TRANSFORMER HEALTH MONITORING SYSTEM USING IOT

Submitted in partial fulfillment of the requirements for the award of

Bachelor of Engineering Degree in

Electrical and Electronics Engineering

by

S.swetha (Register No. 38140056)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
Accredited with Grade "A" by NAAC
JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **Swetha.s** (Reg. No 38140056) who carried out the project entitled **"TRANSFORMER HEALTH MONITORING SYSTEM USING IOT"** under our supervision from November 2021 to May 2022.

20/04/22

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Head of the Department

Submitted for Viva voce Examination held on_____________________

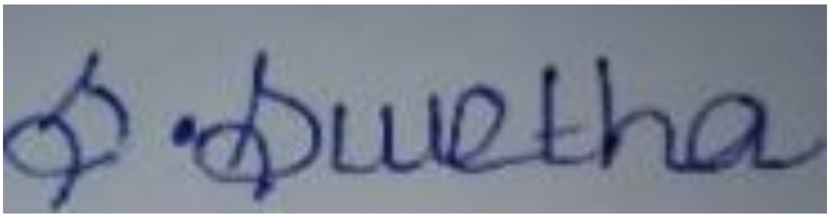
Name:

Signature:

Internal Examiner **External Examiner**

DECLARATION

We **SWETHA.S** (Reg. No. 38140056) hereby declare that the Project Report entitled **"TRANSFORMER HEALTH MONITORING SYSTEM USING IOT"** done by us under the guidance of **Dr.D.N.S.RAVIKUMAR** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electrical and Electronics Engineering.



DATE: 23/04/22. **1) Swetha.s**

PLACE : Chennai **SIGNATURE OF THE CANDIDATES**

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ABSTRACT

A recent huge interest in Machine to Machine communication is known as the Internet of Things (IOT), to allow the possibility for autonomous devices to use Internet for exchanging the data. This work presents design and execution of real time monitoring and fault detection of transformer and record key operation indictors of a dispersion transformer oil and encompassing temperatures. They have to look at it continuously by using this project it can minimize working efforts and improve accuracy, stability, efficiency in this project, sensors are used to sense the main parameters of equipment such as temperature and oil level this sensed data is sent to microcontroller and this controller checks parameter limits which further send to the IOT web server Adafruit software using Wi-Fi module of these data makes sure the right information is in hand to the operator and operator can make useful decisions before any catastrophic failure on basis of that data of parameters.

LIST OF FIGURES

LIST OF ABBREVATIONS

ASCII	- AMERICAN STANDARD CODE FOR INFORMATION INTERCHANGE
FTP	- FILE TRANSFER PROTOCOL
HF	- HIGH FREQUENCY
HTTP	- HYPERTEXT TRANSFER PROTOCOL
HTML	- HYPERTEXT MARKUP LANGUAGE
IC	- INTEGRATED CIRCUIT
I/O	-INPUT/OUTPUT
IDE	- INTEGRATED DEVELOPMENT ENVIRONMENT
KHZ	- KILO HERTZ
LCD	- LIQUID CRYSTAL DISPLAY
LED	- LIGHT EMITTING DIODE
LF	- LOW FREQUENCY
MHZ	- MEGA HERTZ
PWM	- PULSE WIDTH MODULATION
RAM	- RANDOM ACCESS MEMORY
UHF	- ULTRA HIGH FREQUENCY
VLF	- VERY LOW FREQ

CHAPTER 1

INTRODUCTION

Electricity plays an important role in our life. Every moment of our life depends upon electricity. Electricity has several components and equipment helping human to transfer and regulate the distribution according to usage. The most crucial equipment of transmission and distribution of electric power is transformer. In Power system, an electrical component transformer directly distributes power to the low-voltage users and its operation condition is an criteria of the entire network operation. The majority of the devices have been in service for many years in different (electrical, mechanical, environmental) conditions. They are the main components and constitute the large portion of capital investment. Operation of distribution transformer under rated condition (as per specification in their name plate) guarantees their long service life. However their Iife is significantly reduced if they are subjected to overloading, heating low or high voltage current resulting in unexpected failure and loss of supply to a large number of customers thus is effecting system reliability. Overloading, oil temperature load current and ineffective cooling of transformer are the major cause of failure in distribution transformer. As a large number of transformers are distributed over a wide

area in present electric systems, it's difficult to measure the condition manually of every single transformer. So we need a distribution transformer system to monitor all essential parameters operation, and send to the monitoring system in time. It provides the necessary information about the health of the transformer. This will help and guide the utilities to optimally use the transformer and keep this equipment in operation for a longer period This Proposed project presents design and implementation of a IOT embedded system to measure load currents, over voltage, transformer oil level and oil temperature. This is implemented by using on-line measuring system using Internet of Things (IOT), with single chip Arduino microcontroller and sensors. It is installed at the distribution transformer site. The output values of sensors are processed and recorded in the system memory. System programmed with some predefined instructions to check abnormal conditions. If there is any abnormality on the system, details are automatically updated in the internet through serial communication. This Internet of Things (IOT) will help the utilities to optimally utilize transformers and identify problems before any catastrophic failure occurs. Thus online measuring system is used to collect and analyze temperature data over time. So Transformer Health Measuring will help to identify or recognize unexpected situations before any serious failure which leads to a greater reliability and significant cost savings.

Transformer is one of the important electrical equipment that is used in power system. Monitoring transformer for the problem before they occur can prevent faults that are costly to repair and result in a loss of electricity. Currently, failure of the transformer can be detected by color changing of silica gel and decreasing the quality and viscosity of oil. The main aim of the project is to acquire real-time data of transformer remotely over the internet falling under the category of Internet of Things (IOT).

1. For this real-time aspect, we take one temperature sensor, one potential transformer and one current transformer for monitoring Temperature(T), Voltage(V), Current (I) data of the transformer and then send them to a remote location.

2. These three analog values are taken in multiplexing mode and connected to a programmable microcontroller of 8051 families through an ADC 0808.

3. They are then sent directly to a Wi-Fi module under TCP IP protocol to a dedicated IP that displays the data in real-time chart form in any web connected PC / Laptop for display in different charts. The real-time data is also seen at the sending end LCD display interfaced with the microcontroller

CHAPTER 2

LITERATURE SURVEY

most power companies, for online monitoring of power transformers, use supervisory control and data acquisition (SCADA) system, but for online monitoring of power transformer, the extending the SCADA system is an expensive proposition. Power transformers are currently monitored manually, where a person visits a transformer site, for maintenance and taking records purpose. But main drawbacks of these systems are, it cannot provide information about overloads (Voltage & Current) and overheating of transformer oil & windings. Due to these , the transformer life is reduced.

Monika Agarwal et al. [1] This paper represents that they are designing a system where there exits communication between system and operator. For this we are using Transformer, microcontroller, logic level converter and GSM i.e. global system for mobile communication modem. This GSM modem helps to monitor transformer health by sending message to the system.

Hongyan Mao, et al. [2] This paper represents a large number of power distribution transformer stations and they are far away from city, wireless GPRS transmission provides a good communication solution to supervise power distribution transformer stations. The scheme of remote wireless monitoring system for power distribution transformer station based on GPRS wireless network was designed in this paper. A control terminal system implement was mainly given, which adopted LPC2132 as main processor, GR47 as the date communication module. The monitor terminal software and flow chart were also designed. At last, the way of configuring the GPRS module to connect network is analyzed.

CHAPTER 3

3.1 EXISTING SYSTEM

This is presents design and implementation of a mobile embedded system to monitor and record key operation indicators of a distribution transformer like load currents, transformer oil and ambient temperatures. The proposed on-line monitoring system integrates a global service mobile (GSM) Modem, with standalone single chip microcontroller and sensor packages. It is installed at the distribution transformer site and the above mentioned parameters are recorded using the built-in S-channel analog to digital converter (ADC) of the embedded system.

The acquired parameters are processed and recorded in the system memory. If there is any abnormality or an emergency situation the system sends SMS (short message service) messages to designated mobile telephones containing information about the abnormality according to some predefined instructions and policies that are stored on the embedded system EEPROM. Also, it sends SMS to a central database via the GSM modem for further processing. This mobile system will help the utilities to optimally utilize transformers and identify problems before any catastrophic failure.

3.2 PROPOSED SYSTEM

The proposed project is about acquiring real time status of transformer health parameters. Temperature and oil level of transformers are monitored and send over internet The live tracking of these parameters can be done using IOT technology from anywhere around the world .This is cost effective in nature Thus the responsible authority can access information on any power failure or maintenance.

