# A DESIGN OF BOILER FEED WATER AND TEMPERATURE MONITORING SYSTEM BESED ON PLC

A thesis report submitted to the department of mechanical engineering for the partial fulfillment of the degree of Bachelor of Science in Mechanical Engineering

A Thesis by


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# APPROVAL

This is to certify that the project on **"A DESIGN OF BOILER FEED WATER AND TEMPERATURE MONITORING SYSTEM BESED ON PLC".** By Md. Al-Mamun (ID No: BME 1901017553), Mst. Kohinur Aktar Lota (ID No: BME 1901017060), Md. Abdul Bari (ID No: BME 1901017640), Mahedi Hasan (ID No: BME 1802015322), Md. Mellat Hosen (ID No: BME 1901017534), Habibul Bashar (ID No: BME 1901017214) has been carried out under our supervision. The project has been carried out in partial fulfillment of the requirements of the degree of Bachelor of Science (B.Sc.) in Mechanical Engineering of years of 2022 and has been approved as to its style and contents.

**……..**

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# DECLERATION

We, hereby, declare that the work presented in this project is the outcome of the investigation and research work performed by us under the supervision of Md. Minhaz Uddin, Lecturer, Department of Mechanical Engineering, Sonargaon University (SU). We also declare that no part of this project and thesis has been or is being submitted elsewhere for the award of any degree.


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# Abstract

Boiler is the main component in generating steam in thermal power generation units and its control is very important in many applications. In present situation conventional PID control is being used for this purpose. These conventional controllers in power plants are not very stable when there are fluctuations and, in particular, there is an emergency occurring. Continuous processes in power plant and power station are complex systems characterized by nonlinearity, uncertainty and load disturbances. The conventional controllers do not work accurately in a system having nonlinearity in it. So, an intelligent control using fuzzy logic is developed to meet the nonlinearity of the system for accurate control of the boiler steam temperature and water level.

The Control system of the industry boiler water level is designed. The control algorithm used normalized PID control algorithm based traditional PID. A normalized parameter setting method is introduced for adjustment of PID parameters. The boiler water level control system is designed based on the King view software development platform. The main controller is realized with PLC. The configuration software is used to configure hardware and network. The experimental results prove that the combination of the PLC control system and King view configuration software is valuable for design, testing and application.

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# Chapter 1
# Introduction

## 1.1 Introduction

The boiler liquid level is a very important parameter. It is particularly important for boiler liquid level control system [1]. The PID control algorithm has been widely used in industrial [2] because the PID algorithm is accuracy and real-time. According to the dynamic characteristics of the control object, PID algorithm is used in P, PI, and PID control regulation. The most complex control uses the PID control law. But because of its parameter setting complexity and specialization, many applications are blocked. A normalized parameter setting method is introduced for parameter adjustment, which is greatly convenient for users to use. Configuration software King view is general configuration software which has such advantage as ease for use, openness, integration, and can complete the real-time multitask control [3][4]. Application of King view can also enable the engineer to focus on control object, instead of every communication protocol, complex graphics, and boring statistics [5]. The enterprise integrated automation can be realized. A real-time boiler liquid level monitoring and control system is designed based on King view software and PLC controller.

Temperature controllers are needed in any situation requiring a given temperature be kept stable. This can be in a situation where an object is required to be heated, cooled or both and to remain at the target temperature (set point), regardless of the changing environment around it. Temperature controllers are used in a wide variety of industries to manage manufacturing processes or operations. There are several reasons for using automatic temperature controls for steam applications. For some processes, it is necessary to control the product temperature to within fairly close limits to avoid the product or material being processed being spoilt. Steam flashing from boiling tanks is a nuisance that not only produces unpleasant environmental conditions, but can also damage the fabric of the building. Automatic temperature controls can keep hot tanks just below boiling temperature. Also for economy, quality and consistency of production, saving in manpower, comfort control, safety and to optimize rates of production in industrial processes boiler temperature control is necessary.

Conventional control system in power station adopts PID controller. system could not attain well result by using PID parameter which previously set. Since the introduction of fuzzy set theory by Zadeh and the first invention of a fuzzy controller by Mamadani, fuzzy control has gained a wide acceptance, due to the closeness of inference logic to human thinking, and has found applications in some power plants and power systems. It provides an effective means of converting the expert-type control knowledge into an automatic control strategy. A fuzzy control mainly simulates control experience of human and gets rid of control object. It discusses definite nature, fuzzy and imprecise information system control in the real world.

## 1.2 Objective:

The objectives of this thesis are …

1. To monitoring temperature of boiler.
2. To monitoring water level of boiler.
3. To control temperature automatically.
4. To achievement proper knowledge of PLC.
5. To achieved knowledge of wireless control system.
6. To know how to used protective device

# Chapter 02

# Literature Review

## 2.1 Introduction:

The boiler is the mechanical equipment that the water is heated into hot water or steam by using of fuel or other heat energy. The boiler can used to provide continuous hot water and central house heating. Boiler level is an important parameter of the boiler to ensure the normal operation. That the level is too low will affect the steam amount, then tends to dry out and even results into a serious accident, while the higher level will cause steam with entrained water and even overflow. Therefore, the boiler level must strictly be controlled [6][7]. Boiler liquid level is considered as the controlled variable. The main factors that change the boiler liquid level includes as follows: one is the boiler inflow; another is the boiler water yield. The change of the boiler water yield takes a certain time to react to the boiler level changes, but with relatively large time constant and longer time delay, which has not timely controlled to the system, weak anti-jamming capability and poor control accuracy.

## 2.2 THE FUNCTION OF BOILER LEVEL CONTROL SYSTEM

The history of drain cleaners parallels the development of common drain systems themselves. As a result, there is not an extensive history of cleaners in the US, as municipal plumbing systems were not readily available in middle-class American homes until the early 20$^{th}$ century. Prior to this time, Americans often discarded the dirty water collected in basins after use. Limited piping systems gradually developed with lead materials, but after WWI when the poisonous properties of lead became more well-known, piping was reconstructed with galvanized iron. Galvanized iron is actually steel covered in a protective layer of zinc, but it was soon discovered that this zinc layer naturally corroded due to exposure to the atmosphere and rainwater, as well as cement, runoff, etc. Once corrosion occurred down to the base metal, plaques and rust would form, leading to sediment build-up that would gradually clog these drains. Thus, the first motivation for drain cleaners came to be. The struggle against corroding galvanized iron pipes eventually led to are placement by copper orplastic (PVC) pipeing by the 1960s.Copper and plastic do not possess that zinc layer that naturally corrodes to expose the base metal to decay. Still, however, natural substances such as hair, grease, or other oils continued to be an issue in drain clogs, and so, the development of more effective chemical drain cleaners became necessary.

