Multi Security System Using GSM and PIC 16F877A
Rahul Antony, Reema Mathew A, Divya K, Teenu Jose
Dept of E & I VJEC, Chemperi, Kerala, India

Abstract—GSM Technology is used in cellular communication all around the world today. We are implementing this technology in controlling household equipment (gate, fan, lights, etc) from remote place. By this implementation we are using the existing networks as the path way for controlling equipment. We are able guarantee security and reliability as much as the cellular companies guarantee to their user. It is more economic as it is implemented in an existing technology.

In this project we introducing a group of equipment which could receive a call or text message from a cell phone located in remote. This message is decoded and this signal is used for controlling the household equipments. The recipient part consists of GSM-module (recipient & decoder) and microcontroller (to manipulate working of the equipment as per the received information). We are also trying to introduce a two way communication between user and the equipment. Various sensors are used for feedback. We can also keep a record of this communication if needed by just introducing a storage device. The proposed work uses PIC16F877A as the controller.

Keywords—GSM, PIC16F877A, IComsat SIM 900, SMS, Relay

I. INTRODUCTION

GSM technology can be used to control home appliances from a remote area. Often people forget to switch off devices while leaving home. This can cause energy wastage. So needs arise to operate devices while we are not able to access them physically. GSM based home automation system works on GSM network technology for transmission of SMS from sender to receiver. The system is capable enough to instruct user via SMS from a specific cell number to change the condition of the home appliances according to the user needs and requirements[9].

The hardware component i.e. GSM modem allows the user to send and receive SMS to and from the system. Communication with system takes place via RS232 serial port. Mobile at the system transfer it to the microcontroller. The microcontroller operates the devices according to the command received.

It can be used as security system for theft alert. The advantages of the system are that the system has global range, low cost and low power requirement. It has applications in access control devices, transaction terminals, supply chain management. This home automation system consists of 4 sensors. Level sensor for the detection of water level in the tank, light sensor to automatically detect day light and switch off the bulb. We also require an IR sensor for gate motion control and a temperature sensor for switching off the fan. The sensors are connected to relay and to the microcontroller. The software loaded in the microcontroller receives the input signals from the sensors connected to GSM and displays status of devices and according to it can be controlled.

II. BLOCK DIAGRAM

A) BLOCK DIAGRAM DESCRIPTION

1) GSM
The GSM system consists of mobile with user at remote location and another GSM module connected to the microcontroller at home. The GSM module activates upon a call from the specified phone number of the user
recognizing the number the GSM module will send the status of home devices to the user via SMS. The user send commands to change the status of devices according to requirement via SMS.

II) INTERFACE
Serial interface is provided between GSM module to microcontroller. The interface used is of RS232 standard. The GSM modem makes use of AT commands to send SMS. The data cable of the mobile is DB9.

III) MICROCONTROLLER
The microcontroller is embedded on Arduino UNO board. The microcontroller used here is ATmega328. The ATmega328 is a low power, high performance microcontroller with data bus width of 8 bit. It has an operating voltage of 1.8 to 5.5 volt.

IV) MOTOR DRIVER
The motor driver IC used here is L293D. It is designed to provide bidirectional drive currents of up to 600 milliampere at voltages from 4.5 volt to 36 volt. The device is designed to drive inductive loads such as relays, solenoids in positive supply applications. The L293D are characterized for operation from 0°C to 70°C.

V) DEVICES
The devices controlled here are fan, water level of the tank, light, gate. The sensor used for fan is temperature sensor LM35. The water level is sensed by point level sensor. For the gate movement detection we use IR sensor which looks for the presence of human heat moving across the field of view. A light sensor is used to detect day light for switching off the bulb if it is left on. LDR is the main component used in the light sensor circuit.

III. GSM

GSM is Global system for mobile communication. It is the globally accepted standard for digital cellular communication[6]. Cellular radio system operated at 900hz. It was introduced in 1991.

It is divided into 3 major systems:
- Switching system
- Base station system
- Operating and support system

Switching system
It is responsible for performing call processing and subscriber related functions.

Base station system
It consists of base station controller and base transceiver station for controlling, transmitting receiving purpose.

Operating and supporting system
It has an operating and maintenance centre (OMC) is connected to all equipment in the switching system and to the BSC. The implementation of OMC is the operating and support system. The purpose of OSS is to offer the customer cost effective support for centralized, regional and local operation and maintenance activities that are required for GSM network.

GSM modem
Basically a modem is a device for transmitting digital information. GSM modem is a specialized type of modem which accepts subscriber identity module and operates over a subscription to a mobile operator just like a phone. It allows to send and receive SMS messages. To perform this task a GSM modem must support an “extended AT command set” for sending or receiving SMS messages.

