfaces may be used with this sensor.

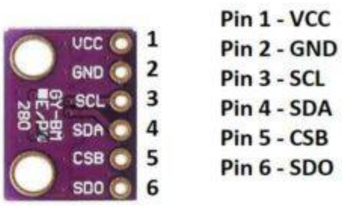

Figure 2. BMP 280 pinout diagram

B) SSD1306 OLED

The SSD1306 micro-chip driver serves as a link between the display matrix and the microcontroller. It controls the OLED SSD1306 display, which is an SSD1306 device. SSD1306 screens offer a broad viewing angle and are brilliant thanks to the organic LEDs in the matrix's natural light. Similar to the monochrome screens found on vintage cell phones, these tiny displays are small. The SPI interface (software of hardware) and the I2C interface are two of the interfaces that are included.

Figure 3. SSD1306 OLED

C) SPDT Relay

Single Pole Double Throw is a shorthand for SPDT. Because its internal configurations, this is currently quite popular. It provides us with two different outputs after accepting a single input. With the aid of electronic circuits for low-power signal transmission, an electro-mechanical switch manages a high-power application. Two electromagnetic coils, two N/O and N/C pins, and one common pin are among the five distinct pins.

Figure 4. SPDT Relay

Software Used

A) Arduino IOT Remote Cloud

The ability to configure your various IOT devices is offered by this IOT platform. It gives us with the ability to synchronise the sensor data on your Android device over the cloud. This Arduino IOT Remote Cloud serves as a platform for the creation of several IOT initiatives by giving us access to all the necessary tools for customization, system coding, publishing, and result display. Since it already has built-in characteristics of numerous components, there is no need to load libraries into it. Both using and comprehending it are simple.

Here, the sensor BMP280 measures the outside temperature and transmits it as digital signals to the SSD1306 OLED and Arduino ESP32. The OLED displays the real outside temperature, and the ESP32 processes and reads the data. The output of the ESP32 is sent to the relay that is linked to the AC if the input value is larger than 40 degrees or to the relay that is connected to the heater if the input value is less than 20 degrees, respectively. As a result, the room's temperature is automatically adjusted to reflect the weather outside. What if, however, we like a warm indoor temperature of 25 degrees? In order to link the Voice integration with Arduino, we are utilising a programme called Arduino IOT Remote Cloud. When voice input is received and Arduino sends signals to relay based on the input, we added an extra condition that would execute. so that we may adjust the room's temperature as needed. In this approach, we added vocal innovation to this device for regulating room temperature.

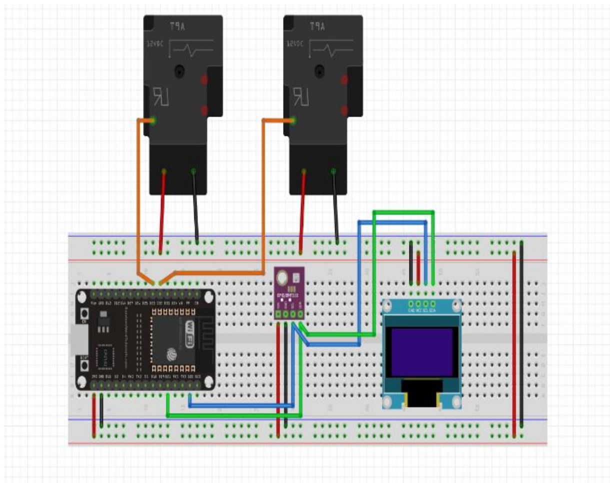

Figure 6. View of all hardware connections

4. Conclusion

The automatic room temperature management system described in this paper uses an Arduino board and a

BMP280 temperature sensor to recognize spoken commands. Arduino ESP32 microcontroller, BMP280 temperature sensor, SS1D1306 OLED display, and a voice recognition system are the hardware and software that are utilized, respectively. The heater kicks on when the temperature in the room drops below 20 degrees, and the AC comes on when the temperature in the room exceeds 40 degrees. This is made possible by the temperature sensor, and the speech recognition system's goal is to make it possible to simply provide voice commands to turn on the heater or air conditioner when the room's temperature is between 20 degrees and 40 degrees. The comfort, affordability, minimal maintenance costs, small system, ease of access, and user-friendliness of this system are its key benefits. We utilize Arduino IOT Remote Cloud, which is simple to use and doesn't need to import any libraries. There is an inbuilt function in it to connect IoT devices directly to do the work on applications of IoT. This system is excellent and reasonably priced, and it may be used to maintain a comfortable temperature in homes, companies, and schools across the world.

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