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Smart home automation with IoT enabled by using abode cybernation

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***Abstract*---**The abundant usage of natural resource and wastage of the natural resources are increasing day to day in order to meet the human requirements. The extent and the increasing need for self-comfort of the humans has been a major requirement. Here comes the intervention of IOT, which gives us the role to control and access our appliances from any place around the world. With this mindset of saving resources and to efficiently use the energy, the user of Abode cybernation is smart enough to conserve and save energy and reduce the human effort to save them by providing more automated appliances. The smart automated home will be an advantage to the environment and allow seamless control over any appliance from anywhere globally. Throughout the implementation of the system, it is possible to explore a huge exposure to different challenges, including the software programming PCB design WiFi, TCP/IP protocols, connectivity logic design, and many other aspects. This Adobe Cybernation provides us with a great insight into software and hardware design challenges.

***Keywords*---**IoT, energy conservation, automated devices, TCP/IP protocols, sensors.

Introduction

As growing the wastage of energy and resources [1], we need the technology to lend a helping hand towards involving a new way to conserve energy and introduce a smart way to control and analyze them, IoT [2]. Here comes the idea of an intelligent home [3] that allows the user to access and control the required

appliances. Using innovative [4] technology to lower energy consumption. Node MCU microcontroller is the heart of this system Which communicates with hardware and software development in the project. The smart home [5] offers a variety of options to correct any small human error that can cause disasters like fire hazards. It offers the user functionalities like switching from a manual to a digital[6] era like turning on and off appliances, changing values, or any input to appliances connected to the system.

Overview of the System

Another feature of the system is that we use the IR sensor over the motion sensor because there have been many drawbacks of motion sensors as the motion sensors were unable to capture the presence of a person, whereas their sensor emits light to find the presence or movement of the user as per the requirement. Many existing systems are controlled only by voice assistants or Android apps or Bluetooth [7], or manuals. This system has all the possible ways of communication simultaneously are

- Manual way
- Voice assistant
- Android app
- IR sensor.

Presently, Home automation has been becoming increasingly essential to increase the comfort or feasibility of life using the technology. The convenience and ease of use are what technology brings us in day-to-day life that strives to make things easier to control or access. Home automation gives an individual a wide range of opportunities and control over his appliances and home in every aspect from anywhere around the globe. Like turning on/off appliances which help in good and efficient energy use. Nevertheless, there has been an issue in adapting this home automation mainly because of the price factor to establish the requirements and complexity [8] in configuration for home automation has been a significant issue for the minor adaption of home automation. This home automation helps elders and people differently-abled [9] easily control the appliances around them with just a smartphone click.

Existing Work

The existing [10] works of this domain are like individually implementing control of WiFi or Bluetooth or android app or use of motion sensor. There may be exciting works [11] like models based on the GSM [12] module to communicate messages and the Bluetooth module. The developments in the present technology have created a broad scope of connectivity using WiFi and Bluetooth. Through the WiFi technology there, we eliminate the strict and old use of wired connectivity [13] on the microcontroller where The WiFi module helps to retrieve the data seamlessly over the internet via the WiFi module on the microcontroller. The WiFi shield needs a hotspot or source of the network to get connected to the internet to be a gateway between the Node MCU microcontroller and the internet. This concept has been a vital concept of the system enabling the user to communicate with the appliances over the internet.

Proposed System

The proposed system is a finite automaton where the user can control the appliances in his range using the technologies that the internet of things possesses. This system incorporates all the different possible ways to control an appliance using IoT and sensors that play a vital role in home automation as shown in Figure 1.