3.3 BLOCK DIAGRAM

C

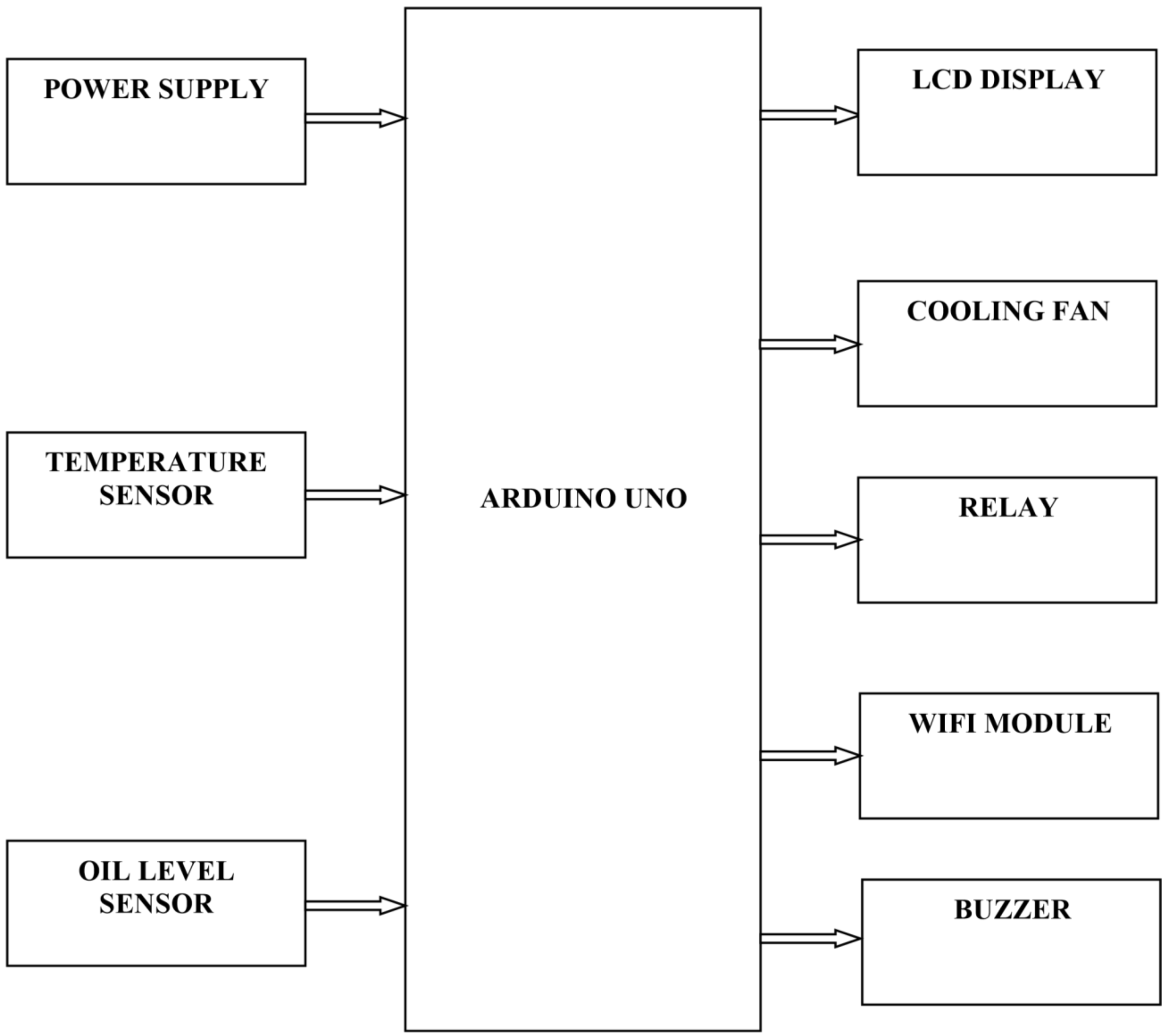

FIG 3.1 BLOCK DIAGRAM

3.4 WORKING PRINCIPAL

This system is designed for online monitoring of distribution transformers parameter can provide useful information about health which will help the utilities to optimally use their transformers and keep the asset in operation for a long time. In this system we used four sensors for monitoring that is level sensor temperature sensor, current sensor and voltage sensor. We used a power supply to operate arduino UNO and WiFi modem. Above figure shows the connection between all modules. Sensor sense the data and display it on LCD display at the same time Wi-Fi module sends the data to the user on given IP address as per program. If we get an unsecured data about the system can avoid failure. This is proposed a model of real-time transformer monitoring system using IoT. This is classified in four parts-power supply, controlling, data processing and data uploading.

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3.5 Temperature

Excessive load current alone may not result in damage to the transformer if the absolute temperature of the windings and transformer oil remains within specified limits. Transformer ratings are based on a 24-hour average ambient temperature of 30°C (86°F). Due to over voltage and over current, temperature of oil increases which causes failure of insulation of transformer winding.

3.6 Oil Level Fault

Oil mainly used in transformer for two purposes one is for cooling of transformer and another use is for insulation purpose. When temperature of transformer goes high, oil level in transformer tank decreases due to heating effect. For normal operation of transformer oil level should maintain at required level. If oil level decreases beyond required level, it affect cooling and insulation of the transformer.

CHAPTER 4

4.1 COMPONENTS DETAILS

HARDWARE CONFIGURATIONS

Arduino Uno

Power Supply

Temperature sensor

Ultrasonic Sensor

Relay

LCD Display

WIFI Module

DC fan

Buzzer

SOFTWARE CONFIGURATIONS

Arduino IDE

4.2 ARDUINO UNO

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. Message can be sent to the board what to do by sending a set of instructions to the microcontroller on the board. To do so the Arduino programming language and the Arduino Software (IDE) are used.

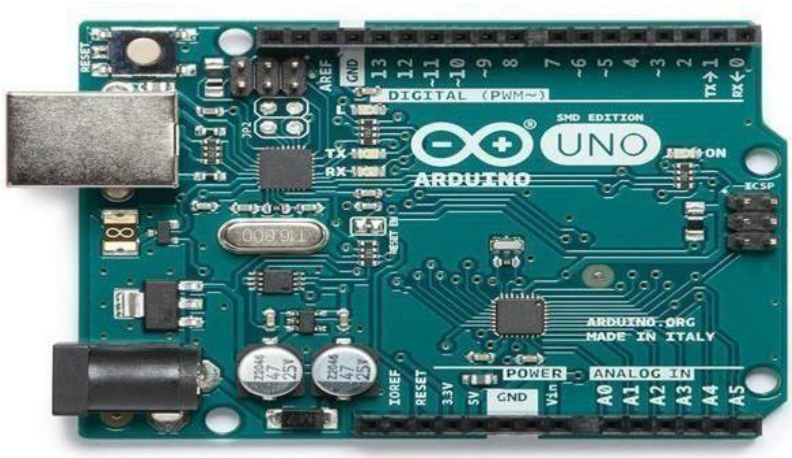


Fig.4.1Arduino UNO

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming.

As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IOT applications, wearable, 3D printing, and embedded environments.

4.2.1 CONFIGURATION

Ø Microcontroller ATmega328

Ø Operating Voltage 5V

Ø Input Voltage(recommended) 7-12V

Ø Input Voltage(limits) 6-20V

Ø Digital I/O Pins 14(of which 6 provide PWM Output)
Ø Analog Input Pins 6

Ø DC Current per I/O Pin 40 mA

Ø DC Current for 3.3V pin 50 mA

Ø Flash Memory 32 KB(ATmega328) of which 0.5 KB used by boot loader

Ø SRAM 2 KB (ATmega328)

Ø EEPROM 1 KB (ATmega328)

Ø Clock Speed 16 MHZ

4.2.2 ATMEGA 328P – MICROCONTROLLER

ATMEGA328P is high performance, low power controller from Microchip. ATMEGA328P is an 8-bit microcontroller based on AVR RISC architecture. It is the most popular of all AVR controllers as it is used in ARDUINO boards.

As said, first we need to program the controller and that is done by writing the appropriate program file in the ATMEGA328P FLASH memory. After dumping this program code, the controller executes this code and provides appropriate response. With program memory of 32 Kbytes ATMEGA328P applications are many. With various POWER SAVING modes it can work on MOBILE EMBEDDED SYSTEMS.

