IOT Based Home Automation Using Arduino

G.Mahalakshmi, M.Vigneshwaran

***Abstract*— While the cost of living is going up, there is a growing focus to involve technology to lower those prices. With this in mind the Smart Home project allows the user to build and maintain a house that is smart enough to keep energy levels down while providing more automated applications. A smart home will take advantage of its environment and allow seamless control whether the user is present or away. With a home that has this advantage, you can know that your home is performing at its best in energy performance. By implementing this system, it is possible to explore a variety of different engineering challenges, including software programming, PCB design, Wi-Fi, TCP/IP protocols, Web Server logic design, and other aspects. This automation system provides great insights to the challenges of software and hardware design.**

***Index Terms*— Arduino uno,MQ-6 sensor,PIR Sensor,Wi-fi module**

I. INTRODUCTION

While the cost of living is going up, there is a growing focus to involve technology to lower those prices. With this in mind the Smart Home project allows the user to build and maintain a house that is smart enough to keep energy levels down while providing more automated applications. A smart home will take advantage of its environment and allow seamless control whether the user is present or away. With a home that has this advantage, you can know that your home is performing at its best in energy performance.

By implementing this system, it is possible to explore a variety of different engineering challenges, including software programming, PCB design, Wi-Fi, TCP/IP protocols, Web Server logic design, and other aspects. This automation system provides great insights to the challenges of software and hardware design.

II. GENERAL DESCRIPTION

A. *Overview of the System*

A low cost and efficient smart home system is presented in this paper. This system has two main modules: the hardware interface module and the software communication module. At the heart of this system is the Arduino UNO microcontroller which is also capable of functioning as a micro web server and the interface for all the hardware modules. All communication and controls in this system pass through the microcontroller. The smart home system offers feature such as environmental monitoring using the temperature, humidity, gas and smoke sensors. It also offers switching functionalities to control lighting ,fans/air conditioners, and other home appliances connected to the relay system. Another feature of this system is the intrusion detection which it offers using the motion sensor and all these can be controlled from the Android Smartphone app or web application.

In the present day, home automation is becoming essential for the purpose of improving our life condition. Convenience and ease of using home appliances is what home automation is offering. Home automation offers a futuristic way of life in which an individual gets to control his entire house using a smart phone, from turning on a TV to locking/unlocking doors; it also offers an efficient use of energy. But to get or acquire such system installed will cost a lot of money and that is the major reason of why home automation has not received much demand and attention, adding to that also the complexity of installing it and configuring it.

Thus it is essential to make it cost effective and easy to configure, if this is granted to people then they will be willing to acquire it in their homes, offices and schools. In other words, a system modification for the home automation is required in order to lower the price of applying it to houses. Also home automation offers ease of mind and body to handicapped and/or elders in their houses by just one click to do what they want as stated above. Overview of the system is shown in Fig(i)

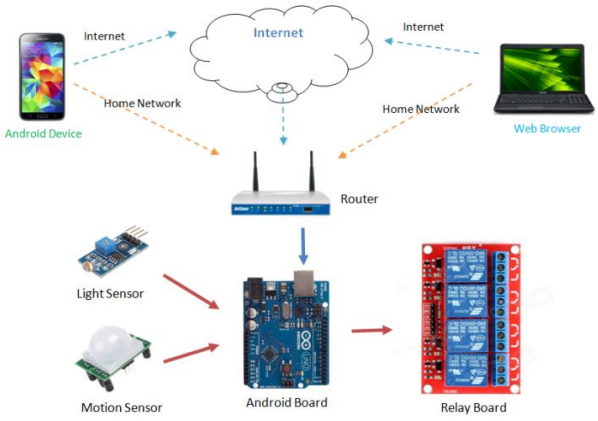

Fig (i) Overview of the System

B. *Existing System*

The Existing system based on with the GSM Module & Bluetooth Module only. The recent developments in technology which permit the Use of Bluetooth and Wi-Fi 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 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 home automation system for remote control of home appliances is designed.

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III. PROPOSED SYSTEM

Our proposed system is an arduino based home automation done with Arduino connected to a wifi and controlled via android app or a social media network. This system deals with the safety in home and smart home technologies which will be cost efficient. Block Diagram of the proposed system is shown in Fig(ii)

Arduino can sense the surroundings by receiving input signal from a variety of sensors and can affect its environment via actuators . An analog temperature sensor is a chip that tells you what the ambient temperature is. The DHT11 is a basic, ultra low-cost digital temperatureand humidity sensor . It uses a capacitive humidity sensor and athermistor to measure the surrounding air, and spits out a digital signalon the data pin (no analog input pins needed). It is fairly simple to use,but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds, so when using our library, sensor readings can be up to 2 seconds old.