Therefore, the system by using the real-time monitoring and control system based on King view software improves the control accuracy, and through PID control [8] makes the boiler level vary with the given value. Furthermore, when the system suffers disturbance, the level will finally stabilize at the given value. The monitoring and control system adjusts the inlet valve opening according to the boiler level h, thus allows eventually the level hr reach the setting value hc, and finally meets the control requirements.

THE ALGORITHM OF WATERLEVEL CONTROL

The output of the PID controller for boiler water level control system is showed as formula

$$u(t) = K_P e(t) + K_I \int_0^t e(t)dt + K_D \frac{de(t)}{dt} \qquad (1)$$

where KP is the proportional coefficient, KI=KP•T/TI is the integral coefficient, TI is the integral time, T is the sampling period, KD=KP•TD/T is the differential coefficient, TD is differential time. The role of PID algorithm as follows:

(1) Proportion: Reflect the difference between the signal control system, deviation once generated, regulator immediately produce the control, reduce the error.

(2) Integral: To eliminate the static error, and improve the system stability, integral time constant TI increased integral effect is weak, whereas more strong.

(3) Differential: To reflect the variation trend of deviation in the deviation becomes too large, before effective introduction of early correction of signal, to reduce the time of system regulation.

THE DESIGN OF HARDWARE SYSTEM

The control system structure shows in Figure 2, where the transmitter is used to convert actual level into the analog electrical signal and transmit to the control center or display devices. The output signal of transmitter depends on the specific application, of which some are simulation, other digital. Figure 2 is a structure diagram of continuous system, which cannot design the digital controller until discrete treatment.

The system hardware structure diagram is given in Figure

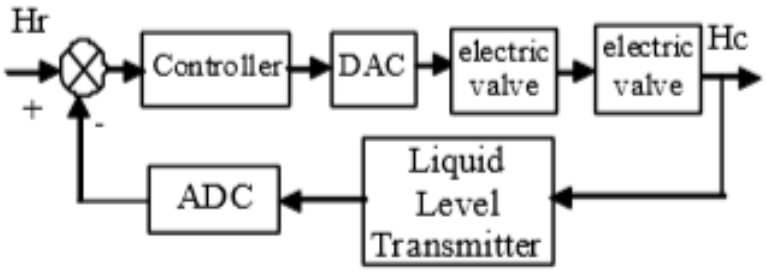



Fig. 2. Structure of level control system

*Figure 2. 1 Structure of level control*

The industrial control computer is used as host controller of the liquid level control system. The programmable logic controller (PLC) is used as slave controller of the liquid level control system. The interface of slave controller includes the analog to digital converter (ADC) and the digital to analog converter (DAC). The PCL-818L is the ADC module from Yan Hua corporation. The PCL-726L is the DAC module from Yan Hua. The actuator of control system uses the electromagnetic valve. In figure 3, the liquid level sensor and the turbine flowmeter via standard industry connector box send the collected data to DAC module from Yan Hua Corporation, through RS485/RS232 by PLC, and then send out data to the host computer, which records and analysis. According the results PLC transmits control signals to the electronic valve, and then changes the valve opening, finally finishes the purposes that adjust the boiler inflow to achieve control

## 2.4 Chemical Drain Cleaners

Be they liquid, gel or powder form, most of the drain cleaners you'll find on stores helves use strong chemicals, and they come in liquid, gel and powder forms. All chemical reactions involve moving electrons, and drain cleaners work by either taking or giving electrons to the clogging substance, generating heat in the process. There are three main types of drain cleaners:

Aside from their effect on pipes, there are other disadvantages to chemical drain cleaners. They’re extremely toxic if swallowed, and they can burn eyes, skin and mucous membranes and eat through clothing. They can release noxious fumes, and if used improperly, they can cause explosions. These products can also harm epic systems by killing beneficial bacteria, and they can bathroom and kitchen fixtures. If you use chemical drain cleaners, read the directions carefully and heed all the warnings. Use the product in a well-ventilated area, wear rubber gloves, and keep children and pets away from the drain. Never mix different drain cleaners, and don't us expunger in conjunction with drain cleaners. Most drain cleaners advise waiting 15 minutes or more after pouring the product in to the drain before flushing it with hot water. If your drain is still clogged a afterward, you may need to repeat the process.

## 2.6 The Design of Alarm System

In King view Touch Explorer directory, after choosing "database alarm group", double click on the Icon of "please double click here to enter < alarm group > dialog box..." showed in the right area. Then popup the dialog for the alarm group definitions, as well as set the variables alarm attribute and alarm group for the project (such as boiler level alarm).

## 2.7 The Design of Trend Curve

Trend curve, including real-time trend curve and history trend curve, is used to reflect the change of the data variables with time. The difference between the two kinds of trend curves is that during running the picture program, real-time trend curve rolls automatically with time, and responds the latest variables change, therefore cannot reflects the variable history data. The history trend curve can observe the historical data, but it does not automatically scroll. In the establishment of two kinds of trend curves, the X, Y scale interval and data update frequency etc are also needed to define.

## 2.8 Parameter Setting

When system is running, the user can modify the boiler level given value and can adjust PID control parameters. The interface window of parameter setting is included in the main monitoring interface window. The actual boiler level will track the given value by control system.

# Chapter 03

# Methodology

## 3.1 Process of Project:

- Creating an idea for Design and construction of Android Control Automatic Drain Cleaner.
- And designing a block diagram & circuit diagram to know which components need to construct it.
- Collecting the all components and programming for the microcontroller to controlled the system.
- Setting all components in a PCB board & soldering. Then assembling the all block in a board and finally run the system &checking.

