DESIGN OF HOME APPLIANCE CONTROL UNIT USING GOOGLE FIREBASE IOT SERVICE

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Abstract - *In the past, different wireless communication schemes were used for controlling home appliances and industrial appliances. Wireless communication schemes are light based and RF based. RF technologies used are mobile communication service via DTMF decoding, messaging services, calling services, short range RF communication, Bluetooth services etc. IR remotes are a very common wireless module used in every home to control TVs air conditioners. With the advent of WIFI services the internet of things came into existence and became the most popular and innovative technology nowadays. This research work focuses on designing a control unit using an Arduino; capable of controlling home appliances using the most recent and innovative technique Google firebase. To switch light and constant voltage operating devices relays are used and devices that need voltage regulation are switched using electronic switches.*

Keywords: Internet of Things (IoT), Google firebase, Arduino, WiFi.

1. INTRODUCTION

With the advent of various wireless communication technologies, IoT became a prime medium to control and monitor standalone houses, industries, offices and other organizations. Aim of these advanced technologies is to provide standard living to humans and minimize human efforts [1]. Nowadays, an educational life and a human's social life is almost impossible without internet services. Electronic systems based on IoT not only monitor parameters of houses and industries but also provide a control electrical, electronic and mechanical device used in multiple types of infrastructures. Internet services used in IoT technology are expressed as multiple computers [2]. IoT is one of the best wireless technologies to automate your home and provide economic automation to any country. IoT is mostly used in monitoring environmental parameters like temperature, humidity, pressure, air pollution, gas leakage wirelessly. In this research work we focus on implementing an IoT based home appliance control system using google firebase service. Google firebase service can be accessed on mobile phone or computer to monitor and control as per design which is known as removal of human interaction [3]. IoT based control systems provide efficient use of electrical energy so it is a very powerful technology in industrial automation [4]. IoT can be also used for electrical billing systems to reduce human efforts in monitoring customer's energy meters. It also used to design smart homes by providing security and safety along with automating home appliances like ACs, lightings, fans, TVs and other home appliances. Using firebase services and NodeMCU having ESP8266 used to collect information [5]. Many applications like solar system parameters temperature, velocity of wind, irradiation and other parameters affecting solar system output can be monitored and data is uploaded to server for future analysis and prediction of solar power other applications like wireless sensor network deployed in sea and borders of countries can be advent with application of unlimited ranging IoT system. So IoT is the best service which can be used in all applications for home related systems and industrial automation systems. Home automation systems using IOT is a way through which one can explore and control home appliances or devices with the help of internet connection. The main purpose of this research work is to develop a home automation system to make true the concept of "SAVE ELECTRICITY" when not used and as it is the important part of our daily life it should be saved for further purpose when not in use.

2. RELATED WORK

Vinay Sagar [6] used internet service to control home appliances named as wireless home automation systems. Intel Galileo processor board is used to provide integration of wireless communication systems and cloud networking so that data can be stored on the cloud. This system is capable of controlling home appliances from anywhere using internet access. He used multiple sensors like temperature

sensor, gas sensor, PIR sensor light sensors and an alarming system to provide security.

Ravi Kishore Kodali [7] designed a smart security system and automated home appliances using IoT. This system sends a message to the owner in case of any trespass and raises an alarm and also used to automate home devices. To control the overall process the author used TI-CC3200 launchpad manufactured by Texas instrument. TI-CC3200 launchpad has onboard WiFi shield facilities so it is very useful for IoT based applications.

Gaurav Panwar [8] designed IoT based home automation using cloud computing which is able to control devices from a central host PC. Wireless data networks such as WiFi connectivity (IEEE802.11) applied to control home appliances and some sensors and actuators are providing security related issues. Wireless communication module ESP8266 provides 2.4GHz WiFi connectivity. To switch devices, relays are used as an electromechanical way.

Bhavna [9] presented an IoT based home automation system to control the home from his or her computer and depending upon light and temperature in home measured by sensor; system takes action. Author used LCD to check sensors status on site and WiFi module to monitor home from offshore.

Lalit Mohan Satapathy [10] presented a reliable, flexible and low-cost home security and automation system to access and control devices wirelessly from anywhere due to WiFi based internet connectivity on client side. Arduino is connected with WiFi module esp8266 and interfaces of various appliances such as TV, fan, light etc. Author also compared different wireless technologies like Bluetooth, Zigbee and ESP8266 in terms of network topology, power consumption, IEEE standards, data rate, range and cost of modules.