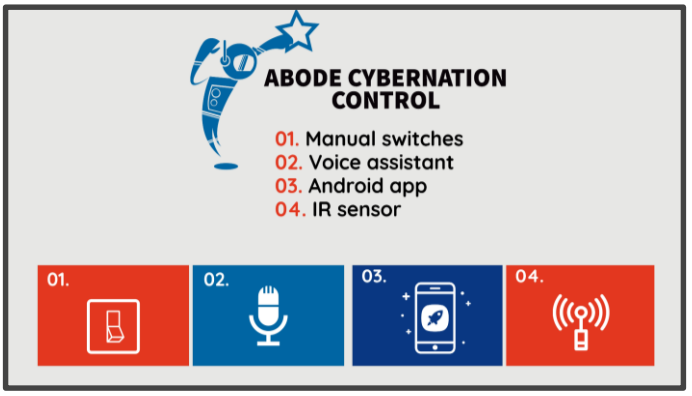

Figure 1: Features of the proposed system

There will be a bespoke app that we made for this system where we will be able to control the appliances with the help of buttons. This mode of control is Voice control uses the voice commands to the microprocessor using the wifi module within the app itself. This automation mode has been the main reason for introducing the voice assistants, which enables the user to control all the devices over the same network seamlessly using the voice assistant, e.g., Alexa, google assistant. The most crucial and Fundamental feature of any system is manual control. The system does make some minute mistakes, which then needs the user to interact with appliances directly using this manual control. This control of IR sensor is for a more comfortable way of controlling the automation where we need to make contact with their sensor where their sensor works on the basic functionality of emitting light waves to find the presence of the user, which on contact with the sensor will change the present state of the appliances to the opposite state say if the appliances are OFF on contact to the sensor, the appliances state change to ON. The Fire sensor shows the scope of IoT in each corner of the home. The most important place for fire sensors [14] at home is the kitchen. This sensor's working Principle is detecting smoke or heat. These sensors respond to the presence of smoke or extremely high temperatures, which are way more than the usual temperatures. As the parameter triggers the device gets activated, it will send a signal to the alarm system if any else performs the programmed response for that zone. After which, we will be Sharing/Posting the Fire Sensor values at ThingSpeak.

Hardware Requirements

01. NodeMCU ESP8266
02. Relay Board
03. IR Sensor

04. Fire Sensor
05. Soldering Kit
06. Electrical Appliances
07. Jumper Wires
08. Electrical Wire
09. Electrical Switches

NodeMCU ESP8266

NodeMCU is an IoT ESP8266 Wi-Fi Module, as in Figure 2. NodeMCU uses Lua Scripting language and is an open-source Internet of Things (IoT) platform that can connect IoT devices and allow the devices to communicate and transfer data using the Wi-Fi protocol.

Relay Board

A relay Module is a board that can control the voltage and load of appliances, as shown in Figure 2. It is designed to interface with a microcontroller such as Arduino.

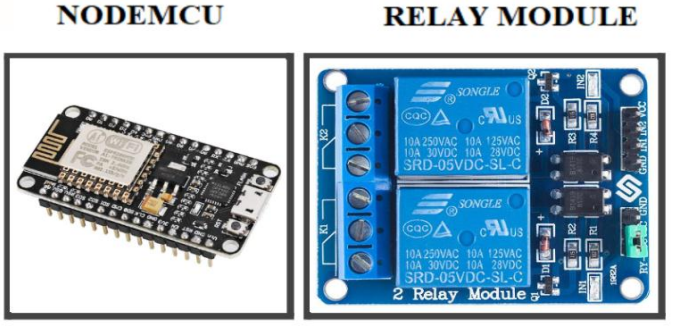

Figure 2: Node MCU Relay Module

- Connect Vcc of the relay with pin 3.3v of nodemcu
- Connect the GND of the relay with the GND of NodeMCU
- Connect the pin signal of the relay with pinD7 (GPIO 13) of NodeMCU
- Connect one terminal of Bulb with NC of relay
- Connect one terminal of Adaptor with Pin C of relay
- Connect the other terminal of the bulb with another terminal of the adaptor

The NodeMcu is connected to the relay module in the above way, which enables the control over the voltage in the relay by the NodeMCU. Which enables the nodeMcu to stop the power supply to the appliances using the relay board.

IR Sensor

IR sensors are now widely used in motion detection and building services with the collaboration of IoT to control appliances or alarm systems to detect unknown presence. Which is shown in Figure 3 is The schematic diagram of the module.

The basic fundamental concept of the sensor is that it emits light to detect the surrounding elements and detect the infrared radiation that changes over time.

Fire Sensor

This sensor's basic working Principle is detecting smoke or heat. The module reference is in Figure 3. These sensors respond to the presence of smoke or extremely high temperatures, which are way more than the usual temperatures. As the parameter triggers the device gets activated, it will send a signal to the alarm system if any else performs the programmed response for that zone.The basic fire sensor principles are based on the perceived parameters, i.e., heat, smoke, radiation, and production of any chemical substances. The magnitude of the sensed parameters such as smoke, Temperature, and flame received from the sensors enables fire detection as they offer greater flexibility in handling imprecision and Nonlinearities.

