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Voice Control Based Home Automation using Raspberry Pi Pico

[1]M.Ramakrishna, [2]K.Harini, [3]N.Akhil Sai, [4]G.Ramu, [5]T.Rakesh

[1]Associate Professor, Department of ECE,Jyothishmathi Institute of Technology and Science,Karimnagar

[2,3,4,5,6]B.Tech Final year students, Department of ECE,Jyothishmathi Institute of Technology and Science, Karimnagar

Abstract: Wireless Voice-Controlled Automation of the Home Based on internet, Bluetooth, and wi-fi, this project integrates a mobile phone (application) with an integrated system to provide the elderly and disabled with the ability to fully control their home utilities using voice commands on their phone. The non-technical individual will find it easy to carry, install, configure, run, and maintain this device due to its design. Connecting specific electrical equipment that are used in a home is known as home automation. Home automation purpose is to let the handicapped and elderly handle all of their home utilities with their voice commands. Home automation refers to the process of linking various electrical devices used in a house. This systems allows to control home appliances using a mobile app . Here we propose an automated home automation that works on speech processing. The system utilizes an HC-05 Bluetooth module to receive voice commands from a smart phone , the Pi processor now processes user's speech to extract keywords related to load switching. On processing of user spoken keywords the board operates a relay based circuit to switch loads on/off. The relay based circuit is used to switch AC supply loads easily using user commands. This project aims to demonstrate a cost-effective, user-friendly solution for home automation, leveraging the flexibility and low power consumption of the Raspberry Pi Pico

Keywords: Raspberry, Micro controller, Bluetooth module:

I. INTRODUCTION:

These days, individuals want to do jobs with the least amount of effort and as quickly, efficiently, and easily as possible. This need can be simply satisfied by adding a home automation system and turning "normal" homes into "smart" ones. The phrase "smart home" is not new to the scientific community; it has been in use for many years. Home automation is becoming a fast-expanding sector as electronic technology continue to progress.

Numerous smart systems with internet, Bluetooth, and other control mechanisms have been proposed. Homeowners find the idea of using a Raspberry Pi for speech recognition control of appliances and security to be appealing.

Automation is becoming more and more prevalent in the industrial and economic spheres as well as in day-to-day life. Cost and simplicity of installation and use, however, continue to be obstacles to wider adoption. This study aims to create an open source, low-cost, and adaptable system that can handle a growing number of devices that need to be controlled. Voice recognition-based home automation systems have the potential to improve user friendliness and ease of use for elderly and disabled individuals. A home automation system will improve the quality of life for elderly or disabled people.

We employ the Raspberry Pi, a low-cost, high-performance computer, in our system. Several generations of Raspberry Pi computing devices feature distinct arrangement. The Raspberry Pi 3, the most recent model, comes equipped with built-in Bluetooth and Wi-Fi. This project will create a number of standard home security peripherals based on Raspberry Pi. There will be a thermostat provided for temperature monitoring. The voice commands are recognized via Google APIs. After receiving the commands, it instructs the system to use the selected equipment to carry out the requested function. The system keeps track of the appliances' present conditions and may be expanded with basic codes and gadgets to offer new features. The primary programming language is Python. This solution offers security in addition to home automation. Motion sensors are used to identify human movement, while camera modules are used to take pictures. of the unauthorized individual, sends it online to the owner's phone, and uses a GSM module to deliver an offline message. Due to the quick advancement of new technologies, monitoring and control services as well as the internet are now offered as a tool for interacting with machinery and other devices. The technology is applicable in various settings, including banks, laboratories, hospitals, and other advanced automated systems, thereby mitigating the risks associated with unlawful access. This technique was developed primarily for security and convenience reasons, but also to save time and labour. As electronic technologies are advancing, the field of home automation is increasing rapidly. There were various smart systems have been proposed where the control is via Bluetooth, internet etc. Design of Controlling Home Appliances through voice recognition using Raspberry pi as well as providing security is an attractive option to homeowners. Automation have a continuously increasing and very important role in the industrial and economic world as well as in the daily experience. However, cost and ease of installation and use are still barriers to widespread adoption. The goal of this paper is to design a low cost, open source, and flexible system with increasing variety of devices to be controlled. The voice recognition based home automation systems for paralyzed and old people can make the system more user friendly and easy to operate. Home automation system for old or disabled people will offer raised quality of life for them. In this system, we use Raspberry pi which is a high performance, low cost computer. Raspberry Pi have several generations of computer systems which have different configuration. The latest version of Pi ‘Raspberry Pi 3’ have on-board Wi-Fi and Bluetooth. Based on Raspberry Pi, this project will implement several common home security peripherals. A thermostat will be available to monitor temperature. Google API’s are used to recognize the voice commands. It receives the commands and tells the system to perform desired function with the desired appliance. The system also tracks the current state of the