With Watchdog timer to reset under error it can be used on systems with minimal human interference.

With advanced RISC architecture, the controller executes programs quickly.

Also with in chip temperature sensor the controller can be used at extreme temperatures.

4.2.3 PINDIAGRAM

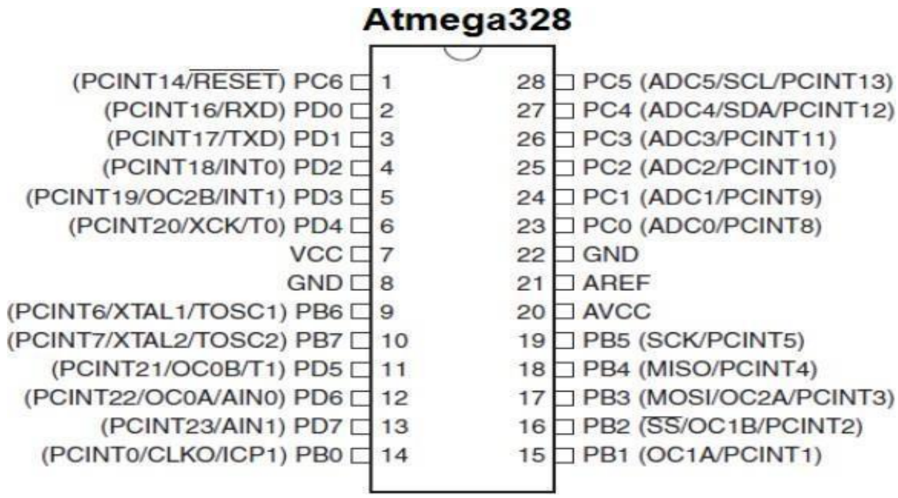


Fig.4.2 Pin Diagram

4.2.3.1)VCC

Digital supply voltage for MCU.

4.2.3.2) GND

Ground for MCU.

4.2.3.3) Port B (PB7:0)

XTAL1/XTAL2/TOSC1/TOSC2 Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, port B pins that are externally pulled low will source current if the pull- up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running.

4.2.3.4) Port C (PC5:0)

Port C is a 7-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The PC5..0 output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The port C pins are tri-stated when a reset condition becomes active, even if the clock is not running.

4.2.3.5) PC6/RESET

If the RSTDISBL fuse is programmed, PC6 is used as an input pin. If the RSTDISBL fuse is unprogrammed, PC6 is used as a reset input. A low level on this pin for longer than the minimum pulse length will generate a reset, even if the clock is not running. Shorter pulses are not guaranteed to generate a reset.

4.2.3.6) Port D (PD7:0)

Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, port D pins that are externally pulled low will source current if the pull-up resistors are activated. The port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.

4.2.3.7) AVCC

AVCC is the supply voltage pin for the A/D converter, PC3:0, and ADC7:6. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter.

4.2.3.8) AREF

AREF is the analog reference pin for the A/D converter.

By combining an 8-bit RISC CPU with in-system self-programmable flash on a monolithic chip, the Atmel ATmega328P is a powerful microcontroller that provides a highly flexible and cost effective solution to many embedded control applications. The ATmega328P AVR is supported with a full suite of program and system development tools including: C compilers, macro assemblers, program debugger/simulators, in-circuit emulators, and evaluation kits.

4.2.4 ARCHITECTURE DESIGN

The ATmega 328P is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega48P/88P/168P/328P achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.

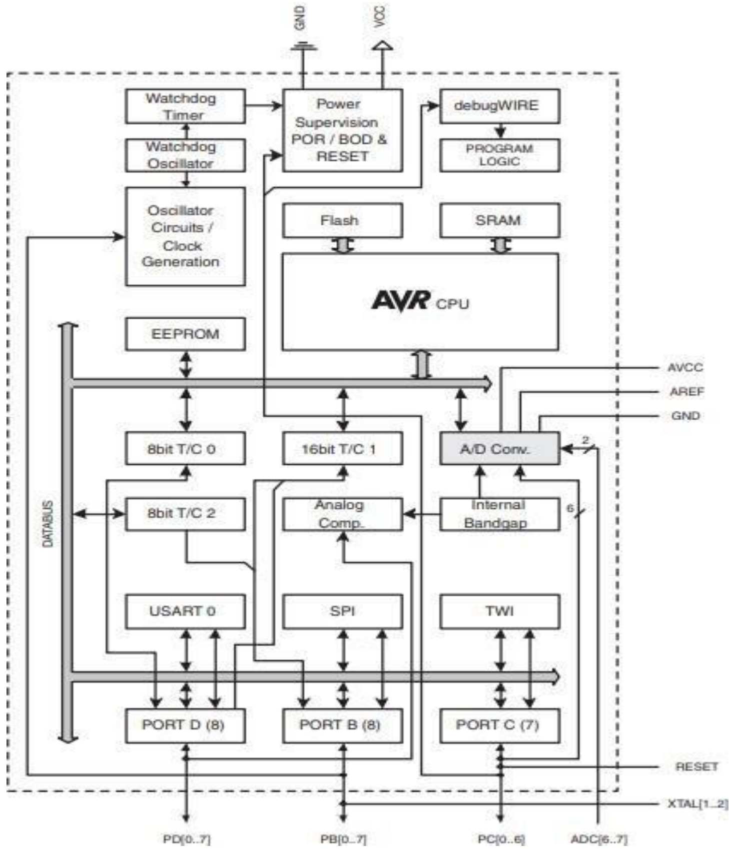


Fig.4.3 Architecture Design of AVR MCU - AT328P

The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

Since ATmega328P is used in Arduino Uno and Arduino nano boards, you can directly replace the arduino board with ATmega328 chip. For that first you need to install the Arduino bootloader into the chip (Or you can also buy a chip with bootloader – ATMega328P-PU). This IC with bootloader can be placed on Arduino Uno board and burn the program into it. Once Arduino program is burnt into the IC, it can be removed and used in place of Arduino board, along with a Crystal oscillator and other components as required for the project. Below is the pin mapping between Arduino Uno and ATmega328P chip**.**

The fast-access register file contains 8-bit general purpose working registers with a single clock cycle access time. This allows single-cycle arithmetic logic unit (ALU) operation. In a typical ALU operation, two operands are output from the register file, the operation is executed, and the result is stored back in the register file – in one clock cycle.

Six of the 32 registers can be used as three 16-bit indirect address register pointers for data space addressing – enabling efficient address calculations. One of the these address pointers can also be used as an address pointer for look up tables in flash program memory. These added function registers are the 16-bit X-, Y-, and Z-register, described later in this section. The ALU supports arithmetic and logic operations between registers or between a constant and a register. Single register operations can also/ be executed in the ALU. After an arithmetic operation, the status register is updated to reflect information about the result of the operation.

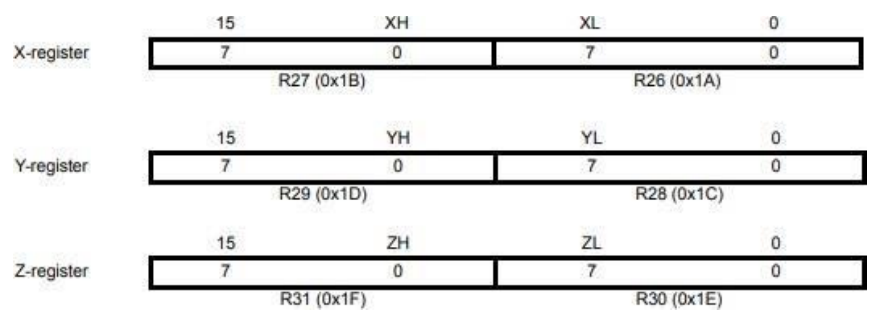


Fig.4.4 Arithmetic operation

Program flow is provided by conditional and unconditional jump and call instructions, able to directly address the whole address space. Most AVR instructions have a single 16-bit word format. Every program memory address contains a 16- or 32bit instruction. Program flash memory space is divided in two sections, the boot program section and the application program section. Both sections have dedicated lock bits for write and read/write protection. The SPM instruction that writes into the application flash memory section must reside in the boot program section. During interrupts and subroutine calls, the return address program counter (PC) is stored on the stack.

