AI/IOT Based Smart Classroom

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ABSTRACT

This project presents the overall design of a Classroom Automation System (CAS) with low cost and wireless system. It specifically focuses on the development of an IOT based classroom automation system that is able to control various components via the 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 classroom. 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 stronger automation. The system is 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 in order to fulfil the needs of elderly and disabled in classroom. Also, the smart classroom concept in the system improves the standard living at classroom.

Keywords: Automation Applications, Node MCU, ESP8266, Wi-Fi, Bluetooth, Virtual Assistant, AI, Smart Classroom.

INTRODUCTION

Internet of Things (IOT) is a concept where each device is assign to an IP address and through that IP address anyone makes that device identifiable on internet. The mechanical and digital machines are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. Basically, it started as the "Internet of Computers." Research studies have forecast an explosive growth in the number of "things" or devices that will be connected to the Internet. The resulting network is called the "Internet of Things" (IoT). The recent developments in technology which permit the use of wireless controlling environments like, Bluetooth and Wi-Fi that have enabled different devices to have capabilities of connecting with each other. Using a WIFI shield to act as a Micro web server for the Arduino which eliminates the need for wired connections between the Arduino board and computer which reduces cost and enables it to work as a standalone device. The Wi-Fi shield needs connection to the internet from a wireless router or wireless hotspot and this would act as the gateway for the Arduino to communicate with the internet. With this in mind, an internet based classroom automation system for remote control and observing the status of classroom appliances is designed. Due to the advancement of wireless technology, there are several different type of connections are introduced such as GSM, WIFI, and BT. Each of the connection has their own unique specifications and applications.

LITERATURE REVIEW

IOT BASED HOME AUTOMATION SYSTEM: This project explores home automation using the Internet of Things (IoT). It involves integrating various devices and appliances within a home to create an interconnected system. The study covers topics such as specifications, pin definitions, and programming with Arduino IDE. It also delves into flashing NodeMCU firmware on the ESP8266, which is a popular microcontroller for IoT projects.

Smart Home Automation: Smart home technology, now integrated into the IoT, provides homeowners with peace of mind by allowing them to monitor and protect their houses remotely. This research study provides a comparative literature review on smart home automation, emphasizing its benefits and applications.

Communication Methodologies: Various communication methods are explored, including GSM, Wi-Fi, IoT, and Bluetooth. The pros and cons of each technique are discussed, along with their features.

Overall Study: The overall study of new technologies used for home automation is presented. Key terms include Apple Home Kit, Amazon Echo, Google's Nest Thermostat, IFTTT, Belkin's Wemo Switch, and Blynk App. Advantages of Home Automation: Home automation refers to the remote monitoring and control of appliances. With the continuous growth of the Internet, this field continues to evolve.

SYSTEM ARCHITECTURE

In this circuit diagram, Arduino Node MCU is used as a micro controller. Four push buttons are used for settings. Four channel 5 volts relay module is used for four loads. A 5 volts and 2 ampere adapter is used for power source. The main power source is 220 volts that is for our loads. For loads, we have used a fan, a switch and light bulbs. To operate other part of circuit, power adapter is used, that will provide 5 volts DC input. Make accurate connections for smooth working. Make sure all of the parts are connected correctly after building the circuit. Turn on the system, check the manual switches, and keep an eye on Firebase's modifications. To operate appliances remotely, use the smartphone app. Check to see if the relays react correctly to manual and app-based inputs.
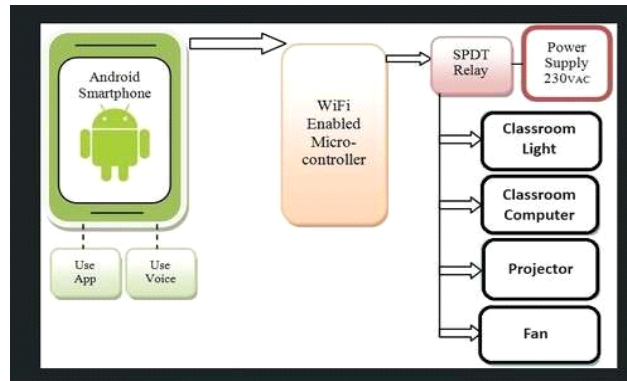