appliances and other functionalities can be added to the system with simple codes and devices. Python is used as the main programming language. Along with home automation, security is also provided in this system. We use motion sensor to detect human motion and a camera module which captures the image of the unauthorized person and sends it to the owner's phone via internet and also sends an offline message using GSM module. By the rapid developments of new technologies, monitoring, controlling services have been started to be served along with internet as an instrument providing interaction with machinery and devices. The system can be used in several places like banks, labs, hospital and other sophisticated automated system, which reduces the hazards of unauthorized entry. The main reason to develop this system is to save time and man power along with security and convenience. Controlling home appliances through voice along with security makes this system

II. LITERATURE SURVEY

It provides a quick overview of the literature on intelligent home network systems and attempts to categorise the works into three main types: decision support, service provision, and real implementation. The classification is based on the authors' primary contributions. First, efforts have been made to improve the efficiency of the decision-making process for residential networks. As an illustration, the intelligent house control [1] project concentrated on developing home control systems that offer users intelligent services via active sensor networks. Second, the Home Automation with Raspberry Pi [2] project focuses on leveraging any mobile device with Wi-Fi capability to remotely control household equipment. The Arduino-based smart house system [3] project suggested a system that manages security and home appliances.

Increased home automation features, such as alarm-based smart locks, smart water tanks, and mosquito detection, are made possible by the smart home project [4], which is based on sensing mechanisms. Home automation is currently the most required and requested technology now a days. People are looking for various ways to automate their living in cheapest way possible. There are various variety of a automation systems in the market but only few can be popular among the people and users.

The Raspberry Pi single board computer is used to create a home automation system. In this research paper the author explains us how to interface the raspberry pi computer to a relay switch along with an electric connected to the relay switch. For quite a long time, the web has been generally utilized for the cycles like surfing on the pages, looking through data, downloading visiting, and establishment. By the fast improvements of new advancements, checking, controlling administrations have been begun to be served alongside the web as an instrument furnishing communication with apparatus and gadgets. The framework can be utilized in a few spots like banks, labs, hospitals, and another complex computerized framework, which decreases the perils of unapproved sections. The principal reason to foster this framework is to save time and labour along with security and comfort.

III. EXISTING SYSTEM

A microcontroller-based voice-activated home automation system is an advanced combination of hardware and software intended to simplify home administration with voice commands. The microcontroller platform, such as Arduino, Raspberry Pi, or ESP32/ESP8266, which serves as the central processing unit, is the foundation of the system. This microcontroller coordinates the operation of several household gadgets and interprets voice commands that are received. The HM-10 and EasyVR voice recognition modules are integrated to precisely understand spoken instructions and convert them into commands that the microcontroller can follow.

The efficiency of the system depends on its capacity to communicate with tangible objects, which is accomplished by actuators or relays. These parts act as a conduit between the physical world of fixtures and appliances and the digital world of the microcontroller. The microcontroller may carry out commands to control lights, temperature, and other electronic gadgets in the home by turning on relays or actuators.

The system may be equipped with optional sensors to improve responsiveness and functionality. These sensors collect environmental data and, in response to preset parameters, initiate automatic operations. Motion sensors, for example, can identify movement within a space and trigger the system to change temperature control settings or turn on lights appropriately. In a similar vein, light sensors optimise comfort and energy economy by adjusting lighting levels based on ambient brightness.

IV. PROPOSED SYSTEM

The Voice control based home automation and Security using Raspberry Pi Pico. These paper deals with both Software and Hardware components. The hardware part consists of input command is voice, it means controlling home appliances by voice. The block diagram consists of a Raspberry Pi, Bluetooth module, temperature sensor, motion sensor, Gas sensor, Ethernet cable, Wi-Fi router, Relay circuit board, 5v power supply and android mobile. Python is used as a main programming language provided by Raspberry pi pico.

