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ABSTRACT

Landslide is a natural disaster damaging the social life every year. It can be defined as the movement of mass of rock, debris down a slope. It occurs due to natural or man made activities. Asia was found to be the most affected continent where 75% of landslides occurred. India also faced the loss of humans due to landslides which occurred last year during monsoon in Kerala. The main aim of the proposed system is to detect those conditions which lead to the occurrence of landslide and notify it well before time so that necessary steps can be taken to reduce or save the human loss.

The proposed system uses soil moisture and accelerometer sensors. Moisture sensor readings are indicative of the moisture content in the soil whereas accelerometer checks movement of land. The readings crossing the defined thresholds give alarm to local citizens to safeguard themselves. All the readings from micro-controller are also uploaded on thingspeak cloud to analyze them and alert the rescue team in case of MIDDLE and DANGER zones. The system takes 10ms time to collect data from sensor and transmit it to things speak server is about 30 second.

CHAPTER 1: INTRODUCTION

A landslide is movement of a mass of rock, debris, or earth down a slope. In monsoons the rain water percolates and develops hydraulic pressure which exceeds the elastic limit of the soil or rocks. Due to this the strain gets accumulated which forces the soil and rocks to loosen their adhesive strengths entailing landslides. Landslides destroy agricultural/forest lands, road transports, destroys earth's natural environment as a whole causing great loss to life. Landslides can also be said of "Mass Wasting", which refers to any down slope movement of soil and rock due to gravity.

It causes property damage, injury and death. Also, it adversely affects a variety of resources such as water supplies, fisheries, sewage disposal systems, dams and roadways for years after a slide event. The landslides occur when the slope changes from a stable to an unstable condition. This change in the stability of a slope can be caused by many factors together or alone. The Natural causes, such as, ground water pressure acting to destabilize the slope, erosion at the bottom of a slope by rivers or ocean waves, earthquakes adding loads to barely stable slope, earthquake caused liquefaction destabilizing slopes. The Man made causes, such as, deforestation, cultivation and construction which destabilizes the already fragile slopes, vibrations from machinery or traffic. Rock avalanches, debris flows, soil movement, mud flows are the various forms of landslide.

Landslides occur in rocky mountainous regions like Himalayasssss, koan railways, Lonavala ghats and marshy regions of Kerala in India. Lanslides are hazards all over the world. Hillsides with steep slopes are prone to landslides. Landslide prediction, detection and monitoring have been done by researchers for different case studies all over the world. Landslide detection can be done by using diverse methods like visual inspection using image/video processing, satellite remote sensing, using statistical methods or using machine learning algorithms. Landslide detection can also be based on data driven approaches using wireless sensor networks (WSN). The main objective to study the landslide detection is to prevent the natural calamity by detecting its early movement. This will reduce or save the human loss caused by the landslide. Also, the objective is to find a certain way in which the sensing elements should respond quickly to rapid changes of data and send this sensed data to data analysis center.The proposed WSN/Internet of things (IoT) based landslide detection and monitoring system is a low cost, robust and delay efficient.

1.1 Objective of Project Work

1. The main objective to study the landslide detection is to prevent the natural calamity by detecting its early movement. This will reduce or save the human loss caused by the landslide.
2. The very second objective is to detect the water level for instance if the limit is of 100 meter and the water rises above 100 meters then it will send an alert.
3. The third objective is to detect landslide by different parameters i.e water level sensor, vibration sensor and soil sensor
4. If there is any other emergency in a particular region for example swine flu alert or bird flu so currently in rural areas this is now done by letters which consumes a lot of time so this main control unit installed at the government office will display the message of emergency and send the message to an official too.

1.2 Problem Statement

As landslide is one of the major problems in the current scenario, the current IOT based landslide detection only help to detect a landslide and no major action takes place. Also the projects in this domain that are present only send SMS which can be neglected easily and no major step can be taken to avoid disaster so in the proposed system SMS & alarm will be added so that necessary steps are taken.

CHAPTER 2 : LITERATURE SURVEY

Landslides in heavy rainfall areas are making threat to the people living in nearby area. Also, it becomes difficult to predict about it either. So, combining with partnership of professional laboratories i.e. IS Terre: earth science and LCIS: embedded electronics, telecommunication is aimed to make a new predictive tool which can be used to analyze the area movement using sensors. The basic plan is that the sensors sense the field's movement with minimal cost and power consumption. The monitoring techniques uses geolocation using wireless sensor networks which is based on LoRa (Long Range) transmission technology. In order to achieve geolocation using a network of sensors, a common technique is used to have a set of fixed (non-mobile) nodes and anchors whose location is already known. The computation of sensor nodes location is done using various techniques. In one such particular technique one anchor is elected to the role of master as it receives information from the other anchors.

Another survey is based on the landslide which occurred in Guizhou area in China [2] with major human loss. The threat there increases after rainfall. It introduces ZICM2410 based WSN for monitoring landslide. In this system there are acquisition nodes, base station, monitor host and PC. Several nodes constitute together to form a WSN which collects the information of landslide parameters such as landslide displacement, soil temperature, soil moisture, tilt angle, local rainfall, etc. This system has chosen the ZICM2410 Zigbee chip to build wireless sensor network which is low-cost and can exchange and use the information. It supports multiple network topologies such as point-to-point, point-to-multipoint and mesh network. At the base station, GSM technology is used to transfer the data to the monitor from remote places.

CHAPTER 3: SYSTEM DEVELOPMENT

3.1 BLOCK DIAGRAM

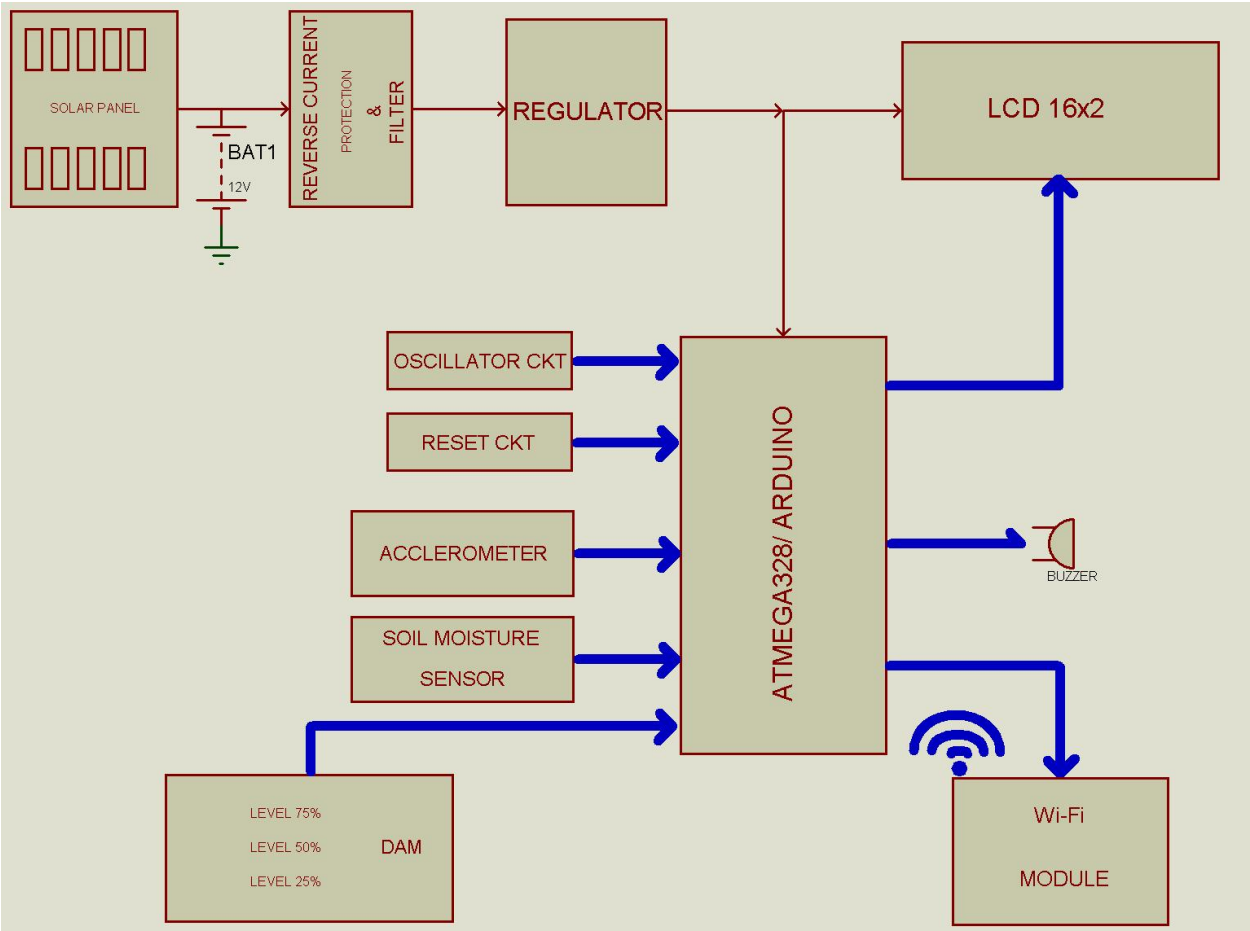

Fig3.1: Block Diagram

POWER SUPPLY

Here arduino uno board required 12V power supply and soil moisture sensor, accelerometer module required, LED indicators, sensors circuit operates with DC 5V. solar panel with battery backup circuit provides DC output and regulator to obtain regulated DC supply.