The stack is mainly used for storing temporary data, for storing local variables and for storing return addresses after interrupts and subroutine calls. Note that the stack is implemented as growing from higher to lower memory locations. The stack pointer register always points to the top of the stack. The stack pointer points to the data SRAM stack area where the subroutine and interrupt stacks are located.

A flexible interrupt module has its control registers in the I/O space with an additional global interrupt enable bit in the status register. All interrupts have a separate interrupt vector in the interrupt vector table. The interrupts have priority in accordance with their interrupt vector position.

The lower the interrupt vector address, the higher the priority. The I/O memory space contains 64 addresses for CPU peripheral functions as control registers, SPI, and other I/O functions. The I/O memory can be accessed directly, or as the data space locations following those of the register file, 0x20 - 0x5F. In addition, the ATmega328P has extended I/O space from 0x60 - 0xFF in SRAM where only the ST/STS/STD and LD/LDS/LDD instructions can be used.

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts. The power pins are as follows

- VIN. The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

- 5V Regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.

- A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

- GND Ground pins.

 Sleep modes enable the application to shut down unused modules in the MCU, thereby saving power.

 The AVR provides various sleep modes allowing the user to tailor the power consumption to the application’s requirements. When enabled, the Brown-out Detector (BOD) actively monitors the power supply voltage during the sleep periods.

4.2.5 CIRCUIT DIAGRAM

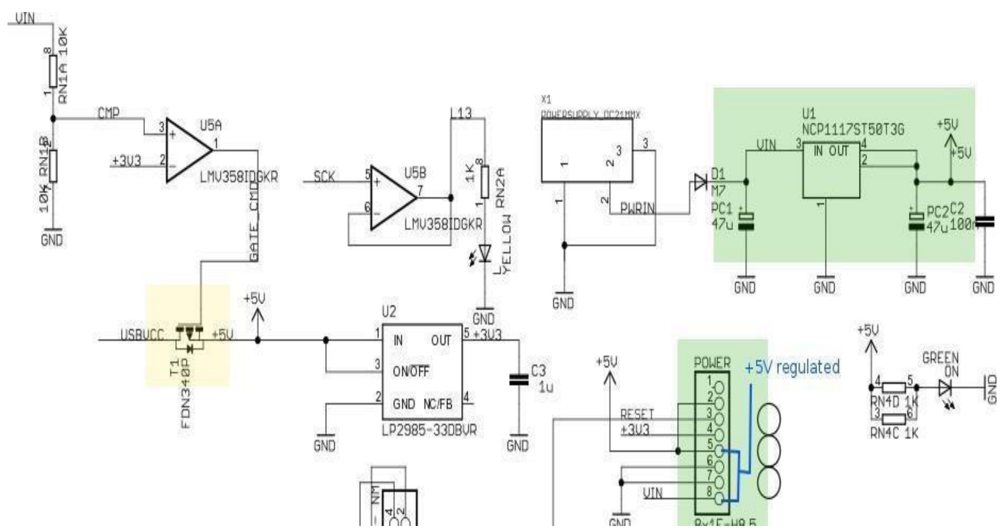


Fig.4.5 Circuit Diagram of Power Supply Design – Arduino UNO

4.2.6 MEMORY

The Atmega328 has 32 KB of flash memory for storing code (of which 0,5 KB is used for the boot loader); It has also 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library). It is organized as a separate data space, in which single bytes can be read and written. The EEPROM has an endurance of at least 100,000 write/erase cycles.

All ATmega48P/88P/168P/328P I/Os and peripherals are placed in the I/O space. All I/O locations may be accessed by the LD/LDS/LDD and ST/STS/STD instructions, transferring data between the 32 general purpose working registers and the I/O space. I/O Registers within the address range 0x00 - 0x1F are directly bitaccessible using the SBI and CBI instructions. In these registers, the value of single bits can be checked by using the SBIS and SBIC instructions. Refer to the instruction set section for more details. When using the I/O specific commands IN and OUT, the I/O addresses 0x00 - 0x3F must be used.

4.2.7 GENERAL PURPOSE INPUT AND OUTPUT

Each of the 14 digital pins on the Uno can be used as an input or output, using pin Mode (), digital Write (), and digital Read () functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 KOhms. In addition, some pins have specialized functions

Serial 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB- to-TTL Serial chip.

External Interrupts 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attach Interrupt () function for details.

PWM 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite () function.

SPI 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.

LED 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The Uno has 6 analog inputs, each of which provides 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analog Reference() function. Additionally, some pins have specialized functionality

I 2C 4 (SDA) and 5 (SCL). Support I2C (TWI) communication using the Wire library.

AREF. Reference voltage for the analog inputs. Used with analogReference(). • Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board. See also the mapping between Arduino pins and Atmega328 ports.

4.2.8 LAYOUT CONNECTION OF ARDUINO UNO

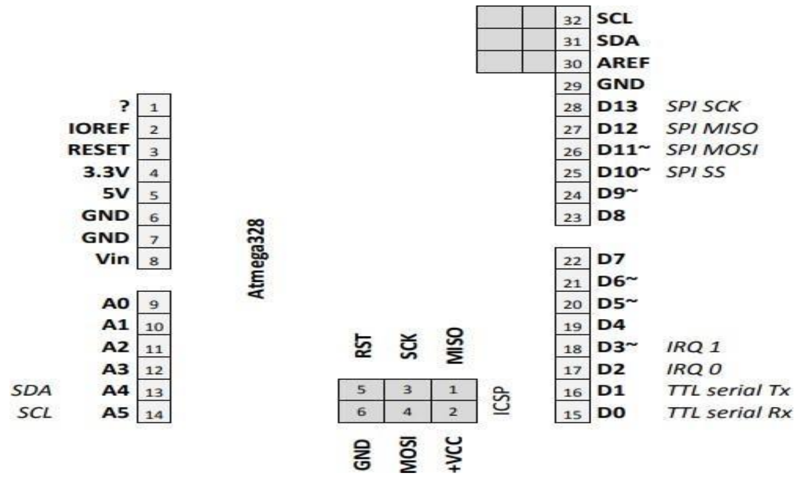


Fig.4.6 Layout diagram of Arduino

4.2.9 FEATURES OF ARDUINO

- Microcontroller ATmega328.
- Operating Voltage 5V.
- Input Voltage (recommended) 7-12V.
- Input Voltage (limits)
- Digital I/O Pins 14 (of which 6 provide PWM output)
- Analog Input Pins 6.
- DC Current per I/O Pin 40 mA.
- DC Current for 3.3V Pin 50 mA.
- Protocol : USART, SPI & I2C.

- Low Power Consumption 0.3mA/MHz
- Operating Frequency : 20 MHz

4.2.10 BENEFITS OFARDUINO

- Inexpensive - Arduino boards are relatively inexpensive compared to other microcontroller platforms
- Cross-platform - The Arduino software runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.
- Simple, clear programming environment - The Arduino programming environment is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well.
- Open source and extensible software - The Arduino software is published as open source tools, available for extension by experienced programmers.
- Open source and extensible hardware - The Arduino is based on Atmel's ATMEGA8 and ATMEGA168 microcontroller.

4.2.11 ARDUINO IDE

The Integrated Development Environment (IDE)is a combination of editor, linker and a compiler which helps the developer to make their Firmware for their Innovative Projects. Arduino IDE play a major role in open source platform for fast prototyping and easy to access of library. It is user friendly tool for beginners and it supports programming language like embedded C, Luna etc. Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. Its supports all the variant of Arduino boards like Arduino Uno, Nano and Mega etc. As soon as it reaches a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments

4.2.12 ARDUINO IDE SOFTWARE

With this Arduino Integrated Development Environment you can edit, compile and upad Arduino sketches to the Arduino boards.