The voice recognition-based home automation and security utilising Raspberry Pi block are both hardware and software components are covered under the project. The hardware component comprises of voice input command, which allows speech control of household appliances. The Raspberry Pi, Bluetooth module, temperature sensor, motion sensor, gas sensor, Ethernet cable, Wi-Fi router, relay circuit board, 5-volt power supply and Android mobile phone are all shown in the block diagram. Python is the primary programming language that Raspberry Pi offers.

A microcontroller-based voice control and home automation system that integrates appliances and other household items with a central microcontroller unit such as an Arduino or Raspberry Pi that acts as the automation system's brain is being proposed. With voice recognition built into the system, users could communicate with their smart home by only speaking commands to it. These commands might be used to manage security cameras, turn on and off lights, change thermostats, operate entertainment systems, and more. Using suitable interfaces like Wi-Fi, Bluetooth, or Zigbee, the microcontroller would receive voice commands, process them using logic that had been preprogrammed, and then carry out the necessary operations by sending signals to the associated devices. To collect information about the home

environment and enable automation depending on variables like occupancy, temperature, and light levels, the system may also include sensors. All things considered, this suggested solution provides a practical and effective means for homeowners to use voice commands to control and manage different areas of their homes, improving user comfort, convenience, and energy efficiency.

V. HARDWARE DESCRIPTION

In this research work, we have used a Raspberry Pi Pico microcontroller along with a HC-05 Bluetooth module to control all the electronic devices connected to the system. The Pico microcontroller does not have the Bluetooth capability by default, so we are using the HC-05 module to contact the devices through Bluetooth.

A. Raspberry Pi Pico

The Raspberry Pi Pico microcontroller is one of the cheapest microcontrollers in the market. It can run both Micro-python and c language programs on it. Micro-Python is a programming language derived from the computer language python. Micro python is generally used to work with low level devices like the Pico. It contains all the important features of the python language without having all the inbuilt libraries that python has. The Raspberry Pi Pico is the first microcontroller from Raspberry Pi foundation. It comes with the RP2040 chip which was designed by the Raspberry Pi foundation.

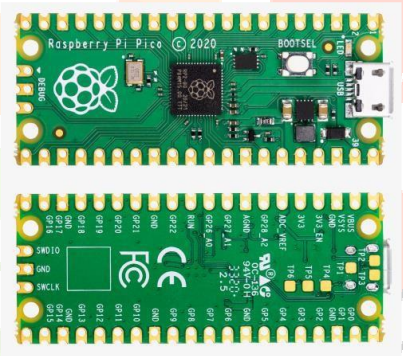

Fig 1. Raspberry Pi Pico

B. HC-05 Bluetooth Module

In this research work, the HC-05 chip is used to provide the Raspberry Pi Pico with Bluetooth capability. The HC- 05 module operates at 5V and uses 30mA current. The range is around 100 meters. It uses the USART protocol for communication and follows the IEEE 802.15.1 standard protocol for Bluetooth communication. It can operate in both Master, Slave modes. The supported baud rates for the HC-05 module are: 9600, 19200, 38400, 57600, 115200, 230400, and 460800.

Fig 2. HC-05 Bluetooth Module.

The HC-05 has 2 operating modes, they are Data mode and AT command mode. In the data mode it can send and receive information from another device with Bluetooth. In the later mode, the device's default settings can be altered manually.

C. Relay Module

A relay module is used a bridge between the DC current to 240V AC current to switch the electronic devices ON/OFF. The relay module has 6 inputs IN1through IN6 with a low-level light coupling. The relay comes with octal-coupler isolation and supports all SCM control. The relay switch in general is an electrical switch which can trigger power supply in circuits just like normal physical switches. A suitable voltage pull 5V DC in this case is required to alter the relay state between ON/OFF. There are various types of relays ranging from different input voltage like 5V, 12V, 24V etc. When this threshold of voltage is reached the relay coil present inside the relay module gets energized and thus, closing the circuit.

VI. WORKING PRINCIPLE

In this research work, we are using the Raspberry Pi Pico microcontroller for building a home automation system along with the HC-05 Bluetooth module. Firstly, when a signal is sent to the HC-05 module from a smart phone or a computer through Bluetooth, the HC-05 takes wireless input and triggers the Pico microcontroller. Then, the Pico runs the Micro-Python code and sends a signal to the particular relay which is connected to the target electronic device.

