

IoT Based Smart Home System

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Abstract- Omnipresent availability of 4G networks, broadband and wi-fi hotspots has caused tremendous rise in usage of smart phones for communication as well as other allied purposes. Thus by making efficient use of IoT(Internet of Things) for controlling various not so smart homely appliances over smart phones/laptops is on utmost demand. This project IoT based smart home system prototypes an indoor scenario where in appliances can be controlled by a webpage which can be accessed through mobile devices. The focus has been mainly kept upon speed regulation of an actual AC ceiling fan. The system comprises of a webpage on user interface end through which commands are send to turn ON or OFF any appliance as per requirement, the commands are serially received over Wi-Fi to the server. The server in turn is interfaced to a controller (Arduino) which operates that specific appliance through relay board. Above this the system also has provision for controlling the speed of AC ceiling fan. This system provides a cheap alternative to operate appliances remotely in a modern home as it can be coupled to already existing traditional manually operating wall mounted switch boards.

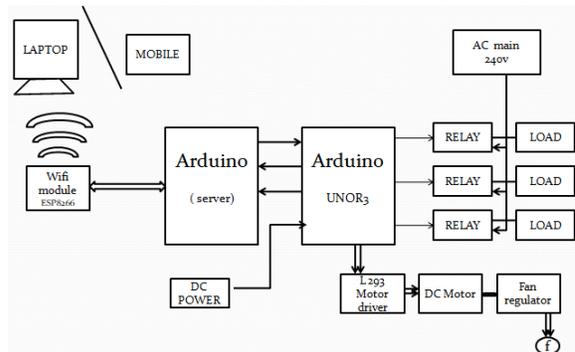
Index Terms- IoT, Arduino, Home automation, Wifi Module ESP8266, Ceiling fan speed regulation, Webpage

I. INTRODUCTION

As the title suggests ‘Smart Home system’ is practical application of automation technology to conventional wall switches present at every modern home to operate upon mobile devices like laptops tablets or mobile phones. The basic requirement is the device must contain a web-browser and a Wi-Fi trans-receiver. The system is currently operated in an indoor environment on local network only, but can be further modified to operate upon internet remotely. At present many such solutions are available for operation of appliances over internet but hardly any systems were capable of actually regulating speed of an AC ceiling fan. As the ceiling fans are not designed to be operated digitally, it’s a complex task to accomplish regulation digitally. Our system

provides a electro-mechanical solution to regulate the speed of fan. A web page is designed on the input side for the user to interface with the system. We have used a webpage to make the system compatible with mobile phones or laptops running any operating system. The system is designed such that people with least technical knowledge can operate this webpage with ease. Current solutions for home automation and industry control use GSM or Ethernet or Bluetooth for connectivity. This does not pose a problem until the system is planned well in advance and installed during the physical construction of the building. This is the reason Wi-Fi was used in spite of being quiet complex to design with.

II. SYSTEM SPECIFICATION



The above diagram shows the basic building blocks of Smart Home System. Here 2 Arduino can be seen, which is heart of ‘smart home system’. One acts as primary and controls the appliances/loads through the relay board. Another is coupled to the Wi-Fi module which acts as a server and communicates with the user. The L293D is motor driver IC used for reversing the direction of DC motor. Wi-Fi module used here is ESP 8266 which is readily compatible with Arduino. System uses a 12v DC power supply to operate itself. Also a 240v AC power supply will be required to run the appliances. Let’s take a bit insight about the components used and their interconnections.

Arduino UnoR3: It is a microcontroller based on ATMEL's ATmega328p. This board had the required number of input output pins and hence was chosen. Also it had a 3.3v dc power output which makes it compatible to Wi-Fi module. Two such boards are used out of which one board is designed to operate the relay board and motor driver IC. Pins 8, 9 and 10 are programmed to operate the relays which in turn operate the loads. Pins 6 and 7 are interfaced to the motor driver IC. A 12v DC power supply is used to power this primary board. Further the onboard 5.5v output of this primary board powers the rest of the system. The secondary board is coupled to primary using serial Tx-Rx onboard communication ports. This secondary board acts as a server also it is interfaced to the Wi-Fi module which in turn communicates with the user. This module is powered by onboard 3.3v output of this secondary arduino.

WI-FI Module ESP 8266: This module is a self contained system on chip meant to provide Wi-Fi access to microcontrollers. It is capable of hosting an application or offloading all Wi-Fi networking functions from another application processor. It comes with integrated TCP/IP protocol and thus is a plug and play kind of device. Here we have used this module in local LAN mode of operation. It is programmed to be a Wi-Fi receiver in our system. It needs a 3.3v DC power supply to operate and this is provided by the secondary Arduino's onboard 3.3v output.

Motor Driver IC L293D: This L293D IC is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. This IC is basically used for the reversibility of the DC motor that is driving the regulator. Also the motor driver is a little current amplifier, the function of motor driver is to take a low-current signal and then turn it into a higher current signal that can drive a motor. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively. We have used pins 2 and 7 which are connected to the pin 6 and 7 of the primary arduino respectively. This connection decides the direction of rotation depending upon the logic that is

sent through arduino. The DC motor is connected to pins 3 and 6 of the IC.