Figure 1. System Architecture

IMPLEMENTATION

MIT App Inventor is a high-level block-based visual programming language, originally built by Google and now maintained by the Massachusetts Institute of Technology. It allows newcomers to create computer applications for two operating systems: Android and iOS, which, as of 25 September 2023, is in beta testing. The web interface consists of a graphical user interface (GUI) very similar to Scratch and StarLogo, allowing users to drag-and-drop visual objects to create an application that can be tested on Android and iOS devices and compiled to run as an Android app.
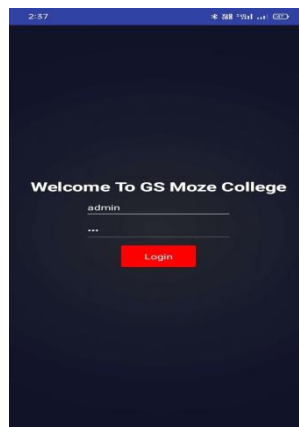

Figure 2. Login Page

International Journal of Enhanced Research in Management & Computer Applications
ISSN: 2319-7471, Vol. 13, Issue 4, April-2024, Impact Factor: 8.285
Presented at "ICRETETM-2024", Organized by GSMCOE, Pune, on 22ⁿᵈ - 23ʳᵈ April 2024

Figure 3. Home Screen

Figure 4. Result

IOT Control 4 Load is a comprehensive software suite that enables the prototyping, deployment, and remote management of connected electronic devices at any scale. Whether it's personal IOT projects or commercial connected products in the millions, IOT Control 4 Load empowers users to connect their hardware to the cloud and create iOS, Android, and web applications, analyze real-time and historical data from devices, remotely control them from anywhere. (Figure 2 Login Page)

Home screen consists of up to 3 tabs depending on the configuration: Devices, Automation. (Figure 3)
This section is open by default when you open the app. As login page of android app will be open and the user has to enter the login id and password to use the application. As user login he/she will get the main window of the application as it will allow the user to handle all the appliances remotely. Firstly user has to turn on the power mode then only he can on/off the devices present in the room. Also an user can operate the devices by giving a voice command.
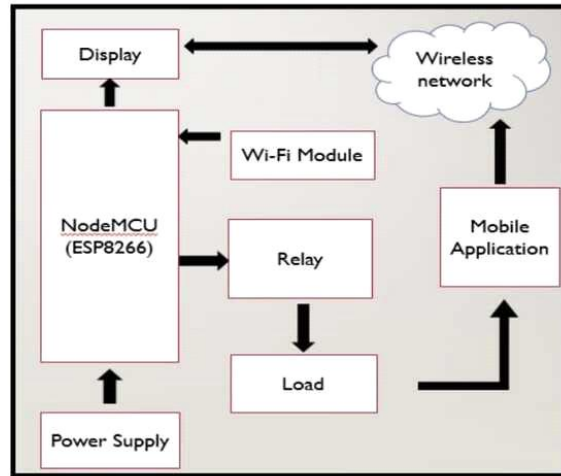
Fig:- Block Diagram

EXPERIMENTAL METHODOLOGY

Node MCU is the microcontroller unit in the prototype. It has an in built Wi-Fi module (ESP8266) that establishes wireless remote switching of classroom appliances. Four channel relay module consists 4 individual relays physically connected between Node MCU and the classroom appliances. It takes signals form GPIO pins of Node MCU and accordingly connects or disconnects classroom appliances from the supply. They act as the switching device.

LED and resistors are used in this prototype to replace real appliances. They indicate power being turned on and off to the appliances. In real time operation they would be replaced by actual classroom appliances.
Android application was designed for the Internet of Things.

It can control hardware remotely, it can display sensor data, it can store data, visualize it, etc. the prototype primarily uses android application to sense commands from user to the hardware over wireless network.

Google assistant is a system software present on the android phone. It interprets the voice commands by the user to turn on or off an appliances.

IFTTT application the voice commands interpreted by the google assistant isn't understandable by Android application thus unable to send to the hardware. IFTTT is an intermediate application that interprets commands from Google assistant and sends on and off signal to Android application Via Cloud server.

Block Diagram the block diagram gives the functionality of the overall project. The Node MCU unit is the microcontroller or the main controlling unit of the system. The user uses the mobile application in setting commands for functioning of the appliances. The mobile application interprets the command form in user in voice or switch mode and sends signal to the Node MCU unit, over a wireless network established by Wi-Fi communication. Hence the Wi-Fi module (actually inbuilt into Node MCU), helps the microcontroller establish Wi-Fi communication with a device and take commands from an application over wireless network. The Node MCU on further receiving the signal then turns on/off the appliance with the help of relay. The Node MCU, relay and the final appliances are physically connected. There is a power supply unit that powers the microcontroller, the relay as well as the final appliances. There is also a display unit that displays the status of the application.