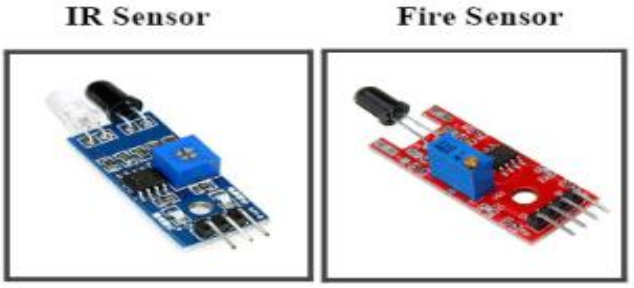

Figure 3: IR Sensor FireSensor

The NodeMCU over Arduino UNO is chosen [15] due to the compatibility which is described in the below Table 1 and Table B of comparison.As per the below comparison there exists an advantage at NodeMCU ESP8266 over Arduino UNO Hence we have chosen to use NodeMCU in our Automation system. NodeMCU is an ESP8266 microcontroller with an inbuilt Wi-Fi module Integrated into It. The NodeMCU module is a microcontroller coded by the individual based on the use case. The Microcontroller allows the user to connect with the internet to communicate with the appliances/devices via Wi-Fi seamlessly

Table 1 : NodeMCU vs Arduino comparison

Function	NodeMCU ESP8266	Arduino UNO
Microcontroller	ESP8266	ATmega328P
Flash Memory	4 MB	32 KB
SRAM	128 KB	2 KB
EEPROM	512 BYTES	1 KB

CLOCK Speed	80 MHz OR 160 MHz	16MHz
Operating Voltage	3.3V DC	5V DC
Input Voltage	7-12 DC	6V-20V DC
Current consumption	15 μA – 400 mA	40 mA - 80 mA
DC Current per I/O Pin	12mA	40mA
Digital IO Pins	17	14
Analog Input Pins	1	6
UARTs	2	1
SPI	2	1
I2C	1	1
PWM	4	6
WiFi	Yes	No
Bluetooth	No	No

As per the above comparison there exists an advantage at NodeMCU ESP8266 over Arduino UNO Hence we have chosen to use NodeMCU in our Automation system is shown in Table 1.

Software Requirements

- Arduino Software (IDE)
- Android Studio
- ThingSpeak

Thinkspeak is an IOT analytics platform that visualizes and analyzes live data streams in the cloud. You can send data to things you speak from your devices, create instant live data visualization, and send alerts using web services like Twitter, Twilio, and other applications. It can also supports live stream data visualization. MATLAB is integrated with it, making it highly recommended for IoT systems.[16], as shown in Figure 4.

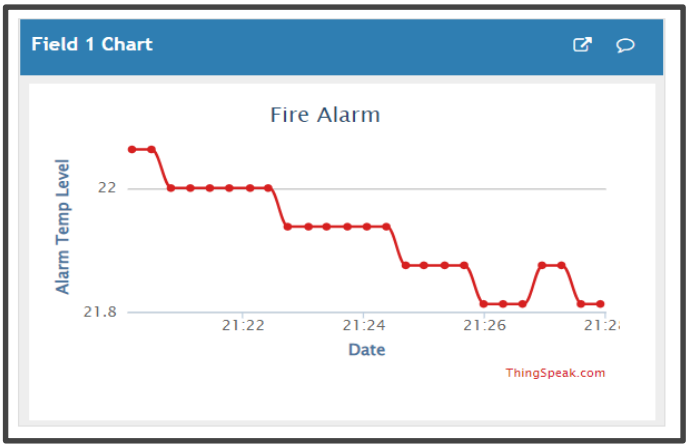

Figure 4 : Alarm Temp Level

Proposed System Architecture

This system incorporates all possible ways to control an appliance using IoT. We designed the systemic flow diagram of our system, as shown in Figure 5.

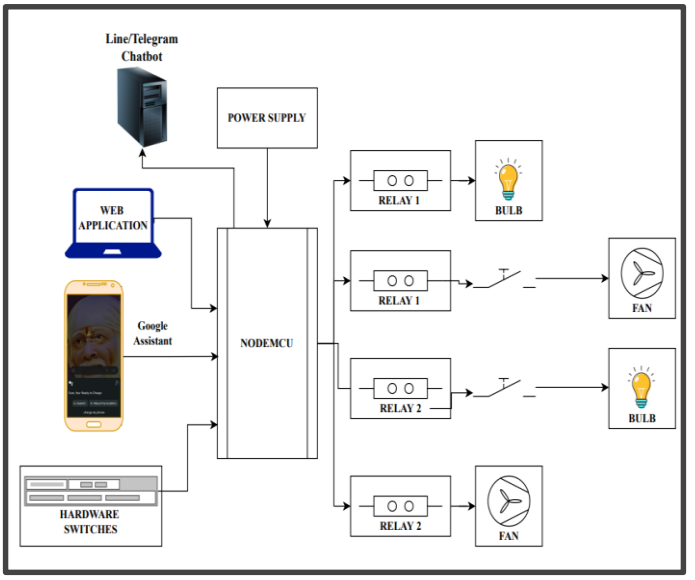

Figure 5: Proposed Architecture diagram

In this home automation, the user gives commands to the App, IR-sensor., Manual, and Voice, home appliances like bulbs, fans, motors, and other appliances. It can be controlled accordingly. The commands given through the adafruit are decoded and then sent to the microcontroller. The microcontroller will in turn, control the relays connected to it. The device connected to the respective relay can be turned ON or OFF as per the user's request .The microcontroller used is NodeMCU (ESP8266), and the communication between the microcontroller and the application is established via Wi-Fi (Internet).The system eliminates the wiring complication as we have used the WiFi in due technology.

