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COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

COMMUNICATION STREAM

Project title: Flood protection system using GSM technology (In Case of Kindo Didaye at Wolaita, Southern Ethiopia)

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Abstract

Floods are among the most common disasters and natural hazards in the world, in the developing contries like Ethiopia particularily wolaita area affecting human lives and causing severe economic damage in last three years, for this case “Flood protection system using GSM technology in the case of wolaita zone Kindo Didaye woreda,” has become a popular study topic. It is understood that flood risks will not decrease in the future. To minimize the extent of damages caused by flood, warning systems to inform the people of the disaster should be implemented in the areas. The system should be designed to be able to detect the levels of water so appropriate warnings to the authorities and the public can be sent. The flood notification SMS and social network especially at the critical situation. The specific SMS is sent from the GSM modem to the station through a regular GSM network. The Micro controller will continuously check the status of the sensors. The control system will include two separate units: the GSM modem, and the control unit. Main components are PIC microcontroller, sensor, display unit and motor. The sensor senses the presence of water and gives indication to the microcontroller. The microcontroller produces the control signals to drive the motor and display the condition on LCD in the system. Finally the simulation result using protous software and Micro-C pro or PIC with GSM modem for the designed system to the early warning of the flood in the area.

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Acronym /Abbreviation

A/D: Analog to Digital

CDMA: Code Division Multiple Acces

CPU: Central Processing Unit

DC: Direct Current

DCE: Data Communications Equipment

DTE: Data Terminal Equipment

Fa: Anti-Resonant Frequency

Fs: Resonant Frequency

GSM : Global System For Mobile Communication

I/O: Input/Output

IC: Integrated Circuit

KB: Kilobit

LED: Light Emitting Diode

PIN: Personal Identity Number

PUK: Personal Unblocking Key

ROM: Read Only Memory

RX: Receiver

SIM : Subscriber Identity Module

SMS: Short Message Service

TDMA: Time Division Multiple Acces

TX: Transmitter

USART: Unversal Synchronuoes And Asychronous Receiver And Transmitter

CHAPTER ONE

1.1 Introduction

Floods are among the most common disasters and natural hazards in the world, affecting human lives and causing severe economic damage. It is understood that flood risks will not decrease in the future. With the beginning of climate change, flood intensity and frequency will threaten many regions of the world. To minimize the extent of damages caused by flood, warning systems to inform the people of the disaster should be implemented in high risk areas.

This system will be able to reduce the damages of flood. The system should be designed to be able to detect the rising levels of water so appropriate warnings to the authorities and the public can be sent. In general, such a flood notification SMS and social network especially at the critical situation. The majority of people who lost their lives by flood did not receive any alert from the flood control center about the increasing water level caused by continuous rainfall and overflow of river. Here we are doing wireless water level detection and flood protection system by integrating water level indicating sensor and GSM modem with microcontroller via the MAX232 and RS-232 serial port. The specific SMS is sent from the GSM modem to the station through a regular GSM network.

The Microcontroller in the system interprets the received signal from the sensors and initiates the required action and acknowledgement signal is then generated, which is sent back to the GSM modem as a regular SMS. The Micro controller will continuously check the status of the sensors. If any of the sensor's condition breaks, then the Microcontroller detects that and sends respective SMS through GSM modem to the stations. The control system will include two separate units: the GSM modem, and the control unit. Therefore, there will be two operating environments. The control unit gets its input from the sensors and interprets it accordingly, so that the signal that goes out from it can be compatible with GSM modem technology [3].

The other aspects of our project is also to solve major problems that our country faces in the supply of water. What makes the situation even more frustrating is drought and landscape. So sustainability of available water resource in many reasons is now a dominant issue. Therefore, efficient use and water monitoring are potential constraint for home or office water management system. Measuring water level is an essential task, to control the water level in a container.

The water level is controlled by using programmable microcontroller approach, in order to automatically sense the level and control it. Main components are PIC microcontroller, sensor, display unit and motor. The sensor senses the presence of water and gives indication to the microcontroller. The microcontroller produces the control signals to drive the motor and display the condition on LCD. If there is no water, then microcontroller gives control signal to start the motor and if there is sufficient water in the field, then the microcontroller gives control signal to stop the motor. And also the microcontroller enables the display and the status of water level when the motor is ON/OFF; hence the level of water in a field can be automatically controlled.

1.2 Background Information

Of all the natural hazards capable of producing a disaster, floods are the most common phenomenon that causes human suffering, inconvenience and widespread damage to buildings, structures, crops and infrastructures. Floods have been observed to disrupt personal, economic & social activities and set back a national security & development by destroying roads, buildings and other assets. According to UNEP – Division of Early Warning & Assessment technical report (2002) [7], flood disasters account for about a third of all natural disasters throughout the world and are responsible for more than one half of the fatalities (Berz, 2000) [5]. Economically, floods are a leading course of losses from natural events. The money spent worldwide on flood control through building dykes, reservoirs, barrage, etc. has been found to be far greater than that spent on protection of other impacts from nature. More frightening assessment is that the trend of major flood disasters and the losses generated by them have increased drastically in recent years. In countries like Bangladesh, China and Cuba, floods are frequent enough to be considered as annual event (UNED Division of EW, 2002) [7]. According to (Glickman et al., 1992) between 1945 and 1986, the average annual numbers floods causing 25 or more deaths have more than tripped, a trend that is confirmed by the OFDA series from 1964 to 1996. The burden of flood is most heavily borne by the impoverished countries of Asia. While less than half of all flood disasters occurred in Asia (41%), over 80% of people killed, affected or made hopeless are located in this continent.

There is also a mounting evidence of flood disaster that has created huge impact in African livelihood and economy. The major recorded flood disaster that still lingers in our mind

is the Mozambique flood (2000) and the current flood in Ethiopia (2006) [5]. The occurrence of the current flood in Ethiopia can be characterized as national catastrophe. The flooding occurred in almost all parts of the country. In the North, localities in Tigray and in the northeast, Amhara region have been affected by emerging floods. In the south and East, the major flood damage was registered with loss of huge number of human and animal lives, loss of property. In the South, the Baro River was swelling to create a flood situation. From reports of various climate prediction centers, (unpublished IPCC report) [5], it has been indicated that there is a tendency of increased rainfall in the eastern part of Africa while rainfall may decrease in the western and southern Africa.

The evidence of recent flooding coupled with the prediction makes Ethiopia more vulnerable than ever. Therefore, flood hazard in Ethiopia may continue as a result of increasing population that intensifies the flood damage due to increasing land and forest degradation, encroachment of people to settle in close proximity to the flood prone areas. Ethiopia should look forward efficient, cost effective adaptation mechanism to cope with the future flood ravage. The purpose of this concept note is to underline the importance of establishing institutionalized Flood Management System in the country and indicate range of alternative flood mitigation options that may be implemented through institutionalized arrangements. Furthermore, it is intended to indicate the direction of immediate research and development areas with respect to technical, technological and Institutional issues essential to institutionalized flood management system. Ethiopia is perhaps one of few countries in the world who has been ravaged by the two extreme hydrological phenomena, i.e. Extreme flood and drought. The overall conceptual approach of Flood Management in Ethiopia may be framed around two concepts [7]:

- Minimizing the damage of Flood Water through Maximizing the Benefits of Flood for Food Security and Poverty Reduction.
- Efficient, Cost Effective and Sustainable Flood Management System that is institutionally manageable and technologically advanced and flexible.

The first framework will form part of a continuous study, research and development to convert the ill effects of floods through deriving the benefit from flood water. In most cases, this involves

building structural measures such as reservoirs, diversion structures and directing the flood water to dry areas for the purpose of beneficial use. The second concept focuses on institutionalized flood detection, prediction and issuing early warning to potential flooding area. The focus of this concept note lies on the second alternative of flood damage reduction which entirely depends more on software aspect than physical control structure.

1.3 Statement of Problem

Floods are major causes of loss of life and property in many countries. In developing country like Ethiopia, the lack of proper technology leads to more loss of life and property due to flood than the developed countries. This is due to lack of flood protection systems. This study may solve this problem by implementing an early flood detection and precautions mechanism in the time of flood at the selected study area. In this study, we will connect electrodes at different levels. And the electrodes will be interfaced with microcontroller through comparator. GSM modem containing a SIM card will be connected to microcontroller. At the other end mobile will be used. Mobile number of user will be stored in microcontroller program coding. Whenever water level reaches to electrode, SMS will be sent to flood monitoring station.

1.4 objectives

1.4.1 General objective

The objective of this project is to monitor the flood situation & send alert in case of danger in the form of text message to the flood monitoring station.

1.4.2 Specific objectives

- For agricultural land protections
- To protect soil erosion due to the consequence of flood
- To increase the stability of people who lives very close to river basin (low land).
- For agricultural specialist (experts) to collect data of agricultural land remotely in the study area
- To indicate and investigate frequently occurring flood risk to a specific place in the study area
- To have reliable evidence about flood affected areas.
- To protect people properties from flood risk.

- To introduce the wireless technology in the agricultural application

1.5 Methodology

The major phases and the activities performed are explicated in figure below:

