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A Smart Control System of Home Appliances Using SMS

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Abstract- This paper is about the development and implementation of a GSM based password protected control system for electrical home appliances that enables to control remotely. GSM module is used for receiving short message service (SMS) from user's mobile phone that automatically enable the controller to take any further action such as to switch ON or OFF the home appliances such as lights, air-conditioners, fans, water pumps, door locks, TVs etc. Hardware of the system has been developed using an Arduino Uno board, a GSM modules, some switching relays and some other easily available electronic components. The driving software has been made using the Arduino IDE. The system is activated when only the user sends the SMS to the controller at home with the exact password. Upon receiving the SMS command, the microcontroller unit will decode the received SMS automatically and controls the electrical home appliances by switching ON or OFF the device according to the user direction. The ON and OFF of the appliances has been controlled by relays and the Arduino board. In addition to the controlling of the common home appliances, a smart water pump control has also been developed. The prototype has been successfully developed and its performance has been studied. It works perfectly and it could provide an effective means of remote controlling and efficient use of energy resource.

Keywords: GSM-SIM808, 5v relay Unit, water level sensor, Arduino Uno (controlling unit) and Arduino development interface (IDE).

1. INTRODUCTION

Nowadays most of the people from any places at any time are connected with the mobile phone and want to get easy access of technology through their cell phones. With the development of the electronics technology in the last two decades, a new concept called Smart Home has become prevalent and through this concept people have been trying to control and secure their home appliances remotely by using SMS with low cost. GSM based remote control management is a subject of creating interest which has found application in different zones. Many works are going on in this field all over the world. Tan and et al.^[1] developed an automatic power meter reading system to send the power consumed reading to e-billing system at authorized office. The system works by integrating the

GSM modem that was embedded with digital kWh power meter. It utilizes the GSM network to send power usage reading using SMS to the authorized office. The authorized office collect and manage the received SMS message contain the meter reading to generate the billing cost and send back the cost to the respective consumer through SMS. Authors^[2] developed a system for acquiring water level and temperature status via SMS by utilizing PIC 16F877 and MPLAB IDE software for programming. The project was designed to detect level and temperature of the water in a pool. The system functions when the level of water and the temperature in pool exceed the desired limits. At the same time the PIC circuit will automatically interface to the mobile phone and send the alert message to the user. Furthermore, Author of [3] also developed a remote and security control system via SMS to control the switch for lamp, door and alarm system using Visual Basic 6.0 software. Visual Basic was chosen because it can easily communicate between computer and mobile phone.

Moreover, Wahab and et al.^[4] developed a Integrated Water Billing System through GSM network. The system is designed to facilitate the Water authority to manage the monthly billing system without the use of human services. The system generates current billing by receiving SMS from the meter to central databases. It again sends an SMS notification to the user regarding the total amount that has been billed. A very similar work has been reported by an Author^[5] who has developed and designed a device that can control variety of electrical home appliance using SMS. The system utilizes Ericsson T10s mobile phone as a receiver which is connected to the AT 9052313 microcontroller. It also used MPLAB IDE software for programming. It can control 8 electrical home appliances at any time. The work presented by B.Woodward and et al.^[6] is about the development of a telemedicine system using a mobile telephone which interfaced with sensors to a patient's body using GSM simulation. The work presented here uses the same technique as described above, but here the system will be more versatile and secured by password.

Electricity has become an essential part of our life. So, we can't afford to misuse any fraction of it. If we unmindfully leave any of the home appliances switched on, this will lead to energy wastage. With an aim to solve this problem, a control system based on microcontroller device has been developed which automatically control

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any electrical equipment at home remotely both for long and short distances using mobile phone. Hence, using this system we can protect our home from any accident caused by over use of home appliances like- electric iron, microwave oven, water pump etc. Our developed system is more versatile and smarter that can control home appliances and water pump. The water pump will be controlled smartly by the system and the user through SMS. Traditional water pump is controlled manually which results wastage of time, energy as well as resources. Our system is designed in such a way which can control water pump automatically.