The Passive Infra-Red (PIR) sensors allow one to sense motion, almost always and are used to detect whether a human has moved in orout of the sensors range. The PIR sensor is a pyroelectric device thatdetects motion by measuring changes in the infrared level emitted bysurrounding objects. This motion can be detected by checking for a highsignal on a signal I/O pin .

They are small, inexpensive, low-power, easy to use and don't wear out. For that reason they are commonly found in appliances and gadgets used in homes or businesses. MQ6 is a semiconductor type sensor, which can appropriately sense the presence of smoke, LPG, methane, butane, propane and other hydrocarbon combustible gases. The sensitive material in this sensor is tin-dioxide(SnO2). When it comes in contact with the gas to be monitored, the electrical resistance of the sensor decreases; enabling the microcontroller to respond to the situation.

When it detects the concentration of combustible gas in the air it outputs its reading as an analog voltage. The sensor can measure concentrations of flammable gas of 300 to 10,000ppm. The sensor can operate at temperatures from -20 to 50°C and consumes less than 150 mA at 5 V. To allow connection for power plugs and switching of electrical load within the home, relay switches are used. The relay switches have capability to carry a maximum load of10A at 240V. This is sufficient to carry any household appliance as these devices do not draw much current. The Wi-Fi shield provides internet connectivity for the embedded micro web server which allows internet access and controls from a web application.

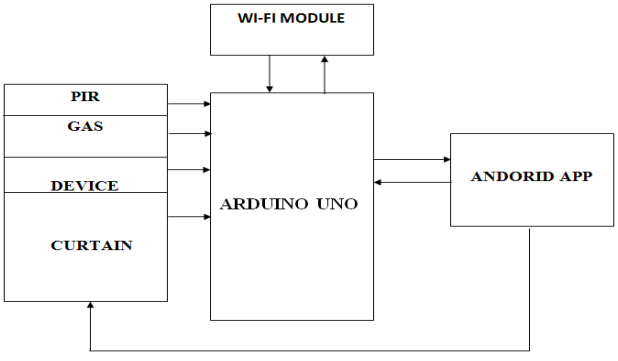


Fig (ii)Block Diagram of the proposed system

IV. ARDUINO UNO

The Arduino Uno is a microcontroller board based on the ATmega328 as shown in Fig(iii). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

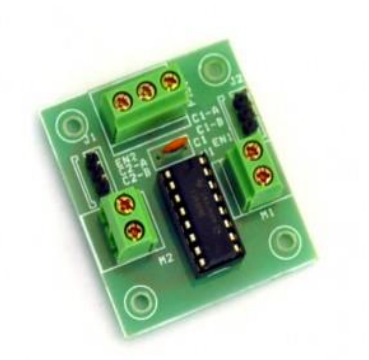
Fig.(III) Arduino UNO

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.
Revision 2 of the Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode.

A. MOTOR DRIVER

Future Electronics has a full programmable motor driver selection from several chip manufacturers that can be used for a motor driver IC(integrated circuit), bipolar stepper motor driver, H bridge motor driver,servo motor driver, DC motor driver, brushless motor driver or for anycircuit that may require a motor driver.Motor driver is shown in Figure (iv)

Simply choose from the motor driver technical attributes below and your search results will quickly be narrowed in order to match your specific motor driver application needs. If you have a preferred brand, we deal with several semiconductor manufacturers such as Free scale Semiconductor, ON Semiconductor ,ROHM Semiconductor or STMicroelectronics, among others. You can easily refine your motor driver product search results by clicking your preferred motor driver brand below from our list of manufacturers. Motor drivers can be found in a wide array of applications including Relay and solenoid switching,• Stepping motor, LED and incandescent displays,• Automotive applications, Audio-visual equipment,PC Peripherals



Fig(iv) Motor Driver

B. Wi-Fi Module

The ESP2866Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontrolleraccess to your Wi-Fi network. The ESP2866 is capable of eitherhosting an application or offloading all Wi-Fi networking functionsfrom another application processor. Each ESP2866 module comespre-programmed with an AT command set firmware, meaning, youcan simply hook this up to your Arduino device and get about asmuch Wi-Fi-ability as a Wi-Fi Shield offers (and that's just out of thebox)! The ESP2866 module is an extremely cost effective board witha huge, and ever growing, community.This module has a powerful enough on-board processing and storagecapability that allows it to be integrated with the sensors and otherapplication specific devices through its GPIOs with minimaldevelopment up-front and minimal loading during runtime. Its highdegree of on-chip integration allows for minimal external circuitry,including the front-end module, is designed to occupy minimal PCBarea. The ESP2866 supports APSD for VoIP applications and Bluetoothco-existance interfaces, it contains a self-calibrated RF allowing it towork under all operating conditions, and requires no external RF parts.Wifi module is shown in Fig (v)

Fig(v) Wi-Fi module

C. Sensors

A sensor is a device that detects and responds to some type ofinput from the physical environment. The specific input could be light,heat, motion, moisture, pressure, or any one of a great number of otherenvironmental phenomena. The output is generally a signal that isconverted to human-readable display at the sensor location ortransmitted electronically over a network for reading or further processing.