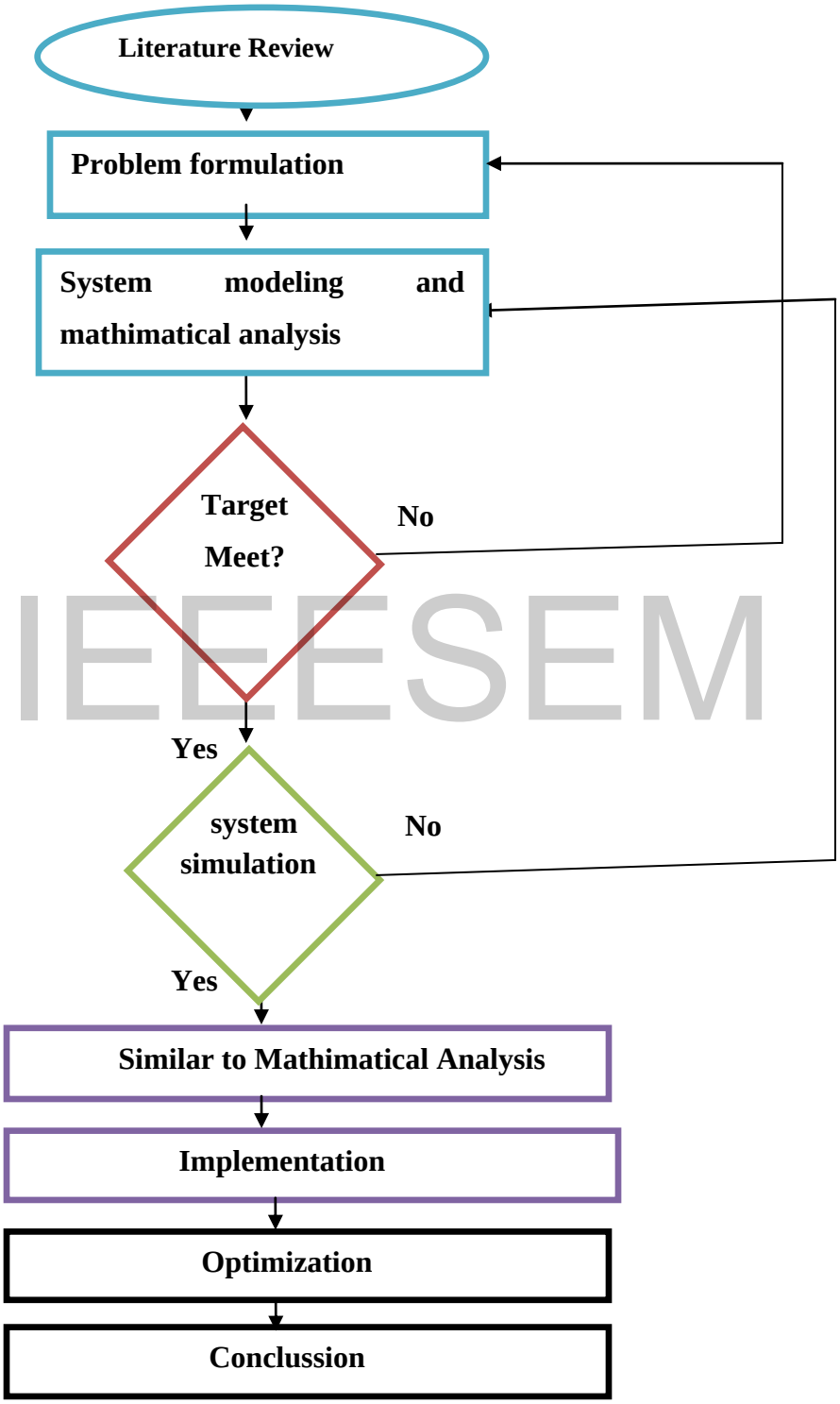

Fig1.1 Methodology flow chart

1.6 Scope of the paper

The proposed approach for designing this system is to implement a microcontroller-based control that sends its instructions and commands from a GSM modem over the GSM network coverage to the flood monitoring station. This study is limited to the design and the functions of the system, which primarily focuses on the following aspects:

- Mobility of monitoring water level
- SMS monitoring Provide on-time communications.
- Provide on-time communications
- Can be used at any time (flexibility), in anyplace (mobility), and by anyone (Easily Used).
- Sending SMS using GSM, Low power usage and developing High Endurance system.

1.7 Motivation

In the Wolaita Zone area like Kindo Didaye woreda in which its nature is highland, high water (flooding) is a serious problem, because when a heavy rain is rained the flood cleans the soil which contains an important nutrient for our green plants and it decreases green plantation. Not only that area but also whole Ethiopia the same things happened last three years. In addition to this there is a problem in power and energy production in a sense it destroys the great dams that can be used for electricity source and other industrial source. so that we motivated in doing this project to overcome such a problem in our country which retarded back from development.

1.8 Assumptions

- It is assumed that the GSM network service provider will provide continuous and good service throughout the time.
- It is assumed that SMS is delivered on time or no delay throughout the process.

1.9 Report Outline

This paper is the main documentation of the whole study. It contains technical data of wireless flood protection system using GSM technology in case of wolaita zone, Kindo Didaye. This document is composed of five different chapters. In the first chapter included an overview of the project and discuss the functions, hypothesis, problems, specifications, delimitations, and assumptions made on this study. The second chapter presents the literature review; discusses the history, background, infrastructures and services of GSM and others discussions in this chapter is PIC16F877A, AT Command, MAX232, transformer, LCD, water sensing module, USART and programming Code are included. The third chapter presents the system design and implementations; the design of the hardware and software is shown and the setting and programming is shown as well also included. The fourth chapter presents the tests and its results of the output design of the whole system. It also covers the discussion on the test and its results. The last chapter draws conclusion and recommendation of each part of the system and the combination of the system and lastly we included the reference used and appendices.

CHAPTER TWO

2. Literature Review

2.1 Basic concept

One of the most frequent natural disasters that hit our country is flood. In the most recent flood incident that hit this country, millions worth of properties and hundreds of lives are sacrificed. This scenario is a norm when flood happens because the people are not aware of the incoming disaster. Plenty of options are available for flood management and mitigation measures. These measures can be classified broadly into structural and non-structural measures. Many considerations have to be sought to select suitable flood mitigation measures. Some of the factors such as the type and characteristics of the flood (magnitude, return period, peak, damage, etc.), cost implications and opportunity to maximize the benefit from the flood water must be considered in selecting feasible solution. The structural measures (engineering or technical solution) are designed and constructed to modify the characteristics of floods before arriving to the flood damage area through various physical constructions such as reservoirs, diversions, levees, dykes, or channel modifications and river retaining works. Structural measures such as diversion or flood storage dam may be suitable to prevent the ravages of flash floods but the enormity of the financial, economic and ethical requirement undermines the importance of the flood prevention measures. Alternatively, instead of damming the flash flood Rivers, it may be possible to identify most flood generating sub-watersheds and implement series of check dams and detention dams reduce cost [5].

These methods are usually capital intensive and in some instances drain the national economy. Nonstructural measures are designed to modify the damage potential of the flood without interfering to the characteristics of the flood (magnitude, peak, duration, etc.). Such methods focus on software and hardware technological aspects, such as flood proofing, flood warning system, land use control, etc. For instance through flood forecasting and early flood warning mechanism, the potential of flood damage to properties and human lives can be reduced. Early warning system can be implemented to evacuation the population and property at risk before the flood wave reaches to the flood prone area [5]. However, flood warning systems requires efficient communication network to relay information and message from

observation stations to forecasting center and from forecasting to response agencies (like DPPA) and to potential flood affected area. For Instance, the flood of Omo River, Baro and other big rivers are affected by slowly rising floods and gives comparatively more chance of saving property and life than the rapid flash floods as the one occurred in Dire Dawa [5].

As far as flood damage is concerned, a simplified flood warning and communication system suffices the purpose. Therefore through national flood mapping and zoning, one or combination of methods can be implemented to reduce the damages of flood in the country, however, before implementing measures, detail study and analysis on alternative options is a paramount importance. However, the focus of this concept note is to introduce alternative measure application flood forecasting and early warning system technology as an alternative flood managements system in Ethiopia.

Generally; utilizing the flood water requires some sort of controlling or diverting its course to area benefit is required (structural measures). This essentially requires construction of structures along all flood prone areas to effectively utilizes the water as well as reduce the flooding. This may be the best solution that may occur immediately to anyone as there is already discussion towards construction of dams and diversion structures to reduce food insecurity in the country but it may be less feasible solution to the country as it has huge cost implication. The best solution is to establish National Flood Management Centre that recommends feasible combination of measures applicable to different flooding areas in the country [5].

Some kind of safety measure must be taken to warn the people once the water starts to accumulate outside the house. A water sensor can be used to notify the people about the danger that’s coming. The water sensor detector is a self-contained electronic device that senses when its sensor is in contact with water. There are two types of water sensor detectors passive and active. The passive detector uses a 5-volt battery. The moisture sensor is placed on the floor and activates the sensor when it becomes wet. Damp locations or high temperatures may reduce the life of the battery, so the detector should be checked regularly to see if it is working properly. These detectors can be purchased at most home improvement stores. Therefore, it would be a waste to communicate without knowing the stories behind the development of communication. One of the vast contributions technologies in communications is none other than GSM technology. In this chapter, literature review will be focused on GSM technology, essential components, and its

services. PIC16f877A, RS-232, USART, Mikro C programming, and AT Command will be discussed here too.

2.2 GSM Modem

GSM also known as Global System for Mobile Communications [3] is a set of standards specifying the infrastructure for a digital cellular service and initially developed and introduced in European countries during the late 80‟s and early 90‟s. Since GSM is the first known digital mobile telephony system, it has speedily gained recognition throughout the world, sharing portion of the market cake. It is a hardware component that allows the capability to send and receive SMS to and from the system. The communication with the system takes place via RS232 serial port. Cell phone can be attached at the place of GSM hardware but it limits the hardware functionality such as sending or receiving of SMS. The GSM modem provides the communication mechanism between the user and the microcontroller system by means of SMS messages. GSM modem is a plug and play device and is attached to the PC which then communicates with the PC via RS232 port. GSM modem is a bridge responsible for enabling or disabling of SMS capability. GSM MODEM is a class of wireless MODEM devices that are designed for communication of a computer with the GSM network. It requires a SIM card just like mobile phones to activate communication with the network [3].

2.2.1 SIM

A subscriber identity module is a removable smart card for mobile phones [6]. SIM cards store the required information to identify the mobile device. It also contains data required for voice encryption to make listening in on calls almost impossible (except when the wireless carrier itself is doing the eavesdropping). In this way the customer ID (and personal number) is tied to the SIM card and not to a certain mobile phone. This allows for a seamless interchange of the same SIM card between different GSM mobile phones. SIM cards also serve as storage for SMS messages and the user's contacts. Current SIM cards can store up to 250 name/number pairs and up to 50 SMS text messages.

The SIM card cannot store multiple numbers per contact or other more complex information. This means that if you copy your contacts info from the phone memory to the SIM

memory, contacts get broken up into as many entries as there are numbers for each individual contact and discards the other information. All GSM phones and most iDEN phones require a SIM card to operate.

There are certain types of phones (CDMA, TDMA, AMPS) that do not use a SIM. Instead, the required data is programmed directly into the phone. There are two numeric passwords associated with a SIM card. One is the Personal Identification Number (PIN) that the user must input each time they start the device (this can be turned off via the phone settings). When entering the PIN number the user has only three input attempts. If all three are incorrect, the card gets locked and a PUK (Personal Unblocking Key) must be entered in order for the card to work again. Only ten attempts to enter the PUK are permitted before the card is permanently locked and made unusable [6].

A GSM MODEM can perform the following operations:

- Receive, send or delete SMS messages in a SIM.
- Read, add, search phonebook entries of the SIM.
- Make, Receive, or reject a voice call.

The MODEM [3] needs AT commands, for interacting with processor or controller, which are communicating through serial communication. The controller sends these commands. The MODEM sends back a result after it receives a command. Different AT commands supported by the MODEM can be sent by the controller computer to interact with the GSM cellular network.

AT commands are used to control MODEMs functionality.

Fig 2.1: GSM Module (SIM 900**)**

2.3 MAX232

The MAX232 is an integrated circuit that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual driver or receiver and typically converts the RX, TX, CTS and RTS signals. The drivers provide RS-232 voltage level outputs (approx. ± 8.5 V) from a single +5 V supply via on-chip charge pumps and external capacitors. This makes it useful for implementing RS-232 in devices that otherwise do not need any voltages outside the 0V to + 5 V range, as power supply design does not need to be made more complicated just for driving the RS-232 in this case. The receivers reduce RS-232 inputs (which may be as high as ± 25 V), to standard 5 V TTL levels. These receivers have a typical threshold of 1.3 V, and a typical hysteresis of 0.5 V. The MAX232 from Maxim was the first IC which in one package contains the necessary drivers and receivers to adapt the RS-232 signal voltage levels to TTL logic. It became popular, because it just needs one voltage (+5V or +3.3V) and generates the necessary RS-232 voltage levels.