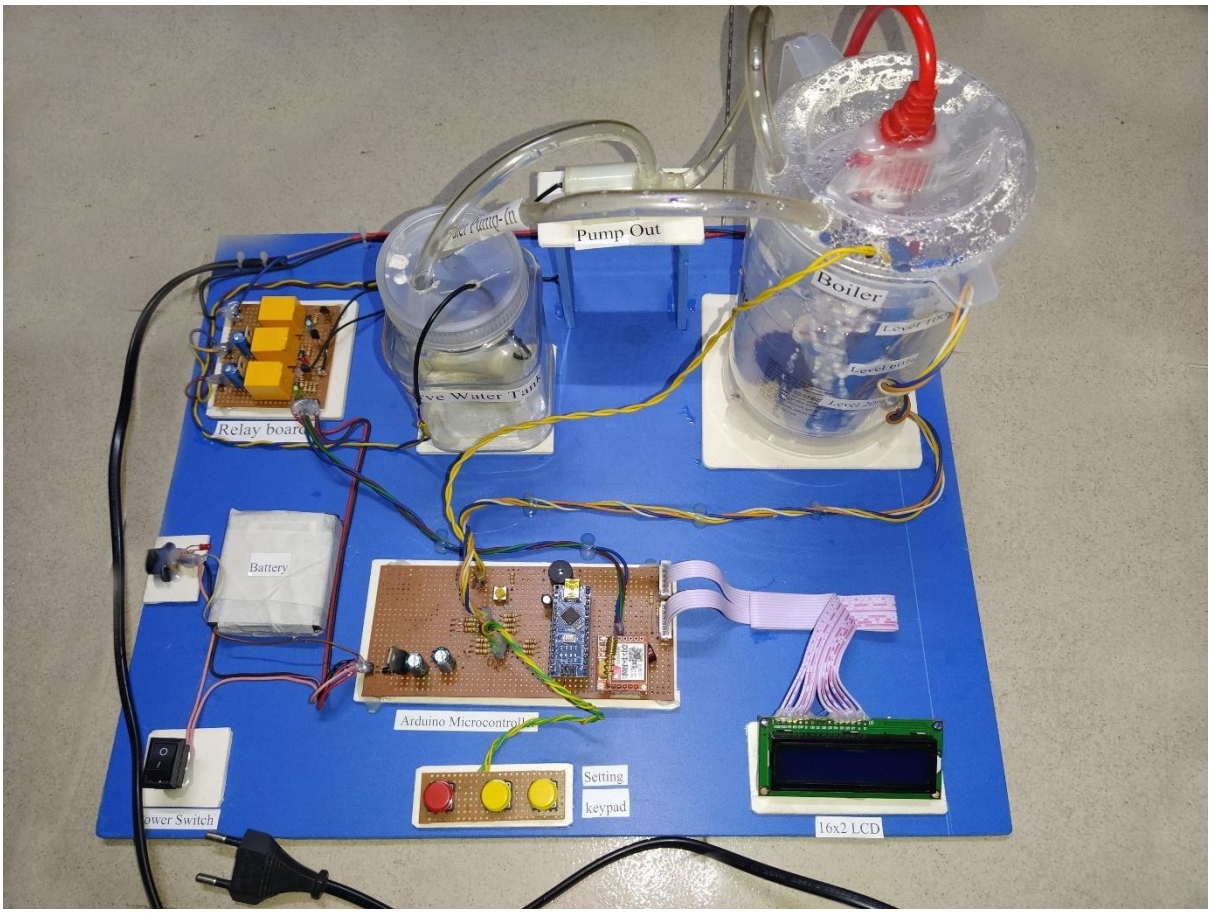



Figure 3.1 Complete Project Picture.

