Microcontroller Based Single Phase Load Control Using Wireless System

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***Abstract*: This paper presents a single phase electrical energy meter based on a microcontroller from Microchip Technology Inc. PIC family. This electronic meter does not possess any rotating parts, and the energy consumption can be easily read from a four-digit display. All Electrical loads are automated in this system. There is also an internet module that is used to notify the status of home appliances using Twitter. The advantage of the internet module is that the home appliances can be controlled from anywhere in the world. Besides that, energy consumption is stored in the microcontroller's EPROM memory. This action is necessary to ensure a correct measurement even in the event of an electrical outage or brown out. As soon as the supply is restored, the meter restarts with the stored value. Using this system, physically weak people can control home appliances from anywhere. This system can be implemented in houses, offices, hospitals, industries, or even in universities. The user interface is kept simple, so user from beginner to advanced level internet users can use the system without problem. As this meter is compatible with the electromechanical ones, no additional costs will be incurred by the utility companies in their replacement.**

***Keywords*: Android debug bridge, Arduino, CMOS, GSM modem, Internet module, Microcontroller.**

1. Introduction

The automation market is mainly guided by flourishing need for efficient solutions in various household applications such as lighting, safety and security and energy legislation. The development of smart cities and high-tech homes in the North America and Middle East region is make an impression about the growth of overall home automation market. The home automation market is initially driven by increasing the necessity of effective solutions in several household applications such as lighting, safety and security, energy management, audio and video entertainment. Smart home based home automation has huge demand in market nowadays.

Smart phone based home automation apps are already running successfully in global market. Within 2020 year, home automation will run as expectations in Bangladesh as well as in whole world. Now we can say that, user's awareness and attraction for new technology are increasing the growth of home automation in North America, Europe and Asia pacific zone. Research for home automation will increase revenue and global development within 2015-2020. Advantages of home automation will explore soon and the effect of it will develop the growth of society. So, this seminar will create a good opportunity at south Asian market.

Our designed home automation system is a flexible system that can control and make a communion between nearly all load appliances of the house. All appliances can control from indoor also outdoor from any places. Our automated home can be called a smart home. If one forgets to switch off the lights or other appliances while going out, it allows you to turn off the appliance with your cell phone. By using twitter, you can get status of your home and also can control your home power devices. This is a simple automation system which contains remote mobile host controller and several home appliances. We have five features in this seminar. We implement home automation using Bluetooth, GSM-SMS, GSM-DTMF, PIR (passive infrared sensor), and an internet module for Twitter. At first, we set up Bluetooth then GSM-SMS then GSM DTMF (Dual-Tone Multi-Frequency) then PIR and the last part is the internet module using twitter.

The main features of this system are:
1. Control through android mobiles.
2. Control by SMS where device is capable of recognizing the user.
3. Through GSM modem, appliances can be controlled by DTMF (Dual-Tone Multi-Frequency) tone. All devices can be controlled using phone calls.
4. The user can control appliances through Twitter.
5. Another feature is detecting humans or intruders by using motion detector or PIR sensor.

A. Smart Home Automation System

A home automation Security System called Smart Eye using GPRS also uses a central controller, to which many individual home controllers are connected. This system proposes a real time monitoring system and home automation. The system notifies the homeowner by mobile phone using GPRS. Smart Eye uses video cameras for security. This proposed system is also not suitable for securing single homes, but suits for a group of homes. This central controller-based security system is difficult to implement and can cause some very serious privacy concerns. Bluetooth-based Home Automation System The work of N. Sriskanthan shows the implementation of a home

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automation system using Bluetooth. They use a host controller, which is implemented on a PC, is connected to a micro-controller based sensor and device controllers.