II. SYSTEM DESIGN

A simplified block diagram of the System is given in Fig.1. The mobile unit has been used as a transmitting section from which the subscriber sends text messages that contain commands and instructions to the mobile station. The received SMS message is stored in the SIM memory of the GSM module and then extracted by the microcontroller and processed accordingly to carry out specific operations requested by the user. The SMS from the user cell phone has been transmitted through the GSM chip to the microcontroller and the microcontroller finally performs the required actions as stated by the user. The relay driver unit has been used to drive the relays which switch different appliances connected to them. Two water level sensors have also been used for getting the notification of the present conditions of water tanks. According to the notification of the system the user can remotely turn ON/OFF the water pump through SMS. When the water level sensor senses the highest level of water in the over-head tank, it automatically turns the pump OFF. The design of different units is described below:

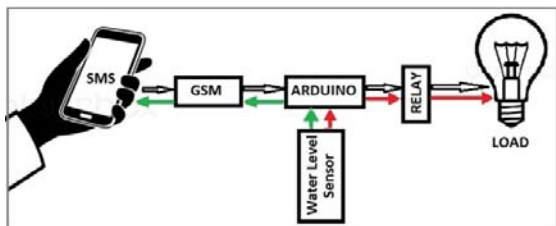


Fig.1: Block Diagram of Full Project

a) GSM Module-(SIM 808)

SIM 808 module is a GSM and GPS two-in-one function module. It supports GSM/GPRS Quad-Band network. The module is controlled by AT command and supports 3.3V and 5V logical level. To interface the GSM module with the Arduino board Tx and Rx pins of GSM module have been connected to the pin 2 and 3 of Arduino, respectively. The GSM module could have been connected to the Rx and Tx pins of Arduino Uno. As these pins are also used for uploading program into

Arduino, the GSM module has been connected to the digital pins (pin 2 and pin 3).

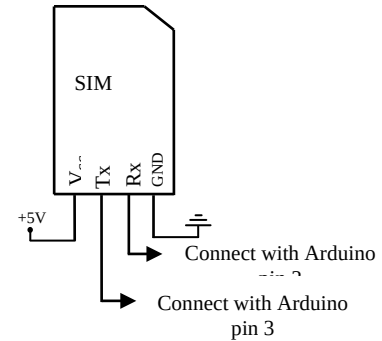


Fig. 2: GSM SIM808

b) 5V Relay Unit

Since the load ON/OFF frequency for any home appliances is very low, in this system, relays have been used for switching purpose. Moreover, for AC applications relays are very suitable and needs very simple connections. Here, 5V-10A AC relays have been used. The relays connect or disconnect the home appliances to the 220V AC power. The relays have been connected to the Arduino board using transistors. There are 4 channels in the relay unit. The channels ch-1, ch-2, ch-3, ch-4 are connected to the Arduino pin no. 8, 9, 10, 11 respectively. In a basic relay there are three contacts: Normally-Open (NO), Normally-Closed (NC) & Common (COM). When the relay is not energized, the COM is connected to NC. All loads are connected with COM port of Relay and direct power source is connected with NO port.