The amount of power supply is also controlled as per the requirement of the system. WiFi module is used in this home automation, the user gives commands to the App, IR-sensor., Manual, and Voice, home appliances like bulbs, fans, motors, and other appliances. It can be controlled accordingly. The commands given through the adafruit are decoded and then sent to the microcontroller. The microcontroller will in turn, control the relays connected to it. The device connected to the respective relay can be turned ON or OFF as per the user's request .The microcontroller used is NodeMCU (ESP8266), and the communication between the microcontroller and the application is established via Wi-Fi (Internet) shown in the figure 1.5.This system eliminates the wiring complication as we have used the WiFi in due technology. The amount of power supply is also controlled as per the requirement of the system.We have used a WiFi module in our system where the operating range is more than the Bluetooth[18] . The idea of our automation system is to control via App, IR-sensor, Manual, and control home devices with voice. In this project, we use Adafruit, a cloud-based [17] hosting24.com web server used to create virtual switches and send messages and enable call services from open source applications like Line and Telegram.

Convoluted System View

The Working flow of the IR sensor and Voice control feature using the app are described in Figure 6. In the below diagram, we can control the appliances using the IR sensor, where the sensor changes the present state of the appliances on request from the user by movement near the sensor, whereas the voice control enables the user to get control over appliances from anywhere around the globe.

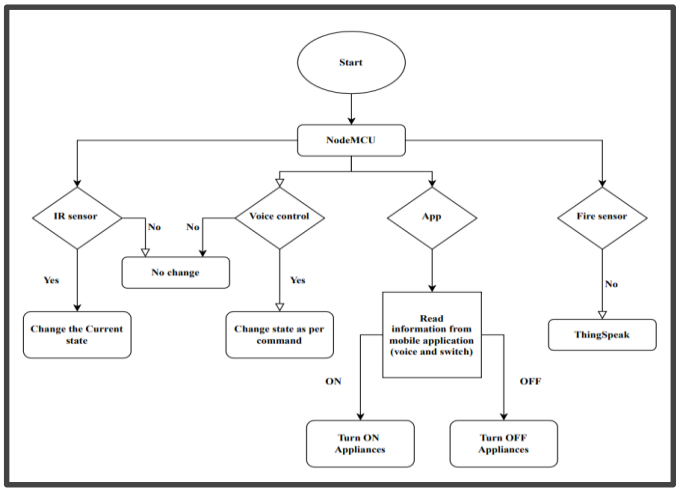

Figure 6 : Sequence diagram of IR sensor and Voice control

Each Relay will have 2 options: switch ON or switch OFF the appliances.The Firesensor will communicate with the microprocessor, which, as per the instructions given via Arduino IDE, the microprocessor will send the acquired data from the Sensor devices and Send it to ThingSpeak by communicating to the internet. The data sent from the IoT devices are analyzed with the Matlab code

present in Things Speak. It is often used for prototyping and IoT systems for data Analytics. The basic system works with a power supply and where the microcontroller and Relay are 2 sources of communication and control access over the appliances. The more superficial view of the automation where the power input is directed to the application without a microcontroller. In contrast, the relay board stops the power until instructed by the user via a microcontroller and allows the current to pass through to the required appliances as per the user's request.

APP Preview

The primary view of the application is shown in Figure 7. We have used Java [19,20] to build the application as Java makes IoT devices more integrated and has the ability of automatic up-gradation, making it cost-efficient and a better choice for IoT devices. Our application has buttons to control the state of the appliance and voice control incorporated in the application where Line or Telegram can be integrated for sms or call requests as per the user requirement, which gives the current status of appliances shown in the tour of this paper.