Pin Configuration of Node MCU Development Board This module provides an access to the GPIO subsystem. All the access is based on I/O index number of Node MCU kits, not the internal GPIO pins. For example, the D0 pin on the development kit is mapped to GPIO pin 16. Node MCU provides access to the GPIO pins and the following pin mapping table is a part of the API documentation.

The ESP8266 Node MCU has total 30 pins that interface it to the outside world. The pins are grouped by their functionality as:

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ISSN: 2319-7471, Vol. 13, Issue 4, April-2024, Impact Factor: 8.285
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Power pins: There are four power pins viz. one VIN pin three 3.3V pins. The VIN pin can be used to directly supply the ESP8266 and its peripherals, if you have a regulated 5V voltage source. The 3.3V pins are the output of an onboard voltage regulator. These pins can be used to supply power to external components.

GND: is a ground pin of ESP8266 Node MCU development board.

12 IC Pins: are used to hook up allsorts of I2C sensors and peripherals in your project. Both I2C Master and I2C Slave are supported. I2C interface functionality can be realized programmatically, and the clock frequency is 100 kHz at a maximum. It should be noted that I2C clock frequency should be higher than the slowest clock frequency of the slave device.

GPIO Pins: ESP8266 Node MCU has 17 GPIO pins which can be assigned to various functions such as I2C, I2S, UART, PWM, IR Remote Control, LED Light and Button programmatically. Each digital enabled GPIO can be configured to internal pull-up or pull-down, or set to high impedance. When configured as an input, it can also be set to edge trigger or level-trigger to generate CPU interrupts.

ADC Channel: The Node MCU is embedded with a 10bit precision SAR ADC. The two functions can be implemented using ADC viz.
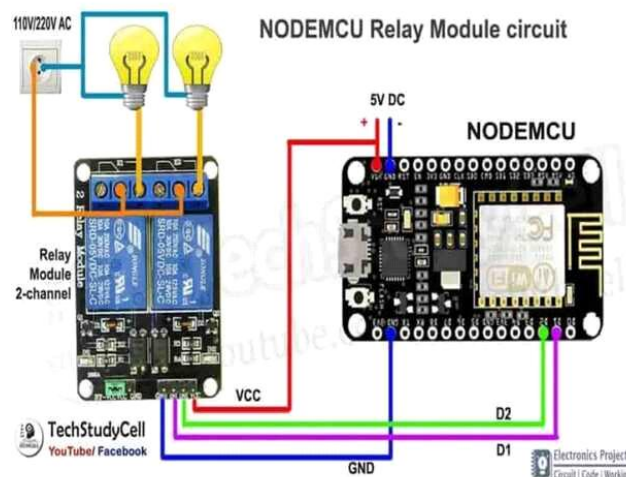
2.5 CIRCUIT DIAGRAM

Fig:-Circuit Diagram

Testing power supply voltage of VDD3P3 pin and testing input voltage of TOUT pin. However, they cannot be implemented at the same time. UART Pins: ESP8266 Node MCU has 2 UART interfaces, i.e. UART0 and UART1, which provide asynchronous communication (RS232 and RS485), and can communicate at up to 4.5 Mbps. UART0 (TXD0, RXD0, RST0 CTS0 pins) can be used for communication. It supports fluid control. However, UART1 (TXD1 pin) features only data transmit signal so, it is usually used for printing log. SPI Pins: ESP8266 features two SPIs (SPI and HSPI) in slave and master modes. These SPIs also support the following general-purpose SPI features: • 4 timing modes of the SPI format transfer • Up to 80 MHz and the divided clocks of 80 MHz • Up to 64-Byte FIFO SDIO Pins: ESP8266 features Secure Digital Input/output Interface (SDIO) which is used to directly interface SD cards. 4-bit 25 MHz SDIO v1.1 and 4-bit 50 MHz SDIO v2.0 are supported.

PWM Pins: The board has 4 channels of Pulse Width Modulation (PWM). The PWM output can be implemented programmatically and used for driving digital motors and LEDs. PWM frequency range is adjustable from 1000 s to 10000 s, i.e., between 100 Hz and 1 kHz.