### 3.2 Block Diagram:

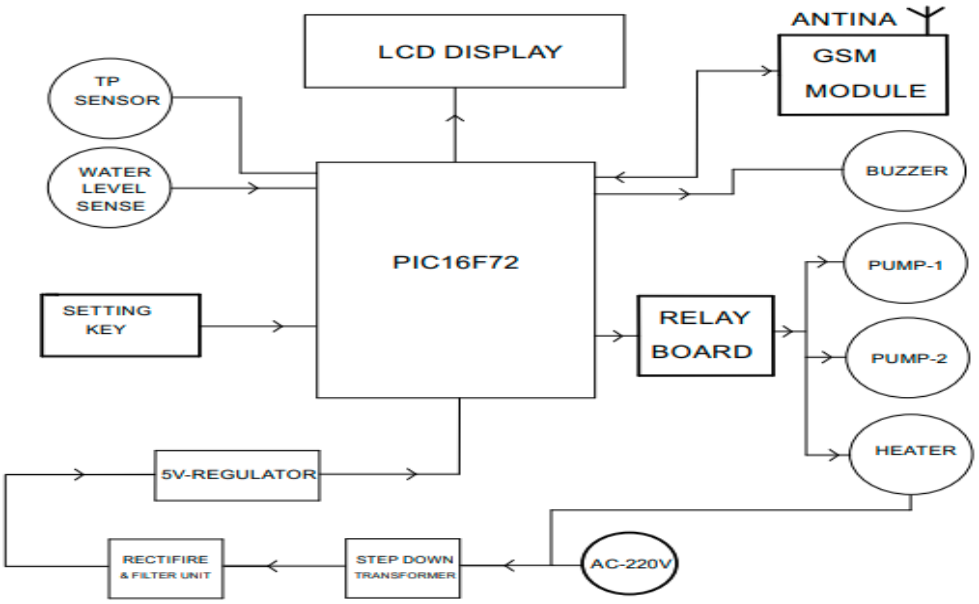



Figure 3.2 Block Diagram of Boiler water flow and temperature control system

### 3.3 Circuit Diagram:

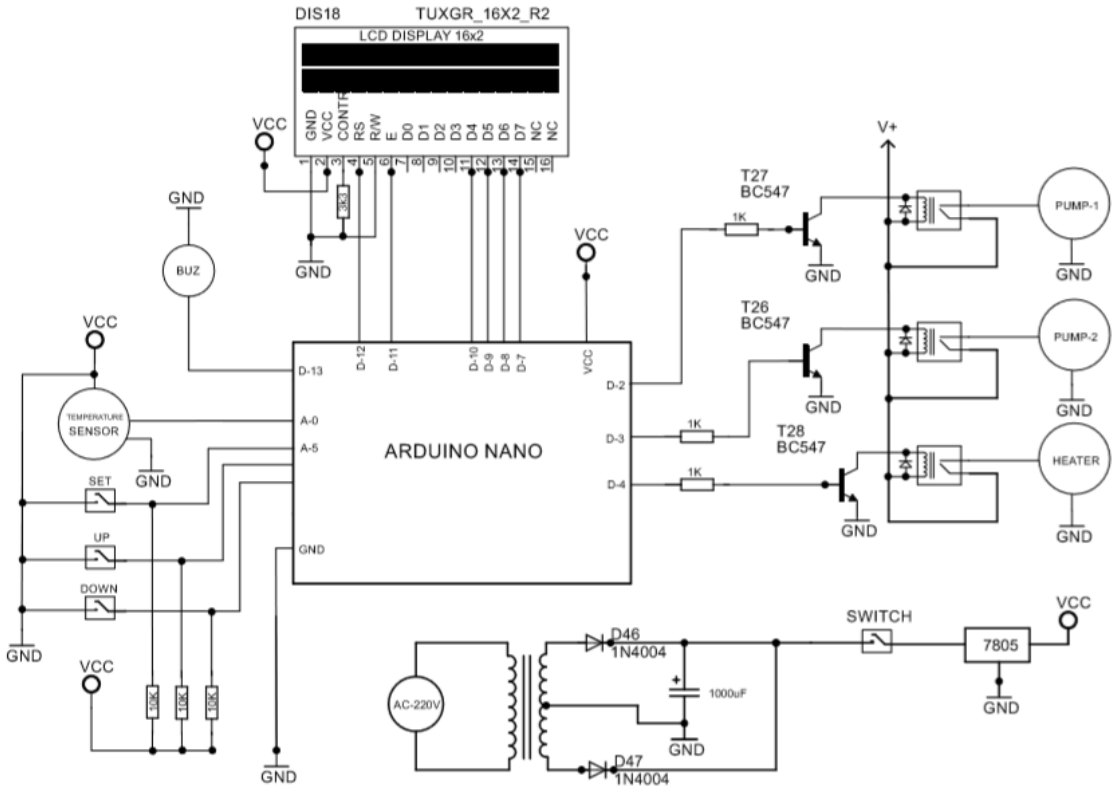



figure 3. 3Boiler water flow and temperature control system

## 3.4 Working Principal:

In this Boiler water flow and temperature control system project we use Arduino Nano microcontroller, 12v adapter, 5v dc water pump, 16x2 LCD display, 7805 voltage regulator, 12v dc relay, GSM module, and 220v-500w water heater.

Arduino nano have 2 types of input /output pin Analog pin and Digital pin Analog pin also called Analog to Digital Converter (ADC) pin. For Input single we use analog pin A0 for temperature data read, A1 for 100% water level, A2 for 50% water level, A3 for 25% water level. A4- A7 pin for setting keyboard ( A5 for UP button, A6 for Down button, A7 for Set button. TX and RX pin of Arduino use for GSM module. D2 pin for pump-1 (water in Pump), D3 pin for pump-2 (water out Pump) and D-4 for heater on and off. D7-D12 for LCD data pin and D13 for alarm system. We use 12v adapter for supply for control section and water pump and 220v supply for heater. 12v dc supply connect with input of 7805 voltage regulator and this regulator output supply 5v regulated supply that called VCC and negative supply of 12v adapter is called GND. In starting we press set button and set heater on temperature we can change value of temperature setting using up and down button. Then we again press setting button for set heater off temperature. If water level less 25% then system automatically on pump -1 and when water level 100% then pump-1 automatically off. We can turn on and off Pump-2 using GSM commanding. If boiler temperature > heater off temperature then microcontroller turn off heater and if boiler temperature <heater on temperature then microcontroller automatically turn on heater.System send every information to our phone using GSM module. like pump on and off, heater on and off, water level and temperature.

Also we can see water level and temperature value in 16X2 LCD. We use 12v relay for switching power for two pump and heater.

### 3.4.1 PROPOSED METHODOLOGY

The proposed method consists of two sections. First section is to develop a steam temperature monitoring and control system and the second section consists of water level control. For both of the sections Fuzzy Logic Control will be used. A microcontroller will be programmed with the fuzzy knowledge base rule. The temperature sensor will be interfaced with the microcontroller to monitor the steam temperature and a level indicator circuit will be interfaced with the microcontroller which will indicate the water level inside the boiler chamber. The microcontroller will take the temperature sensor output and level indicator output as the two inputs for the Fuzzy Inference System. After russification of the inputs and applying suitable rules and defuzzifying the output the microcontroller generates appropriate control signals.

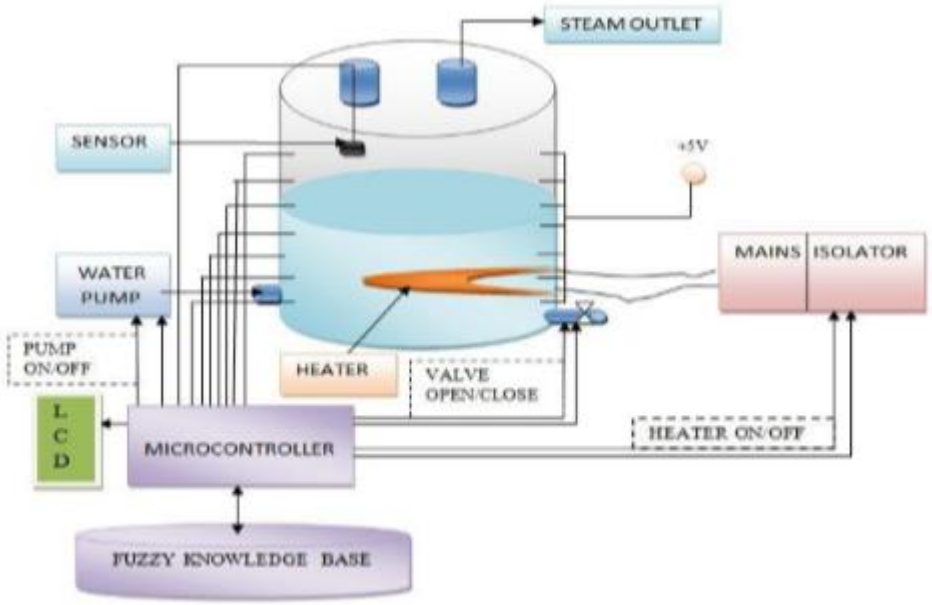



Fig.2. Proposed FLC based boiler control

*Figure 3. 4 Process of FLC based boiler control*

### 3.4.2 TEMPERATURE MONITORING & CONTROL

Temperature Monitoring

The temperature is measured using the sensor. The sensor output is compared with the set value. The error or deviation from the set value is given as an input to the fuzzy logic control system.