Figure 7 : Application preview

The code is integrated with the microcontroller, The IFTTT service helps decode the command given, and the respective operation is carried out.The Set of commands we used in our system is attached for reference in Figure 8. IFTTT is platform representing if this then that which means if the command specified extings in set of commands then that will trigger the respective action set by the user. Eg: If Light off Then Relay state 0

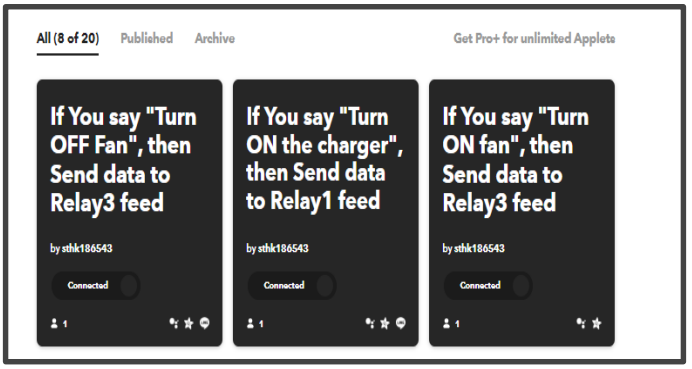

Figure 8: IFTTT Applet commands console

The Adafruit console looks like figure 9, where the buttons connect to the appliances and are controlled using the Adafruit Web application.

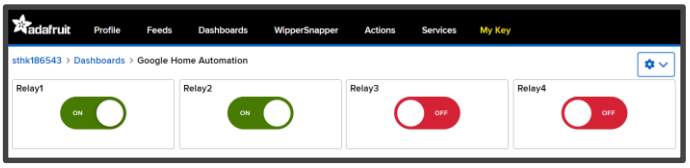

Figure 9: Adafruit Dashboard View

A Notification will be sent form the IFTT chatbot via Line application where it shows the current status of the appliances in our automated system as referred in Figure 10 . Here in the below image the IFTTT has send the Trigger message to The Line chatbot to send a message of the request made by the user for acknowledgment. The role of the chatbot in our system home automation is sending the user a message via the application we are using regarding the current status of the appliances. The different notifications our chatbot can send are the ON/OFF of the appliances.

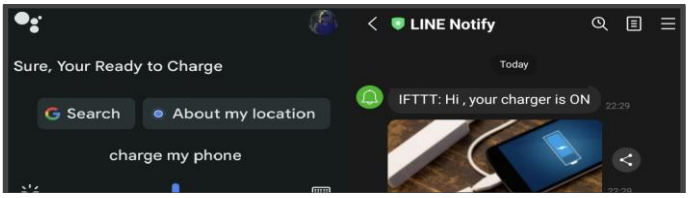

Figure 10 :Notification from Line via IFTTT bot

We have to write commands like IF (Command) and Then (What to do) in this service as shown in Figure 11. We can integrate open source services like the Line and Telegram application.

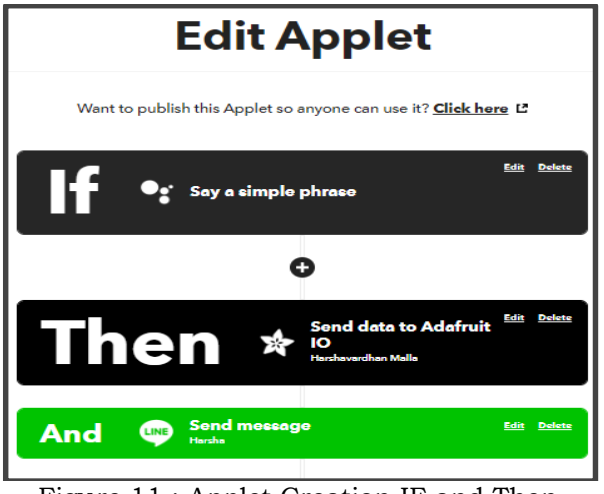

Figure 11 : Applet Creation IF and Then

Conclusion and Future Scope

Throughout the paper, we have discussed different ways of controlling our Abode Cybernation System. Given the project's future Scope, improvements are possible only if we consider the various issues and shortcomings in the current technical approaches.We can design a fully automated home using all the technologies and techniques in IoT. It has been a crucial role and fundamental aspect of making life easy and comfortable for mankind. Given the further development process in our system. we can add things like Light Curtain sensors for Curtain automation, Camera for security, a solar system to manage Electrical Resources, Humidity sensors for Air Conditioner control or Humidifier Control, Sensors to ensure soil fertility for gardens, motion sensors and Auto door control, Smart boxes to receive Online Delivery products in our absences with OTP lock System, Health tracking devices and many other techniques to identify the authentic and efficient way of a process as It is one of the Futures interest. Auto-cleaning Bots to ensure the cleanliness of the Homes, IoT machinery to fold clothes, WiFi-enabled appliances to control them as per the user's requirement to have more sophisticated life.

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