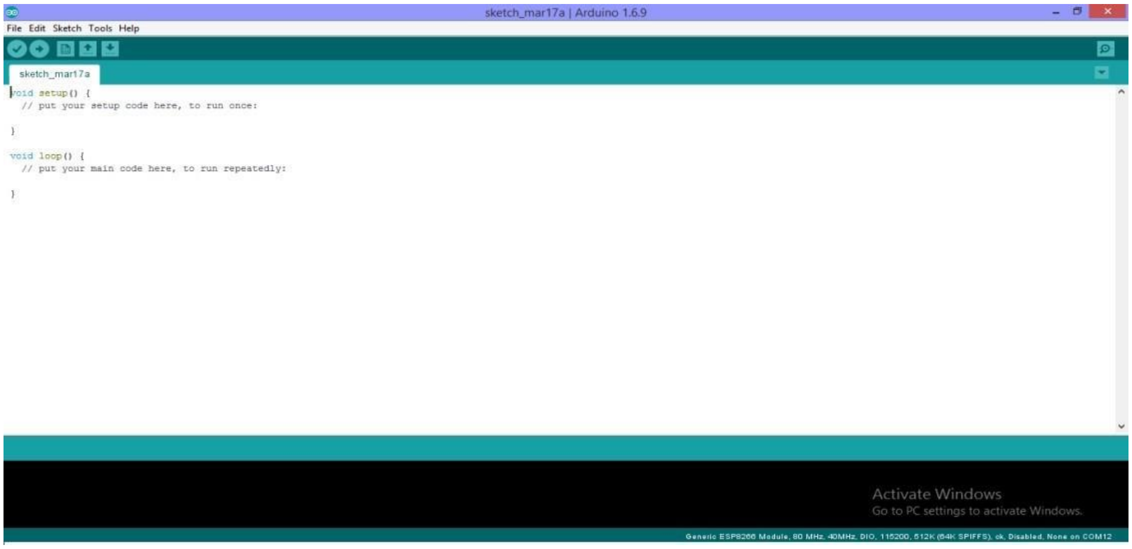


Fig.4.7 Arduino IDE software

4.3 POWER SUPPLY

This is a simple approach to obtain a 12V and 5V DC power supply using a single circuit. The circuit uses two ICs 7812 and 7805 for obtaining the required voltages. The AC mains voltage will be stepped down by the transformer, rectified by bridge and filtered by capacitor to obtain a steady DC level.The 7812 regulates this voltage to obtain a steady 12V DC. The output of the IC1 will be regulated by the 7805 to obtain a steady 5V DC at its output. In this way both 12V and 5V DC are obtained.

4.3.1 BLOCK DIAGRAM

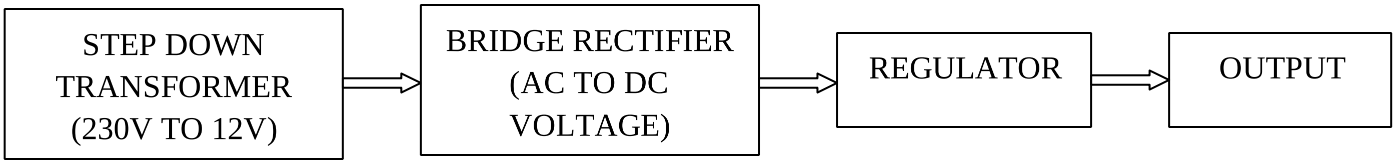


Fig.4.8 Block Diagram

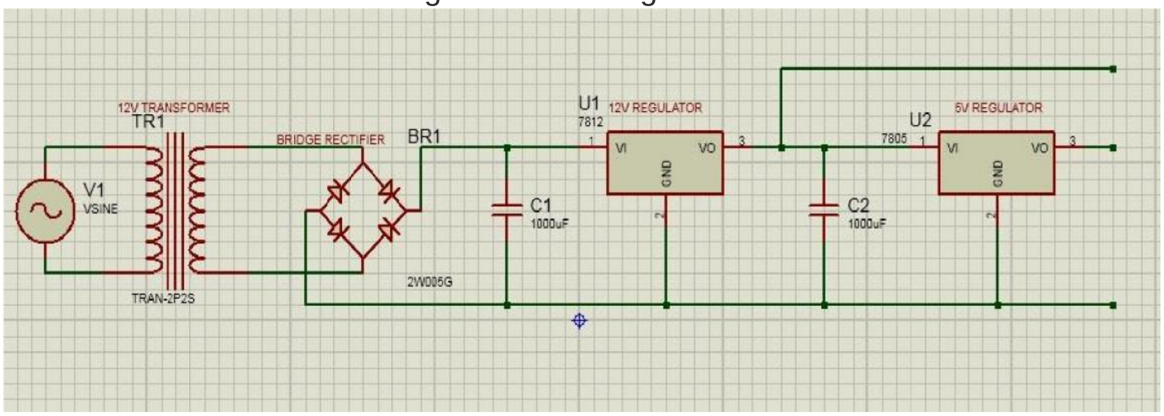
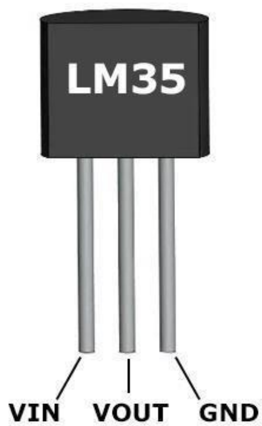


Fig.4.9 Circuit diagram

Initially small stepdown transformer is used to reduce the voltage level 230V AC into 12V AC. The output of the transformer is a pulsating sinusoidal AC voltage, which is converted to pulsating DC with the help of a rectifier. This output is given to a filter circuit which reduces the AC ripples, and passes the DC components. 7812 regulator is used to converts 12V DC study voltage. And 7805 regulator is converts constant 5V DC

4.4 LM35 4TEMPERATURE SENSOR

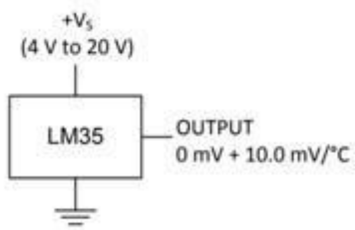
The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C to 150°C temperature range. Lower cost is assured by trimming and calibration at the wafer level. The low-output impedance, linear output, and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy. The device is used with single power supplies, or with plus and minus supplies. As the LM35 device draws only 60 µA from the supply, it has very low self-heating of less than 0.1°C in still air. The LM35 device is rated to operate over a −55°C to 150°C temperature range, while the LM35C device is rated for a −40°C to 110°C range (−10° with improved accuracy). The LM35-series devices are available packaged in hermetic TO transistor packages, while the LM35C, LM35CA, and LM35D devices are available in the plastic TO-92 transistor package. The LM35D device is available in an 8-lead surfacemount small-outline package and a plastic TO220 package.



4.4.1 HOW TO USE LM35 TEMPERATURE SENSOR:

LM35 is a precession Integrated circuit Temperature sensor, whose output voltage varies, based on the temperature around it. It is a small and cheap IC which can be used to measure temperature anywhere between -55°C to 150°C. It can easily be interfaced with any Microcontroller that has ADC function or any development platform like Arduino.

Power the IC by applying a regulated voltage like +5V (V_S) to the input pin and connected the ground pin to the ground of the circuit. Now, you can measure the temperate in form of voltage as shown below.



If the temperature is 0°C, then the output voltage will also be 0V. There will be rise of 0.01V (10mV) for every degree Celsius rise in temperature. The voltage can converted into temperature using the below formulae.

V_{OUT} = 10 mv/°C × T

where

- V_{OUT} is the LM35 output voltage
- T is the temperature in °C

4.4.2 LM35 TEMPERATURE SENSOR APPLICATIONS:

- Measuring temperature of a particular environment
- Providing thermal shutdown for a circuit/component
- Monitoring Battery Temperature
- Measuring Temperatures for HVAC applications.

4.4.3 FEATURES

- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor
- 0.5°C accuracy guaranteeable (at +25°C)
- Rated for full −55° to +150°C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts

- Less than 60 μA current drain

4.5 ULTRASONIC SENSOR

Ultrasonic ranging module HC - SR04 provides 2cm - 40cm the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitter, receiver and control circuit. The basic principle of work:

(1) Using IO trigger for at least 10us high level signal,

(2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back. (3) IF the signal back, through high level , time of high output IO duration is the time from sending ultrasonic to returning.Test distance = (high level time×velocity of sound (340M/S) / 2

4.5.1 INTERFACING PINS

5V Supply

Trigger Pulse Input

Echo Pulse Output

0V Ground

Ultrasonic transmitter emitted an ultrasonic wave in one direction, and started timing when it launched. Ultrasonic spread in the air, and would return immediately when it encountered obstacles on the way. At last, the ultrasonic receiver would stop timing when it received the reflected wave. As Ultrasonic spread velocity is 340m / s in the air, based on the timer record t, we can calculate the distance (s) between the obstacle and transmitter, namely: s = 340t / 2, which is so- called time difference distance measurement principle The principle of ultrasonic distance measurement used the already-known air spreading velocity, measuring the time from launch to reflection when it encountered obstacle, and then calculate the distance between the transmitter and the obstacle according to the time and the velocity. Thus, the principle of ultrasonic distance measurement is the same with radar. Distance Measurement formula is expressed as: L = C X T In the formula, L is the measured distance, and C is the ultrasonic spreading velocity in air, also, T represents time (T is half the time value from transmitting to receiving).