Fig 2.2: MAX232 Serial Cable

2.4 RS-232

Information being transferred between data processing equipment and peripherals is in the form of digital data, which is transmitted, in either a serial or a parallel mode. Parallel communications are used mainly for connections between test instruments or computers and printers, while serial is often used between computers and other peripherals. Serial transmission involves the sending of data one bit at a time, over a single communications line. In contrast, parallel communications require at least as many lines as there are bits in a word being transmitted (for an 8-bit word, minimum of eight lines are needed). Serial transmission is beneficial for long distance communications, whereas parallel is designed for short distances

or when very high transmission rates are required. Standards one of the advantages of a serial system is that it lends itself to transmission over telephone lines. The serial digital data can be converted by modem, placed onto a standard voice-grade telephone line, and converted back to serial digital data at the receiving end of the line by another modem. Officially, RS-232 is defined as the "Interface between data terminal equipment and data communications equipment using serial binary data exchange."

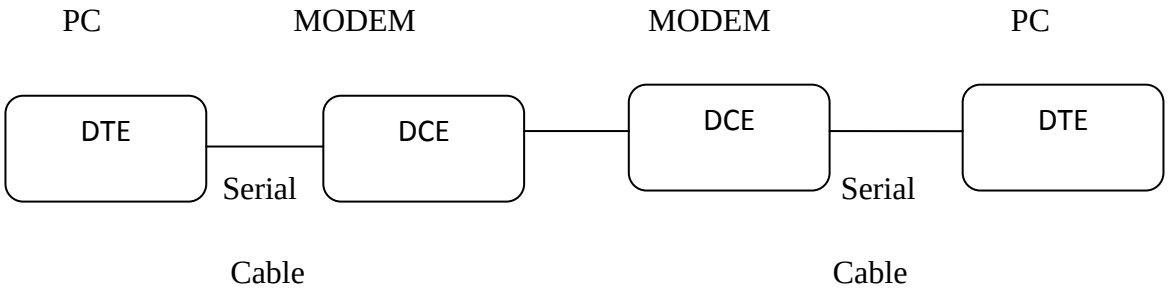

Fig 2.3: RS232 Protocol

This definition defines data terminal equipment (DTE) as the computer, while data communications equipment (DCE) is the modem. A modem cable has pin-to-pin connections, and is designed to connect a DTE device to a DCE.

Fig 2. 4: RS-232 Serial Cable

2.5 Microcontroller

Microcontroller is a general-purpose device, which integrates a number of the components of a microprocessor system on to single chip. It has inbuilt CPU, memory and peripherals to make it as a mini computer. Microcontroller is the heart of this project, which handle all the inputs and out puts of the system by performing internal calculation on the inputs. The calculation

Performed are according to the program loaded into the microcontroller's ROM. We choose Microcontroller because it is an IC chip that is programmed to perform almost any control, monitoring, displaying function and its relatively low cost made it the choice of all designers. Its great advantage is no other external components are needed for its application because all necessary peripherals are already built into it. Thus, we can save the time and cost which is needed to construct low cost devices. Microcontrollers are frequently used in automatically controlled products and devices, by reducing the size cost and power consumption compared to a design using a separate microprocessor, memory and input/output devices. This device has 40 pins which make it easier to use the peripherals as the functions are spread out over the pins and to decide what external devices to attach without worrying too much if there enough pins to do the job. One of the main advantages is that each pin is only shared between two or three functions so it's easier to decide what the pin function (other devices have up to 5 functions for a pin). Note: A disadvantage of the device is that it has no internal oscillator so you will need an external crystal of other clock source. Which is used to control the light bulb, fan, and gear motor with the help of relays by the input data of the temperature sensor.

Microcontrollers have limited memory, indeed a few kilobytes; therefore it is hard to implement every standard of programming as these standards require memory. To some extent these standards are then applicable in microcontrollers with more memory, but in this smaller controller like PIC16F877A with just 8k memory it is not expected that an object oriented model be implemented. So programming microcontroller is a two way challenge on one hand you have to achieve the result you want with limited computing capabilities. On the other hand you have to manage the availability resources, limited program memory, and limited variables storage [1, 2].

Features of PIC16F877A:

□High Performance RISC CPU:

- Operating speed:20Mhz, 200ns instruction cycle
- Operating voltage:4.0-5.5volts
- Industrial temperature range(-40 to +85 degrees)
- 15 Interrupt sources
- 35 single word instructions
- All single-cycle instructions except for program branches

□Special Microcontroller features:

- Flash memory:14.3KB(8192 words)
- Data SRAM:368 bytes
- Data EEPROM:256 bytes
- Self-reprogrammable under software control
- In-circuit serial programming via two pins
- Watchdog timer with on-chip RC oscillator
- Programmable code protection
- Power-saving code protection
- Selectable oscillator options
- In-circuit debug via two pins

□Peripheral features:

- 33 I/O pins : 5 I/O ports
- Timer0:8-bit timer/counter with 8-bit prescaler
- Timer1:16-bit timer/counter with prescaler
- Timer2:8-bit timer/counter with 8-bit period register, prescaler and postscaler
- Two capture, compare, PWM modules

- Synchronous serial port with two modes
- USART/SCI with 9-bit address detection
- Parallel slave port
- Brown-out detection circuitry for brown-out reset

Analog Features:

- 10-bit, 8-channel A/D converter
- Brown-out reset
- Analog comparable module

The programming software we had used to write the source code is MikroC PRO for PIC.

Fig 2.6 : PIC16F877A Microcontroller

2.6 LCD

The on-chip flash allows the program memory to be reprogrammed in system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with flash on a monolithic chip, the 16F877A is a powerful microcomputer, which provides a highly flexible and cost effective solution to many embedded control applications. These components are "specialized" for being used with the microcontrollers, which means that they cannot be activated by standard IC circuits. They are used for writing different messages on a miniature LCD.A model described here is for its low price and great possibilities most frequently used in practice. It is based on the HD44780 microcontroller and can display messages in two lines with 16 characters each. It displays all the alphabets, Greek letters, punctuation marks, mathematical symbols etc. In addition, it is possible to display symbols that user makes up on its own. Automatic shifting message on display (shift left and right), appearance of the pointer,

backlight etc. are considered as useful characteristics. LCD screen consists of two lines with 16 characters each. Contrast on display depends on the power supply voltage and whether messages are displayed in one or two lines. For that reason, variable voltage 0-Vdd is applied on pin marked as VEE. Trimmer potentiometer is usually used for that purpose. Some versions of displays have built in backlight. When used during operating, a resistor for current limitation should be used (like with any LE diode) [2, 6].

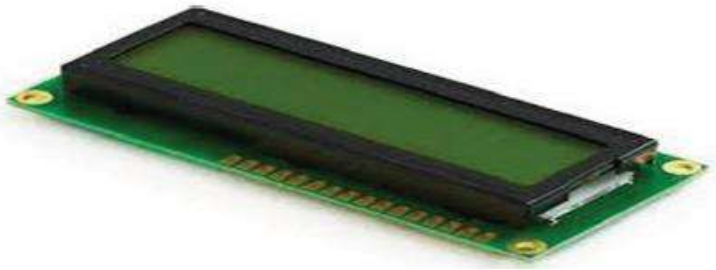

Fig 2.7: 16x2 LCD Display

2.7 Crystal Oscillator

A crystal oscillator is an electronic circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency. This frequency is commonly used to keep track of time (as in quartz wristwatches), to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers.• The most common type of piezoelectric resonator used is the quartz crystal, so oscillator circuits designed around them were called "crystal oscillators". The usual model of a crystal is a network of two capacitors, an inductor and a resistor. The shunt capacitance (C0) is introduced by the metal plates used for electrical connections to the quartz wafer. Crystals are capable of oscillating at multiple frequencies. These frequencies are commonly referred to as overtones. For each overtone, a series RLC combination is added to the model. At the rated frequency of operation, the impedance of a crystal is inductive. The reactance of the crystal is capacitive up to a series resonant frequency (Fs) and beyond the anti-

resonant frequency (Fa), the reactance is also capacitive. This means that the frequency of oscillation is bounded by Fs and Fa. The exact steady state frequency is determined by amplifier gain and load capacitance. Load capacitors are used to form a tuned LC tank circuit in resonance. The combined capacitive impedance and other stray capacitance equals the inductive reactance of the crystal.

Frequency of operation can be estimated by:

In many cases, the voltage at EXTAL and XTAL actually swings outside the ground and supply rails. Changing capacitance values will slightly change the operating frequency and can significantly change the voltage at EXTAL and XTAL. It is important to size these elements correctly and to use quality capacitors with long life, very low ESR, and good stability over temperature [4].

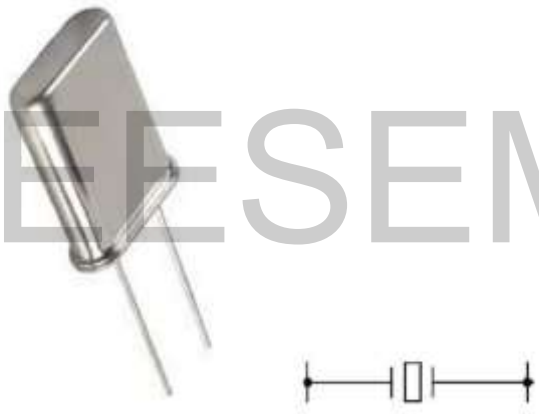

Fig 2.8: Crystal Oscillators with its Circuit Diagram

2.8 USART

USART [6] means Universal Synchronous and Asynchronous Receiver and Transmitter. USART is a module used to interface with serial communication using MAX232 equivalent chip. Most microcontrollers today, like PIC and AVR, have USART, but the Synchronous function is not often used as they have other synchronous devices like I2C and SPI.

Asynchronous data transmission means without a separate clock signal, so both ends of the link must know what the data transfer rate should be, otherwise garbled transmission will occur. This is known as the *baud rate*, which is usually up to 115,200 bits per second when

microcontrollers are used, although they can be much slower, such as 4,800, 9,600 or 19,200. Note that each step is double the last speed and the seemingly odd values are due to historic reasons. You don't actually have to use them but these are the standard values that all serial devices can be set to. If you were creating your own units at both ends of the link, you could use any baud rate you like, but would have to calculate how to setup the value in your microcontroller. The faster the baud rate, the more likely errors are to occur at the receiver so this is a trade-off between speed and reliability. When using the USART on a microcontroller the error rate is also affected by the crystal frequency of the system as this affects how accurately the USART can generate the correct baud rate.

2.9 Light-Emitting Diode

LED Converts current to light. If the semiconductor is a direct band gap material, such as GaAs (Wide energy gap), the electron and hole can recombine, and a photon or light wave can be emitted. In an LED, the diode current is directly proportional to the recombination rate, which means that the output light intensity is also proportional to the diode current. LED do not have a filament(incandescent lamps) that will burn out, so they last much longer and easily fit into modern electronic circuits. In conventional incandescent bulbs, the light production process involves generating a lot of heat which wastes energy where LED's generate very little heat light emitting diodes have a higher luminous efficiency [6].

2.10 Switch

A *switch* is an electrical device used to control continuity between two points.

- ✓ *Hand* switches are actuated by human touch.
- ✓ *Limit* switches are actuated by machine motion.
- ✓ *Process* switches are actuated by changes in some physical process (temperature, level, flow, etc.).