### 3.4.3 Temperature Control

The Fuzzy Inference system fuzziest the inputs and applies suitable rules and calculates the defuzzified value. It then decides the suitable control action to be per- formed. The microcontroller gives command to perform the required control action to turn the heater ON/OFF for safe operation of the boiler.

### 3.4.4 LEVEL CONTROL

The water level control is also an important parameter for boiler control. The water level inside the boiler chamber needs to be controlled because of changing load demand. When there is a need of more steam water level should be high and when there is a need of less steam the water level should be low. To maintain the water level inside the boiler, chamber a level indicator

circuit is used and the circuit is interfaced with the microcontroller. The Fuzzy Inference System stored inside the microcontroller then fuzziest the inputs and applies suitable rules and then gives the defuzzified values which is then processed by the microcontroller to give the suitable control action to turn ON/OFF the inlet pump and OPEN/CLOSE the outlet valve.

FUZZY INFERENCE SYSTEM

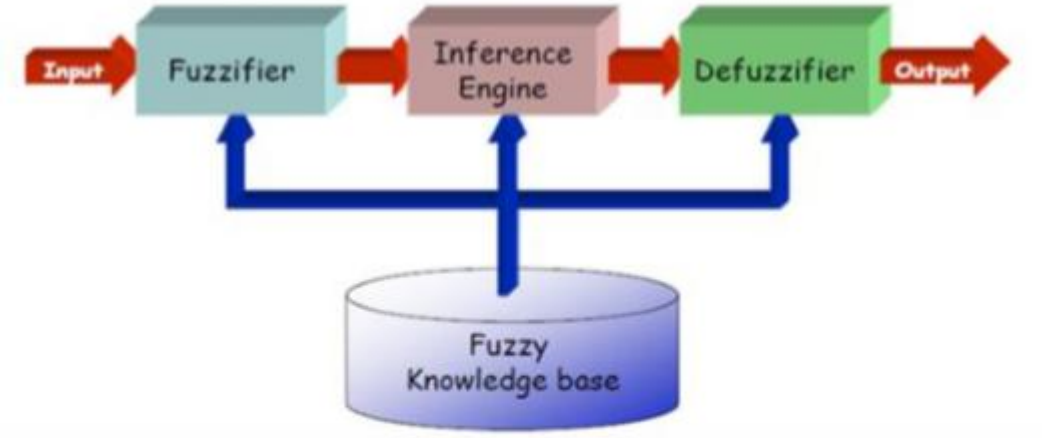



Fig.6. Block diagram of fuzzy inference system

*Figure 3. 5**Fuzzy interface system***

### 3.5 Required component:

# LIST OF COMPONENT

| SL | COMPONENT NAME | QTY |
|---|---|---|
| 1. | ARDUINO NANO | 1 |
| 2. | 16X2 LCD DISPLAY | 1 |
| 3. | TEMP SENSOR | 1 |
| 4. | 12V RELAY | 2 |
| 5. | 12V TRANSFOMER | 4 |
| 6. | BUZZER | 1 |
| 7. | DIODE | 5 |
| 8. | CAPACITOR | 5 |
| 9. | RESISTER | |
| 10. | BC547 TRANSISTOR | 3 |
| 11. | BD135 TRANSISTOR | 2 |
| 12. | LED | |
| 13. | POWER SWITCH | 1 |
| 14. | 7805 REGULATOR | 1 |
| 15. | AC CORD | 1 |
| 16. | PCB BOARD | 1 |
| 17. | PROJECTS STRUCTURE | 1 |
| 18. | HEATER | 1 |
| 19. | BOILER POT | 1 |
| 20. | TANK POT | 1 |
| 21. | 5V DC PUMP | 2 |
| 22. | PUSH SWITCH | 3 |

## 3.6 Arduino Nano Microcontroller Board

### 3.6.1 Defining Arduino Nano

An Arduino is actually a microcontroller based kit which can be either used directly by purchasing from the vendor or can be made at home using the components, owing to its open source hardware feature. It is basically used in communications and in controlling or operating many devices. It was founded by Massimo Banzi and David Cuartielles in 2005.

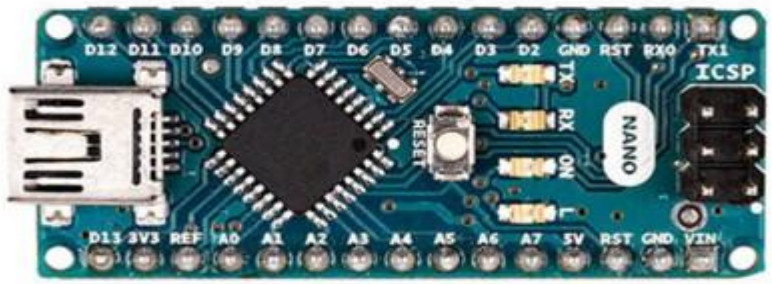



*Figure 4. 1 Arduino NANO*

### 3.6.2 How to Design your own Arduino?

We can also design our own Arduino by following the schematic given by the Arduino vendor and also available at the websites. All we need are the following components- A breadboard, a led, a power jack, a IC socket, a microcontroller, few resistors, 2 regulators, 2 capacitors.

The IC socket and the power jack are mounted on the board.

Add the 5v and 3.3v regulator circuits using the combinations of regulators and capacitors. Add proper power connections to the microcontroller pins. Connect the reset pin of the IC socket to a 10K resistor. Connect the crystal oscillators to pins 9 and 10 Connect the led to the appropriate pin. Mount the female headers onto the board and connect them to the respective pins on the chip. Mount the row of 6 male headers, which can be used as an alternative to upload programs.

Upload the program on the Microcontroller of the readymade Arduino and then pry it off and place back on the user kit.