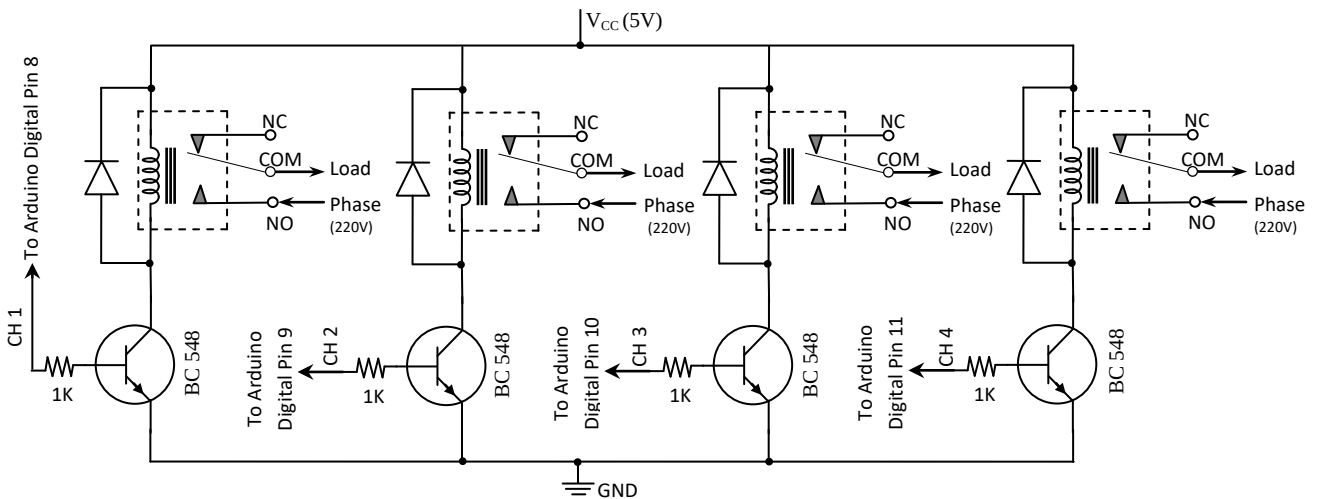


Fig. 4: 4-Channel 5V Relay Unit

c) Water Level Sensor

This simple transistor based water level sensor circuit is very useful to determine the water level in a tank. Whenever the tank gets filled, different sensors are activated at particular water levels. In this system, two level sensors have been used one for indicating low level of water and the other for full of the tank. The level sensors have been developed using galvanized metal (steel) strips. The metal strips are placed at the appropriate level of the tank and another metal strip has also been used to supply +5V into the water tank. When

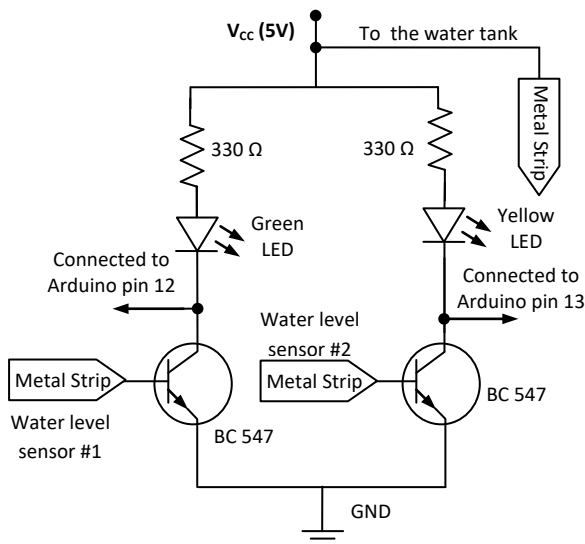


Fig. 3: Circuit diagram of Water level Sensor

water touches the metal strip the corresponding transistor turns on and the collector voltage goes to 0V. In this way the transistors sense the position of the water level and produce signals for the Arduino. Two LEDs have also been connected in this sensing circuit, to indicate two levels-Green LED) for lower level and Yellow LED for higher level. When Green LED glows it sends

signal to the pin-12 of the Arduino. When Yellow LED glows it sends signal to the pin-13 of the Arduino.

Circuit Components:

- BC547 Transistors -2 pcs
- Resistors 330Ω -2 pcs
- Color LED -2 pcs
- 5V DC power source

d) Controlling Unit

The main controlling unit of this system is made by an Arduino Uno which contains ATmega328P microcontroller and other supporting chips. The technical specifications of the Arduino Uno are given below. This controlling unit gets signals from the GSM module and water level sensor circuit and controls the home appliances according to the conditions given in the driving software.

