

AN EMBEDDED GSM APPROACH TO CONTROL APPLIANCES WITH BACKUP SOLAR ENERGY

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Abstract The nature of this thesis is to achieve many aims with accuracy of temp. for example energy saving. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, and toys. This research work investigates the potential of 'Full Home Control', which is the aim of the Home Automation Systems in near future. The analysis and implementation of the home automation technology using Global System for Mobile Communication (GSM) modem to control home appliances such as light, conditional system, and security system via Short Message Service (SMS) text messages is presented in this paper. The proposed research work is focused on functionality of the GSM protocol, which allows the user to control the target system away from residential using the frequency bandwidths. The solar cells that we see are also called photovoltaic (PV) cells, which as the name implies (photo meaning "light" and voltaic meaning "electricity"), convert sunlight directly into electricity. A module is a group of cells connected Electrically and packaged into a frame (more commonly known as a solar panel), which can then be grouped into larger solar arrays.

Key words: Home automation; Global System for Mobile Communication (GSM); Short Message Service (SMS); PIC microcontroller; RS232 standard, Solar Panel.

1.0 Introduction

In recent years, there has been a growing interest among consumers in the smart home concept. Smart homes contain multiple, connected devices such as home entertainment consoles, security systems, lighting, access control systems and surveillance. Intelligent home automation system is incorporated into smart homes to provide comfort, convenience, and security to home owners. Home automation system represents and reports the status of the connected devices in an intuitive, user-friendly interface allowing the user to interact and control various devices with the touch of a few buttons.

1.1 GSM Module SIM300 Interface

In this section, we will know how we have connected the SIM300(as shown in figure 1.1) and LCD module to make a basic test rig.



Figure 1.1: GSM module sim300[11]

1.2 Microcontroller PIC16F88A

The PIC microcontroller PIC16F877A is one of the most renowned microcontrollers in the industry. This controller is very convenient to use, the coding or programming of this controller is also easier. One of the main advantages is that it can be write-erase as many times as possible because it uses FLASH memory technology. It has a total number of 40 pins and there are 33 pins for input and output.

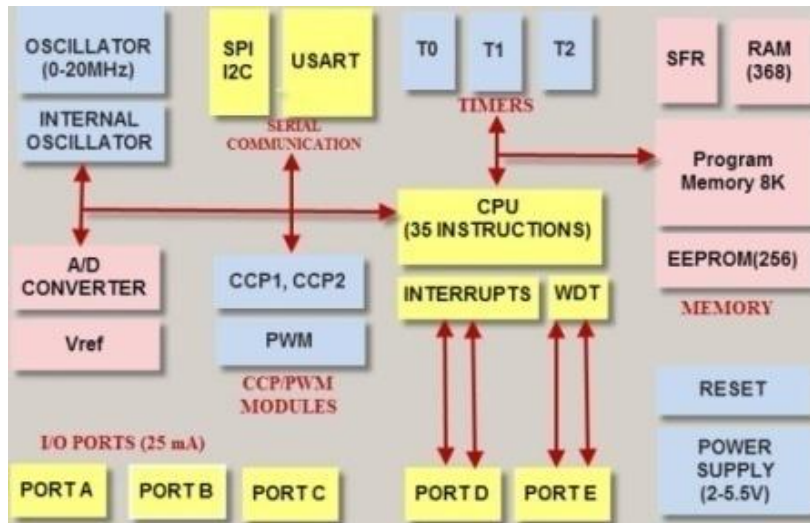


Figure 1.2: Architecture of PIC Microcontroller [12]

1.3 Memory Organization

The memory module in the PIC microcontroller architecture consists of RAM (Random Access Memory), ROM (Read Only Memory) and STACK.