RESET BUTTON

The Arduino has a reset button (10). Pushing it will temporarily connect the reset pin to ground and restart any code that is loaded on the Arduino. This can be very useful if your code doesn't repeat, but you want to test it multiple times.

POWER LED INDICATOR

Just beneath and to the right of the word "UNO" on your circuit board, there's a tiny LED next to the word 'ON' **(11)**. This LED should light up whenever you plug your Arduino into a power source. If this light doesn't turn on, there's a good chance something is wrong. Time to re-check your circuit!

TX RX LEDs :

TX is short for transmit, RX is short for receive. These markings appear quite a bit in electronics to indicate the pins responsible for serial communication. In our case, there are two places on the Arduino UNO where TX and RX appear – once by digital pins 0 and 1, and a second time next to the TX and RX indicator LEDs **(12)**. These LEDs will give us some nice visual indications whenever our Arduino is receiving or transmitting data (like when we're loading a new program onto the board).

MICROCONTROLLER ATMEGA 328 (13)

In this arduino board (atmega328 28 pin microcontroller) works with external clock frequency, used for (timer configuration). Reset circuit requires. 6 channel 10 bit inbuilt ADC available, 6 PWM pins available, multiple serial communication available, up to 20 programmable pins available.

RESET AND OSCILLATOR CIRCUIT

Any microcontroller requires oscillation frequency for its operation it can be internal for few microcontrollers like PIC and for few it required external like ATMEL, ATMEGA. This microcontroller requires external oscillator frequency.

Reset circuit requires for the re-start program from beginning it used when microcontroller hangs particular operation or if we required to stop the running condition with beginning process.

ACCLEROMETER

Accelerometer is acceleration sensor used to sense acceleration in X and Y directions, its output changes with accelerometer angle from 0 to 1800 degree. Accelerometer output is low required to amplify to detect in digital format. So op-amp is used in investing and non inverting configurations. And flex sensor is used to sense and control grip movement.

SOILMOISTURE SENSOR

Soil moisture sensor is used to sense the moisture in soil, its output is available in both format analog and digital. It has 3 pins VCC, Ground, Output. It has probes to sense soil moisture. It is used to measure soil moisture in land slide possibility area.

LCD DISPLAY

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCD's are economical, easily programmable, have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

3.2 HARDWARE DETAILS

3.2.1 RESISTOR

A package of material which exhibits a certain resistance made up into a single unit is called a resistor. Different res. having the same resistance value may be different in physical size and construction depending on its power and applications.

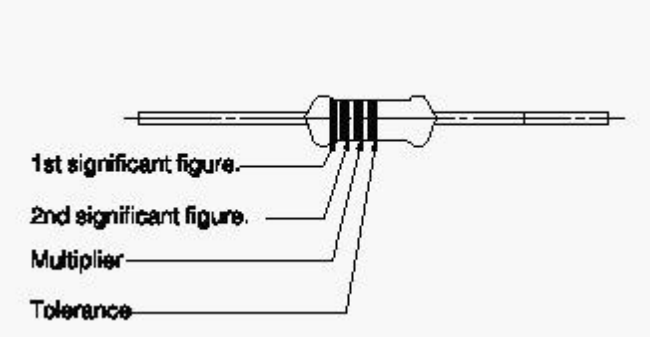

Fig 3.2 :Resistor

Figure above shows a typical carbon film res. which is commonly used in the market. Chip resistor is becoming more common nowadays replacing carbon film resistor.

VALUE AND TOLERANCE OF RESISTANCE

Unit of resistance is ohms; the symbol for ohm is an omega. Res. values are normally shown using colored bands. Each color represents a number as shown in the table below.

Color code

Color	First digit	Second digit	Third digit	Multiplier	tolerance	
					%	Code
Black	0	0	0	1		
Brown	1	1	1	10	±1	F
Red	2	2	2	10^2	±2	G
Orange	3	3	3	10^3	±0.05	W
Yellow	4	4	4	10^4		
Green	5	5	5	10^5	±0.5	D
Blue	6	6	6	10^6	±0.25	C
Violet	7	7	7	10^7	±0.1	B
Grey	8	8	8			
White	9	9	9			
Gold				10^{-1}	±5	J
Silver				10^{-2}	±10	K
None					±20	M

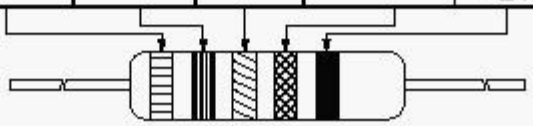

Table 3.1 : Colour Code

3.2.2 DIODE

There are many types of semiconductor diodes namely Selenium, Germanium and Silicon types. Selenium type is commonly used in the early days in ac power suppliers but in recent years it has been replaced by silicon type as it sometimes emit toxic fumes when it burnt out. The characteristic is that it allows current to flow in one direction as shown in the symbol below. It has a cathode and an anode which determine the flow of the current. Current can only flow from anode to cathode.

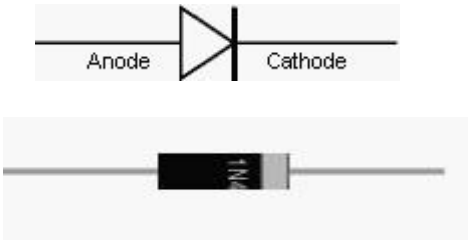

Fig 3.3 : Diode

Silicon V-I characteristics are shown in the figure below. The junction barrier for silicon is about 0.7V and for Germanium is about 0.3V. It is also called forward voltage drop. Most of the diode used today is of silicon type as they are robust and reliable from DC to RF small signal applications.

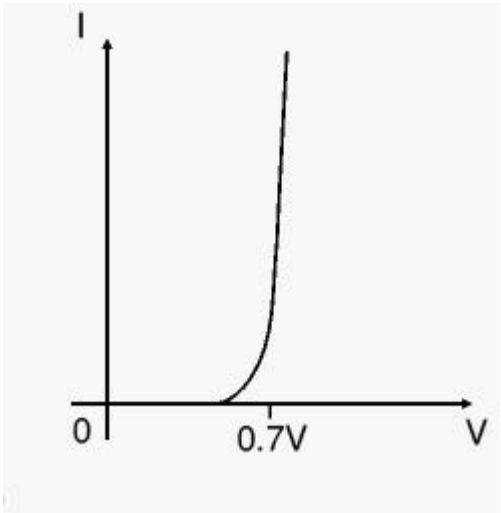

Fig 3.4 : V-I Characteristics

The Peak Reverse Voltage (PIV) of silicon types is available up to 1000 volts or more. They can also carry up to 100A DC current. In typical applications, it is advisable to ensure that it operates within the maximum ratings specified by the manufacturer and apply the

Failure Mode and Effects Analysis to the device. The temperature of the device is one of the more important parameter to consider. Heat sinks may be used where they have to handle large amount of power.

When reverse voltage is applied, there will be a small leakage current usually in the region of uA. Beyond this voltage, it will breakdown and will be damaged permanently.

3.2.3 ALUMINUM ELECTROLYTIC CAPACITOR

Compact but glossy, these are available in the range of <1 μF to 1 F with working voltages up to several hundred volts DC. The dielectric is a thin layer of aluminum oxide. They contain corrosive liquid and can burst if the device is connected backwards. The oxide insulating layer will tend to deteriorate in the absence of a sufficient rejuvenating voltage, and eventually the capacitor will lose its ability to withstand voltage if voltage is not applied. A capacitor to which this has happened can often be "reformed" by connecting it to a voltage source through a resistor and allowing the resulting current to slowly restore the oxide layer. Bipolar electrolytic (also called Non-Polarized or NP capacitors) contain two capacitors connected in series opposition and are used when the DC bias voltage must occasionally reverse. Bad frequency and temperature characteristics make them unsuited for high-frequency applications. Typical values are a few nf to fared.

Fig 3.5 : Capacitor

A **capacitor** or **condenser** is a passive electronic component consisting of a pair of condenser separated by a dielectric. When a voltage potential difference exists between the conductors, an electric field is present in the dielectric. This field stores energy and produces a mechanical force between the plates. The effect is greatest between wide, flat, parallel,

narrowly separated conductors. The applications of capacitor are energy storage, power factor correction, signal coupling, noise filters, and motor starters.