PIR SENSOR

Fig(v) PIR Sensor

A PIR-based motion detector shown in fig (v) is used to sense movement of people, animals, or other objects. They are commonly used in burglar alarms and automatically-activated lighting systems. They are commonly called simply "PIR", or sometimes "PID", for "passive infrared detector".

An individual PIR sensor detects changes in the amount of infrared radiation impinging upon it, which varies depending on the temperature and surface characteristics of the objects in front of the sensor. When an object, such as a human, passes in front of the background, such as a wall, the temperature at that point in the sensor's field of view will rise from room temperature to body temperature, and then back again. The sensor converts the resulting change in the incoming infrared radiation into a change in the output voltage, and this triggers the detection. Objects of similar temperature but different surface characteristics may also have a different infrared emission pattern, and thus moving them with respect to the background may trigger the detector as well.

PIRs come in many configurations for a wide variety of applications. The most common models have numerous Fresnel lenses or mirror segments, an effective range of about ten meters (thirty feet), and a field of view less than 180 degrees. Models with wider fields of view, including 360 degrees, are available typically designed to mount on a ceiling. Some larger PIRs are made with single segment mirrors and can sense changes in infrared energy over thirty meters (one hundred feet) away from the PIR. There are also PIRs designed with reversible orientation mirrors which allow either broad coverage (110° wide) or very narrow "curtain" coverage or with individually selectable segments to "shape" the coverage.

MQ-6 SENSOR

This is a simple-to-use liquefied petroleum gas (LPG) sensor, suitablefor sensing LPG (composed of mostly propane and butane)concentrations in the air. The MQ-6 can detect gas concentrationsanywhere from 200 to 10000 ppm.This sensor has a high sensitivity and fast response time. The sensor'soutput is an analog resistance. The drive circuit is very simple; all youneed to do is power the heater coil with 5V, add a load resistance, andconnect the output to an ADC.This sensor comes in a package similar to our MQ-3 alcohol sensor, andcan be used with the breakout board below

Fig(vi) MQ6Sensor

LPG Gas Sensor (MQ6) Features:
•High Sensitivity to LPG, iso-butane, propane
• Small sensitivity to alcohol, smoke
• Detection Range: 100 - 10,000 ppm iso-butane propane
• Fast Response Time: <10s
• Simple drive circuit
• Heater Voltage: 5.0V
Dimensions:
• 18mm Diameter,• 17mm High excluding pins
Applications include , Gas leak detection system, Fire/Safety detection system, Gas leak alarm, Gas detector

D. Software Description

Eclipse was inspired by the Smalltalk-based Visual Age family ofintegrated development environment (IDE) products. Although fairlysuccessful, a major drawback of the Visual Age products was thatdeveloped code was not in a component-based software engineeringmodel. Instead, all code for a project was held in a compressed lump(somewhat like a zip file but in a proprietary format called .dat).Individual classes could not be easily accessed, certainly not outside thetool. A team primarily at the IBM Cary NC lab developed the newproduct as a Java-based replacement. In November 2001, a consortiumwas formed with a board of stewards to further the development ofEclipse as open-source software. It is estimated that IBM had alreadyinvested nearly $40 million by that time. The original members wereBorland, IBM, Merant, QNX Software Systems, Rational Software, RedHat, SuSE, Together Soft, and Web Gain. The number of stewardsincreased to over 80 by the end of 2003. In January 2004, the EclipseFoundation was created.Eclipse 3.0 (released on 21 June 2004) selected the OSGi ServicePlatform specifications as the runtime architecture.

The Association for Computing Machinery recognized Eclipse with the2011 ACM Software Systems Award on 26 April 2012.Eclipse uses plug-ins to provide all the functionality within and on top ofthe runtime system. Its runtime system is based on Equinox, animplementation of the OSGi core framework specification.In addition to allowing the Eclipse Platform to be extended using otherprogramming languages, such as C and Python, the plug-in frameworkallows the Eclipse Platform to work with typesetting languages likeLaTeX and networking applications such as telnet and databasemanagement systems. The plug-in architecture supports writing anydesired extension to the environment, such as for configurationmanagement. Java and CVS support is provided in the Eclipse SDK,with support for other version control systems provided by third-partyplug-ins.With the exception of a small run-time kernel, everything in Eclipse is aplug-in. Thus, every plug-in developed integrates with Eclipse in thesame way as other plug-ins; in this respect, all features are "created equal". Eclipse provides plug-ins for a wide variety of features, some ofwhich are from third parties using both free and commercial models.Examples of plug-ins include for Unified Modeling Language (UML),for Sequence and other UML diagrams, a plug-in for DB Explorer, andmany more.