2.11 Motor and Relay Unit

A motor is a device which converts an electrical energy in to the mechanical energy based on the principle of electromagnetism. A current carrying conductor generates a magnetic field, when the conductor is placed in an external magnetic field, it will experiences a force proportional to

the current in the conductor. Motor is controlled by the microcontroller, the microcontroller switching the power supply to motor by relay mechanism. The motor employed is DC motor which has high starting torque and constant speed. Relay are simple switches which are operated both electrically and mechanically. The switching mechanism is carried out with help of electromagnet. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The main operation of relay comes in places where only a low power signal can be used to control a circuit. The high end application of relays requires high power to be driven by electric motors. Such relays are called contactors. Diode is a two terminal electronic component with asymmetric transfer characteristics, with low (ideal zero) resistance to current flow in one direction, and high (ideal infinite) resistance in the other. The most common function of a diode is to allow an electric current to pass in one direction (forward direction), while blocking current I the opposite direction (reverse direction). It prevents the reverse current flowing from the relay to the motor [4].

CHAPTER THREE

3. System Design and Programming

3.1Block diagram representation and Descriptions

Flood can happen in any time, and when flood hazard happens and the level of water increasing rapidly, the sensor will sense the levels of water and the data are send to the flood controller system (monitoring station). In the prototype model of the system, it contains four sensors (water level detector). In this system, we are using GSM for sending the information to the flood monitoring station, which has ability to spread the information to whole people who live in the area of flood and the output of the system displayed by LCD. The system also gets regulated and rectified input DC power from transformer. Additionally, all the information, which has been received at flood control center, will upload to the website to send notification through popular social network like the face book and twitters. We have used the following components in the block diagram as shown below:

- Transformer
- Rectifier
- Regulator
- GSM module
- IC(integrated circuit)
- Microcontroller
- LCD display
- Water sensing unit

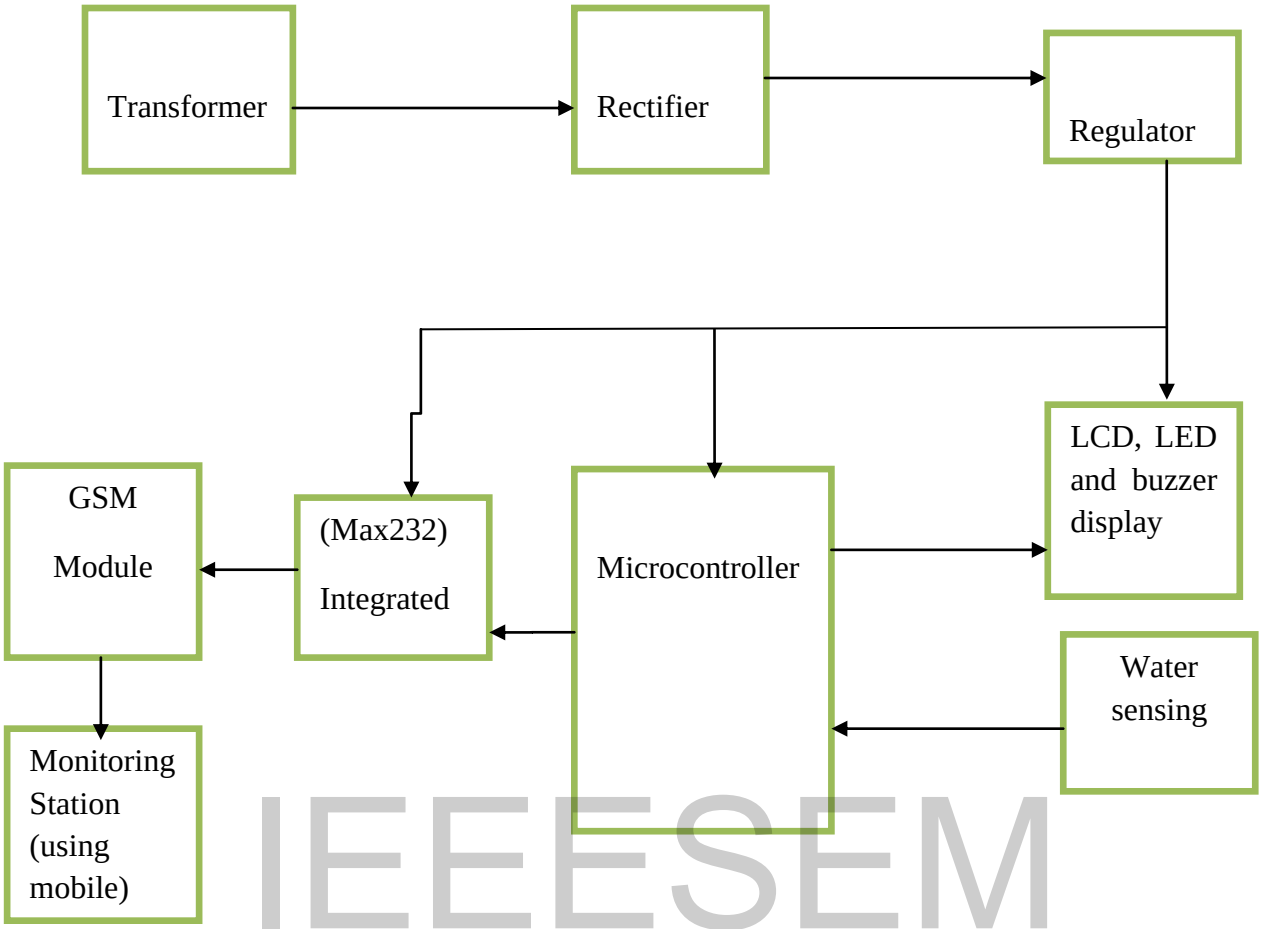

Fig 3.1: Block diagram representation for wireless flood detection.

3.2 Power Supply Design

The input to the circuit is applied from the regulated power supply. We need a constant low voltage regulated power supply of +5V, providing input voltages to the microcontroller, MAX232, sensors and LCD display which requires 5 volts supply and this power supply unit contains the following parts.

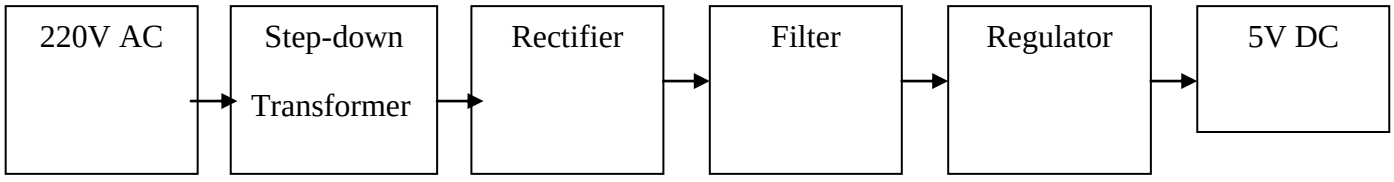

Fig 3.2: Block Diagram of Power Supply Design

Transformer

Transformer is electromagnetic device that transforms electrical energy from one circuit to another through inductively coupled conductors. A varying current in the primary side creates varying magnetic flux in the transformer's core and thus a varying magnetic field through the secondary winding. Step down transformer is used while designing the power supply to our system, since the microelectronic circuit needs only 5 V. A step down transformer accepts a given voltage on the primary side and gives lower voltage output on its secondary side. It uses 220V at 2A from the feeder line and steps down to safer 9 V at 500mA; using the transformer equations we have the following calculation;

$$\frac{V1}{V2}=\frac{N1}{N2}=\frac{I2}{I1}\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3.1)$$

Form the above equation and the give values for input output we can calculate number of turns, $I_1 = 2A, I_2 = 500mA, V_1=220V, V_2=9V$

$$\frac{V1}{V2}=\frac{220}{9}=24.4$$

So from these we get the turn ratio is 24:1 assume that number of turn in secondary be 50

$$\frac{220}{9}=\frac{N1}{50}= 1222$$

Rectifier

The input from step down transformer is 9 volts AC is converted to DC voltage using a 4 diodes bridge rectifier circuit. 1N4007 rectifier diodes have been used. These diodes have a voltage drop of 0.9 volts across them and maximum rating of 5 / 1. It also gives better rectified output compared to other rectifier diodes. First we need to convert the RMS power supply voltage to its peak voltage value (amplitude) as follows:

$V_{peak} =V_{rms}=X9 =12.73V$

So the average DC voltage level at the output of rectifier is calculated as

$$Vdc = 0.9 \times 12.73 = 11.457V$$

And Ripple factor: $r=\frac{Vrms}{Vdc}=0.788$

Therefore, we get 11.457 V and 600mA at the output

Capacitor

Capacitors are used as a filtering component. They filter out the AC ripple present in the output of full wave rectifier. The value of capacitor is calculated as follows for full wave rectifier.

$$C = \frac{1}{\sqrt[4]{3}} \text{ xfx r} = 0.003F$$

We use standard electrolytic capacitors of rating 100μF/25V and 1000 μF/16V for this purpose. We require 1 μF for 1 mA. Therefore, for 500mA we will require 500 μF. Hence we use 1000 μF (standard) filter capacitor and 100 μF (standard) ripple capacitor.

Regulator

Since we require a constant 5 V DC supply voltage for the entire circuitry, we have to regulate the output from the bridge rectifier circuit. So we use LM2937 500mA Low dropout regulator. The LM2937 is a positive voltage regulator capable of supplying up to 500 mA of load current. The use of a PNP power transistor provides a low dropout voltage characteristic. With a load current of 500 mA the minimum input to output voltage differential required for the output to remain in regulation is typically 0.5V (1V guaranteed maximum over the full operating temperature range). Special circuitry has been incorporated to minimize the quiescent current to typically only 10 mA with a full 500 mA load current when the input to output voltage differential is greater than 3V. The LM2937 requires an output bypass capacitor for stability. As with most low dropout regulators, the ESR of this capacitor remains a critical design parameter, but the LM2937 includes special compensation circuitry that relaxes ESR requirements. The LM2937 is stable for all ESR below 3Ω.

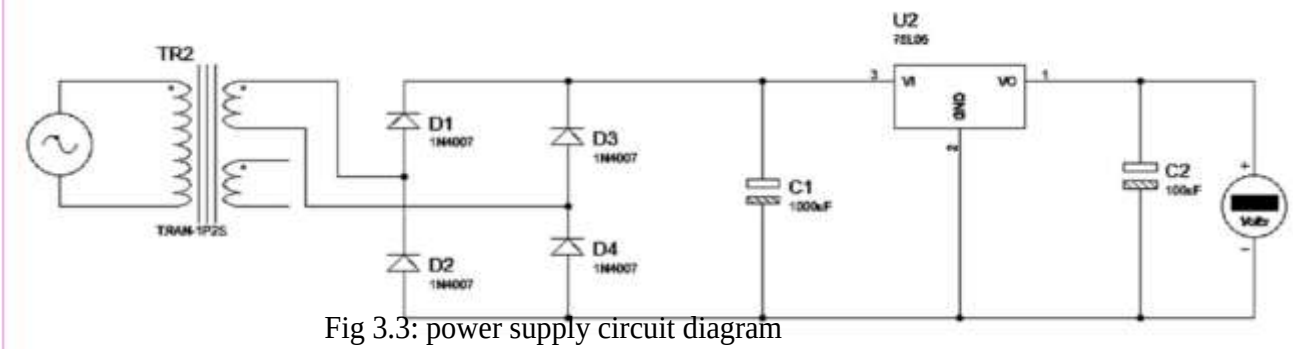

Fig 3.3: power supply circuit diagram

2.3 Water Sensor Module

Water Level Sensors module can be made of capacitors circuits or using the pressure to measure the water levels since the deeper the water, the higher the pressure, it is invented based on the simple fact of water's electrical conductivity. Most types of water contain aquatic ions that expedite electron transfer. In here, water probe is open circuit when water level is below the sensor, but it becomes a closed circuit and signals the transmitter system once water level reaches the probe.