3.2.4 CRYSTAL OSCILLATOR

Fig 3.6 : Crystal Oscillator

A **crystal oscillator** is an electronic oscillator 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 incorporating them became known as crystal oscillators, but other piezoelectric materials including polycrystalline ceramics are used in similar circuits.

Quartz crystals are manufactured for frequencies from a few tens of kilohertz to hundreds of megahertz. More than two billion crystals are manufactured annually. Most are used for consumer devices such as wristwatches, clocks, radios, computers, and cell-phones. Quartz crystals are also found inside test and measurement equipment, such as counters, signal generators, and oscilloscopes.

Ceramic caps with crystal act as loading capacitor for oscillator. Usually they are used for adjusting the crystal frequency. Crystal oscillator vendors specify the value of loading caps to be used along with oscillator to give the perfect frequency. If we check a crystal alone

on an oscilloscope you will find that frequency is little higher than that of what is specified, so loading caps shift this frequency to a lower value normally the required value.

3.2.5 LM78XX 3-TERMINAL 1A POSITIVE VOLTAGE REGULATOR

FEATURES

- Output Current up to 1A
- Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24V
- Thermal Overload Protection
- Short Circuit Protection
- Output Transistor Safe Operating Area Protection

DESCRIPTION

The MC78XX/LM78XX/MC78XXA series of three terminal positive regulators are available in the TO-220/D-PAK package and with several fixed output voltages, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut down and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

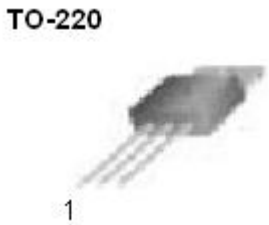

Fig 3.7 : Regulator

Notes:

I. To specify an output voltage. Substitute voltage value for "XX." A common ground is required between the input and the Output voltage. The input voltage must remain typically 2.0V above the output voltage even during the low point on the input ripple voltage.

II. CI is required if regulator is located an appreciable distance from power Supply filter.

III. CO improves stability and transient response.

3.2.6 ARDUINO

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

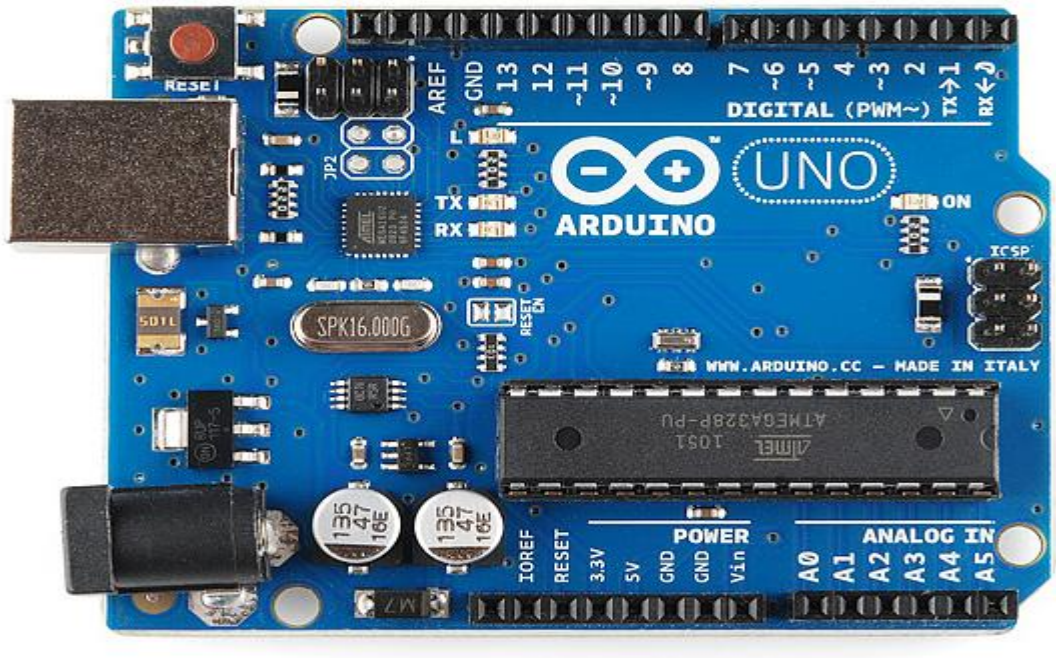

Fig 3.8 : Arduino nuo

The Uno is one of the more popular boards in the Arduino family and a great choice for engineering programming demonstration.

3.2.7 LCD 16 x 2 DISPLAY

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A **16x2 LCD** means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

Pin Diagram:

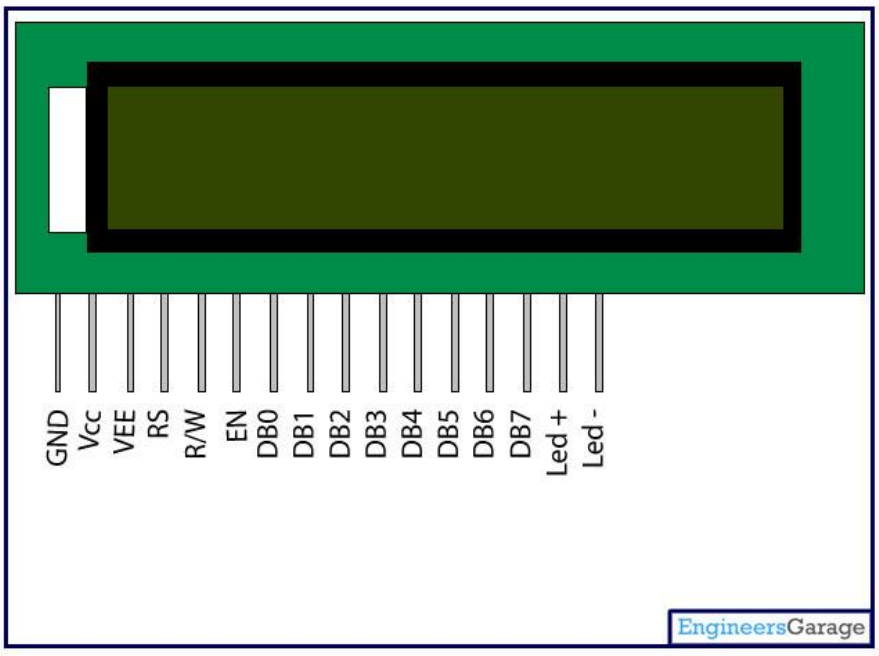

Fig 3.9 : LCD Display

PIN DESCRIPTIN

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

Table 3.2 : Pin Description of LCD Display

3.2.8 ESP 8266 Wi-Fi MODULE

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. This module comes with AT commands firmware which allows you to get functionality like arduino wi-fi shield, however you can load different firmwares to make your own application on the modules' memory and processor. Its a very economic module and has a huge and growing community support.

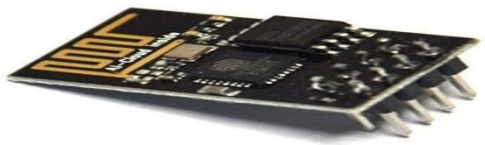

Fig 3.10 : Wi-Fi Module

This module has onboard 80Mhz low power 32 bit processor which can be used for custom firmwares. This also means that you can host small webpages without any external controller. For more details see : NODEMCU . The ESP8266 supports APSD for VoIP applications and Bluetooth co-existance interfaces, it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts.

ESP8266 is transforming the world with its low cost and high features which makes it an ideal module for Internet Of Things (IOT). It can be used in any application where you need to connect a device to your local network or internet.

PIN DESCRIPTIN

Pin Number	Pin Name	Alternate Name	Normally used for	Alternate purpose
1	Ground	-	Connected to the ground of the circuit	-
2	TX	GPIO – 1	Connected to Rx pin of programmer/uC to upload program	Can act as a General purpose Input/output pin when not used as TX
3	GPIO-2	-	General purpose Input/output pin	-
4	CH_EN	-	Chip Enable – Active high	-
5	GPIO - 0	Flash	General purpose Input/output pin	Takes module into serial programming when held low during start up
6	Reset	-	Resets the module	-
7	RX	GPIO - 3	General purpose Input/output pin	Can act as a General purpose Input/output pin when not used as RX
8	Vcc	-	Connect to +3.3V only	

Table 3.3 : Pin Description Of Wi-Fi Module

FEATURES

- 802.11 b/g/n
- 1Mb Flash size
- Wi-Fi Direct (P2P), soft-AP
- Integrated TCP/IP protocol stack
- Integrated TR switch, balun, LNA, power amplifier and matching network
- Integrated PLLs, regulators, DCXO and power management units

- +19.5dBm output power in 802.11b mode
- Power down leakage current of <10uA
- Integrated low power 32-bit CPU could be used as application processor
- SDIO 1.1 / 2.0, SPI, UART
- STBC, 1×1 MIMO, 2×1 MIMO
- A-MPDU & A-MSDU aggregation & 0.4ms guard interval
- Wake up and transmit packets in < 2ms
- Standby power consumption of < 1.0mW (DTIM3)
- Access Point and Station Modes

3.2.9 MICROCONTROLLER IN ARDUINO BOARD(ATMEGA328)

Why ATmega328

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button.