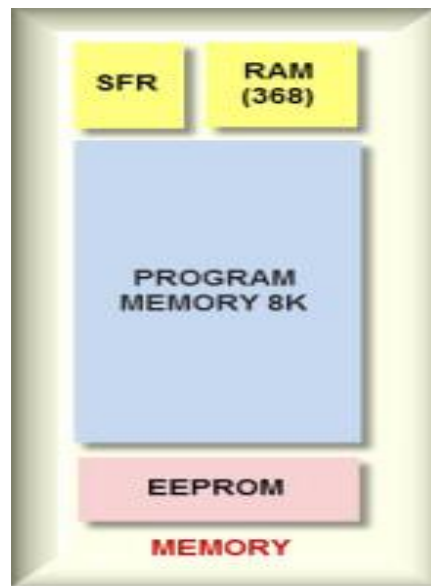


Figure 1.3:Memory Organization [12].

1.4 BUS

BUS is used to transfer and receive the data from one peripheral to another. It is classified into two types such as data bus and address.

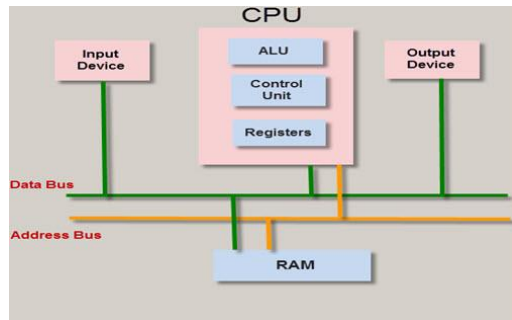


Figure 1.4:BUS[12]

Data Bus: It is used for only transfer or receive the data.

Address Bus: Address bus is used to transmit the memory address from the peripherals to the CPU. I/O pins are used to interface the external peripherals; UART and USART both are serial communication protocols which are used for interfacing serial devices like GSM, GPS, Bluetooth, IR, etc.

1.5 A/D converters

As shown in figure 1.5, the main intention of this analog to digital converter is to convert analog voltage values to digital voltage values. A/D module of PIC microcontroller consists of 5 inputs for 28 pin devices and 8 inputs for 40 pin devices.

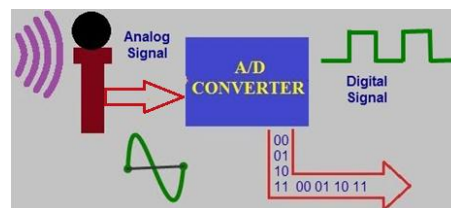


Figure 1.5:A/D Converter [12]

1.6 IC OP-AMP OP07

General description The OP07 has very low input offset voltage (75 μ V max for OP07E) which is obtained by trimming at the wafer stage. These low offset voltages generally eliminate any need for external nulling. The OP07 also features low input bias current (\pm 4 nA for OP07E) and high open-loop gain (200 V/mV for OP07E).

1.7 Working of Relay

The principle on that the relays work is electromagnetic force. When electricity starts flowing through a coil, it becomes an electromagnet. Steel plates are attracted by these electromagnetic coils get attracted, which is attached to a switch. So, the switch's motion (ON or OFF) is controlled by current flowing through the coil, or not respectively.

2.0 LITERATURE SURVEY

C. Peijiang et.al (2008) [1] proposed a Remote Monitoring System Based on GSM in which the fame of home automation has been accelerating due to much high affordability and comfort through Smartphone and tablet connectivity. The implementation of home automation systems using Global System for Mobile Communication (GSM) modem. A technology for digital wireless telecommunications using frequency bandwidths was the prototype of this paper. Serial communication & AT commands have been used for the implementation of GSM based smart home automation system. The research work was focused on functionality of the Android Studio which allows the alteration of speech into text format. The idea of this project was to reduce the human efforts especially of the old and the disabled by providing voice commands as the input to control the electronic devices.

C. K. Das et.al (2009) [2] proposed a Cell Phone based Remote Control System in which many essential appliances like air conditioners and refrigerators which run in our offices and homes draw a heavy starting current. When the main power resumes or turned 'ON' suddenly, all the loads are switched 'ON' at a time and a very heavy initial current was drawn from mains. The current drawn was so high that other equipment's are affected. The valuable home appliances can be ruined for such an incident. Sometimes it causes short circuit effect and fire due to extensive heat. The switching system described in this paper switches 'ON' the loads sequentially with a steady time delay to avoid the limiting inrush current in this odd condition. Also, we have shown a way to control the switching system by a remote control system. Finally, this kind of switching system can be an important tool to save the electrical home appliances from damage due to unwanted or irregular ON-OFF of the main power.

