

# Power Management System for Appliances Using PLC

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**Abstract—** Focus of this paper is to present simple approach to design intelligent home system using the concept of mobile-to-machine and machine-to-mobile communication. The main objective is to provide a wireless communication link to the appliances. A general purpose circuit is designed to control and monitor a variety of appliances was developed with an interface that can be plugged in to GSM (Global System for Mobile Communication) handset units. Power management system for appliances using PLC (Programmable Logic Controller) deals with automatically sending SMS (Short Message Service) to the user if the user had forgotten to turn OFF any particular devices under the control of PLC and later turning OFF the particular appliances after receiving SMS for a valid user, there by optimizing the use of power.

*Keywords — PLC, GSM, Power management.*

## I. INTRODUCTION

Technology has advanced so much in the last decade or two that it has made life easier and comfortable to mankind. The comfort of being able to take control of devices from one particular location has become imperative as it saves a lot of time and effort. Therefore there arises a need to do so in a systematic manner which we have tried to implement with our system. The system can be used as an extended approach to automating a control system.

With the advancement and breakthroughs in technology over the years, the lives of people have become more complicated and thus they have become busier than before. With the adoption of proposed system, one can gain control over certain things that require constant attention. The application of our system comes in handy when people who forget to do some simple things such as turning OFF their devices at home or in their office. They can now do so without their presence that is by the transmission of a simple text message from their cell phone. This development, we believe, will ultimately save a lot of time especially when people don't have to come back for turning OFF switches at their home or at their office once they set out for their respective work. It also saves certain amount of power thereby reducing electricity bills.

The objective of this project is to develop a device that allows a user to remotely monitor and control multiple home/office appliances using a cellular phone. This system will be a powerful and flexible tool that will offer this service

at any time, and from anywhere with some constraints of the technologies being applied. Possible target appliances include climate control system, security systems, lights and any other devices with an electrical interface.

The proposed approach for this system is to implement a PLC based control module that monitors all electrical devices and sends message to user, if user has forgot to turn off any device with electrical interface. PLC receives its instructions and command from a cellular phone over the GSM network. User has to send instructions or commands to the system to control a particular electrical appliance using his cellular phone. PLC will then carry out the issued commands and then communicate the status of a given appliance or device back to the cellular phone.

## II. SYSTEM SPECIFICATIONS

The proposed system is described in the Figure 2.1. It is a simple illustration of implementation of project and various parts involved in it. From the representation, the GSM Modem is used as a transceiver section through which the subscriber and PLC communicates using text messages that contain commands and instructions.

AC to DC converter (230 AC to 24V DC) is used to provide power supply for PLC, Input/output modules and also to drive the relay circuits which switches the different appliances connected to the interface. The HMI (Human Machine Interface) is used to indicate the status of the appliances like whether a particular appliance is turned ON/OFF which makes the overall system user-friendly.

The input from sensors are fed to PLC and processed to operate respective task semi autonomously and autonomously.

Sensors detect the presence of a person in building. Two sensors namely sensor A and sensor B are used and operates with 9V battery. The outputs from these sensors are given to Input/output module through relay since Input/output module works with 24V, relay is used to convert sensors output from 7V to 24V.

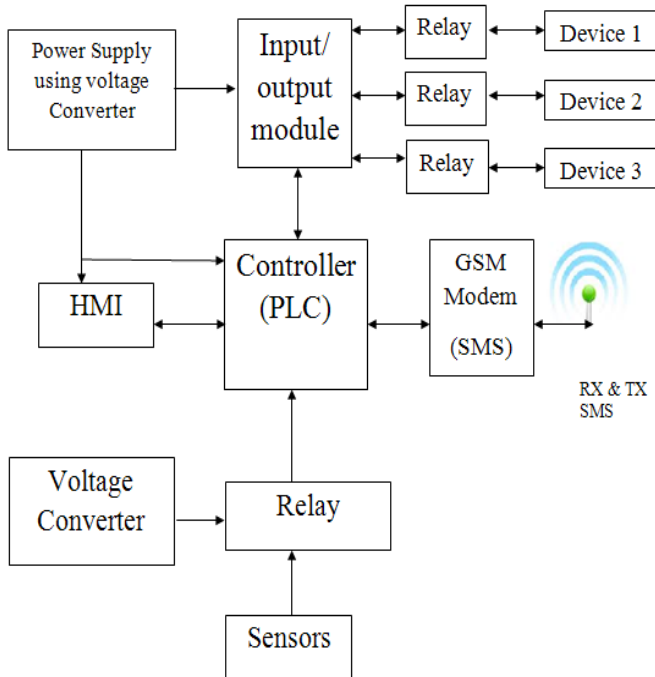


Figure 2.1 Power management systems

When a person enters or exits, count has to be incremented or decremented respectively. If the output from sensor A is detected first and then by sensor B, then person has entered the building. Hence, count has to be incremented. If the person leaves the building output from sensor B is detected first and then by sensor A. Hence count has to be decremented. After incrementing or decrementing the count value sensors has to be reset.