What is ATmega328 & ARDUINO

Difference between Arduino and ATmega328 AVR. In short an ATmega328 is a microcontroller chip found on Arduino Uno boards. ATmega328 microcontrollers are from the 8-bit AVR microcontroller family. In this case it is a small square chip soldered on top of the Arduino.

PIN DIAGRAM

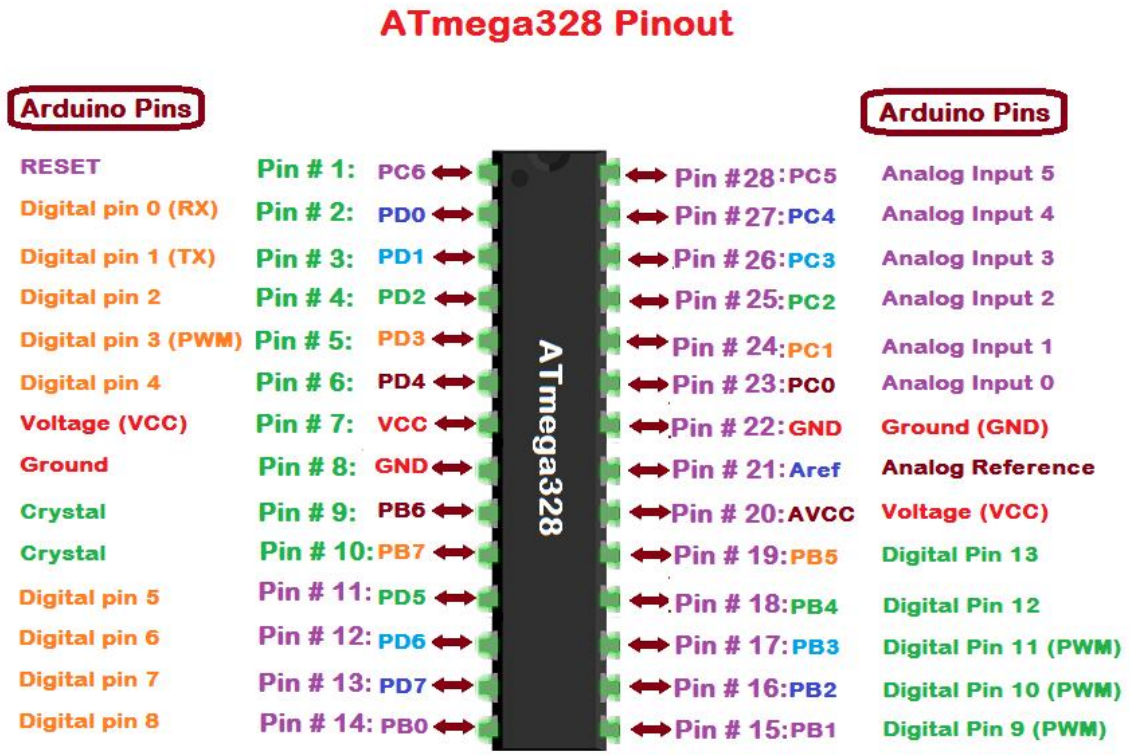

Fig 3.11 : Pin Diagram Of ATmega328

FEATURES

High Performance, Low Power AVR® 8-Bit Microcontroller

Advanced RISC Architecture

- 131 Powerful Instructions
- Most Single Clock Cycle Execution
- 32 x 8 General Purpose Working Registers
- Fully Static Operation
- Up to 20 MIPS Throughput at 20 MHz
- On-chip 2-cycle Multiplier

High Endurance Non-volatile Memory Segments

- 4/8/16/32K Bytes of In-System Self-Programmable Flash progam memory (ATmega48P/88P/168P/328P)
- 256/512/512/1K Bytes EEPROM (ATmega48P/88P/168P/328P)
- 512/1K/1K/2K Bytes Internal SRAM (ATmega48P/88P/168P/328P)
- Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
- Data retention: 20 years at 85°C/100 years at 25°C(1)

- Optional Boot Code Section with Independent Lock Bits In-System Programming by On-chip Boot Program True Read-While-Write Operation
- Programming Lock for Software Security

Peripheral Features

- Two 8-bit Timer/Counters with Separate Prescaler and Compare Mode
- One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
- Real Time Counter with Separate Oscillator
- Six PWM Channels
- 6-channel 10-bit ADC in PDIP Package Temperature Measurement
- Programmable Serial USART
- Master/Slave SPI Serial Interface
- Byte-oriented 2-wire Serial Interface (Philips I2 C compatible)
- Programmable Watchdog Timer with Separate On-chip Oscillator
- On-chip Analog Comparator – Interrupt and Wake-up on Pin Change

3.2.10 SENSORS

Sensors are used for sensing things and devices .

A device that provides a usable output in response to a specified measurement.
The sensor attains a physical parameter and converts it into a signal suitable for processing (e.g. electrical, mechanical, optical) the characteristics of any device or material to detect the presence of a particular physical quantity.

3.2.10.1 ACCLEROMETER

The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 g.

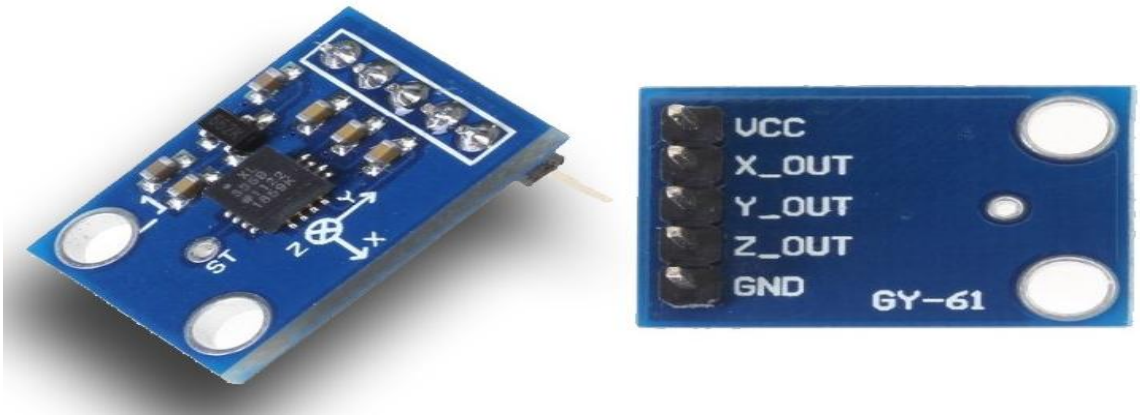

Fig 3.12 : Accelerometer

Operating Voltage	1.8V – 3.6V
Sensing axis	3 axis
Sensitivity	270 to 330mV/g (Ratiometric)
Shock Resistance	Up to 10,000g
Dimension	4mm x 4mm x 1.45mm

3.2.10.2 SOIL MOISTURE SENSOR

The Soil Moisture Sensor uses capacitance to measure the water content of soil (by measuring the dielectric permittivity of the soil, which is a function of the water content). Simply insert this rugged sensor into the soil to be tested, and the volumetric water content of the soil is reported in percent.

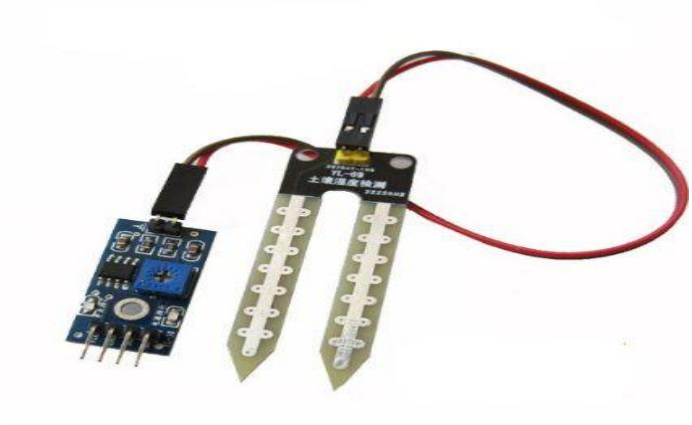

Fig 3.13 : Soil Moisture Sensor

FEATURES

- Sensitivity adjustable the blue digital potentiometer adjustment.
- Operating voltage 3.3V-5V.
- Module dual output mode, digital output, analog output more accurate.
- With fixed bolt hole for easy installation.
- PCB size: 3cm * 1.6cm
- Power indicator (red) and digital switching output indicator (green)
- Comparator LM393 chip, stable

3.3 PCB DESIGNING

There are two types of PCB making

1. Photo printing.
2. Screen printing.

3.3.1 SCREEN PRINTING

PCB production by photo printing method is expensive, through accurate. The screen process uses a resist ink applied through a stencil or mask to the surface of the blank circuit board. The stencil is produced and attached to a fine mesh, metal, nylon, polyester or silk screen. The resist ink is forced through openings in the stencil onto the surface of the blank board. This process produces a positive of the circuit on the copper foil. When dry the board is ready for etching.