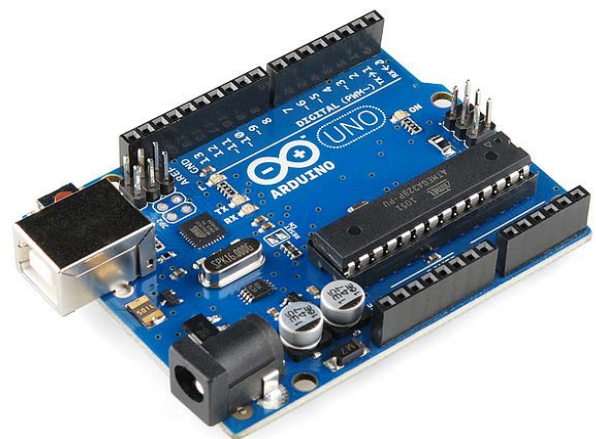


Fig. 5: Arduino Uno

Technical Specification [8]:

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provides PWM output)
PWM Digital I/O Pin	6
Analog Input Pin	6
DC Current per I/O Pin	20mA
DC Current for 3.3V Pin	50mA
Flash Memory	32 KB (ATmega328P) of which 0.5KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
Length	68.6mm
Width	53.4mm
Weight	25g

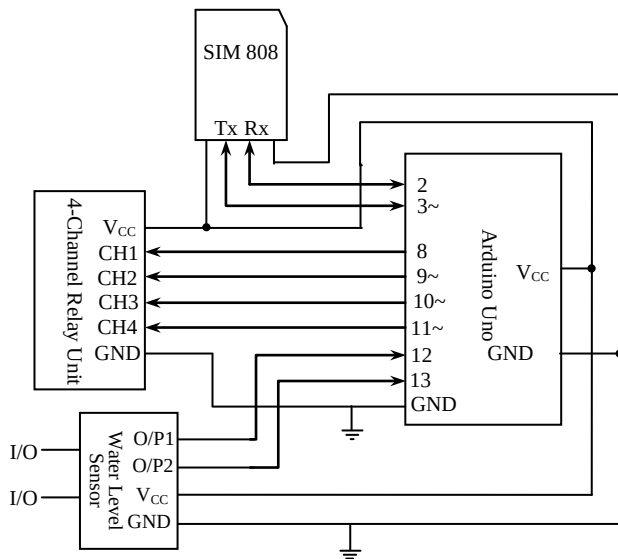
e) *Interconnection of Different Units*

Fig. 6: Schematic Diagram

In this schematic diagram all units are connected together. For sending and receiving SMS, Tx and Rx pin of GSM module are connected with the Arduino pin 3(Rx) and 2(Tx) respectively. Home appliances are connected with Arduino pins 8, 9, 10, 11 through 4-channel Relay Unit. In water level sensor there are two input ports and two output ports. Two inputs are to be placed in water tank for water level measuring. Output terminals are directly connected to Arduino pins 12, 13. For all V_{CC} we've used same 5V source from a mobile power bank.

III. FLOW CHART

The developed system has been made intelligent and automatic using a program. The program

has been developed using Arduino IDE. The flowchart of the program is given in Fig.6. At first, the program initializes all variables and ports. Then it initializes GSM. After that a decision parameter determines whether there is any SMS or not. If there is any SMS available in the GSM module, the microcontroller reads that SMS and compares the password with the pre-set password. If the password matches, it reads the command given in the SMS, decode the command and turns ON/OFF the home appliances according to the command. An example SMS to turn first two appliances ON and another two appliances OFF is 12341100 (password-1234). It will work if the password is correct either it ignores the SMS. From the decision point if there is no SMS, it goes to another decision point which determines whether the water tank is empty or not. If the tank is empty it sends SMS to the user prompting that the tank is empty through the GSM module. Otherwise it will go back to the first decision point. In this way this process will be continued until the system is switched off or power disconnected.