The Eclipse SDK includes the Eclipse Java development tools (JDT),offering an IDE with a built-in Java incremental compiler and a fullmodel of the Java source files. This allows for advanced refactoringtechniques and code analysis. The IDE also makes use of a *workspace*,in this case a set of metadata over a flat file space allowing external filemodifications as long as the corresponding workspace *resource* isrefreshed afterward.Eclipse implements the graphical control elements of the Java toolkitcalled Standard Widget Toolkit (SWT), whereas most Java applicationsuse the Java standard Abstract Window Toolkit (AWT) or Swing.Eclipse's user interface also uses an intermediate graphical user interface layer called JFace, which simplifies the construction of applicationsbased on SWT. Eclipse was made to run on Wayland during a GoogleSummer of Code (GSoC) Project in 2014.As of 2017, language packs being developed by the *Babel Project*provide translations into over 40 natural languages.

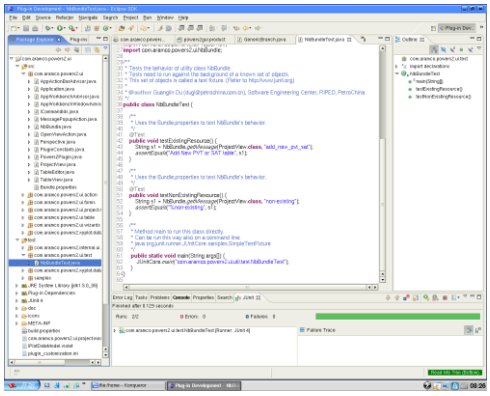
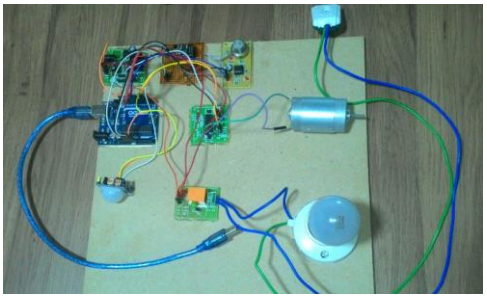


Fig (vii)Eclipse Software

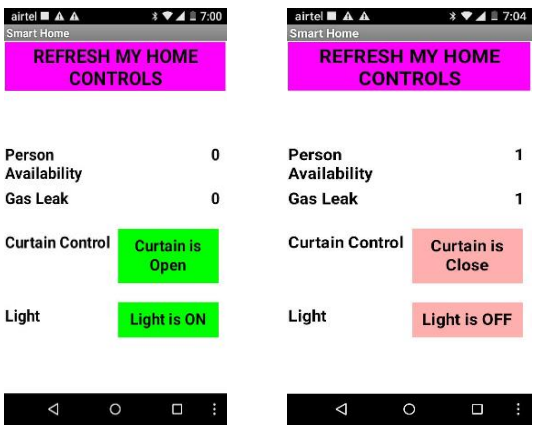
V. HARDWARE IMPLEMENTATION

A model house is built for the home automation system. At the door ofthe house a motion sensor is fixed to detect any movement near the door.Light 1 will turn on automatically when light sensor detects thedarkness. A cooler/Fan will turn on when the room temperature exceedsthe set threshold and in turn reduces the room temperature. The gassensor MQ-6 is placed in the kitchen to detect any gas leakage, if anyleakage is detected the alarm in the hall is raised. Relay is used to switchthe electrical appliances like light, fan etc. The Intel Galileo is placed instore room or garage. The Intel Galileo is connected with Wi-Fi card withthe antennas for the connectivity with internet.

Another feature of this system is the intrusion detection which it offersusing the motion sensor and all these can be controlled from the Android Smartphone app or web application.



Fig(viii) Hardware Implementation



Fig(ix) APP screen shot

The App can be controlled by any place in the world with the help of wi-fi module. This can be useful to aware from home appliances even in work hours. we can control the home appliances using this app and also tense free in any moment. The techniques used in this app will make much sense when compare with humans.

VI. CONCLUSION

In this project, a novel architecture for low cost and flexible home controland monitoring system using Android based Smart phone is proposedand implemented. The proposed architecture utilizes a micro web serverand Bluetooth communication as an interoperable application layer forcommunicating between the remote user and the home devices. AnyAndroid based Smart phone with built in support for Wi-Fi can be usedto access and control the devices at home. When a Wi-Fi connection isnot available, mobile cellular networks such as 3G or 4G can engine thus eliminating the need for an external voice recognitionmodule.

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