Nevertheless, heavy rainfall tends to dilute ion concentration in fresh water. This reduces or even eliminates electrical conductivity in water (i.e., distilled water does not conduct electricity). To combat ion loss in water during heavy rains, a modified water level sensor includes a small container.

Table 3.1: water level sensor status

D0	D1	D2	D3	Status
0	0	0	0	Water level is below D0, indicates **Very Low** level
1	0	0	0	Water level is below D1 and above D0, indicates **Low** level
1	1	0	0	Water level is below D2 and above D1, indicates **Medium** level.
1	1	1	0	Water level is below D3 and above D2, indicates **High** level
1	1	1	1	All data pins are active, indicates tank is **Full**

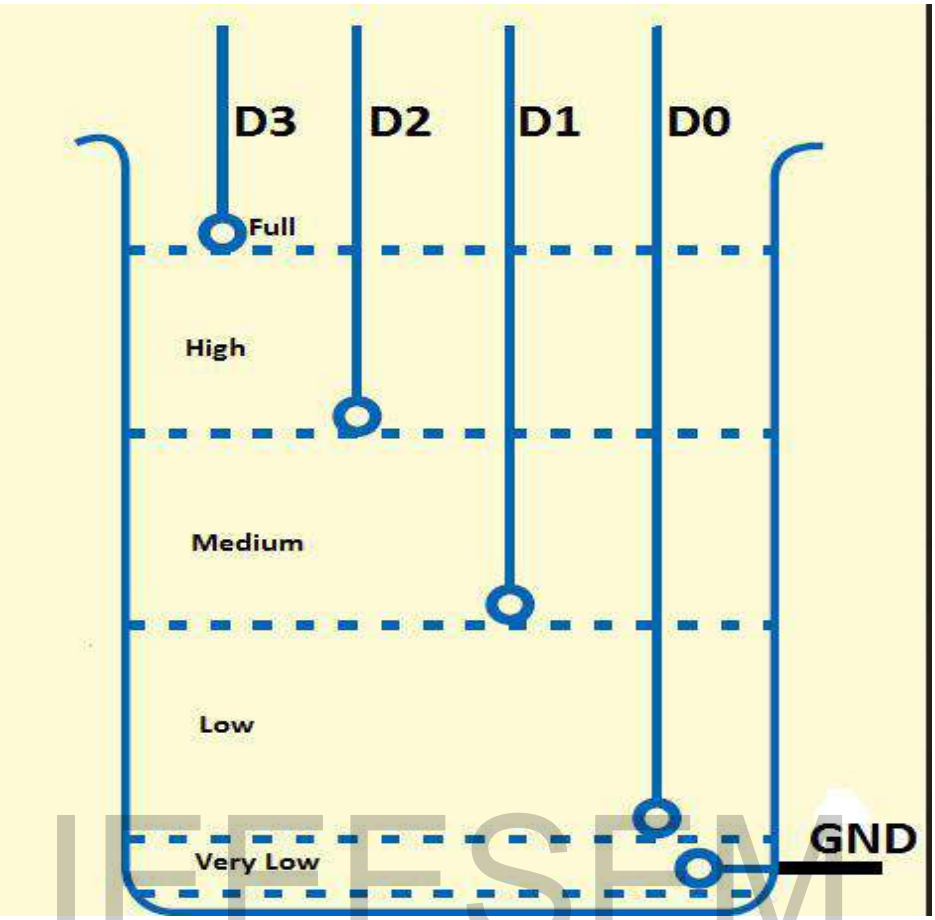

Fig 2.4: water sensing probe

3.4 Program Developing

Microcontrollers [1, 2] have limited memory, indeed a few kilobytes; therefore it is hard to implement every standard of programming as these standards require memory. To some extent these standards are then applicable in microcontrollers with more memory, but in this smaller controller like PIC16F877A with just 8k memory it is not expected that an object oriented model be implemented. So programming microcontroller is a two way challenge on one hand you have to achieve the result you want with limited computing capabilities. On the other hand you have to manage the availability resources, limited program memory, and limited variables storage. The programming software we had used to write the source code is mikro C PRO for PIC. Terminal Equipment on the other side receiving SMS from the Modem, needed to be displayed on the virtual terminal. In this case, mikro C code for PIC has been used to design the virtual terminal to read the SMS periodically.

3.5 Flow chart and Program Description

When the water reaches a certain level at the place, the current will be conducted and thus amplified, triggering the corresponding pin of the PIC port. The voltage level at the pin goes high, which is 5 volt. PIC recognizes the voltage and will show the water level on LCD display. If water level increased due to some conditions raining, pipes full or water flows then the water level increased, for this reason water level sensing starts its cyclic process as it starts water level sensor 0 triggered then it go to water level1 else it shows water level 0 on LCD display and it starts again the process. Now it checks water level1 triggered or not if triggered it go to next level 2 otherwise it displayed water level 1 on LCD display and checks again the water level if it triggered water level 2 raised to ultimate water level sensor 3 where flood is detected and it displayed that “FLOOD IS DETECTED” on the LCD display and sends SMS to the respected official to be carful the hazard or disaster that will occurred latter.

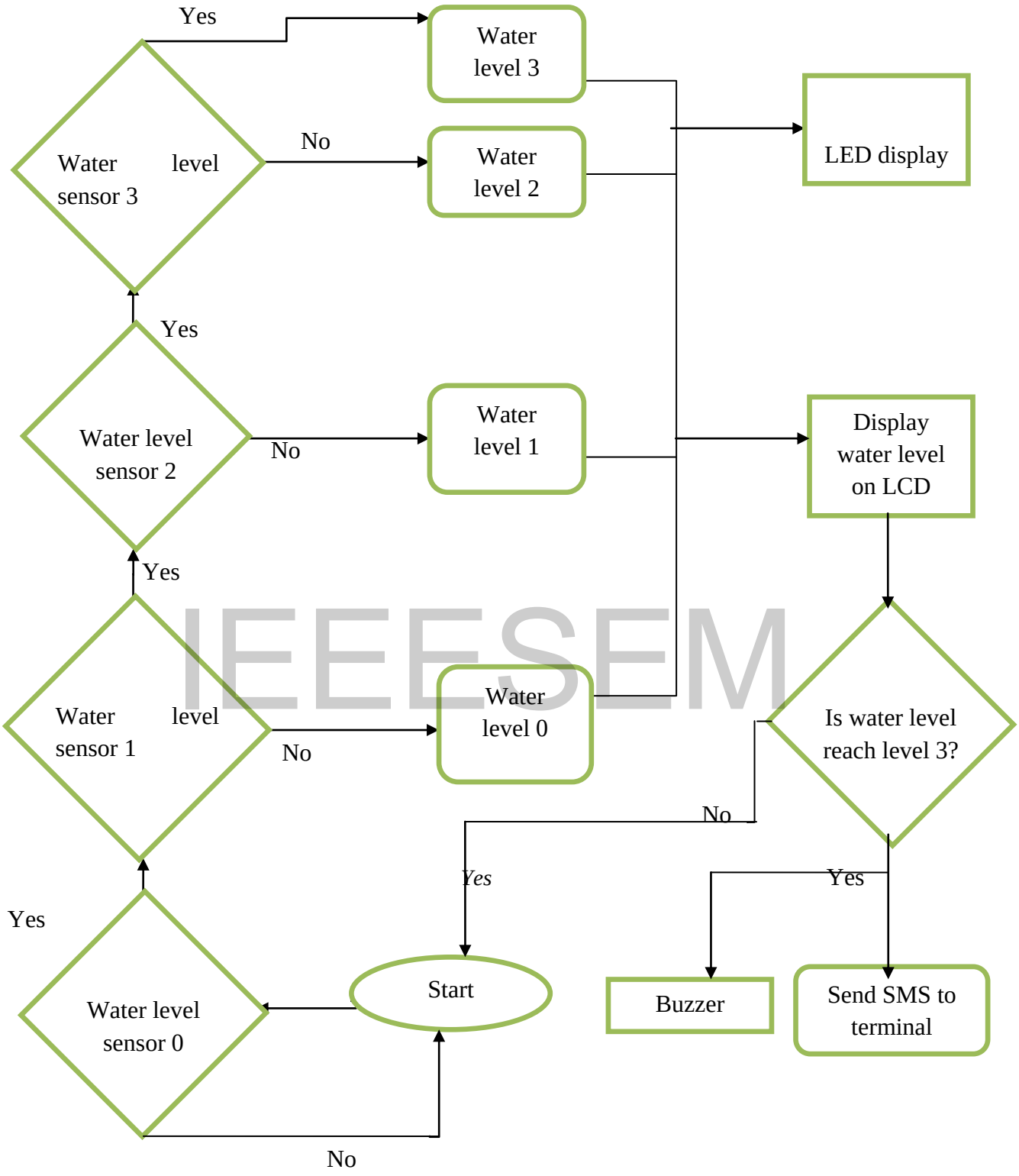

Fig 3.4: flow chart for water level sensing system

3.6 Working Principle of the Circuit

The system we have designed works as a real time system which keeps on scanning the current condition with one which is present in the microcontroller to check if there is any undesirable condition in the water sensing unit (probe). If there is any undesirable condition the current starts flowing and the microcontroller gets input from the water sensing unit which identifies and checks the level of water. We used four water sensor probes which are represented by switch one, two, three & four. When the water level raised each probe starts conduction sequentially as long as the supplied voltage is there. For each switch is closed there is a corresponding output which are displayed on the LCD for indicating water level low, medium, high & flooding from the right start of switch respectively and light emitting diode; green, blue, yellow and red for each switch respectively through precise programming of PIC. When the water level reaches water level three (switch four closed) the system recognized the flood risk, send SMS automatically to the flood monitoring station wirelessly through GSM module using virtual serial port simulator, HyperTerminal, max 232 and compim and a spark sound in the near environment.