Specifications
The GSM module is based on SIMComs SIM900 Module. Quad-band 850/900/1800/1900 MHz would work on GSM networks in all countries across the world. The GPRS mobile station is class B. It can be controlled via AT
commands. AT commands are the standard command for GSM 07.07 and 07.05. The SIMCOM AT commands are enhanced commands. SMS stands for short message service. Through SMS small amounts of data can be sent over the network[1].

The GSM module consists of a SIM card holder and GSM antenna present on board. It has low power consumption. The industrial temperature is -40°C to 85°C. It has 12 GPIOs, 2 PWMs and an ADC.

IV. SENSORS

I) Water level sensors circuit

Level sensors detect the level of substances that flow, including liquids, slurries, granular materials, and powders. Fluids and fluidized solids flow to become essentially level in their containers (or other physical boundaries) because of gravity whereas most bulk solids pile at an angle of repose to a peak. The substance to be measured can be inside a container or can be in its natural form (e.g., a river or a lake). The level measurement can be either continuous or point values[4]. Continuous level sensors measure level within a specified range and determine the exact amount of substance in a certain place, while point-level sensors only indicate whether the substance is above or below the sensing point. Generally the latter detect levels that are excessively high or low.

II) Circuit Diagram explanation

Water level sensor circuit is a circuit which is useful for detecting the presence of water in a tank. This circuit will work if the sensor probe is connected by water, and the signal will then be transformed in an advanced circuit with a specific purpose in the form of sound, LED display, and/or drive a relay to disconnect or connect the power source.

A water level sensor circuit is more complex can be designed based on the desired features. When the desired height it is necessary to detect some multiple probe sensors, each of which signals from the sensors can be further functionalized. For example, various heights in the tank will be detected by the height of the water and then be displayed in the form of LED displays.

When the water is empty the wires in the tank are open circuited and the 180K resistors pulls the switch low hence opening the switch and LEDs are OFF. As the water starts filling up, first the wire in the tank connected to S1 and the + supply are shorted by water. This closes the switch S1 and turns the LED1 ON. As the water continues to fill the tank, the LEDs2, 3 and 4 light up gradually.

When the water is full, the base of the transistor BC148 is pulled high by the water and this saturates the transistor, turning the buzzer ON. The SPST switch has to be opened to turn the buzzer OFF.

As you can see this electronic liquid sensor circuit require very few external components and need to be powered from a 6 volts DC power supply.

III) LIGHT SENSOR

A Light Sensor generates an output signal indicating the intensity of light by measuring the radiant energy that exists in a very narrow range of frequencies basically called "light", and which ranges in frequency from "Infrared" to "Visible" up to "Ultraviolet" light spectrum. The light sensor is a passive devices that convert this "light energy" whether visible or in the infrared parts of the spectrum into an electrical signal output. Light sensors are more commonly known as "Photoelectric Devices" or "Photo Sensors" because the convert light energy (photons) into electricity (electrons).

IV) LIGHT DEPENDENT RESISTOR

As its name implies, the Light Dependent Resistor (LDR) is made from a piece of exposed semiconductor material such as cadmium sulphide that changes its electrical resistance from several thousand Ohms in the dark to only a few
Materials used as the semiconductor substrate include, lead sulphide (PbS), lead selenide (PbSe), indium antimonide (InSb) which detect light in the infra-red range with the most commonly used of all photoresistive light sensors being Cadmium Sulphide (CdS). Cadmium sulphide is used in the manufacture of photoconductive cells because its spectral response curve closely matches that of the human eye and can even be controlled using a simple torch as a light source. Typically then, it has a peak sensitivity wavelength ($\lambda_p$) of about 560nm to 600nm in the visible spectral range.

V. GATE MOTION DETECTION SENSORS

IR sensors

IR sensors looks for the presence of human heat moving across their field of view. The sensors are positive, which means that they are looking for the movement. Unlike radar and ultrasonic systems that emit a signal and look for a reflection, IR sensors just receive.

All IR sensors have some common ratings and specifications. The first is the detection pattern or the field of view. This defines how wide or narrow the IR sensor can detect. Typically they look like the image on the right. The IR Sensor-Single is a general purpose proximity sensor. Here we use it for collision detection. The module consists of a IR emitter and IR receiver pair. The high precision IR receiver always detects a IR signal.

The module consists of 358 comparator IC. The output of sensor is high whenever it IR frequency and low otherwise. The on-board LED indicator helps user to check status of the sensor without using any additional hardware. The power consumption of this module is low. It gives a digital output.

Fan motion detection using temperature sensor.