PREPARATION OF SCREEN

A light rectangular wooden frame is used for this purpose. A piece of screen fabric material is stretched tightly over the frame. Commercial screens are often made of a fine wire mesh. Special frames are available in the market to hold this screen. The frame is hinged on one end of the base of printing board. This base of the printing board is larger in area than the frame. The following equipments are used for screen printing process.

1. Photosensitive film.
2. Developer.
3. Blackout solution.
4. A rubber squeeze.
5. The resist paint or ink.

A pre-sensitized film is used to make the screen stencil. A major source of this material and relater screen process suppliers is the Ulano Company (USA) and wood peck industries (Bombay' India).

The exposure process is very similar to that used to make photographic negative. A black sheet of paper is placed on the exposure board. A piece of film larger than the circuit board is placed film-side down (plastic backing side up) on the top of the paper. The art work is placed on the top of film. They are all held in place with a piece of untainted glass. Exposure is about 8 minutes using a number two photoflood lamp. The lamp should be about 18 inch above the film and glass. After exposure, the film is put in a tray of developing solution for about 90 seconds. Only the developer available from the above companies should be used. Screen preparation chemicals are also available from lunar caustic Pvt. Ltd., pune; Raman industries, Bombay. It is sold in two packages identified as Hi-Fi A and B developer. The direction states that the temperature of the developing solution should be between 40ºC and 46 ºC, but the film in the tray emulsion-side up. The developing solution is not light sensitive as it is prepared from light. The developer life is 24 hours. After that, it becomes useless, fresh developer is required. The tray holding the film and developer must be oriented during development.

After the required time, the film is removed from the tray of developing solution. It is washed in running warm water. Placing the soft side down on the bath may run the work. The purpose of this process is to wash out the film and remove areas which will permute the ink to be printed on to the blank circuit board. The wash out water should flow over the stencil. This will wash away the unexposed emulation on the film. Use gentle water flow; otherwise it will damage the film. This process requires several minutes to complete. After the wash out is finished, the film has to cooled. This will firm the screen stencil. Return the film to flat surface. The glass used to hold the film during the rinse process is convenient, but any solid flat surface can be used. The stencil film is attached to the screen. In order to archives good adhesion, the film stencil must be held on the flat surface and must be raised up higher than the surface you are working on. Use a hard build up of about 1/2". Gently lower the screen and frame onto the film. The weight of frame is sufficient to press the screen material onto the soft film emulsion.

Place a pad of unused newsprint on top of the screen. Gently wipe the newsprint with a soft cloth. This will make the soft emulsion work up onto the screen. Don't apply pressure; change the newsprint until it no longer shows any green film color. Do not use printed paper for the pad. Only clean newsprint will work successfully. Once the moisture is removed by this method, the screen is set aside to dry. This required about one hour of time. When the emulsion is dry, the backing material is carefully peeled off the film. The result is negative mask, attached to the screen. Check the screen again for leaks in areas which should be protected. Hold it under a strong light. Tough up with a small paint brush and block out material thinned with water.

PRINTING BASE PREPARATION

We have now a screen to which a stencil is attached. Areas, which are to appear on the board as conductor or pads are clear. There is no blackout on the screen in these places. The next step is to prepare printing base.

The blank board is placed on the printing frame in exactly the same place each time. The registration guides are used to ensure good registration. Pieces of cardboard or scrap circuit board are tacked in place on the base board. The registration guides are placed on three sides of the area, surrounding the blank board. Sometimes a small piece of double sided tape is placed in the center to hold the board in place.

The screen frame is held to the printing board base with two hinges. Using a hinge with a removable pin will make cleaning easier.

Now, for actually printing, the resist on PC board, place a clean blank board, copper side up in the registration area of the base. Lower the screen and frame so that the screen resets firmly on the copper foil. Pour some of the resist ink or paint on the screen in one of the blocked out areas. Take a rubber squeeze, preferably the kind used for screen printing, and pull the ink over the negative part of the screen. A piece of stiff cardboard may be substituted for the squeeze. Continue pass over the negative in to a block out area. One pass of the ink over the negative part of the screen should do if you have used enough ink. Gently lift the screen frame. The board with resist pattern on the circuit should be seen in all its glory. Carefully left the board from the registration area on the base. Set it aside to dry, the board is ready for etching when the ink on it is dry. There are several different kinds of ink resists available. Some use a water based ink, and other use a lacquer or oil base. Oil base ink is

much slow drying than lacquer based ink. This means that the clean up may be delayed with oil based products. On the other hand, lacquer based ink dries faster and thus speed up the overall processing time of the board. The next step is to clean the board and send it for etching.

3.3.2 ETCHING THE BOARD

All the work done so far has been to prepare a blank copper board for etching. Thematically, any one of the following solution is used to etch a board.

1. Ammonium parasulphite.
2. Chronic acid.
3. Cupric chloride.
4. Ferric chloride.

The most common etchant used in industry is ferric chloride (Fecl3). It is cheap chemical and lest dangerous and easily available in market. Never use kitchen utensils for holding etching solution. Etching is the process of attacking and removing the unprotected copper from the PC board to yield the desired conductor pattern.

Methods of etching include tray rocking, tank etching and spray etching. Out of these, tray rocking is the simplest one. This consists of a tray of pirex glass, attached to a powered rocking table. If powered rocking table is not available, then the PC board is kept on the glass marbles which are kept in the tray along with the etchant solution. Dry etchants are available liquid etchants are available. Ferric chloride crystals of 500gm are mixed in water to make total solution of 1 liter. During the etching process, the concentration weakens because the soluble cupric and ferric ions precipitate out of the solution, in the form of sludge that tends to settle on the bottom of the etching vat.

Ideal etching condition requires that the etchant be heated to a temperature of between 60º to 70 º C. with the temperature maintained reasonably constant, the length of time required for etching will be consistent.

3.3.3 DRILLING OPERATION

The PCB gives the holes to take the various components that will be mounted on it. With greatest precision, these holes must be drilled.

In industry, depending on production volumes, manual, semi – automatic or pneumatically – controlled drilling equipments are used.

A whole stack of boards can be drilled using various jigs and bushes. The speed of drill is an important consideration with maintaining the size and location of holes with required tolerances and minimizing deformity at their edges.

For paper laminates, high speed steel can be used at 8000rpm or less.

For epoxy – glass laminates, it uses tungsten carbide bit at about 15,000 rpm.

For high precision, the drill is at 1, 00,000 rpm.

If accuracy is not important, jigs are used to punch all holes in PCB.

When holes are drilled in a PCB, the laminate is uncovered in PTH.

To provide a conducting layer within the holes, electrode less copper platting is used. The plate is coated with palladium and immersed in an electrolyte containing copper ions.