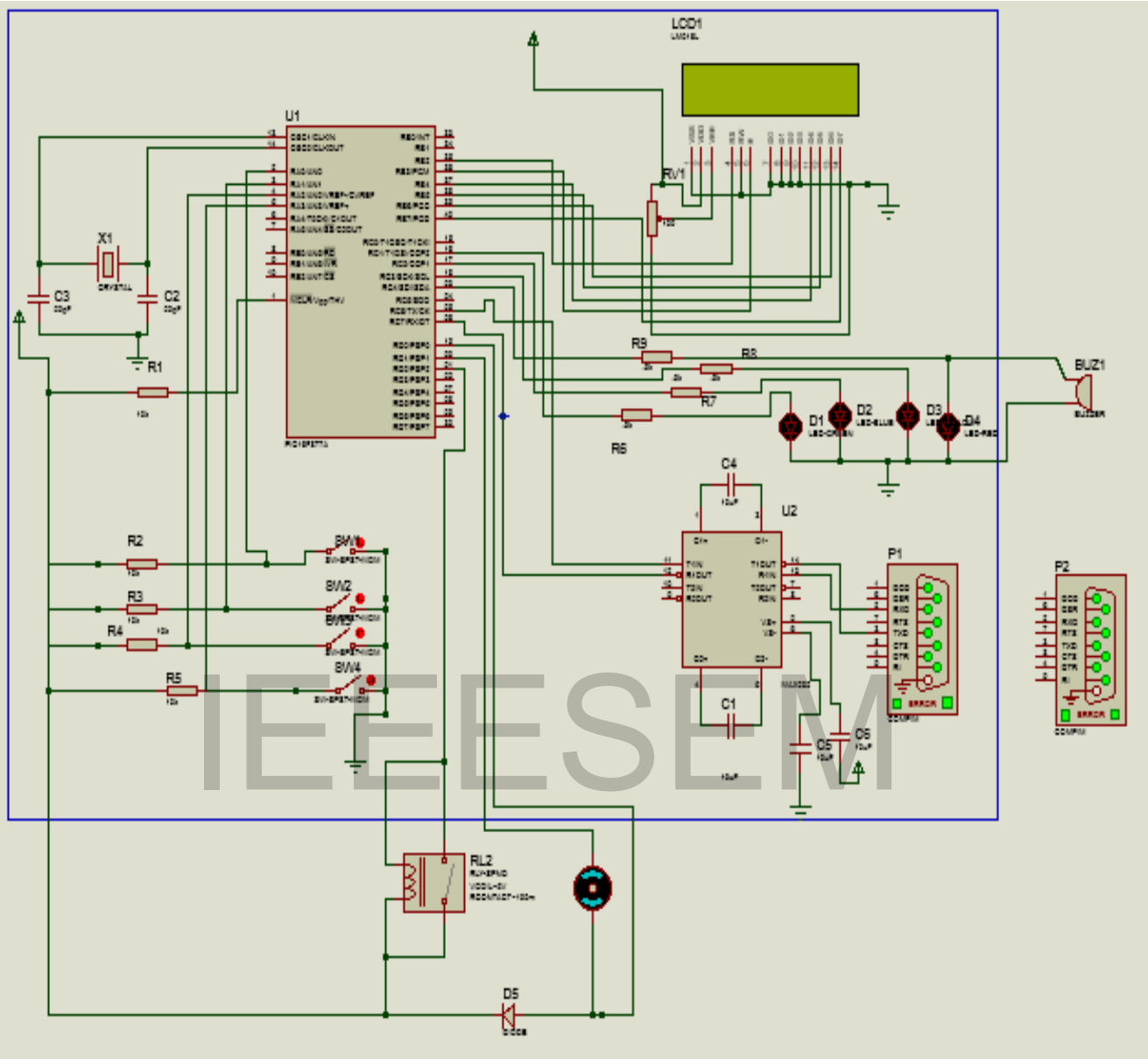

Fig: 3.5 Circuit diagram representation

CHAPTER FOUR

4. Simulation Result and Discussion

4.1 Overall Circuit Diagram of Sensing System

The sensing system senses the condition of water level rise and responds accordingly and the circuit is shown in figure 4.1. If the water level rise detected by water level sensor then the system is activated and gives alarm, display result on LCD, show motor status, ignite LED, and sends the feedback to the flood monitoring station.

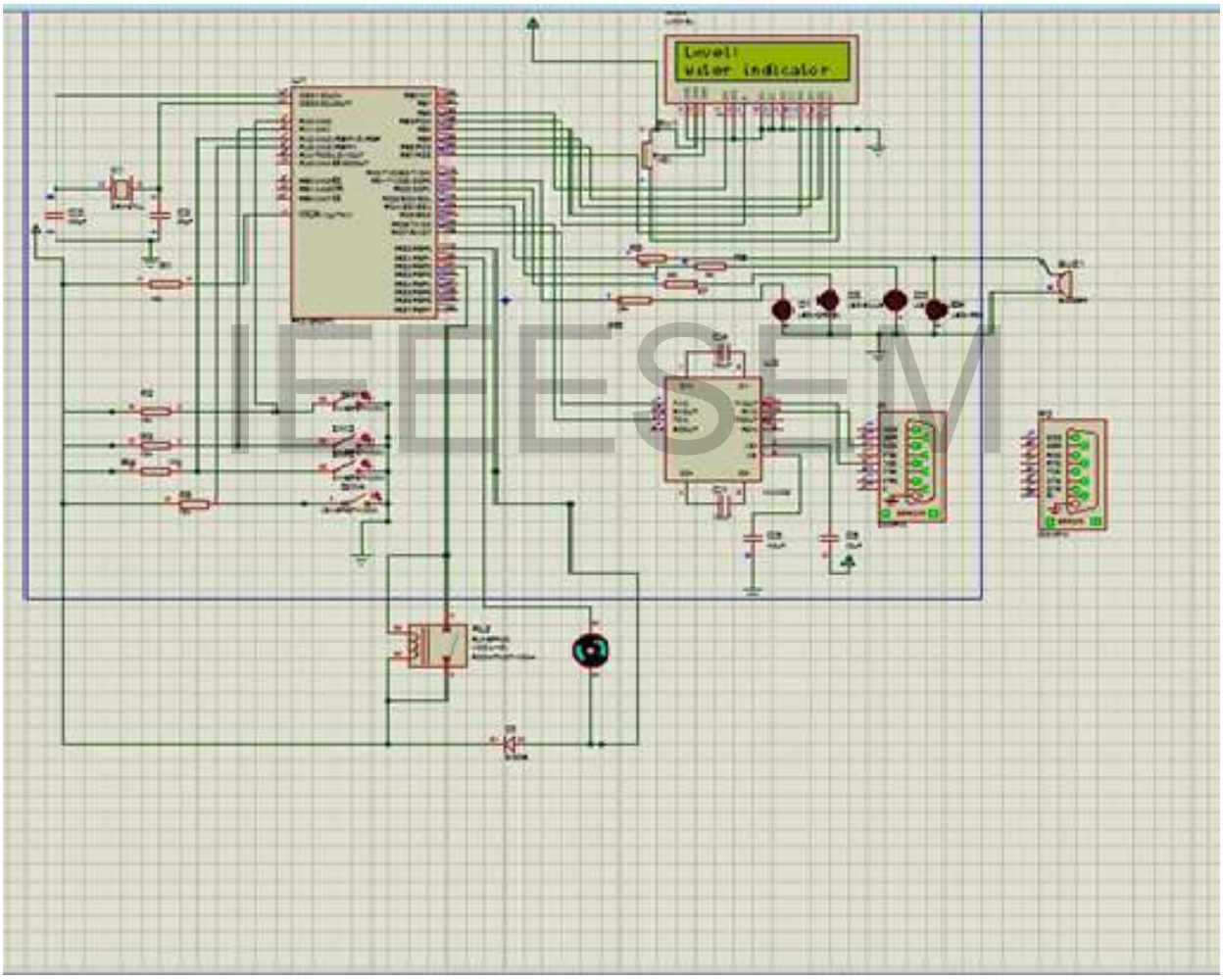

Fig 4.1: Total sensing system

When switch one is “ON” as shown in fig 4.2, the water level 0 will be displayed low level of water on LCD and as the same time LED shows green light.

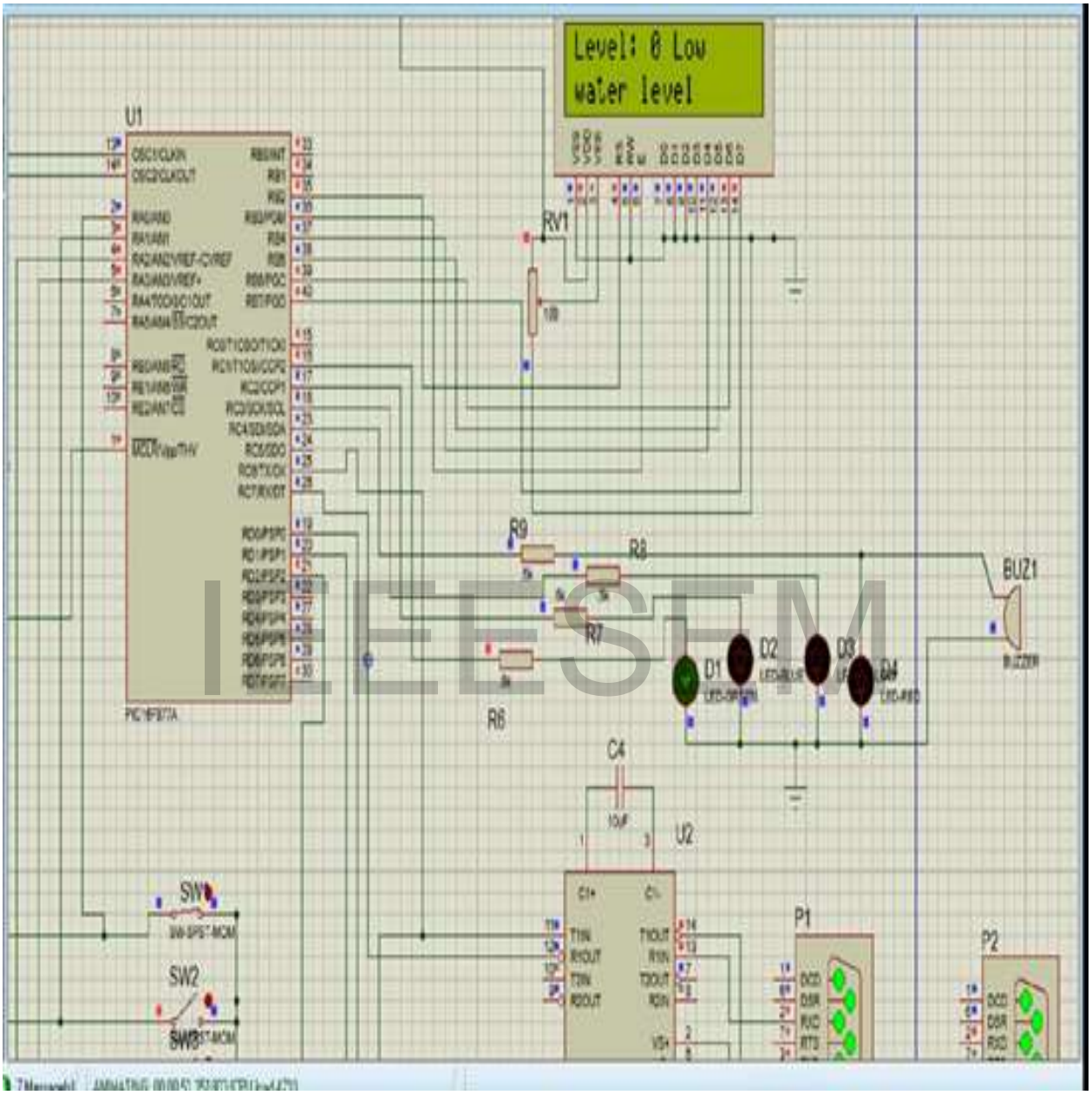

Fig 4.2: Simulated level 0 low water indicator

When switch two is “ON” as shown in the figure below, the water level 1 will be displayed “medium” level of water on LCD and at the same time LED shows a blue light.