Control Pins: are used to control ESP8266. These pins include Chip Enable pin (EN), Reset pin (RST) and WAKE pin. • EN pin – The ESP8266 chip is enabled when EN pin is pulled HIGH. When pulled LOW the chip works at minimum

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power. • RST pin – RST pin is used to reset the ESP8266 chip. • WAKE pin – Wake pin is used to wake the chip from deep-sleep.

Installation of Node MCU: Mostly these days devices download and install drivers on their own, automatically. Windows doesn't know how to talk to the USB driver on the Node MCU so it can't figure out that the board is a Node MCU and proceed normally. Node MCU Amica is an ESP8266 Wi-Fi module based development board. It has got Micro USB slot that can directly be connected to the computer or other USB host devices. Ti has got 15X2 header pins and a Micro USB slot, the headers can be mounted on a breadboard and Micro USB slot is to establish connection to USB host device. It has CP2120 USB to serial converter. In order to install CP2120 (USB to serial converter), user is needed to download the driver for the same. Once user downloads drivers as per its respective operating system, the system establishes connection to Node MCU. The user needs to node down the COM post allotted to newly connected USB device (Node MCU) from device manager of the system. This com port number will be required while using Node MCU Amica. As the CP2120 driver is been installed, the Node MCU can be programmed using Arduino IDE software by coding in embedded C. this requires ESP8266 board installation in Arduino IDE from board manager, and assigning communication port.

FUTURE SCOPE

With IoT devices, such as interactive whiteboards and tablets, teachers can create more engaging and interactive lessons that keep students interested and motivated. For example, a teacher might use an interactive whiteboard to present multimedia content, such as videos and graphics. Artificial Intelligence (AI) has the potential to transform education in many ways, including personalizing learning experiences, automating administrative tasks, improving accessibility, and providing real-time feedback to both students and teachers.

CONCLUSION

It is evident from this project work that an individual control classroom automation system can be cheaply made from low-cost locally available components and can be used to control multifarious classroom appliances ranging from the security lamps, the projector to the computer system and even the entire classroom lighting system. And better still, the components required are so small and few that they can be packaged into a small inconspicuous container. The designed classroom automation system was tested a number of times and certified to control different classroom appliances used in the lighting system, computer system, projector system and many more. Hence, this system is scalable and flexible. Android devices having a lower API version than 16 require internet access to convert the speech data to string data. Currently, the application is made for Android smartphones; other OS platform don't support our application. During voice mode, external noises (voice) may affect our result. The speech instruction that we command in our voice mode may not give exact results as expected. There hence lies an ambiguity in the result.

REFERENCES

[1]. "Smart Energy Efficient Home Automation System IEEE 7ᵗʰ International Advance Computing Conference. "IOT Based Smart Security and Home Automation", by Shardha Somani, Parikshit Solunke, Shaunak Oke, Parth Medhi, Prof. P. P. Laturkar.
[2]. "A Dynamic Distributed Energy Management Algorithm of Home Sensor Network for Home Automation System", by
[3]. Tui-Yi Yang, Chu-Sing Yang, Tien-Wen Sung; in 2016 Third International Conference on Computing Measurement Control and Sensor Network.
[4]. "Enhance Smart Home Automation System based on Internet of Things", by Tushar Churasia and Prashant Kumar Jain; in Proceedings of the Third International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC 2019) IEEE Xplore Part Number:CFP19OSVART;ISBN:978-1-7281-4365-1
[5]. "Visual Machine Intelligence for Home Automation", by Suraj, Ish Kool, Dharmendra Kumar, Shovan Barman.
[6]. "A Low Cost Home Automation System Using WiFi based Wireless Sensor Network Incorporating internet of Things", by Vikram.N, Harish.K.S, Nihaal.M.S, Raksha Umesh, Shetty Aashik Ashok Kumar; in 2017
[7]. "Voice Controlled Home Automation System using Natural Language Processing and Internet of Things", by Mrs. Paul Jasmin Rani, Jason Bakthakumar, Praveen Kumaar.B, Praveen Kumaar.U, Santhosh Kumar; in 2017 Third International Conference on Science Technology Engineering and Management (ICONSTEM)
[8]. Wikipedia(2009). HomeAutomation. From https://en.wikipedia.or
[9]. Theory of IOT from https://internetofthingsagenda.techtarget.com/defini of-Things-IoT using IOT", by Satyendra K. Vishwakarma, Prashant Upadhyaya, Babita Kumari, Arun Kumar Mishra