## 3.7 Power Supply

A power supply is an electronic device that supplies electric energy to an electrical load. The primary function of a power supply is to convert one form of electrical energy to another. As a result, power supplies are sometimes referred to as electric power converters. Some power supplies are discrete, stand-alone devices, whereas others are built into larger devices along with their loads. Examples of the latter include power supplies found in desktop computers and consumer electronics devices. The source of this power can come from different source like the main AC voltage, a battery or even from a renewable power source like solar panel wind turbine or fuel cell to name just a few. The most common source of power is usually the main AC

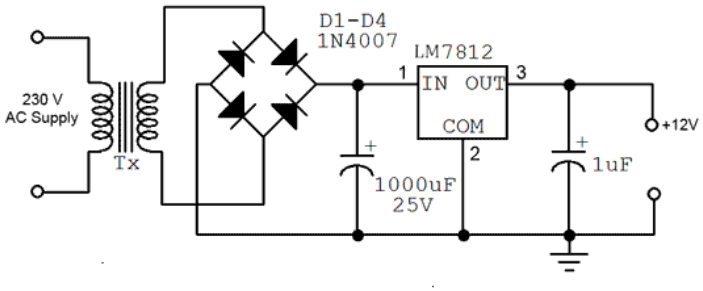



*Figure 4. 2AC-DC Power Supply & Circuit Diagram.*

## 3.7 .1 Transformer

A transformer is a device consisting of two closely coupled coils called primary and secondary coils. An AC voltages applied to the primary appears across the secondary with a voltage multiplication proportion to the turn ratio of the transformer and a current multiplication inversely proportional to the turn ratio power is conserved turn ration = VP/VS=NP/Ns and power out = power in or Vs

VB=(NA/NP)*VP

VB = (NB / NP) * VP

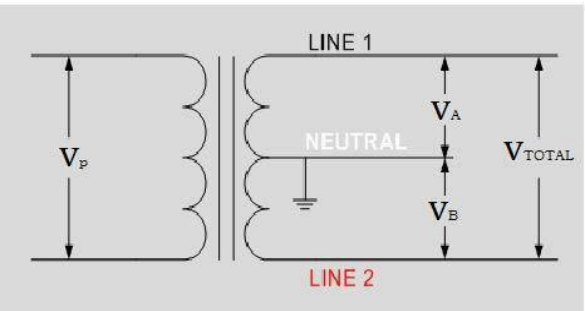



Diagram of transformer

## 3.8 Diode

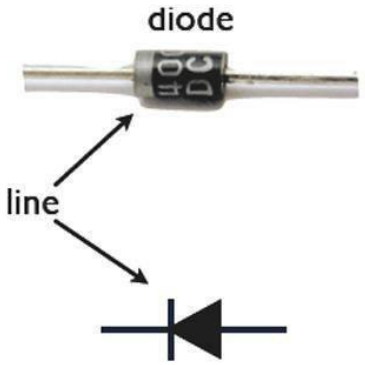



*Figure 4. 3Diode and symbol*

The term diode usually implies a small signal device with current typically in the milliamp range. A semiconductor diode consists of a PN unction and has two (2) terminals, an anode (+) and cathode (-) current flows from anode to cathode within the diode. Diodes are semiconductor device that might be described as passing current in one direction only. The latter part of that statement applies equally vacuum tube diodes. Diodes however are far more extremely versatile in fact. Diode can be used as rectifier, voltage regulators, turning devices in radio frequency tuned circuit, frequency multiplying device in radio frequency circuit, mixing devices application or can be used to make logic decision in digital circuit.

### 3.8.1 Full-Wave Rectifiers

A rectifier is an electronic circuit that converts AC voltage to DC voltage. It can be implemented using a capacitor diode combination. The unique property of diodes, permitting the current to flow in a single direction is utilized in here. It converts an ac voltage into a pulsating dc voltage using both half cycles of the applied ac voltage. Bridge rectifier is a full wave rectifier circuit using the combination of four diodes to form a bridge. It has the advantage that it converts both the half cycles of AC input into DC output.

### 3.8.2 Working of a Bridge Rectifier

•During the positive half cycle of secondary voltage, diodes D2 and D3 are forward biased and diodes D1 and D4 are reverse biased. Now the current flows through D2– >Load–>D3.

•During the negative half cycle of the secondary voltage, diodes D1 and D4 are forward biased and rectifier diodes D2 and D3 are reverse biased. Now the current flows through D4– >Load>D1 .

•In both the cycles, load current flows in the same direction. Hence we get a pulsating DC voltage as shown in fig (3.5,3.6).

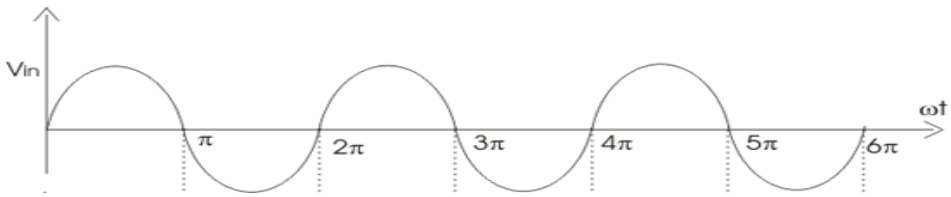



*Figure 4. 4Input sine wave*

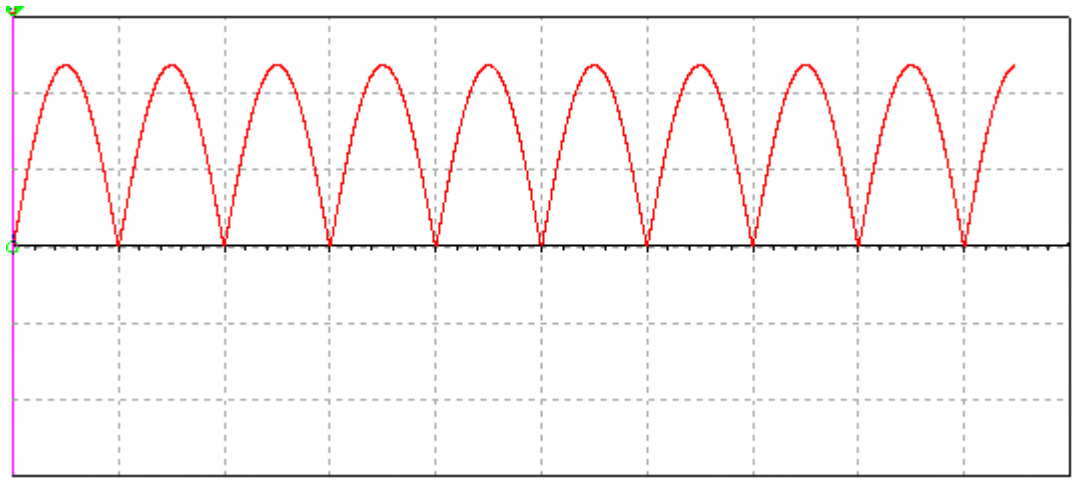


*Figure 4. 5Pulsating DC output*

•Addition of a capacitor at the output converts the pulsating DC voltage to fixed DC voltage.