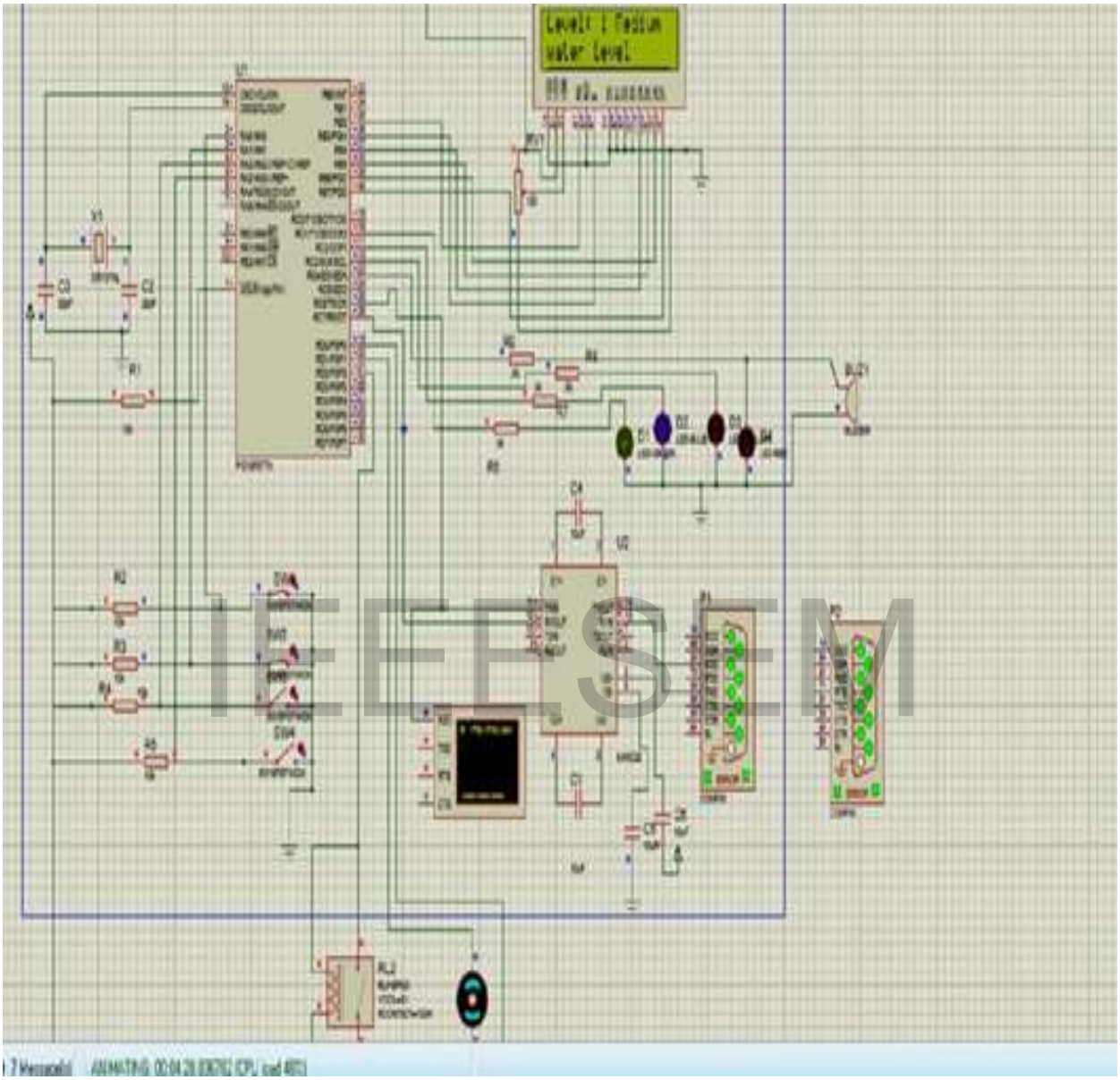

Fig 4.3: Simulated level l medium water indicator

When switch three is “ON” as shown in the figure below, the water level two will be displayed “High” level of water on LCD and LED shows a yellow light and people can understand where the level of water reaches.

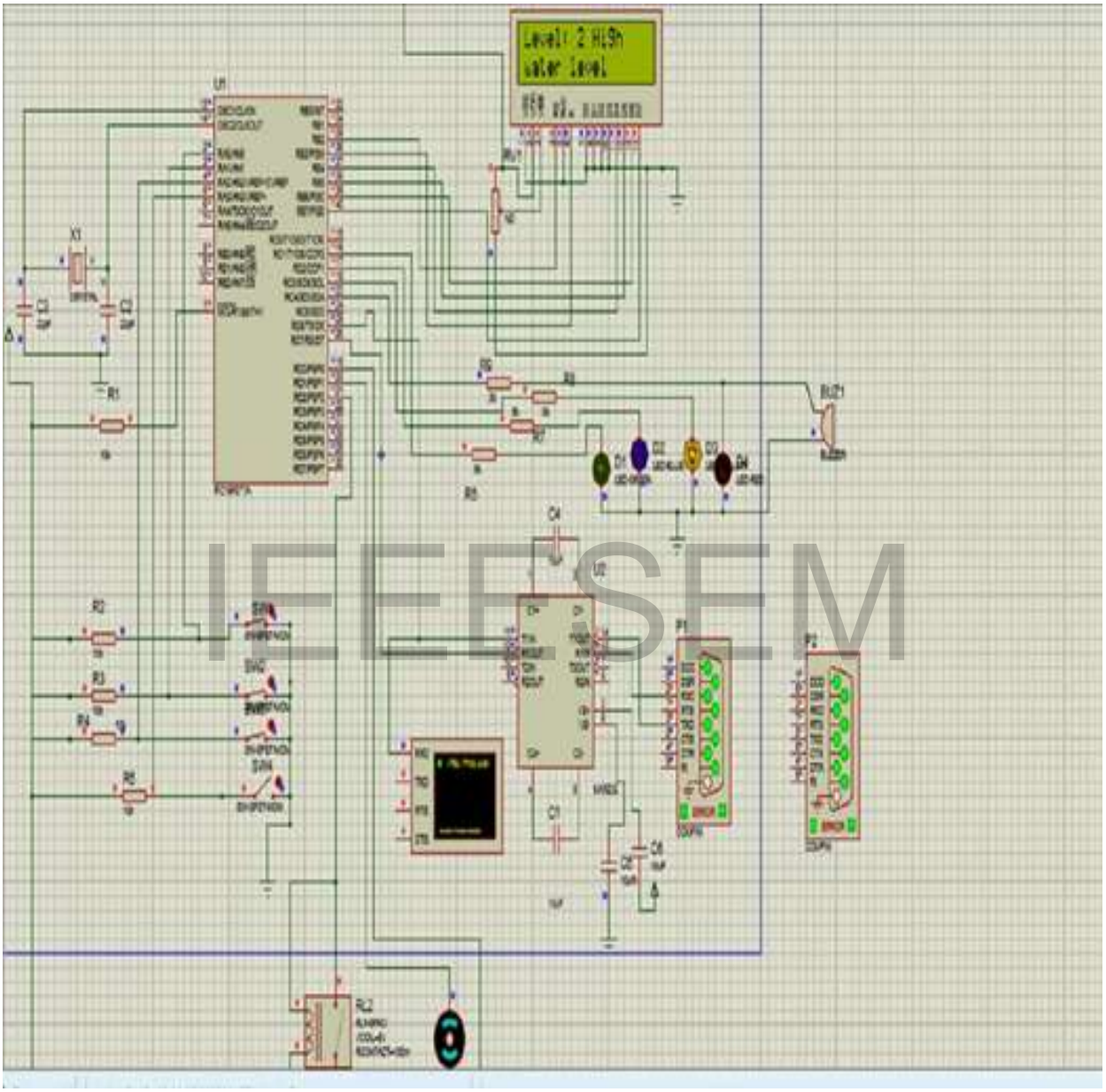

Fig 4.4: Simulated level 2 high water indicator

When switch four is “ON” as shown in the figure below, the water level three will be displayed “flood detected” level of water on LCD and LED shows a red light for warning and a buzzer sounds for an emergency to call that the respected body to take an appropriate measurement on the area where flood is detected.

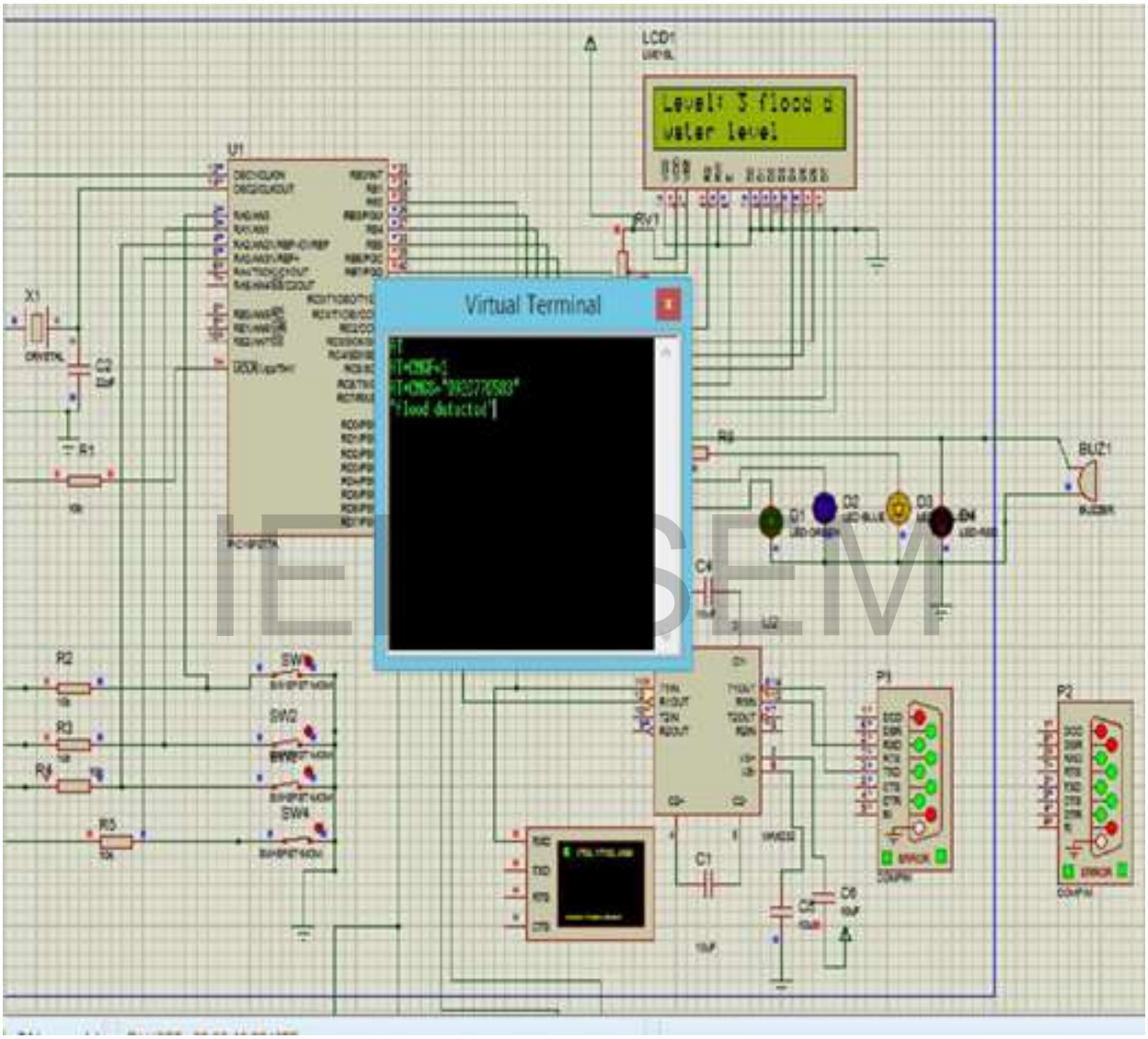

Fig 4.5: Simulated level 4 flood detection indicator

4.2 Interfacing GSM modem with PC using Hyper terminal

GSM Modem is a wireless modem that is connected to GSM wireless network to send and receive data through radio waves. It works in this project by providing Machine to Machine (M2M) wireless communication, which means data communications between machines. The steps below show how to configure Modem to send SMS from the moment switching on mode. After executing HyperTerminal.exe, the windows go to HyperTerminal environment where the Connection Description pops up.