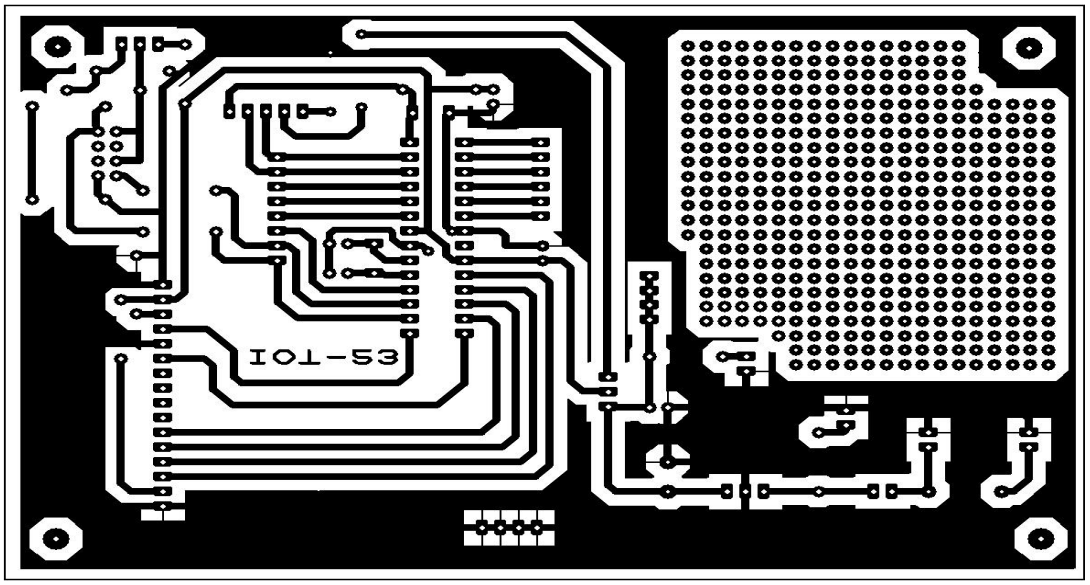

Fig 3.14 : Bottom Side of PCB

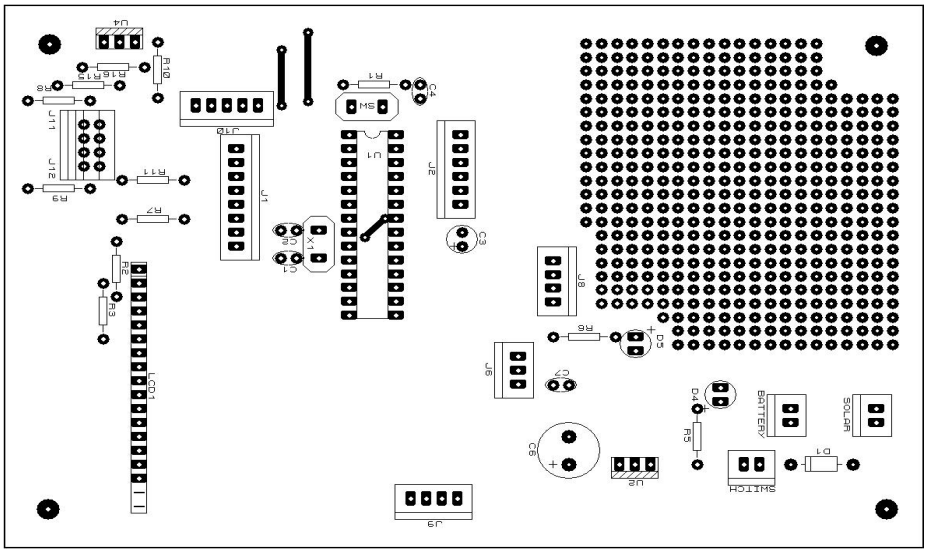

Fig 3.15 : Top Side of PCB

CHAPTER 4 : SOFTWARE

ARDUINO BASIC PROGRAMMING

This program is written in a **programming language** called **C**. The Arduino software only understands programs written in C, so you'll be learning how to write C programs. Assume for a moment that you've written this program. The next step is to compile it.

As was mentioned above, your program will probably look slightly different. In particular, the areas of gray text (the comments) in your code may be different. Don't worry, your program will work the same way that the example program does.

Now you're ready to start programming! There are four steps to writing a program and running it on your LilyPad:

1. Write the program
2. Compile the program
3. Upload the program to the LilyPad
4. Run the program on the LilyPad.

STEPS TO WRITE THE PROGRAM

1. Click on the upward pointing arrow in the Toolbar to open Arduino's built-in library of examples. Select 01.Basics → Blink. You can also get a new window with this code by going to the File menu and selecting Examples → 01.Basics → Blink.
2. A progress bar that shows how long the compiling process will take will appear in the Status Bar.
3. If there are no errors in your program, your compilation will be successful and a "Done compiling." message will appear in the Status Bar. The Feedback Area will display a message that tells you the size of your compiled program.

4.If there are errors in your program—if your C code is formatted incorrectly for instance—your compilation will fail. In this case, the Status Bar will turn orange and a confusing compile error message will appear. You will also get a more detailed and equally confusing error message in the Feedback Area.

5.Most of the error messages that appear in the Status Bar and Feedback Area will be perplexing. They are the computer's way of telling you what's wrong. Don't worry if you don't understand them, but you might be able to get some hints about the error in your program by reading them carefully. As you get more familiar with them they'll become (slightly) more helpful.

6.Try editing your program to introduce an error. Add a new line of random text to the top of the code. Click the compile button to see what happens. Most likely the error message that appears will be meaningless to you. If you can make sense of it, you are a programming prodigy!

7.Remove the extra line you added and recompile your program before moving on to the next step.

8.When a program is compiled it is translated from the code that you wrote into a new code called hex code that the LilyPad can understand. The hex code is a very condensed form of the code that you wrote—essentially it is a long string of numbers. An excerpt of hex code is shown below.

9.Once your program has compiled and hex code has been generated, the next step is to upload the hex code onto your uno. To upload the compiled code, click on the rightward pointing arrow button in Toolbar. When you scroll over this button you'll see the word "Upload."

10.After you click it, you'll see messages in the Status Bar telling you that the program is being compiled and then uploaded. If the upload is successful, you'll see a "Done uploading" message in the Status Bar. A message in the Feedback Area will tell you the size of your uploaded program and the amount of memory available on the uno.

11.If you have not set up your uno properly, the upload process will fail. The Status Bar will turn orange and an error message will appear. If you receive an error like this, return to the setup section of this tutorial and make sure that you have completed all of the necessary setup steps including selecting the appropriate Serial Port and board in the Arduino software. If you are still having problems, see the troubleshooting chart at the end of this chapter.