If output from sensor A is detected and output from sensor B is not detected (If person has not gone through both the sensors) then output of sensor A is reset and vice-versa.

Initially PLC checks the person count value from the sensor unit. If the person count is zero, the PLC waits for a predefined time set by the user. After the predefined time it again checks the person count value. If the person count value is not zero, it returns to monitoring state. If person count is zero again, PLC checks the mains operated devices connected to it. If any devices are still working, then the corresponding message will be sent to the user. The user number will be predefined in the program.

Once message has been sent to user, PLC waits for a predefined amount of time. When the stored timer value elapses, PLC again checks for mains operated devices. If any appliances are not turned off message is sent to the user again.

If the user sends a command to the PLC to turn OFF the appliance the message will be received by the modem, a signal is generated by modem which tells PLC that a new message has been received. Now PLC issues command to delete all messages that are stored previously in the SIM card located inside the modem. After deleting the old messages, command is given to read the new message. From this read message, necessary details are extracted. Decoded message contains command from the user and also contains the mobile number. Using this mobile number, it checks whether the

message is received from valid user. If message received is not from valid user, PLC doesn't perform any actions. If it is from valid user, it checks for the extracted command. Depending on this command, PLC checks this with the predefined command. If the received message matches with the predefined command, PLC issues command to turn OFF the corresponding device. When the device is turned OFF, it acknowledges the user that the particular device has been turned OFF. If the received message is from valid user and extracted message doesn't match predefined message PLC sends message to user telling that invalid command has been received.

HMI is the space where interaction between humans and machines occurs. The goal of interaction between a human and a machine is an effective operation and control of the machine, and feedback from the machine which aids the operator in making operational decisions. Appliances can be turned ON or turned OFF using HMI. Programming has been done in such a way that when appliances are controlled using SMS are also updated in HMI.

The command sets used for communication with GSM modem are shown in Table I.

Table I: GSM modem command sets

Command	Description
AT+CMGS	To Send message
AT+CMGR	To Read message
AT+CMGD	To Delete message
AT+CMTI	Notification of SMS received.

### III. RESULTS AND DISCUSSION

The system was designed using the PLC PM591 and which is capable of interfacing up to ten input/output modules. Each input/output module has sixteen input/output ports. Two appliances AC and TV were selected for testing, for which only one input module was sufficient. When the count of a person is zero the PLC checks for the appliances that are turned ON and sends a message to the user about that particular device. On receiving a message it checks for a valid user if it is from a valid user it performs the operation sent by the user or else discards the message if it is from an unauthorized user. After performing the specified operation indicated by the user PLC acknowledges them back.

Some of the constraints faced while designing the module were the receiver must reside in a location where a signal with sufficient strength available from a cellular phone network.

The interfacing of PLC with the HMI is depicted in figure 3.1

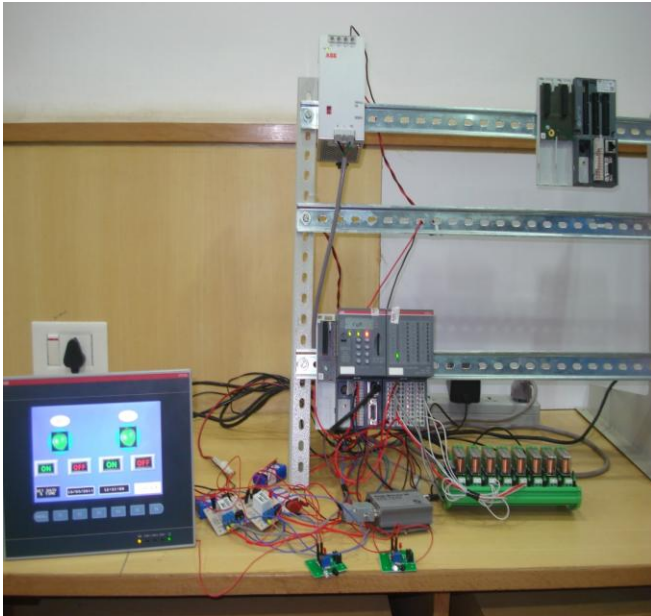


Figure 3.1 PLC and HMI interface

#### IV. CONCLUSION

The extensive capabilities of this system are what make it so interesting. From the convenience of a simple cell phone, a user is able to control and monitor any electrical devices virtually. This makes it possible for users to rest assured that their belongings are secure and electrical appliances were not left running when they left the house. This is just a list of few of the many uses of this system. The end product will have a simplistic design making it easy for users to interact

The PLC is capable of handling almost 160 appliances hence this module can be used not only for domestic purposes but also for Industries. This module helps the users to save a larger amount of time and power.

#### V. FUTURE WORK

The future implications of this project are very great considering the amount of time and resources it saves. The project undertaken can be used as a reference or as a base for realizing a scheme to be implemented in other projects of greater level such as weather forecasting, temperature updates, device synchronization, etc.

The project itself can be modified to achieve a complete Home Automation System and security system which will then create a platform for the user to interface between the appliances.

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