Ultrasonic Application Technology is the thing which developed in recent decades. With the ultrasonic advance, and the electronic technology development, especially as high-power semiconductor device technology matures, the application of ultrasonic has become increasingly widespread: Ultrasonic measurement of distance, depth and thickness; Ultrasonic testing;

Ultrasound imaging; Ultrasonic machining, such as polishing, drilling; Ultrasonic cleaning; Ultrasonic welding;

4.5.2 MODULE OPERATING PRINCIPLE

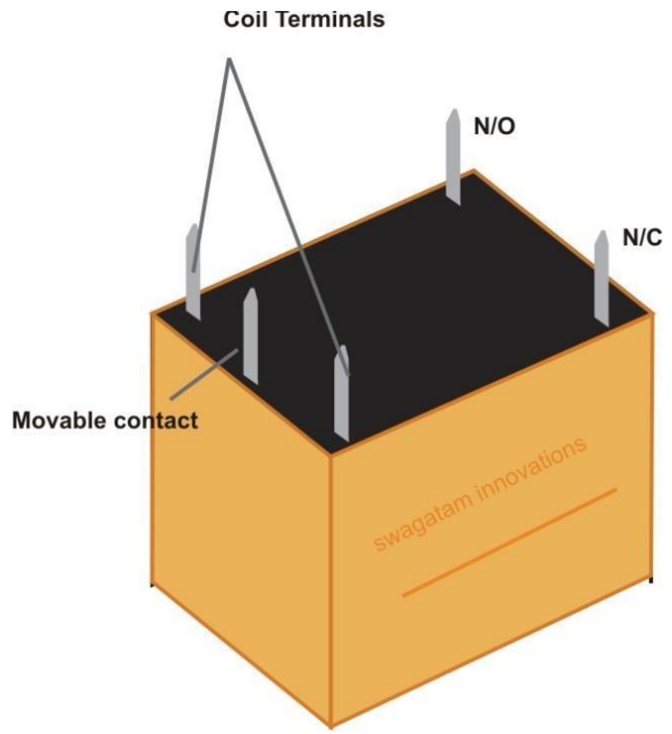
Set low the Trig and Echo port when the module initializes , firstly, transmit at least 10us high level pulse to the Trig pin (module automatically sends eight 40K square wave), and then wait to capture the rising edge output by echo port, at the same time, open the timer to start timing. Next, once again capture the falling edge output by echo port, at the same time, read the time of the counter, which is the ultrasonic running time in the air. According to the formular: test distance = (high level time * ultrasonic spreading velocity in air) / 2, you can calculate the distance to the obstacle.

4.5.3 ELECTRIC PARAMETERS:

- Working Voltage DC 5 V
- Working Current 15mA
- Working Frequency 40Hz
- Max Range 400cm
- Min Range 2cm
- MeasuringAngle 15 degree
- Trigger Input Signal 10uS TTL pulse
- Echo Output Signal Input TTL lever signal and the range in proportion
- Dimension 45*20*1

4.6 RELAY

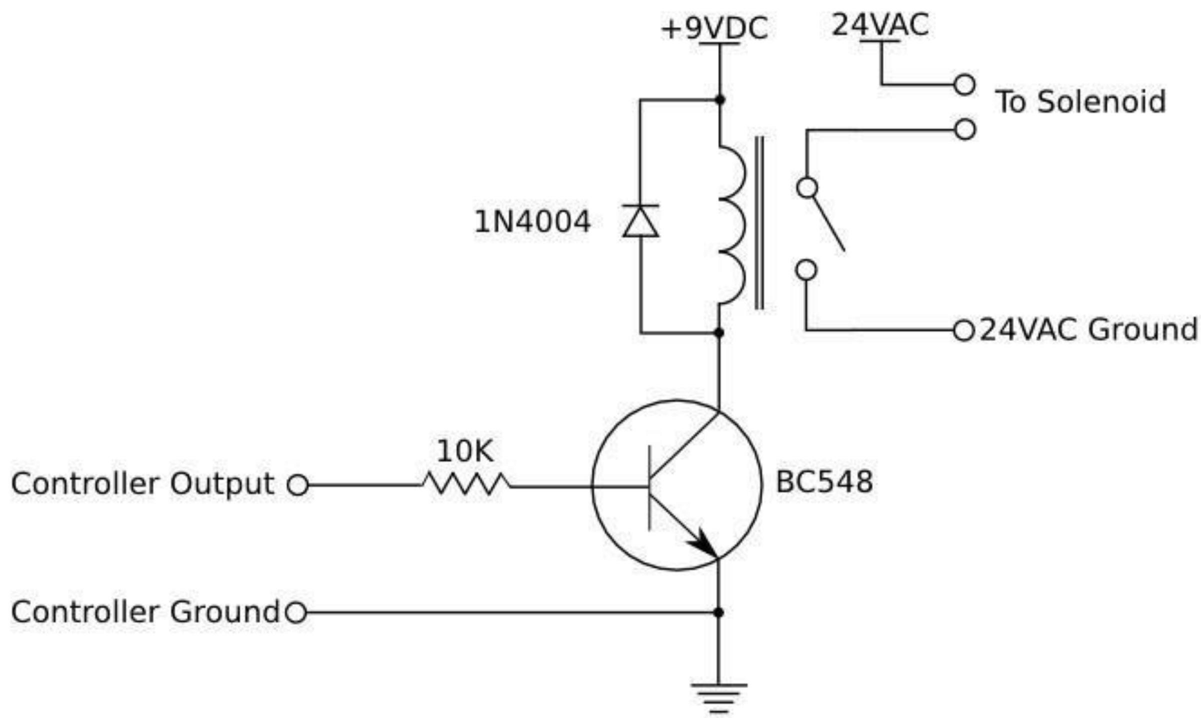
A relay is an electro mechanical switch, it consists of a coil. When small current flows through the coil, magnetic field is induced that causes the switch to move, to close or open the electrical connection. Typically a Relay is used to control High voltage (AC or DC) circuit using small DC voltage circuit without any direct electrical connection between them. It means, high voltage circuit and low DC voltage circuit are magnetically linked but electrically separated.



4.6.1 OPERATIONS OF RELAY

When small DC current flows through the coil of the relay, coil energizes. Thus the armature is attracted towards the NO (Normally Open) pin. When the current flow through the coil stops, armature comes back to the normal position, means COM pin is connected to NC (Normally Connected) pin. Relay operation is same for all basic relays.

4.16.2 **CIRCUIT DIAGRAM FOR RELAY DRIVER**



4.7 LCD DISPLAY

There are many display devices used by the hobbyists. LCD displays are one of the most sophisticated display devices used by them. Once you learn how to interface it, it will be the easiest and very reliable output device used by you! More, for micro controller based project, not every time any debugger can be used. So LCD displays can be used to test the outputs.

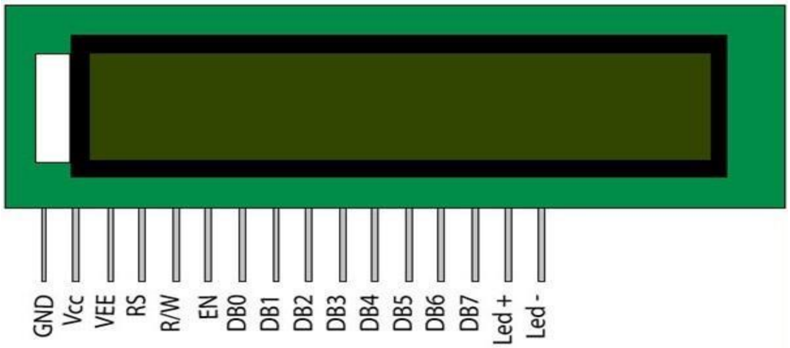


Fig.4.14 LCD Display

LCD accepts two types of signals, one is data, and another is control. These signals are recognized by the LCD module from status of the RS pin. Now data can be read also from the LCD display, by pulling the R/W pin high. As soon as the E pin is pulsed, LCD display reads data at the falling edge of the pulse and executes it, same for the case of transmission. LCD display takes a time of 39-43µS to place a character or execute a command. Except for clearing display and to seek cursor to home position it takes 1.53ms to 1.64ms. Any attempt to send any data before this interval may lead to failure to read data or execution of the current data in some devices. Some devices compensate the speed by storing the incoming data to some temporary registers.