3. RESEARCH METHODOLOGY

In this research work google firebase is used as a software application to control the home appliances remotely. Firebase provides a quick way to persist sensory data collected at the device level, and it works great with the Android APIs, which is supported by Android Things. A lot of mobile and device programmers that I have come across struggle with server-side programming. Firebase can really help bridge that gap and make it easier. It will be interesting to see developers use its offline features. If you are new to IoT or in general any device that collects data and needs to transmit it over networks, the golden rule to be assumed is that network connectivity cannot be assumed. As a result, you will need to collect the data offline and when the network is available, transmit this over to your server. Firebase with its offline feature can really make this simple for a lot of developers.

Firebase has a ton of features including Real-time Database, Authentication, Cloud Messaging, Storage, Hosting, Test Lab and Analytics but I'm only going to use Authentication, Real-time Database.

The following steps are used to implement Google firebase service:
(1)   Create   firebase   account   on https://console.firebase.google.com/ .
(2) Login and click on add project: enter project title and country name as shown below in figure 1.
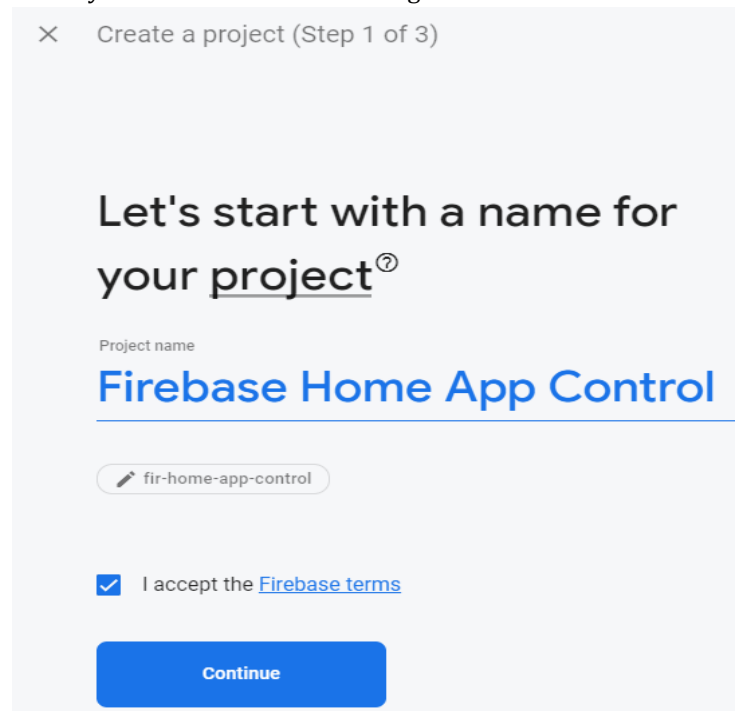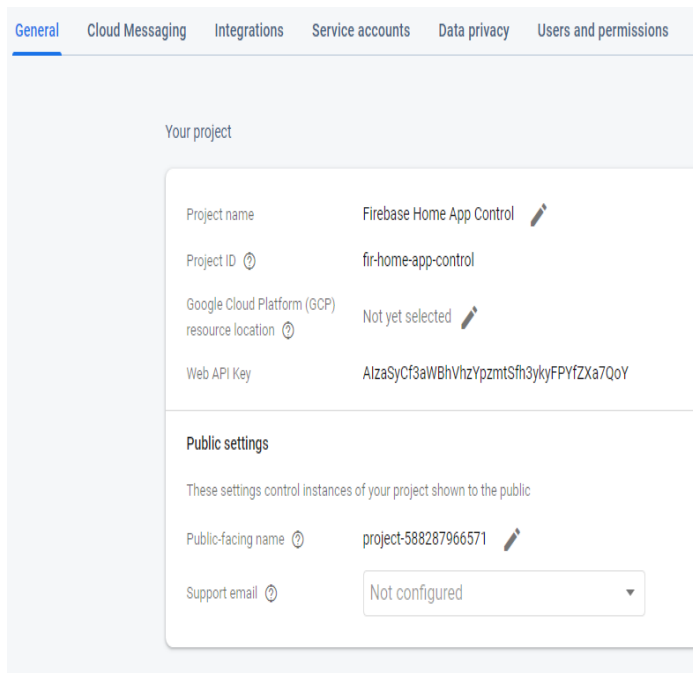

Fig. 1 Google Firebase Login

(3) Now real time database is created with security rules:
```
{
    "rules": {
        ". read": true,
        ". write": true
            }
}
```

So,   a   write   api   key   " AIzaSyCf3aWBhVhzYpzmtSfh3ykyFPYfZXa7QoY"   is generated for project title "Firebase Home App Control" with specific user as shown in figure 2, which is used in Arduino program to connect client to server.