GSM or Mobile-based Home Automation System is attractive to researchers because of the popularity of mobile phones and GSM technology. We mainly consider three options for communication in GSM, namely SMS-based home automation, GPRS based home automation, and Dual Tone Multi Frequency System There are many of home automation systems implemented using GPRS. Researchers M. Danaher and D. Nguyen proposed a home security system using GPRS. The seminar uses a webcam to stream video (DTMF)-based home automation. It shows the logical diagram of how a home's sensors, electrical, and mechanical devices interact with the home network and communicate through the GSM module using a Subscriber Identity Module (SIM). The system converts the machine functions into electrical signals through a transducer, which goes into a microcontroller. A transducer converts physical quantities like sound, temperature, and humidity into some other quantity like voltage, a sensor does that function. For electronic devices, the reading goes directly into the microcontroller.

2. Block diagram of proposed system

We have combined the system with input processing and output that are shown in Fig. 1.
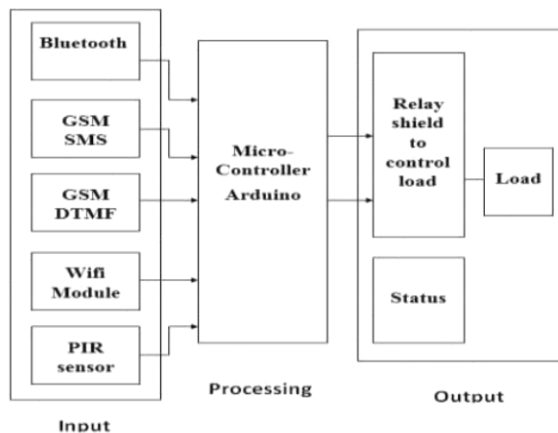

Fig. 1. Block diagram of home automation system
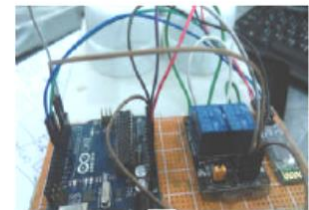
A. Bluetooth

Our first work is using Bluetooth. To create the Bluetooth connection, we needed one Bluetooth device, one Arduino Uno, two input one channel relay shield, one android app to control the system and two bulbs to be able to demonstrate how the system works. Now we describe how the whole system was combined by us. The Bluetooth device has 4 pins, which are Vcc, ground, Rx, and Tx. Rx is the receiver and Tx is the transmitter. We connected Bluetooth Rx, Tx with Arduino Uno Rx, Tx.

Bluetooth device has two more pins. Ground is connected

with Arduino's ground and Vcc is connected with Vcc. Now we describe how the two relay shields were combined. There are also 4 pins: ground, In1, In2, Vcc. In 1 is input 1 which goes to signal and In2 is for second load. Input power 220V is incoming from the other side.
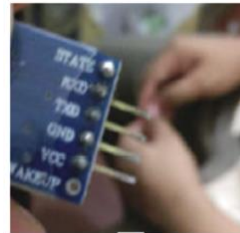
Fig. 2. Bluetooth pin   Fig. 3. Full bluetooth setup

B. GSM-SMS

The system allows household appliance control using cell phone through global system for mobile communication (GSM) technology. Cellular communications is a dynamic solution for such remote controlling activities. SMS (short message service) technology is a technology that can make all communication system in short and it can be used to control household appliances from long distance. Remotely control system allows the home owner to control the home appliances from mobile phone number set by commands (A1B1, A0B0, A1B0 and A0B1) in the form of SMS messages and receiving the appliances that is actually the GSM number for knowing the status as well. If someone sends a message on GSM number like "A1B1" then all lights will be on for this message and if someone send a message like "A0B0" then all lights will be off by this sequence we can control all load connections such as fans, AC, TV, refrigerator etc. So it's a system that if someone cannot reach on home on the right time so that he/she can control all appliances from anywhere.
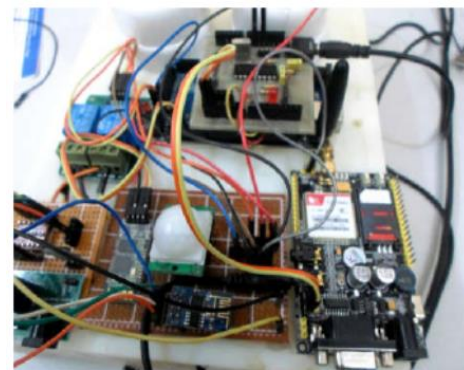