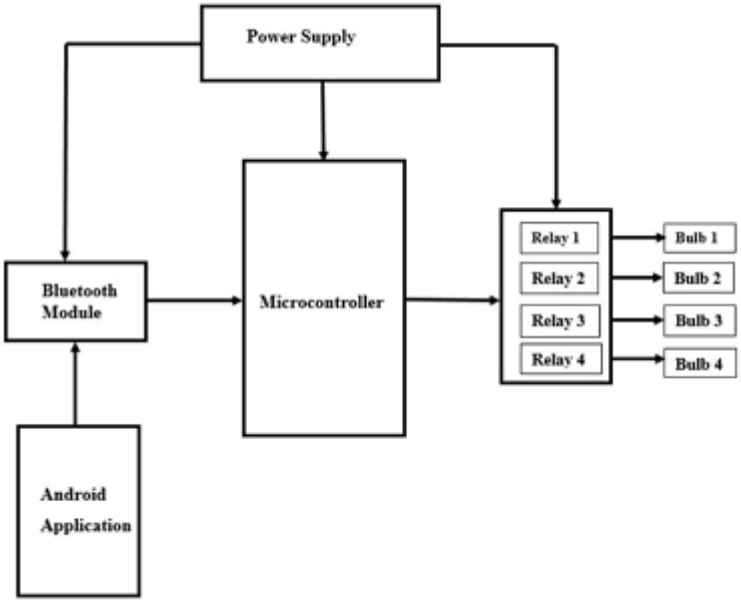

Fig 3: Block diagram

Similarly, a relay can be used along with the Pico microcontroller to build a smart security system that can detect human presence and can trigger an alarm. In this way, the Pico microcontroller can be used to build a home automation system with the HC-05 module.

VII. RESULTS

The entire setup is set and a Bluetooth application to control the devices is made using the kodular.io service. With this, the setup is complete, and the system is tested. In the Fig.4, the entire setup is powered by a 5v DC adaptor and the 240V bulbs are connected to the wall socket. Here, 4 input 5V DC low level relays are used for the connection. The Raspberry Pi

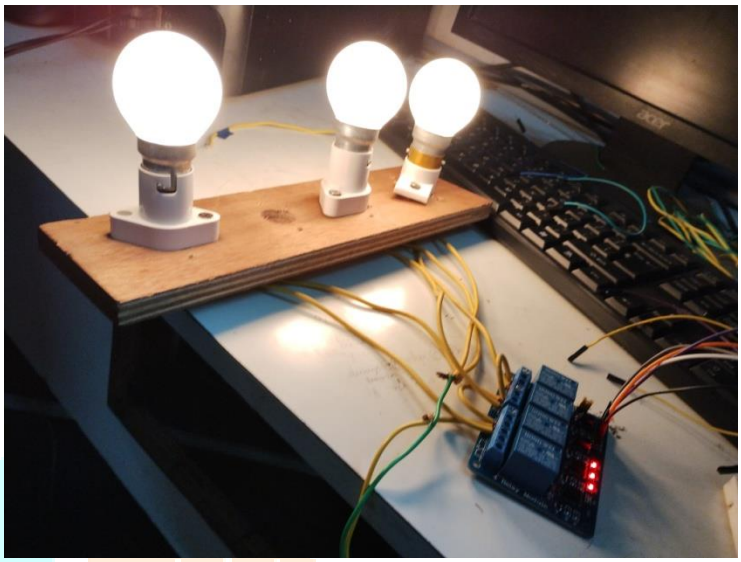

Fig 4:Proto type model

Pico microcontroller and the HC-05 Bluetooth module are mounted on a breadboard as a temporary station, this can be further converted into a complete portable device with a mounting and holding case for the entire setup. we can see that the electronic lights connected to the 240V AC current are controlled by the Pico micro controller via the HC-05 using the Bluetooth application on the smart phone. This can expand to any electronic device in our everyday households.

VIII. CONCLUSIONS

In this research work, we have implemented a home automation system using a Raspberry Pi Pico microcontroller, HC-05 Bluetooth module, Relay Module and a Bluetooth application on a smart phone. Home automation systems in general are very expensive and are not easily customizable to our needs, here in this paper, we have proposed a home automation system using a Raspberry Pi Pico microcontroller which is very cheap and also, we can program the Pico as required by our needs. It can run both C/C++ and Micro Python making it very accessible to everyone. A HC-05 Bluetooth module is used to extend the capabilities of the Pico and giving it a Bluetooth communication capability via the HC- 05 module. In this build, a 5V DC input relay is used to trigger the target electronic devices. The relay is an alternate to the physical switches that we use in our households.

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