•Up to a time period of t=1s input voltage is increasing, so the capacitor charges up to peak value of the input. After t=1s input starts to decrease, then the voltage across the capacitor reverse biases the diodes D2 and D4 and therefore it will not conduct. Now capacitor discharges through the load, then voltage across the capacitor decreases.

•When the peak voltage exceeds the capacitor voltage, diodes D2 or D4 forward biases and as a result capacitor again charges to the peak value. This process continues. Hence we get almost smooth DC voltage as shown in fig (3.7).

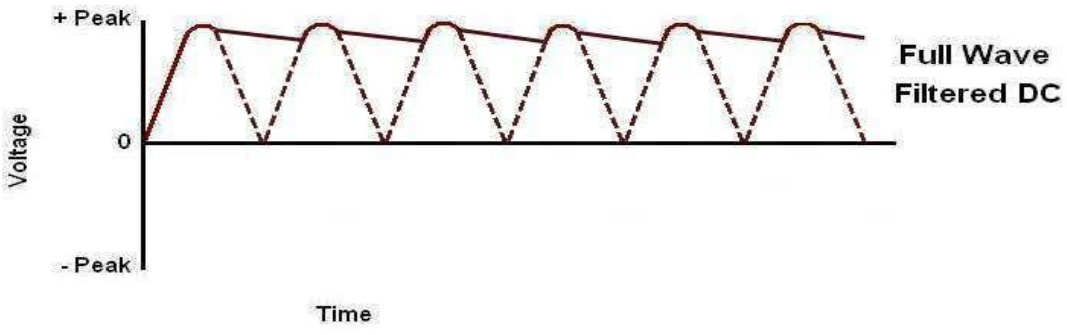



Fig. 3.10 Filtered output

## 3.9 Capacitor

Capacitor is a passive two-terminal electrical component used to store energy in an electric field. The forms of practical capacitors vary widely, but all contain at least two conductors separated by a non-conductor. Capacitors used as parts of electrical systems, for example consist of metal soils separated by a layer of insulating film. A capacitor is passive electronic component consisting of a pair of conductors separated by a dielectric (insulator) when there is a potential difference (voltage) across the detected on one plate and negative charge on the other plate. Energy is stored in the electrostatic field and is measured in farads.

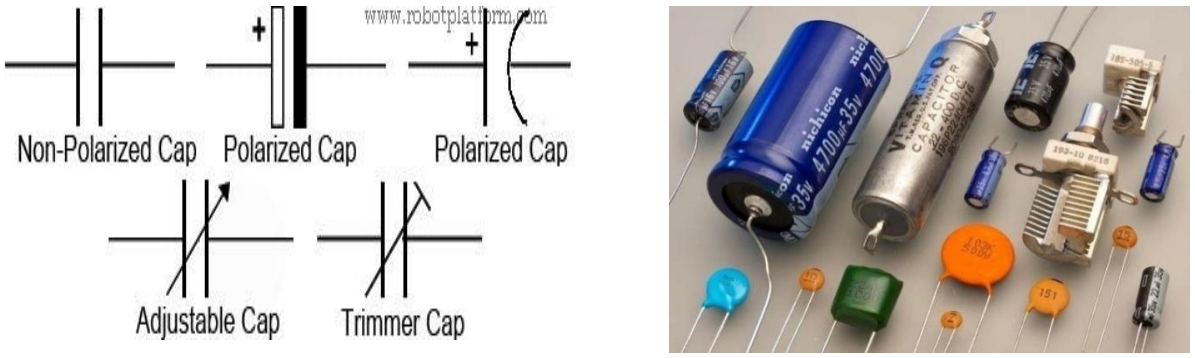



*Figure 4. 6Capacitors & Capacitor symbols.*

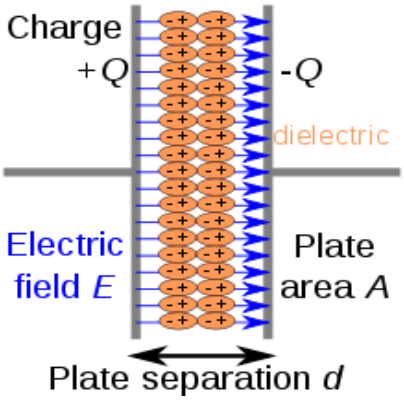



*Figure 4. 7Internal constriction of capacitors*

### 3.9.1 Theory of Operation

A capacitor consists of two conductors separated by a non-conductive region. The non-conductive region is called the dielectric. In simpler terms, the dielectric is just an electrical insulator. Examples of dielectric media are glass, air, paper, vacuum, and even a semiconductor depletion region chemically identical to the conductors. A capacitor is assumed to be self-contained and isolated, with no net electric charge and no influence from any external electric field. The conductors thus hold equal and opposite charges on their facing surfaces, and the dielectric develops an electric field. In SI units, a capacitance of one farad means that one coulomb of charge on each conductor causes a voltage of one volt across the device. An ideal capacitor is wholly characterized by a constant capacitance C, defined as the ratio of charge ±Q on each conductor to the voltage V between them:

$$\boldsymbol{C=QV}$$

Because the conductors (or plates) are close together, the opposite charges on the conductors attract one another due to their electric fields, allowing the capacitor to store more charge for a given voltage than if the conductors were separated, giving the capacitor a large capacitance.

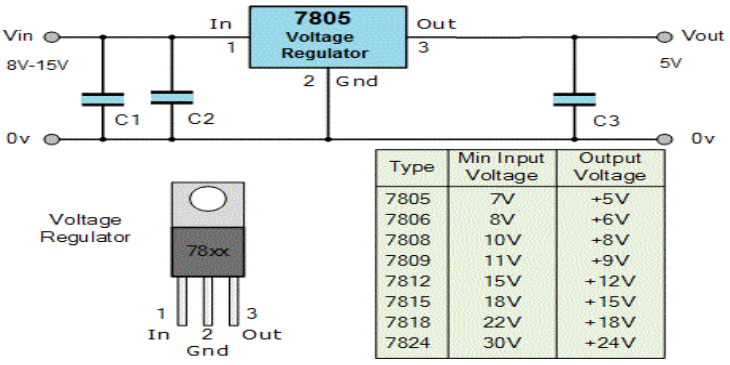
Sometimes charge build-up affects the capacitor mechanically, causing its capacitance to vary. In this case, capacitance is defined in terms of incremental changes:

$$\boldsymbol{C=dQdV}$$

## 3.10 Voltage Regulator

A voltage regulator is a system designed to automatically maintain a constant voltage level. Voltage regulator may use a simple feed-forward design or may include negative feedback. It may use an electromechanical mechanism, or electronic components.