T. Begum et.al (2009) [3] reported monitoring of home automation system via SMS through microcontroller in which the domestic gas cylinders or cooking gas are considered as the source of energy commonly used at homes but, the potential for a serious accident such as gas leak from organizations or flow valves if the gas cylinder or its attachments are not treated properly or simply if the user forgot to close the gas before leaving home. The current project aims to develop a mobile application in order to control the gas cylinder remotely by mobile application in an effective way. The system consists of two parts. A specially designed controller connected to the gas cylinder organizer and an android mobile application to control the cylinder remotely through it. The main functions of this application are, controlling one or more domestic gas cylinder remotely, sending an audio alarm to the user if he leave while the gas cylinder opened and close it, providing an alarm if there was a gas leakage and close it and finally if the system fail to close it due to any reason it call the civil defense.

M. S. Khandare et.al (2010) [4] investigated the potential of 'Full Home Control', in which the aim of the Home Automation Systems in near future achieve by analysis and implementation of the home automation technology using Global System for Mobile Communication (GSM) modem to control home appliances such as light, conditional system, and security system via Short Message Service (SMS) text messages was presented in this paper. The proposed research work was focused on functionality of the GSM protocol, which allows the user to control the target system away from residential using the frequency bandwidths. The concept of serial communication and AT-commands has been applied towards development of the smart GSM-based home automation system. Home owners will be able to receive feedback status of any home appliances under control whether switched on or off remotely from their mobile phones. PIC16F887 microcontroller with the integration of GSM provides the smart automated house system with the desired baud rate of 9600 bps. The proposed prototype of GSM based home automation system was implemented and tested with maximum of four loads and shows the accuracy of $\geq 98\%$.

G. Gu et.al (2010) [5] presented GSM wireless communication system in which research work was focused on functionality of the GSM protocol, which allows the user to control the target system away from residential using the frequency bandwidths. The concept of serial communication and AT-commands

has been applied towards development of the smart GSM-based home automation system. Home owners will be able to receive feedback status of any home appliances under control whether switched on or off remotely from their mobile phones.

G. Mingminget.al (2010) [6] proposed the System of Wireless Smart House Based on GSM and ZigBee in which the implementation of home automation systems using Global System for Mobile Communication (GSM) modem. A technology for digital wireless telecommunications using frequency bandwidths was the prototype of this paper. Serial communication & AT commands have been used for the implementation of GSM based smart home automation system. The research work was focused on functionality of the Android Studio which allows the alteration of speech into text format.

B. S. Rao et.al (2010) [7] proposed a prototype for Home Automation using GSM technology in which concept was used when electricity starts flowing through a coil, it becomes an electromagnet. Steel plates are attracted by this electromagnet coil get attached, which was attached to a switch based on GSM in which the fame of home automation has been accelerating due to much high affordability and comfort. The idea of this project was to reduce the human efforts.

B. I. Ahmad et.al (2011) [9] proposed a Remote Home Management: An alternative for working at home while away in which the home automation turns out to be more and more significant and appealing. It improves the value of our lives by automating various electrical appliances or instruments. This paper describes GSM (global system messaging) based secured device control system using app inventor for android mobile phones. App inventor was a latest visual programming platform for developing mobile applications for android based smart phones. The android mobile phone platform becomes more and more popular among software developers, because of its powerful capabilities and open architecture. It was a fantastic platform for the real-world interface control, as it offers a sample of resources and already incorporates a lot of sensors.

A.W. Ahmad et.al (2011) [10] proposed a ZigBee-GSM based Home Security Monitoring and Remote Control system in which design and implementation of a controller based home security system with GSM technology have been presented and analyzed. Two microcontrollers with other peripheral devices which include light emitting diode (LED), liquid crystal display(LCD), Buzzer and global system for mobile communication (GSM) module are responsible for reliable operation of the proposed security system. In addition, a mobile phone was interfaced with microcontroller through a Bluetooth device in order to control the system. Moreover, a manual keypad was another way to lock or unlock the system. A compiler code vision AVR was used to design a program that controls the system along with maintaining all security functions. The designed program was applied in Proteus software for simulation. At last the results of practical circuit show the proper functions and also verify the reliable security within reasonable cost.