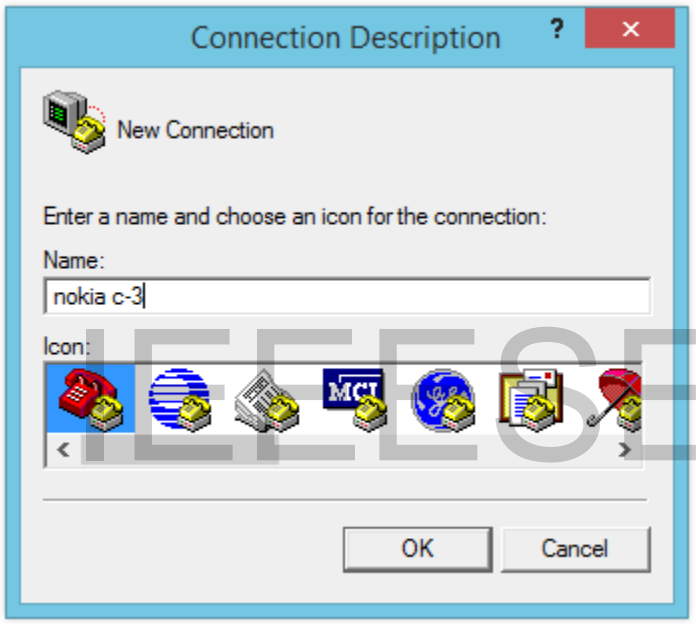

Fig 4.6: Connection Description of HyperTerminal

Enter a name and choose an icon for the connection established for your modem in your own favor. This will save the setting of the connection established in the name you have given.

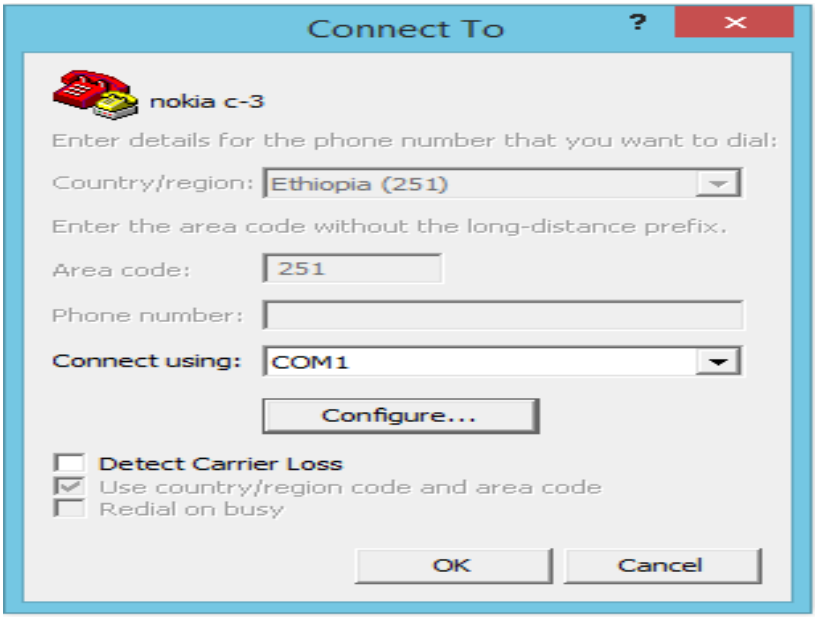

Fig 4.7: Setting the COM Port Number in HyperTerminal

Choose the COM Port that is connected to nokia C-3 USB modem and click OK. The baud rate can be changed after that to interface with PIC as shown figure below.

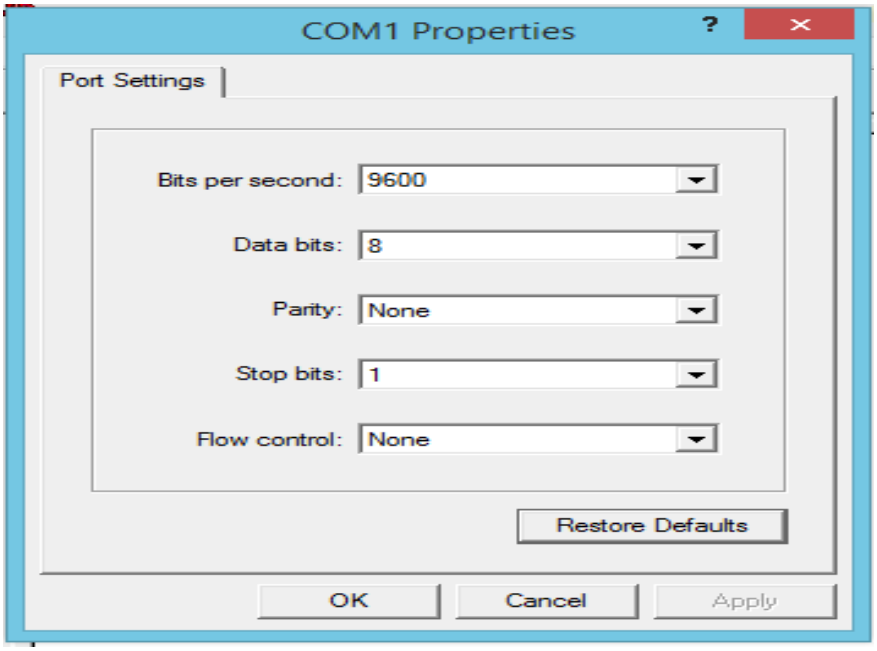

Fig 4.8: Port Setting at HyperTerminal

AT+CMCS: This command is used to select character mode and set GSM character mode to AT+CMCS = “GSM”

AT+CMGS: This command is used to select number of message recipient and message you want to send to recipient

•” AT‟ is sent and the response „„OK‟ shows AT command is supported.

•“AT+CMGF=1‟ is sent and the response “OK‟ shows the mode of SMS has been changed to Text Mode.

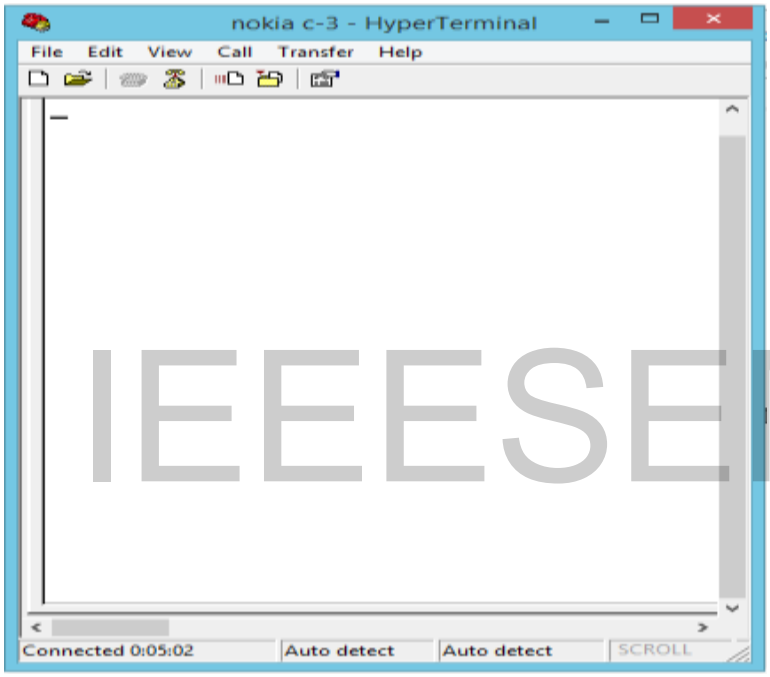

Fig 4.9: sending AT Command window

4.3 Results and Discussion

The Microcontroller continuously sends the SMS at water level 3 to another Terminal Equipment and the SMS sent has been read successfully. The use of SMS however, shows some delay at certain busy hour time, due to the unavailability and busy traffic of GSM network. We can only update the program to suit the changes. The water level control has easy installation, low maintenance, Compact elegant design, the automatic water level controller ensures no overflows or dry running of pump there by saves electricity and water, avoid seepage of roofs and walls due to overflowing tanks, fully automatic, saves man power, consume very little energy, ideal for continuous operation, automatic water level controller provides you the flexibility to decide for yourself the water levels for operations of pump set, shows clear indication of water levels in the overhead tank.

CHAPTER FIVE

5. Conclusion and Recommendation

5.1 Conclusion

The flood protection system is built to identify rising water levels and to warn any potential flood risk. The system has available technical solutions to immediate and long term alleviate flood ravages to study areas. Countries have managed to drastically reduce flood damages through integrated water level detection, flood protection, forecasting, and warning and response actions through institutionally framed process.

This paper concentrates on the design and implementation of wireless flood protection system via cellular phones through GSM modem and microcontroller support and it realizes the help of mobile since this is the cheapest gadget nowadays.

In current study, since it deals with simplicity and low cost, we were able to conceptualize a user friendly device that helps to protect our properties. The result of our final designed project has met our objectives, in which every sensor is working and will sound specific alarm when the system goes into alert condition. The designed project was a really enjoyable and challenging project to work with. It requires a lot of hard work but the result was amazing and gave as reward, a lot of experience in exploring different technologies. Our study is really very effective and practical.

This project has deepened our technical knowledge in each aspect of electrical engineering field. In addition to this, we are proud that we were able to express our own ideas to make this project more meaningful, from the beginning we were realistic about the specifications of our projects.

5.2 Recommendation

Along the course of study completion, I encountered various problems and obstacles. Not everything that I had planned went smoothly during the project development span. I had to start from the research phase at the beginning and needed to gain knowledge on all the devices and components that we had intended to use for our project.

As part of our recommendation, I would like to recommend to the future researcher that hardware interfacing and GSM configuration must be perfectly implemented since the software analysis designed is already here. Furthermore, for additional features such as, temperature sensor, automation, weather, remote sensing and the like should be taken also in consideration for the future development.

Therefore, this is not the end of the project but rather it is the initial step towards exploring other project to be more complete than what I have done and anyone who is interested in this project can do additional modification, especially on the complete hardware implementation. The works on this project will not just stop here and will be further explored to have more functions on it. GSM based remote terminal unit of the flood warning and Control system can be modified to control others home applications and as home security tool. I understood that the lab equipment support from my University and internet availability is not that much, but I am still grateful because of my staffs who keep on mentoring us since this is very beginning of my career.

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Appendix A: Circuit diagram for wireless water level detection and flood protection system