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to temperature (in degree Celsius) calibrated in Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1/4°C at room temperature and ±3/4°C over a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35’s low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55°C to +150°C temperature range, while the LM35C is rated for a −40°C to +110°C range (−10°C with improved accuracy). The LM35 series are available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package[3][5].

The LM35 can be applied easily in the same way as other integrated-circuit temperature sensors. It can be glued or cemented to a surface and its temperature will be within about 0.01°C of the surface temperature. This presumes that the ambient air temperature is almost the same as the surface temperature; if the air temperature were much higher or lower than the surface temperature, the actual temperature of the LM35 die would be at an intermediate temperature between the surface temperature and the air temperature. This is especially true for the TO-92 plastic package, where the copper leads are the principal thermal path to carry heat into the device, so its temperature might be closer to the air temperature than to the surface temperature. To minimize this problem, be sure that the wiring to theLM35, as it leaves the device, is held at the same temperature as the surface of interest. The easiest way to do this is to cover up these wires with a bead of epoxy which will insulate that the leads and wires are all at the same temperature as the surface.

V. MICROCONTROLLER

The microcontroller is embedded on PIC16F877A board. The microcontroller used here is PIC16F877A. The home controller application described in this application note allows the user to program on and off times for up to sixteen devices, using a 2 x 16 liquid crystal display and five push buttons[2]. A built-in light sensor can be used to turn on lights at dusk, and turn them off at dawn.The home controller is designed to facilitate experimentation with home automation using the PIC16F877A. In addition to the PIC16F877A, the board will accept any other PIC microcontroller that shares the same pinout, such as the PIC18F452. Therefore, experimenters may expand on the application using the higher performance of the PIC18 family of parts without changing the hardware.

X-10 is a communication protocol designed for sending signals over 120 VAC wiring. X-10 uses 120 kHz bursts timed with the power line zero-crossings to represent digital information. Plug-in modules available from various vendors enable users to create home automation systems by using the AC wiring already installed within a home. Readers who would like an overview of the X-10 signal format may refer to Appendix A. PICmicro® microcontrollers can easily be used in conjunction with X-10 technology to create home automation applications. The specific PIC microcontroller (MCU) used should be selected based on RAM, ROM, operating frequency, peripheral, and cost requirements of the particular application[2]. The PIC16F877A was selected for this application because of its versatility...
as a general purpose microcontroller, its FLASH program memory (for ease of development), data EEPROM, and ample I/O. This application note discusses the implementation of X-10 on a PICmicro MCU to create a home controller that can both send and receive X-10 signals. The reader may implement the home controller as is, or adapt the circuits and firmware to other applications.

Peripheral Interface Controllers (PIC) is one of the advanced microcontrollers developed by microchip technologies. These microcontrollers are widely used in modern electronics applications. A PIC controller integrates all type of advanced interfacing ports and memory modules. These controllers are more advanced than normal microcontroller like INTEL 8051. The first PIC chip was announced in 1975 (PIC1650). As like normal microcontroller, the PIC chip also combines a microprocessor unit called CPU and is integrated with various types of memory modules (RAM, ROM, EEPROM, etc), I/O ports, timers/counters, communication ports, etc.

All PIC microcontroller family uses Harvard architecture. This architecture has the program and data accessed from separate memories so the device has a program memory bus and a data memory bus (more than 8 lines in a normal bus). This improves the bandwidth (data throughput) over traditional von Neumann architecture where program and data are fetched from the same memory (accesses over the same bus). Separating program and data memory further allows instructions to be sized differently than the 8-bit wide data word.

VI. MOTOR DRIVER IC

The L293D is a monolithic integrated high voltage, high current four channel driver designed to accept standard DTL or TTL logic levels and drive inductive loads (such as relays solenoids, DC and stepping motors) and switching power transistors. To simplify use as two bridges is pair of channels is equipped with an enable input. A separate supply input is provided form the logic, allowing operation at a low voltage and internal clamp diodes are included[3].

This device is suitable for use in switching applications at frequencies up to 5 KHz. The L293D is assembled in a 16 lead plastic package which has 4 center pins connected together and used for heat sinking.

VII. RESULT

A home automation system to control home appliances via GSM technology and microcontroller AT mega 328 was setup. The devices controlled are fan, light, water tank level and gate with the help of four sensors.

VIII. CONCLUSION

A thorough study has been made about and microcontroller PIC16F877A. This home automation system consists of 4 sensors. Level sensor for the detection of water level in the tank, light sensor to automatically detect day light and switch off the bulb. We also require an IR sensor for gate motion control and a temperature sensor for switching off the fan. The sensors are connected to relay and to the microcontroller. The software loaded in the microcontroller receives the input signals from the sensors connected to GSM and displays status of devices and according to it can be controlled.

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