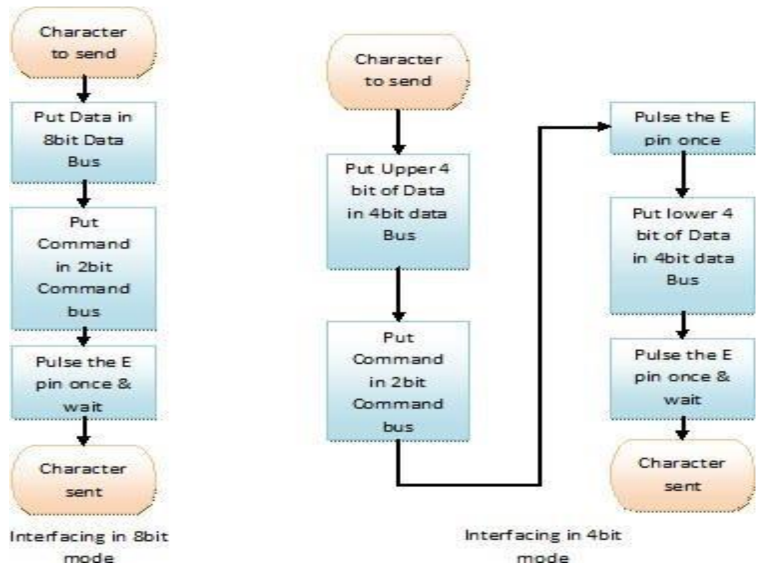


Fig.4.15 Flow chart of interfacing LCD display

LCD displays have two RAMs, naming DDRAM and CGRAM. DDRAM registers in which position which character in the ASCII chart would be displayed. Each byte of DDRAM represents each unique position on the LCD display. The LCD controller reads the information from the DDRAM and displays it on the LCD screen. CGRAM allows user to define their custom characters. For that purpose, address space for first 16 ASCII characters are reserved for users. After CGRAM has been setup to display characters, user can easily display their custom characters on the LCD screen.

4.8 BUZZER

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or key stroke. Buzzer is an integrated structure of electronic transducers, DC power supply, widely used in computers, printers, copiers, alarms, electronic toys, automotive electronic equipment, telephones, timers and other electronic products for sound devices. Active buzzer 5V Rated power can be directly connected to a continuous sound, this section dedicated sensor expansion module and the board in combination, can complete a simple circuit design, to "plug and play."

A buzzer or beeper is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke. It generates consistent single tone sound just by applying D.C voltage. Using a suitably designed resonant system, this type can be used where large sound volumes are needed. At Future Electronics we stock many of the most common types categorized by Type, Sound Level, Frequency, Rated Voltage, Dimension and Packaging Type.

Fig.4.17 Buzzer

4.8.1 FEATURES

- Input supply: 5 VDC
- Current consumption: 9.0 mA max.
- Oscillating frequency: 3.0 ±0.5 KHz
- Sound Pressure Level: 85dB min

CHAPTER 5

5.1 RESULT

5.1.1 Fault No.1

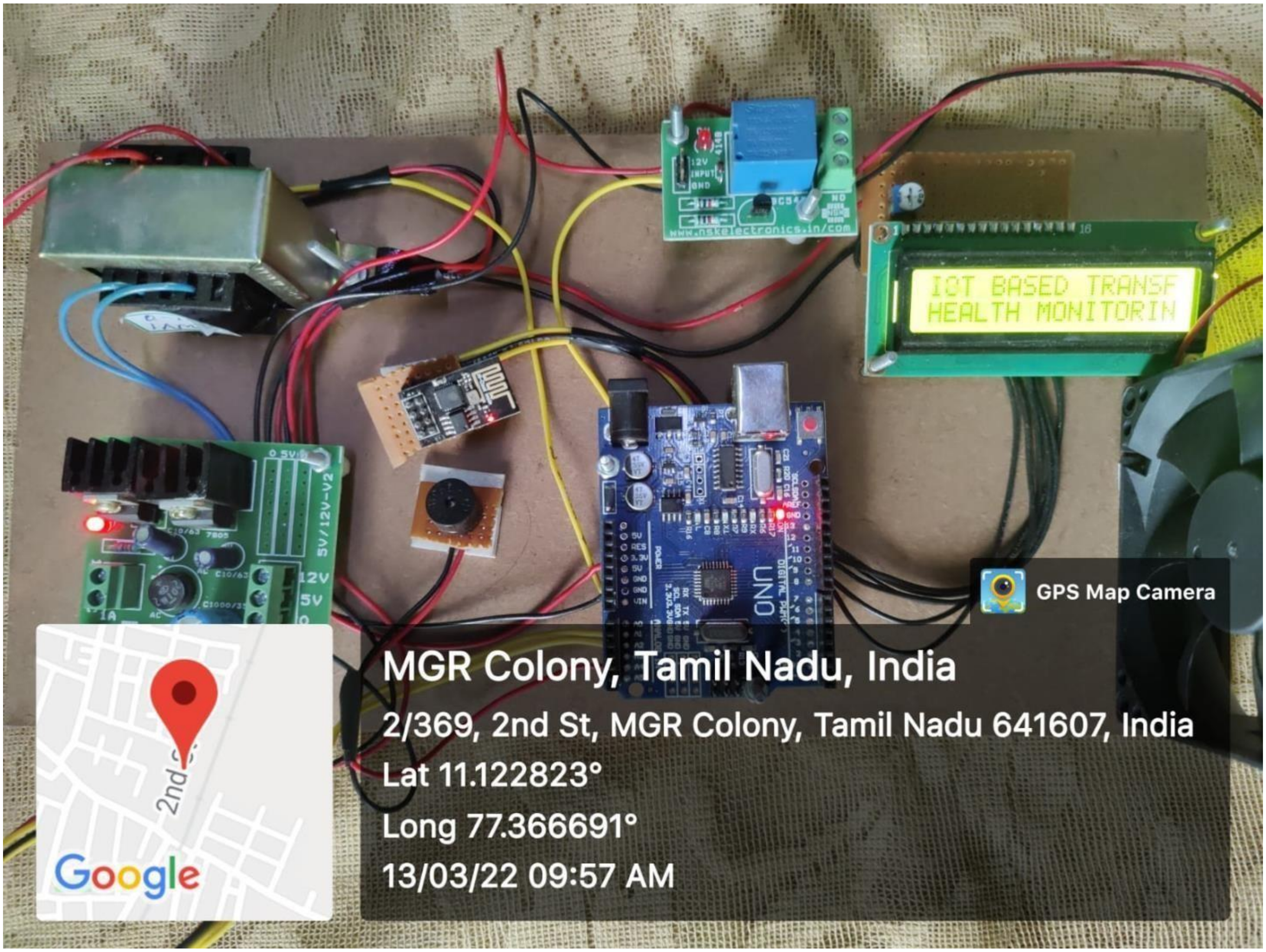
Temperature Ambient temperature of Transformer is high or it will be increase it sense through the sensor LM-35 and gives alert. Through buzzer and automatically cooling will be turn on.

5.1.2 Fault No.2- Oil Level

In this system in transformer oil level is low or high it sense the by using ultrasonic sensor it gives the alert through buzzer.