Fig. 2 Generated API Key

(4) MIT android app inventor (ai2.appinventor.mit.edu) is used to develop an application to control appliances as shown in figure 3.

Fig. 3 Android App

Arduino based microcontroller board is used to check the command received from the server and to send control instructions to attached devices as per program built.

In the Arduino program firebase library "FirebaseArduino.h" is added first then WiFi library "ESP8266WiFi.h" is included. Firebase hosting is done using firebase project ID as " fir-home-app-control.firebaseio.com". Firebase authentication is provided by writing API keys generated " AIzaSyCf3aWBhVhzYpzmtSfh3ykyFPYfZXa7QoY".

WiFi hotspot SSID and Password is entered to which WiFi module on the hardware side is going to connect.

When the WiFi module is connected to WiFi a function "Firebase.getString" is called on various status to check status of buttons. If status is to turn ON the device then the Arduino controller turned ON relay which enables load connectivity to supply. If the request is to turn OFF then controller turned OFF relay to disconnect load from supply.

4. SYSTEM MODELLING

In the present design it has two parts one is software model and other is hardware model. Software model is discussed in the previous section now in this section hardware modelling working procedure of project is discussed. Main hardware used in this project are NodeMCU, Power supply, relays, transistor, bulb, fan, PCB and voltage regulator. NodeMCU is basically a combination of Arduino and WiFi module ESP8266 which is an open source Lua based device. Circuit Diagram of the project is shown in figure 4.
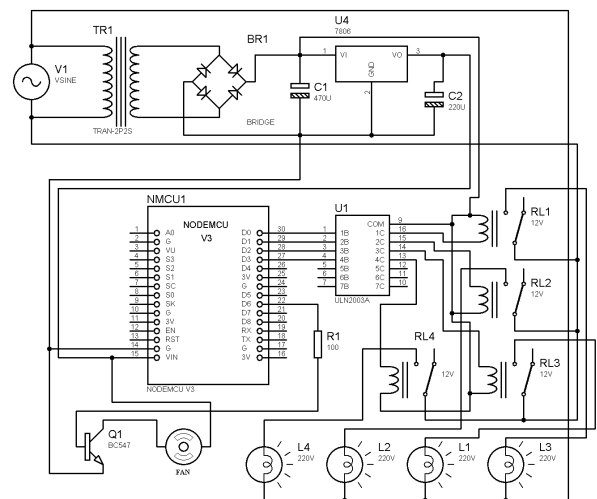
Fig. 4 Project Circuit Diagram

A power supply is made using a bridge rectifier fed with step down transformer and provides output to 6v voltage regulator 7806. Two electrolytic capacitors are connected to input and output of voltage regulator to reduce ripples generated due to loads. Now NodeMCU is connected to a relay driver IC ULN2003 used to drive relays as they need 12v and 200mA current to switch. Bulbs are connected to NO (normally open) terminal of relays and common terminals of relays are connected to neutral of power supply. One terminal relay coil is connected to 12v power supply and the other terminal of coil is connected to ULN2003 output pins which are ground when corresponding input is HIGH. To control switching and regulation of DC fans a transistor is used as a switch. Now PWM technique is used to control the speed of the fan. When NodeMCU receives command from Firebase it turns ON and OFF devices as per instruction.

5. CONCLUSION

A home appliance control unit is designed and developed in this research work to provide user access to home appliances using his/her mobile phone from anywhere with internet connectivity. Designed system is low cost as it uses a combination of Arduino based control unit and WiFi module on the same platform. The system is very robust, reliable and easily installable. Google firebase service is used to store the data and provide easy control on devices and MIT app inventor is used to develop an android application which can be installed in any mobile phone. Motive of this research paper is to give a brief discussion of IoT application in home automation so that researchers, electronic and software hobbyists can use the data to design and develop products for society welfare.

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