DC motor - Fan regulator: A normal DC motor is lower RPM ie 3.5 is used in this system. The motor is connected to the pins 3 and 6 of the motor driver IC. No external power supply is needed to operate this motor as the IC provides enough voltage for operation. The shaft of the motor is connected to the knob of the regulator. Regulator used here is an electronic type, step less regulator. It uses a Triac whose firing angle is altered through the knob. Hole is drilled into this knob where in the shaft was fixed.

Relay board: This board basically comprises of 3 relays. These are connected to pin 8, 9 and 10 of the Arduino respectively through a 1k ohm resistor and base of transistor BC547. The relay is connected to the collector of this transistor directly. A diode IN4007 is connected across every relay for protection. Relay is nothing but an electromagnetic switch that turns appliances working over greater voltages by a signal voltage that is comparatively very low. In our case a 5v relay is used as the output of Arduino is 5v. A relay is an electrical switch that uses an electromagnet to move the switch from the off to on position instead of a person moving the switch. On the mains side the normally closed terminal is connected to the 240v mains supply.

III. SOFTWARE TOOLS

ARDUINO IDE: It provides a development environment for the microcontroller. The Arduino IDE supports the language C and C++ using special rules of code structuring. The programs were written in embedded C language and uploaded to the Arduino using the IDE. A program written with the IDE for Arduino is called Sketch. User-written code only requires two basic function, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware. The libraries for the Wi-Fi module were also loaded using IDE.

The webpage was composed in HTML and also uploaded through Arduino IDE.

Proteus 8: The Proteus Design Suite is a windows application for designing and PCB layout. It can be purchased in many configurations depending upon the requirement and microcontroller families. The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. Schematic capture in the Proteus design suite is used for both the simulation of designs and as the design phase of a PCB layout project. The software is used mainly by electronic design engineers and electronic schematics and electronic prints for manufacturing printed circuit boards. The schematic capture in the Proteus Design Suite is used for both the simulation of designs and as the design phase of a PCB layout project.

IV. WORKING PRINCIPLE

For the user end a GUI is created using HTML based webpage. Following image shows the layout of our webpage. . The ESP is working on local LAN mode.



hence the local IP generated is 192.168.43.137, which needs to be dialed on a web-browser through mobile with hotspot in ON mode. This leads to opening of the above webpage. Once the connection is established user can send commands by clicking on ON/OFF tabs and accordingly the appliances are operated. For the regulation of fan speed there are 3

tabs FIN is meant for increasing the fan speed and F DEC is meant for reducing fan speed. Once the desired speed is reached one needs to press the F OFF button. These commands are received over the Wi-Fi module. The module is interfaced to the secondary arduino. This arduino holds the code for serial reception of on/off commands libraries of ESP 8266 and HTML code for the webpage, secondary arduino acts as a local server. Once the module is paired to the webpage then the system waits for serial reception of commands from the user. This communication is packet based. The ESP 8266 comes with an inbuilt TCP IP stack and hence the commands received over the Wi-Fi are decoded. This commands are forwarded to the primary arduino which gives its output to the relay driver circuit, if the given signal is to turn ON the device, then relay gets energized i.e. normally open and it will turn ON the device. All the devices connected to main power supply. A relay allows you to turn ON or turn OFF a load using voltage and/or current much higher than what Arduino could handle. Relay provides complete isolation between the low voltage circuit on Arduino side and the high voltage side controlling load. It gets activated using 5V from Arduino which in turn controls electrical appliances like fans, lights etc. For speed regulation there are 2 tabs one for increasing the speed and another for decreasing. As these commands arrive at primary arduino it controls the fan speed with the help of DC motor, L293D motor driver IC is connected between arduino and motor. Pins 6, 7 of arduino are connected to pins In1, In2 of the motor driver IC. For fan speed increment it rotates clockwise and for speed decrement it rotates anticlockwise with the help of DC motor. Following logic is used for deciding the direction of rotation.

m1	m2	
0	0	-STOP
0	1	-CLOCKWISE
1	0	-ANTI CLOCKWISE
1	1	-STOP

V. CONCLUSION

Various home automation systems were surveyed and their pros and cons were noted. Finally we conclude that, Smart home is a technique or controlling a process by electronic devices with reduced human involvement. The IOT based home automation

system was found to be best and flexible. For keeping the cost low, system was designed to only work in the short range of WIFI network. The smart home system uses a WIFI module as receiving device. It has a high communication rate, great security and low cost, so it can be implemented as a real time system. This system has most suitable for elderly and handicapped people. This project presents a possible solution whereby the user controls the appliances by using their existing mobile phones, where command is communicated to the arduino from a mobile phone through internet.

The future of smart home system requires to make homes smarter and more convenient. The scope of this project is beyond mentioning and the way it is going to benefit individuals from every dimension is tremendous. System also has scope for expansion and numerous features can be added as per ones need.

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