A.D. Mane et.al (2013) [14] proposed Solar Panel Tracking System for GSM Based Agriculture System in which Solar modules are devices that cleanly convert sunlight into electricity and offer a practical solution to the problem of power generation in remote areas. This project involves the development of an Automatic Solar radiation tracker that could be further used for agriculture purpose, making use of a GSM Module as the control system. Fossil fuels are a relatively short-term energy source consequently; the uses of alternative sources such as solar energy is becoming more wide spread. To make solar energy more viable, the efficiency of solar array systems must be maximized

Y. Zhaiet.al (2011) [15] proposed smart home remote monitoring system based on embedded system in which the popularity of home automation has been escalating in recent years due to much high affordability and ease through Smartphone and tablet connectivity. The execution of home automation systems using global system for mobile communication GSM modem, a technology for digital wireless telecommunications using frequency bandwidths and MQTT protocol are the most important prototype of this paper. The concept of message queue telemetry transport (MQTT), a light weight messaging protocol

operated on the top of TCP/IP protocol was presented in this paper. It was specially designed for the remote locations where network bandwidth was limited. Serial communication & AT command has been used for the implementation of GSM based smart home automation systems.

S. I. Azid et.al (2011) [16] proposed the Analysis and Performance of a Low-Cost SMS Based Home Security System in which project was developed with aims to improve security systems available in current market. This project claims to produce a prototype camera and global system for mobile communication (GSM) interfacing system for security surveillance. This system use sensor, namely passive infrared receiver(PIR). The PIR function was to detect changes in temperature of human in infrared radiation. This project presents a technique for human face recognition was based on PCA algorithm (i.e. eigenface method). In this project, the microcontroller used was PIC 16, where it sends to the computer to activate the camera when the microcontroller receive signal from PIR. MAX232 was used as an interface circuit connecting the microcontroller to the computer. To develop the software for control circuits, software MATLAB was used because the software supports microcontroller PIC 16. Once the camera was activated it will capture image of intruder and it will be saved and sent to the mobile phone, through commands the alarm and door lock gun will be activated. For the transmission of picture(MMS), the software used was MATLAB because they support the process of sending picture from computer to phone via GSM modem.

H. El Kamchouchi et.al (2012) [17] proposed design and prototype implementation of SMS based home automation system in which GSM was one of the major cellular communication technologies used by latest smart home automation systems. The global system for mobile communication technology was started in 1985 by a French company which was previously recognized as group special mobile. GSM makes the whole system online for nearly all time because of its extensive coverage.GSM was a mode of multiplexing, which fragments the available bandwidth amid different channels. The radio spectrum can be shared by different users retrieving similar frequency bands without triggering any kind of interference. A GSM cell phone will act with any other GSM service worldwide as long as it has the same frequency.

K. L. Ku et.al (2015) [18] proposed automatic control system for thermal comfort based on predicted mean vote and energy saving 30 % in which reducing demand on HVAC and lighting systems by effectively using free natural resources was a good way to conserve energy. This paper presents an integrated control of HVAC, lights, shading blinds, and natural ventilation to minimize the total daily energy cost. a novel model was established to capture the key interactions among the above devices.

B. Sun et.al (2013) [19] proposed Building energy management: Integrated control of active and passive heating, cooling, lighting, shading, and ventilation systems in which energy management of a ZEB involves a number of parameters such as real-time power availability, which in turn, was dependent upon weather conditions. Other parameter includes real time load requirement, storage level of batteries, etc. therefore, design and control of the EMS of a ZEB takes into account a large number of entities. Moreover, centralized computation and decision making for such complex systems are strenuous and demand huge investments. Consequently, semi-centralized or decentralized decision making was favored in such systems. This has motivated the incorporation of the concept of multi-agent systems (MAS) for development of the proposed EMS. Buildings account for nearly 40% of global energy consumption. About 40% and 15% of that are consumed, respectively, by HVAC and lighting. These energy uses can be reduced by integrated control of active and passive sources of heating, cooling, lighting, shading and ventilation. However, rigorous studies of such control strategies are lacking since computationally tractable models are not available. In this paper, a novel formulation capturing key interactions of the above building functions was established to minimize the total daily energy cost. To obtain effective integrated strategies in a timely manner, a methodology that combines stochastic dynamic programming(DP) and the rollout technique was developed within the price-based coordination framework.