Fig. 4. GSM based SMS and calling system

C. GSM-calling

For this feature, we use a DTMF (Dual-tone Multi Frequency) module. The DTMF module is a very old device. We have found this device after a long search. DTMF is what a conventional wired phone sends when you press its buttons to

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make a call, or navigate voice mail or corporate phone systems. It works by sending two tones for each button, one tone for each column of buttons, another tone for each row. The maximum guaranteed bandwidth extends from about 300 Hz to 3.5 kHz. DTMF is device that was not made for data transfer; it is designed for control the signals that generate from one device to another devices. Just pressing the phone buttons we can easily control our home appliances from anywhere. For this we have to stuck the DTMF shield on GSM module and connect with Arduino Uno. In GSM modules is a DTMF decoder included. The DTMF tones are controlled by Arduino AT commands. This feature is done successfully from our five features of this seminar.

Fig. 5. DTMF device

D. PIR sensor

We use a passive infrared (PIR) sensor, which is an electronic sensor that detects infrared (IR) light radiating from objects in its field of view. It's also a security system at our home that is controlled by one input and two channel relay shield. If someone enter in home, automatically all appliances will be on for the infrared ray of human. It's also work for knowing the status of load connections in our home. The main work of PIR is that when home owner enter home, all appliances automatically turned on and when they leave, it's automatically goes on turned off. PIR sensors sophisticated sensor that many of the other sensors, because there are lots of variables that affect the sensor input and output.

Fig. 6. Full circuit connection with PIR sensor

The PIR sensor itself has two slots in it each slot is made of a special material that is sensitive to IR. When the sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors. When the warm

body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential change. These change pulses are what is detected. The IR sensor itself is housed in a hermetically sealed metal can to improve noise/temperature /humidity immunity. There is a window made of IR-transmissive material (typically coated silicon since that is very easy to come by) that protects the sensing element. Behind the window are the two balanced sensors.

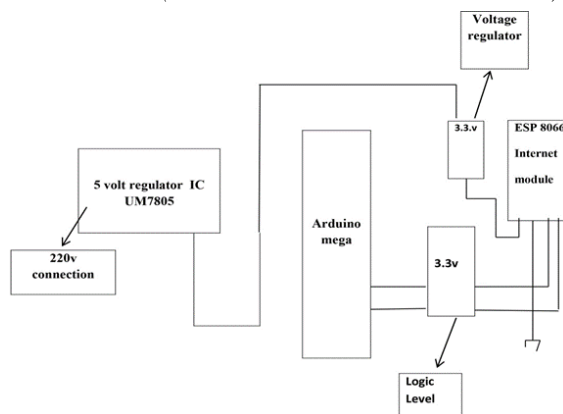### E. Internet Module (For twitter-based home automation)

Fig. 6. Block diagram of twitter connection

A Smart home is not a new term for science society, it is been used from decades. For the last few decades automation system are only for used in local area but by using internet we can control our load connections from anywhere and any places that we want. It's a new system that we are proposed for home automation system. Just guess we are out of our country from our own country and need to be know the status of our home, so just using a twitter account we can control our home appliances from anywhere of world. For this system we have to make an account on Thingspeak website. "ThingSpeak" is an open source Internet of Things (IoT) website and API to store and reclaim data from things using the HTTP protocol over the Internet or via a Local Area Network. ThingSpeak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates.

3. Conclusion

This paper presented implementation of microcontroller based single phase load control using wireless system.

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