CHAPTER 5: PROGRAM CODE

```
#include <SoftwareSerial.h>     // serial header file include
#include <LiquidCrystal.h>      // lcd header file include

SoftwareSerial mySerial(6, 7);  //rx tx
LiquidCrystal lcd(8, 9, 10, 11, 12, 13); // RS, E, D4, D5, D6, D7

#include <String.h>

int xpin = A5;     // analog pin used to connect the Accelerometer
int Ypin = A4;     // analog pin used to connect the Accelerometer

int posx;
int posy;

#define LEVEL1 2
#define LEVEL2 3
#define LEVEL3 4

#define BUZZER 5

#define SOILMOIST A0

int wait=0;

int damlevel=0;

void setup()
{
  // put your setup code here, to run once:
  mySerial.begin(9600);           // the wifi baud rate
```

```
  Serial.begin(9600);            // the system baud rate

  pinMode(LEVEL1, INPUT_PULLUP);  pinMode(LEVEL2, INPUT_PULLUP);
  pinMode(LEVEL3, INPUT_PULLUP);  pinMode(BUZZER, OUTPUT);
  pinMode(SOILMOIST, INPUT);

  lcd.begin(16, 2);              // LCD's number of rows and colomns:
  lcd.setCursor(0,0);            // row 0 , colomn 0
  lcd.print("IOT - LAND SLIDE");    // lcd print
  lcd.setCursor(0,1);            // row 0 , colomn 0
  lcd.print("    DETECTOR");      // lcd print
  delay(2000);
 }

 void loop()
 {
  posx = analogRead(xpin);          // reads the value of the accelerometer (value
between 0 and 1023)
  Serial.println("X=");
  Serial.print(posx);

  posy = analogRead(Ypin);          // reads the value of the accelerometer (value
between 0 and 1023)
  Serial.println("Y=");
  Serial.print(posy);

  lcd.clear();

  lcd.setCursor(0,0);            // row 0 , colomn 0
  lcd.print("X=");    // lcd print
  lcd.print(posx);

  lcd.setCursor(8,0);            // row 8 , colomn 0
  lcd.print("Y=");    // lcd print
```

```
 lcd.print(posy);
if(digitalRead(LEVEL1) && digitalRead(LEVEL2) && digitalRead(LEVEL3) )
 {
  damlevel=0;
  lcd.setCursor(0,1);            // row 8 , colomn 0
  lcd.print("  Empty- Level");    // lcd print

  digitalWrite(BUZZER, LOW);
 }

 if(!digitalRead(LEVEL1) && digitalRead(LEVEL2) && digitalRead(LEVEL3) )
 {
  damlevel=30;
  lcd.setCursor(0,1);            // row 0 , colomn 1
  lcd.print("   Low- Level");    // lcd print

  digitalWrite(BUZZER, LOW);
 }

 if(!digitalRead(LEVEL1) && !digitalRead(LEVEL2) && digitalRead(LEVEL3) )
 {
  damlevel=60;
  lcd.setCursor(0,1);            // row 0 , colomn 1
  lcd.print("  Medium Level");    // lcd print

  digitalWrite(BUZZER, LOW);
 }

 if(!digitalRead(LEVEL1) && !digitalRead(LEVEL2) && !digitalRead(LEVEL3) )
 {
  damlevel=90;
  lcd.setCursor(0,1);            // row 0 , colomn 1
  lcd.print("  Aleart Level");    // lcd print
```

```
  digitalWrite(BUZZER, HIGH);
}

if(posy>330)
{
  digitalWrite(BUZZER, LOW);
}

if(posy<=330)
{
  digitalWrite(BUZZER, HIGH);
  //delay(500);
}


delay(1500);

if(!digitalRead(SOILMOIST)  )
{
  lcd.setCursor(0,1);              // row 0 , colomn 1
  lcd.print("  Wet Detected  ");    // lcd print
}

if(digitalRead(SOILMOIST)  )
{
  lcd.setCursor(0,1);              // row 0 , colomn 1
  lcd.print("  Dry Detected  ");    // lcd print
}
delay(1500);


wait++;

if(wait==60)
```

```
  {
     Connecting_wifi();

     lcd.clear();
     lcd.setCursor(0,0);            // row 0 , colomn 0
     lcd.print("   Delay- For   ");  // lcd print
     lcd.setCursor(0,1);            // row 0 , colomn 0
     lcd.print("  Next Reading  ");      // lcd print
     delay(1000);

     lcd.setCursor(0,1);     // row 0 , colomn 0
     lcd.print("  Refreshing..  ");  // lcd print

     delay(1000);

     wait=0;
  }

}


void ShowSerialData()
{
  while(mySerial.available()!=0)
    Serial.write(mySerial.read());
}


void Connecting_wifi()
{
    mySerial.println("AT+CIPMUX=0");  //set single connection
    delay(2000);
      //
      if(mySerial.available())
```

```
{
 if(mySerial.find("OK"))       //if OK available
   {
   lcd.clear();
   lcd.setCursor(0,0);           // row 0 , colomn 0
   lcd.print("Connecting..OK-1"); // lcd print
   }

 else
   {
   lcd.clear();
   lcd.setCursor(0,0);           // row 0 , colomn 0
   lcd.print("Connecting.error"); // lcd print
   }
}
//ShowSerialData();
delay(3000);
```

```
mySerial.println("AT+CIPSTART=\"TCP\",\"api.thingspeak.com\",80");//start up
the connection
delay(6000);
 //
 if(mySerial.available())
 {
  if(mySerial.find("OK"))       //if OK available
    {
    lcd.clear();
    lcd.setCursor(0,0);           // row 0 , colomn 0
    lcd.print("Connecting..OK-2"); // lcd print
    }
```

```
  else
    {
    lcd.clear();
    lcd.setCursor(0,0);          // row 0 , colomn 0
    lcd.print("Connecting.error"); // lcd print
    }
  }
  //ShowSerialData();
  delay(2000);



        mySerial.print("AT+CIPSEND=");//send data through this TCP Connection.
        String str="GET
https://api.thingspeak.com/update?api_key=JN9E0UX2JXMVVGDT&field1=" +
String(posx)+"&field2=" + String(posx)+"&field3=" + String(damlevel);
        //&field1=" + String(temp1)+"&field2=" + String(temp2)+"&field3=" +
String(temp3)
        //70 up to=
        mySerial.println(str.length()+2);//send data through this TCP Connection.
        delay(2000);



        mySerial.println(str);//send data through this TCP Connection.
        delay(10000);   //waitting for reply, important! the time is base on the condition of
internet



        if(mySerial.available())
  {
    if(mySerial.find("SEND OK"))
      {
      lcd.clear();
      lcd.setCursor(0,0);          // row 0 , colomn 0
```

```
        lcd.print("  Sending Data  "); // lcd print
        delay(2000);

        lcd.setCursor(0,1);            // row 0 , colomn 1
        lcd.print("   Data- Sent   "); // lcd print
        delay(2000);
        }

      else
        {
        lcd.clear();
        lcd.setCursor(0,0);           // row 0 , colomn 0
        lcd.print("Connecting.error"); // lcd print
        delay(2000);
        }
     }


   mySerial.println("AT+CIPCLOSE");//close the connection
   delay(2000);
   ShowSerialData();
}
```

CHAPTER 6: PERFORMANCE ANALYSIS

6.1 WORKING

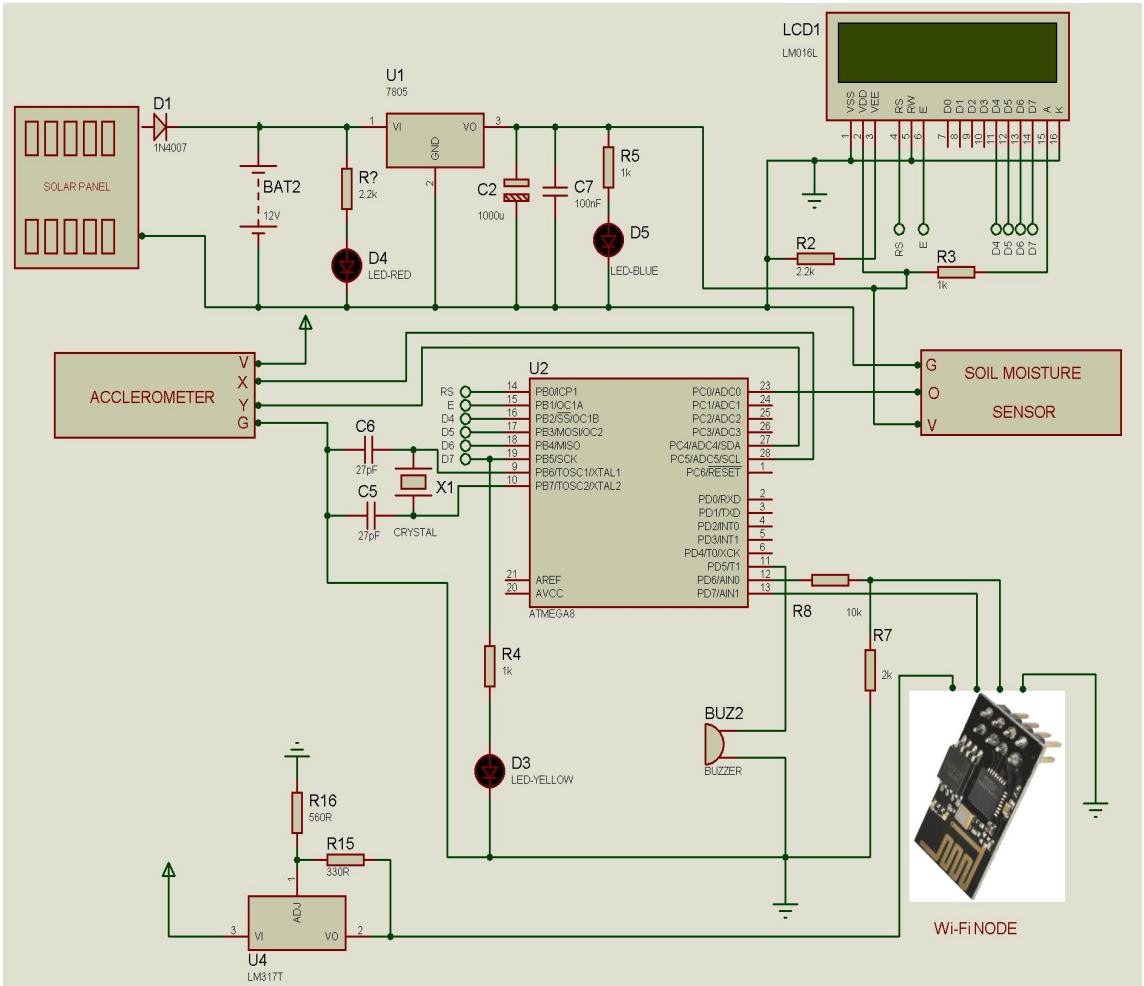

Fig6.1: Circuit Diagram

12V solar output is connected with rectifier diodes 1N4007, fluctuating DC to filter it C1 1000uf capacitor is used. This 12V supply connected with directly for battery charging and arduino board via power jack. Accelerometer, soil moisture sensor required 5V DC (this supply is internally available in arduino board), so 12V is converted in to 5V by LM7805 regulator IC. To cancel loading effect we used here 1000uf capacitor filter.

In this arduino board (atmega328 microcontroller) works with 16MHz frequency used for (timer configuration), the unwanted frequency produced is bypassed by the capacitor of 27pf

capacitor. Reset pin is connected to resistor of 10K whenever reset requires the reset switch (2 lead push to ON switch/ micro push to switch) required pressing.

LCD data pins (AD4 to AD7) is connected to the pin 8, pin 9, pin10, pin 11 to send the data for the LCD display. The control pins of LCD display is connected to pin 12, pin 13 of arduino/microcontroller, respectively take action as RS, E. Variable resistor of 10K (or fixed 2.2K) is connected to the adjust contrast of 16X2 LCD display. 10uf capacitor is used to cancel loading effect and all 0.1uf is used to bypass the unwanted spikes produced in the circuit.