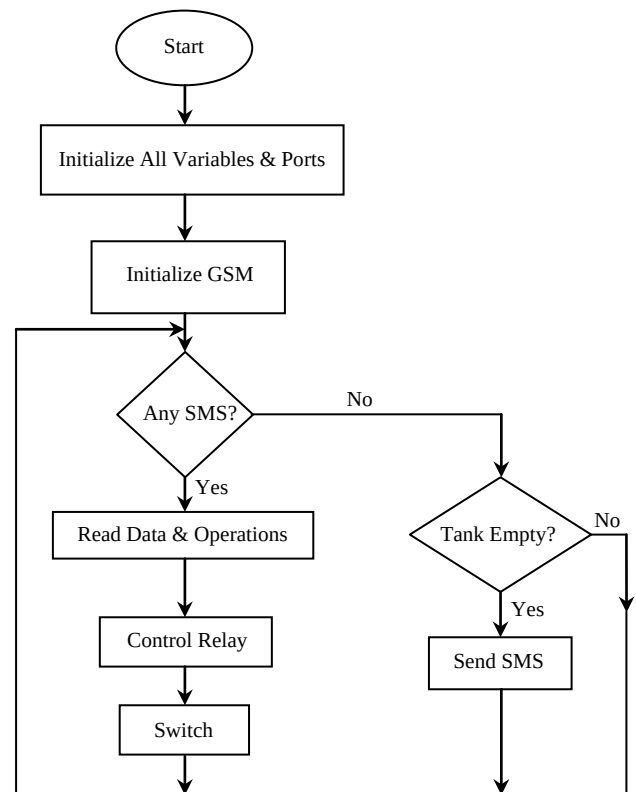


Fig. 7: Flow Chart

IV. RESULTS & DISCUSSIONS

All of the designed units have been interconnected in a bread board and the developed software has been uploaded into the Arduino microcontroller. A prototype model of the home has also been developed. The figures below show the hardware connection and the output results.

Step-1:

The initial state of the system is shown in Fig. 8 & 9. The power switch is off and no message is sent to the system. Hence, all of the appliances are switched off.



Fig. 8: Initial state of the system. All appliances OFF



Fig. 9: Initial state of the system. All appliances OFF

Step-2:

When an SMS (Password Command = 12341111) is sent for all switched ON command then all the appliances are switched ON. This is shown in Fig.10 & 11.



Fig. 10: Photograph of the system with all appliances ON



Fig. 11: Photograph of the system with all appliances ON

Step-3:

When water level goes to under the empty level in water tank then the GSM system sends an SMS to the

user as "Tank Empty". Then user may send an SMS to turn ON the water pump as well as when water tank is full the water pump will automatically be turned OFF as shown in the following results.

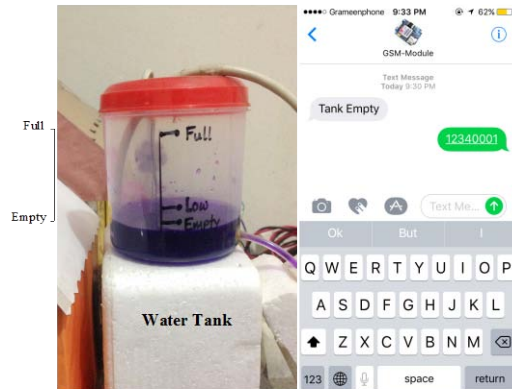


Fig. 11: Photograph of the water tank and its relevant SMS

V. CONCLUSION

SMS based home appliance control system is capable of controlling of the appliances from any place where GSM service is available. This paper presents the design and implementation of a smart control system for electrical appliances based on microcontroller along with GSM for user friendly application. The system is intelligent enough to control the water pump and any other electrical units of home. The system was designed considering some factors such as economic application, availability of components and research materials efficiency, compatibility, portability and durability. The system provides the reliable operation within reasonable cost and removes the system complexity. The system can be made more useful by detecting the water level of reserve tank and turning the pump ON/OFF as required. Although in this project, some common home appliances have been controlled it can be used for any other appliances from any place.

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