3.0 PROBLEM FORMULATION AND OBJECTIVE

As we already discuss and can be observed from the literature survey that at early stages, accuracy in sensing various parameters like temp. is very low max up to 60-70%.

- 1) One of the main objectives of the model is to evaluate temperature with highly accuracy with further control fan or AC accordingly.
- 2) To save energy or power using solar panel. The system discussed over here is based on natural and clean solar power. The solar tracking system will help in capturing maximum sunlight from the sun. This energy will be stored in a DC Battery
- 3) To provide security, the decision-making part will be carried out by the Microcontroller. This is a whole automated system with self-decision making capability.
- 4) To make system automatic, so that less human effort needed. Here the system will be a sensor based one where the bulb will glow only when there is the need of light.
- 5) To make system controllable using GSM when we far from area. The control of the sensors will be made through mobile phone from any remote location. In this section, some related works are connected to the monitoring system using GSM services.

4.0 PROPOSED SYSTEM DESIGN

4.1 Circuit Design and Procedure

It is an outline description of how we have implemented our project and the various steps involved in it. From the block diagram given below,

4.2 Control Circuit for Both SMS Based Design

The control circuit basically contains all the electronic parts and IC's, and its design is as follows:

4.3 Power Supply

Basically, any electronic circuit runs with a power supply. Here we are giving a 5v supply to the various IC's used in the design presented here. We get a 240V supply in our house at any instant.

4.4 Bridge Rectifier

A bridge rectifier basically has four diodes connected as shown in figure 4.1 to provide rectification. This configuration is a widely used, both with individual diodes wired as shown and with single component bridges where the diode bridge is wired internally.

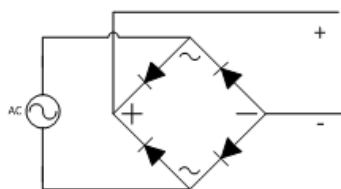


Figure 4.1: Bridge Rectifier [13]

4.5 Voltage Regulator

Then at last voltage regulator as shown in figure42.2 are associated over the circuit to secure the supplies from any kind of voltage variances.

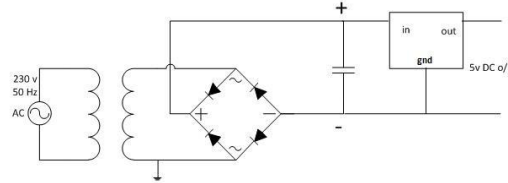


Figure 4.2:5V DC power supply circuit[13]

4.6 Connection of GSM with solar system

The system discussed over here is based on natural and clean solar power. This is a whole automated system with self-decision making capability. The decision-making part will be carried out by the Microcontroller. The solar tracking system will help in capturing maximum sunlight from the sun. This energy will be stored in a DC Battery. In this section, some related works are connected to the monitoring system usingGSM services. However, developed a water meter reading using GSM system which is suitable for remote places to monitor the Lighting system reading before any billing process. This system is used to control home appliances tenuously and offer security when the owner is away from the place.