5.2 HARDWARE OUTPUT IMAGES

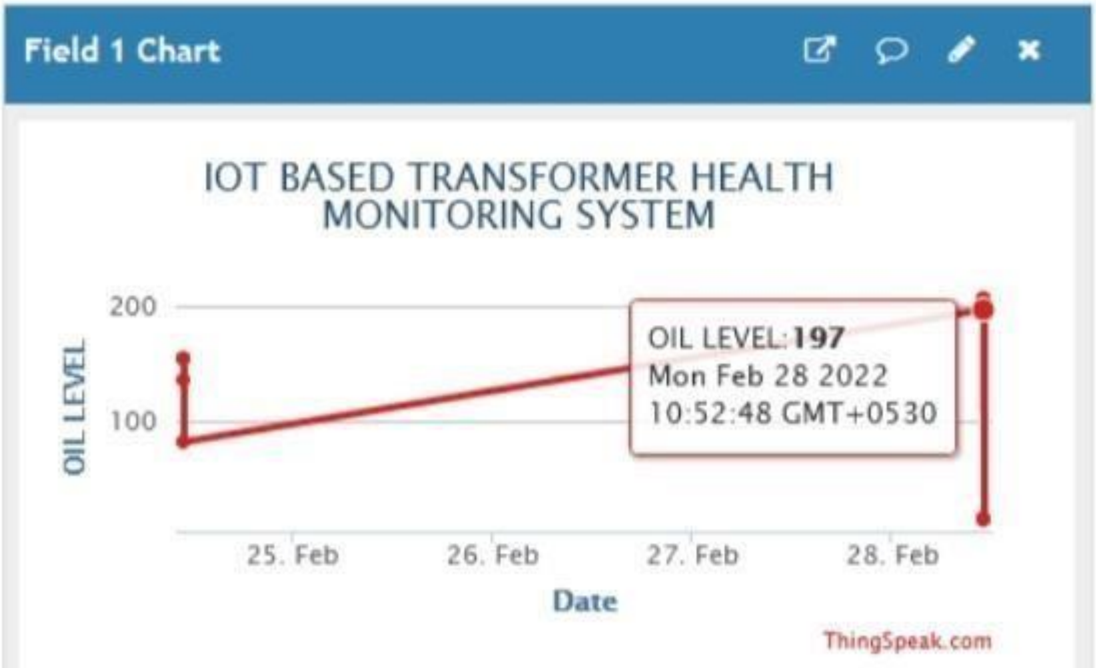

GPS Map Camera
MGR Colony, Tamil Nadu, India
2/369, 2nd St, MGR Colony, Tamil Nadu 641607, India
Lat 11.122823°
Long 77.366691°
13/03/22 09:56 AM
Google


IOT BASED TRANSF
HEALTH MONITORIN
GPS Map Camera
MGR Colony, Tamil Nadu, India
2/369, 2nd St, MGR Colony, Tamil Nadu 641607, India
Lat 11.122823°
Long 77.366691°
13/03/22 09:57 AM
Google

5.3 SOFTWARE OUTPUT

5.3.1 OIL LEVEL

OIL LEVEL



Field 1 Chart
IOT BASED TRANSFORMER HEALTH MONITORING SYSTEM
200
100
OIL LEVEL
OIL LEVEL: 197
Mon Feb 28 2022
10:52:48 GMT+0530
25. Feb
26. Feb
27. Feb
28. Feb
Date
ThingSpeak.com

5.3.2 TEMPERATURE

TEMPERATURE

Fig.5.1 Output Images

5.4 PROGRAM

```
#include<LiquidCrystal.h>
LiquidCrystal lcd(8,9,10,11,12,13);

#include <SoftwareSerial.h>
SoftwareSerial ser(3,2);

const int trigPin = 15; const int
echoPin = 16;

long duration; int distanceCm,
distanceInch; int fan = 7;
int buzzer = 19;
```

```
float valE =0,covalue=0;;
String apiKey = "AV8UVNJT3AW56IU2";
void setup()
{
    pinMode(A0,INPUT);   pinMode(fan,OUTPUT);
pinMode(buzzer,OUTPUT);    pinMode(trigPin,
OUTPUT);    pinMode(echoPin, INPUT);
  Serial.begin(9600);

 lcd.begin(16,2);
 lcd.setCursor(0,0);
 lcd.print("IOT BASED TRANSFORMER ");
 lcd.setCursor(0,1);
 lcd.print("HEALTH MONITORING");

  ser.begin(115200);   ser.println("AT+RST\r\n");
delay(8000);
 Serial.println("Change to station mode");
ser.println("AT+CWMODE=1\r\n");   delay(8000);
 Serial.println("Connect to a network");
//please enter wifi username and password
 ser.println("AT+CWJAP=\"OPPO\",\"caesarswetha\"\r\n");   delay(8000);
 Serial.println("Get the ip address assigned my the router");
 ser.println("AT+CIFSR\r\n");
 delay(8000);

 lcd.clear();

}

void loop()
{
digitalWrite(buzzer,LOW);
digitalWrite(fan,LOW);   digitalWrite(trigPin,
LOW);     delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);     duration =
pulseIn(echoPin, HIGH);     distanceCm=
duration*0.034/2;     distanceInch =
duration*0.0133/2; int temp=analogRead(A0);
int temp1=map(temp,0,1023,0,500);
```

```
   lcd.setCursor(0,0);
lcd.print("TEMP     =                    ");
lcd.setCursor(7,0);    lcd.print(temp1);
lcd.setCursor(0,1);      lcd.print("OIL LEVEL
= ");        lcd.setCursor(12,1);
if(distanceCm<10)
      lcd.print(0);
if(distanceCm<100)      lcd.print(0);
lcd.print(distanceCm);
delay(1000);   lcd.clear();
if(temp1>35)
  {
   digitalWrite(buzzer,HIGH); digitalWrite(fan,HIGH);
lcd.setCursor(0,0);    lcd.print("TEMPERATURE HIGH
");
    lcd.setCursor(0,0);
   lcd.print("COOLING FAN ON  ");    delay(5000);
  lcd.clear();
  }
  if(distanceCm<20)
 {
    digitalWrite(buzzer,HIGH);
lcd.setCursor(0,0);
lcd.print("OIL LEVEL LOW ");

   lcd.setCursor(0,1);      lcd.print("OIL
LEVEL = ");        lcd.setCursor(12,1);
if(distanceCm<10)
      lcd.print(0);       if(distanceCm<100)
lcd.print(0);       lcd.print(distanceCm);

       delay(3000);
lcd.clear();
 }
  digitalWrite(buzzer,LOW);
digitalWrite(fan,LOW);

  esp_8266(distanceCm,temp1);
}
void esp_8266(float  distanceCm,float temp1)
{

  char buf[32],a[32],c[32],d[32];
  String strVolt = dtostrf(distanceCm , 4, 1, buf);
```

```
 String strVolt1 = dtostrf(temp1, 4, 1, buf);


   Serial.print("OIL LEVEL = ");
  Serial.print(strVolt);
  Serial.println();
  Serial.print("TEMPERATURE = ");
  Serial.print(strVolt1);
  Serial.println();


   lcd.setCursor(0,0);     lcd.print("TEMP =
");    lcd.setCursor(7,0);     lcd.print(temp1);
lcd.setCursor(0,1);        lcd.print("OIL
LEVEL = ");        lcd.setCursor(12,1);
if(distanceCm<10)        lcd.print(0);
if(distanceCm<100)       lcd.print(0);
lcd.print(distanceCm);



  String cmd = "AT+CIPSTART=\"TCP\",\"";
cmd += "184.106.153.149";    cmd += "\",80";
ser.println(cmd);   delay(1000);

  if(ser.find("Error")){
   Serial.println("AT+CIPSTART error");     return;
  }


  String getStr = "GET /update?api_key=";
  getStr += "\r\n\r\n\r\n";


  cmd = "AT+CIPSEND=";
  cmd += String(getStr.length());
ser.println(cmd);   delay(1000);
if(ser.find(">")){     ser.print(getStr);
delay(6000);          ser.println("AT+CIPCLOSE");

    }
else{
ser.pri
ntln("
```

```
AT+C
IPCL
OSE")
;

   Serial.println("AT+CIPCLOSE");
  }


  delay(2000);
}
```

CHAPTER 6

6.1 CONCLUSION

The proposed technique with results has shown that the protection scheme works properly with accuracy, sensitivity of this scheme very high for the abnormal and faulty conditions. Transformer Health Monitoring will help to identify or recognize unexpected situations before any serious failure which leads to greater reliability and significant cost savings. If transformer is in abnormal condition we can know from anywhere. No human power need to monitor the transformer. Details about the transformer are automatically updated in cloud when the transformer is in abnormal condition

6.2 FUTURE SCOPE

In future work we can develop database of all parameters of distribution transformer which are placed at different places. We can get all information by placing the proposed system modules at every transformer. We can send the data through Wifi module and also through Ethernet shield. With Ethernet shield we can make remote terminal unit as a server and store data on webpage or website. A Wifi module connects to nearby network and sends information to monitoring node.

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[3].J. H. Estrada, S. Valencia Ramı´rez, C. L. Cortés, E. A. Cano Plata, "Magnetic Flux Entropy as a Tool to Predict Transformer's Failures", Magnetics IEEE Transactions on, vol. 49, pp. 4729-4732, 2013, ISSN 0018-9464

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