Soil moisture sensor is connected to pin A0 of microcontroller. Accelerometer X and Y analog output is connected to A4 and A5 of microcontroller. Digital pins 4, 5, 6 are connected to float sensor to sense dam water level. And buzzer is connected to 11 no pin to indicate alert.

Wi-fi modem is connected to 6 and 7 pin of microcontroller to TX and Rx pin for Wi-fi modem ESP8266. It requires 3.3V supply provided with LM317 variable voltage regulator, with 330 ohm and 560 ohm resistors.

Buzzer is just used for notification alert that dust been is full, controlled via 3 pin of microcontroller, transistor is used to driver buzzer to provide proper required current.

All capacitors of 0.1uf & 100uf connected to reduce unwanted spikes in the circuit, spikes produced by inductive load/sparking contacts of loads. Capacitor of 1000uf/25V at regulator output is connected for the cancel loading effect in the circuit while driving the high current source.

DESIGNED MODEL

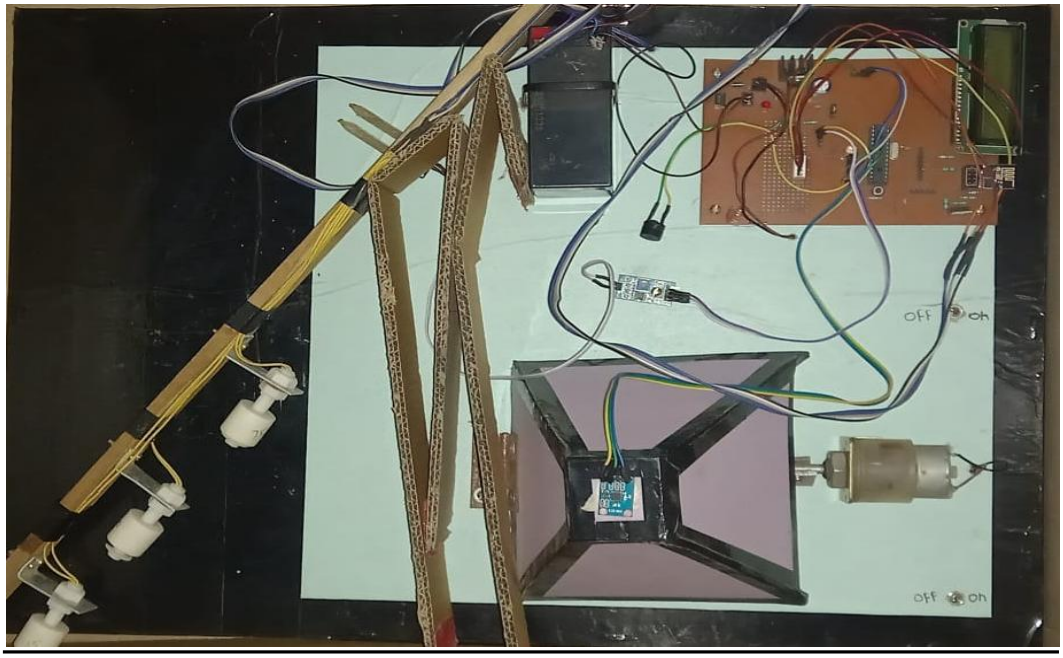

Fig 6.2 : Designed Model

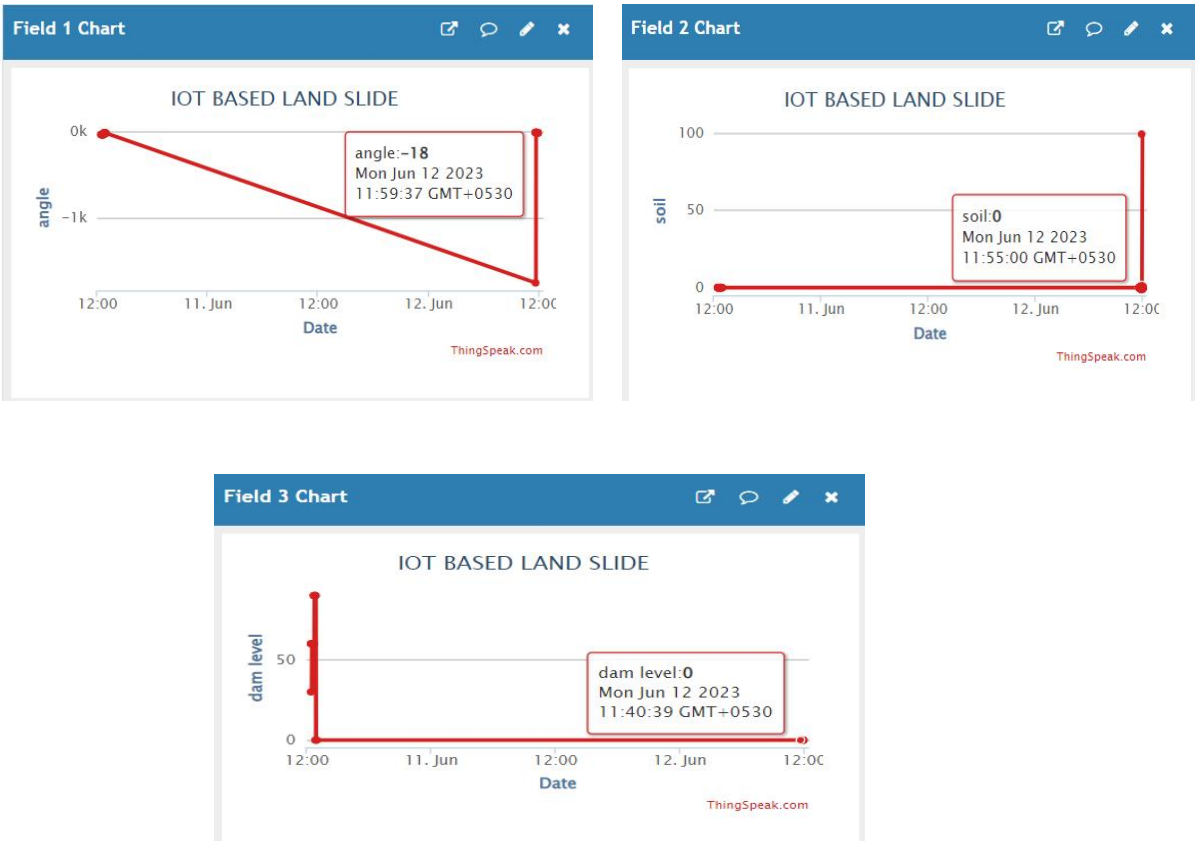

Fig 6.3 : Readings On ThingSpeak Server

CHAPTER 7: ADVANTAGES AND APPLICATIONS

7.1 ADVANTAGES

- Detects acceleration, soil moisture and dam level with alerts.
- Response time is faster of detection and update time on thing speak server less than minuet.
- Current consumption is less and solar operated, it is free energy source.

7.2 APPLICTIONS

- It can be used in home security system also to detect roof top security.
- It can be used in hotels, restaurants for security purpose.
- It can be used in dam to measure water level, bridge to detect its tilting angle.

CHAPTER 8: CONCLUSION.

The landslide detection system is successfully implemented as a prototype. All the sensors and other stuff works as per the expectations. The sensors effectively sense the surrounding conditions and give the readings. Based on readings, the prediction of landslide is achieved successfully. The system senses data and transmits it continuously.

CHAPTER 9 : FUTURE SCOPE

The landslide detection system is successfully implemented as a prototype. All the sensors and other stuff works as per the expectations. The sensors effectively sense the surrounding conditions and give the readings. Based on readings, the prediction of landslide is achieved successfully. The system senses data and transmits it continuously. When NodeMCU tries to connect with Wi-F it consumes 1.6 Watt (i.e. 320mA current is drawn with 5V supply voltage) and when NodeMCU gets connected to Wi-fi and sends data it consumes 0.49 Watt (i.e. 98mA current at 5V supply voltage). To minimize power consumption and increase the battery backup, the NodeMCU can be operated in duty-cycled mode. The system takes 10 ms time to collect data from sensor and transmit it to raspberry pi over MQTT. Also, additional 20 ms time is required to upload data from raspberry pi to ThingSpeak cloud. In order to cover large area, say 1000 sq. ft., approximately 375 nodes are required where one node consist of one soil moisture and one accelerometer. The proposed system uses 8-bit multiplexer, considering this, approximately 188 multiplexers and NodeMCU's are required to cover the aforementioned area. If the system uses 16-bit multiplexer, then approximately 94 multiplexers and NodeMCU's would be required. As the system uses raspberry pi at the monitoring center, machine learning can be implemented in the system through python programming in future work.

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