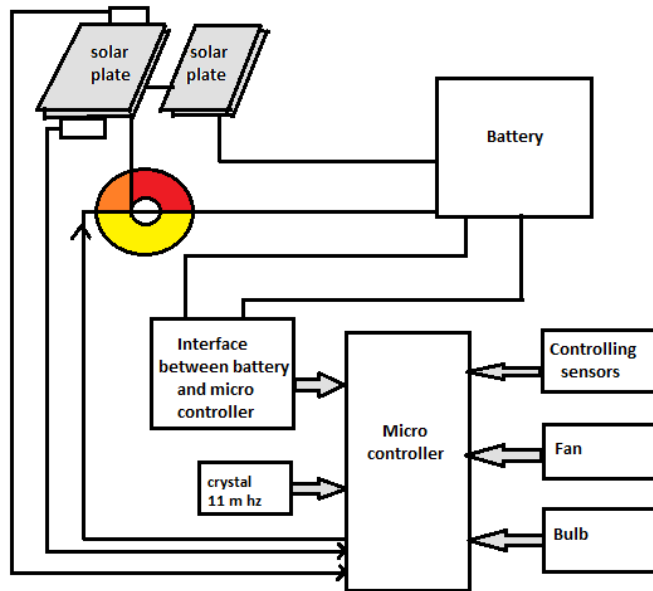


Figure 4.3: Connection of microcontroller with solar[14]

5.0 Results& Discussions

Now the reading shown by the LCD is as given below.As we know output section of project consist of following parameters as shown in figure 5.1



Figure 5.1: LCD section showing all parameter of sensors

A. List of parameters to be measured are listed in below Table 5.1

Table 5.1: List of parameters to be measured in this project.

Sr. No.	Parameters
1	Temperature
2	Humidity
3	Light
4	Solar charged battery

B. List of outputs reading of parameters to be measured are listed in below Table 5.2

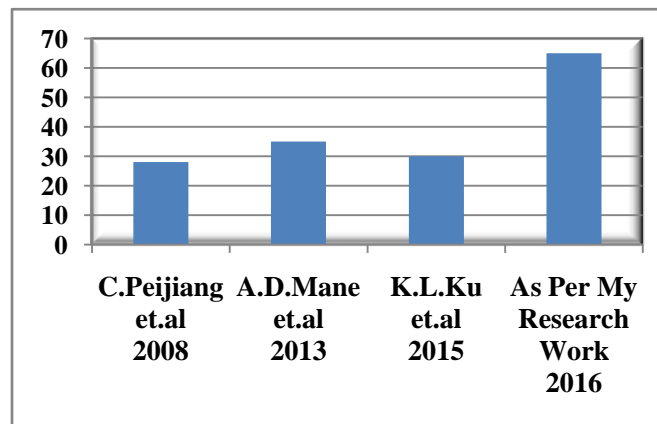
Table 5.2: List of parameters measured in this project

S.N.	Parameters	Readings
1	Temperature	20 C
2	Humidity	22
3	Light	off
4	Solar charged battery	0 %

C. Comparative Study

Table 5.3: Comparison between measured parameters in this project to the other researcher’s research work

Parameter	Research Papers			As Per My Research Work 2016
	C.Peijiang et.al 2008	A.D.Mane et.al 2013	K.L.Ku et.al 2015	
Evaluation of temperature	No Evaluation only controlled by GSM	No Evaluation only controlled by GSM	Evaluation based on predicted mean vote.(less accuracy)	Evaluation using PT100, Digitally Highly Accurate.
Energy Saving	Less Energy save because only GSM Used	Energy saving higher than C.Peijiang’s because solar energy also used	Energy saving is lesser than A.D.Mane’s but more than C.Peijiang’s.	All features used in one system Hence Energy saving high as compare to all.
Security	No such thing mentioned	No such thing mentioned	No such thing mentioned	Security provide to sensors using prog. to GSM.



Graph 5.1: Comparative study of output reading of parameters to be measured.

5.1 Conclusion & Future work Conclusion

As final result, it can be concluded that accuracy in measuring temp. and controlling device can be achieve 100% by digital microcontroller and GSM based system. Evaluation of temperature using PT100, Digitally Highly Accurate.All features GSM, Solar, Sensors used in one system Hence Energy saving 60-70 %. Security provide to sensors using programming to GSM.

5.2 Real life Application and Future work

First application of this system is in home automation system and second application of this system is in controlling agriculture instrument by GSM system. Third application of this system is in industrial machinery control and energy saving.

In future by adding more sensors this system can have more applications as per our requirements.

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