### 4.10.1 Voltage Regulators Output Voltages




| Type | Min Input Voltage | Output Voltage |
|---|---|---|
| 7805 | 7V | +5V |
| 7806 | 8V | +6V |
| 7808 | 10V | +8V |
| 7809 | 11V | +9V |
| 7812 | 15V | +12V |
| 7815 | 18V | +15V |
| 7818 | 22V | +18V |
| 7824 | 30V | +24V |

*Figure 4. 8Voltage regulator output voltages.*

## 3.11 SIM 800L GSM MODULE

### 3.11.1 Introduction:

This document describes SIM800L hardware interface in great detail. This document can help user to quickly understand SIM800L interface specifications, electrical and mechanical details. With the help of this document and other SIM800L application notes, user guide, users can use SIM800L to design various applications quickly

### 3.11.2 SIM800L Overview:

SIM800L is a quad-band GSM/GPRS module, that works on frequencies GSM850MHz, EGSM900MHz, DCS1800MHz and PCS1900MHz. SIM800L features GPRS multi-slot class 12/ class 10 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4.

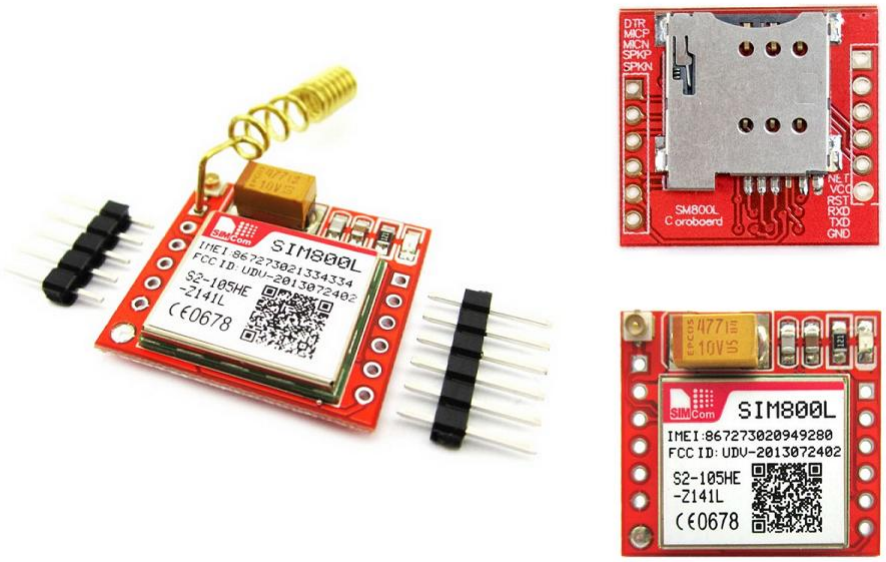



*Figure 4. 9 Overview of SIM800L GSM Module*

With a tiny configuration of 15.8*17.8*2.4mm, SIM800L can meet almost all the space requirements in user applications, such as smart phone, PDA and other mobile devices.

SIM800L has 88pin pads of LGA packaging, and provides all hardware interfaces between the module and customers' boards.

- Support 5*5*2keypads
- One full modem serial port, user can configure two serial ports
- One USB, the USB interfaces can debug, download software
- Audio channel which includes two microphone input; a receiver output and a speaker output
- Programmable general purpose input and output.
- A SIM card interface
- Support FM

### 3.12 LCD Display

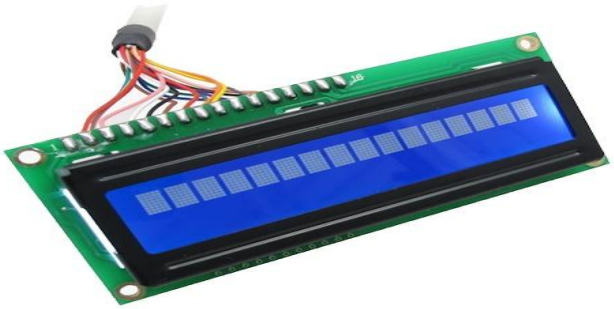


*Figure 4. 1016x2 LCD (Liquid Crystal Display)*

LCD (Liquid Crystal Display) screen is an electronic display module. These modules are preferred over seven segments and other multi segment LEDs. LCDs are economical. A liquid crystal display or LCD draws its definition from its name itself. It is combination of two states of matter, the solid and the liquid. LCD uses a liquid crystal to produce a visible image. Liquid crystal displays are super-thin technology display screen that are generally used in laptop computer screen, TVs, cell phones and portable video games. LCD's technologies allow displays to be much thinner when compared to cathode ray tube (CRT) technology. Liquid crystal display is composed of several layers which include two polarized panel filters and electrodes. LCD technology is used for displaying the image in notebook or some other electronic devices like mini computers. Light is projected from a lens on a layer of liquid crystal. This combination of colored light with the grayscale image of the crystal (formed as electric current flows through the crystal) forms the colored image. This image is then displayed on the screen.An LCD is either made up of an active matrix display grid or a passive display grid. Most of the Smartphone's with LCD display tec hnology uses active matrix display, but some of the older displays still make use of the passive display grid designs. Most of the electronic devices mainly depend on liquid crystal display technology for their display. The liquid has a unique advantage of h aving low power consumption than the LED or cathode ray tube. Liquid crystal display screen works on the principle of blocking light rather than emitting light. LCD's requires backlight as they do not emit light by them. We always use devices which are made up of LCD's displays which are replacing the use of cathode ray tube. Cathode ray tube draws more power compared to LCD's and are also heavier and bigger.

## 3.13 Relay

Definition: The relay is the device that open or closes the contacts to cause the operation of the other electric control. It detects the intolerable or undesirable condition with an assigned area and gives the commands to the circuit breaker to disconnect the affected area. Thus protects the system from damage. It works on the principle of an electromagnetic attraction. When the circuit of the relay senses the fault current, it energises the electromagnetic field which produces the temporary magnetic field.

Fig : Relay

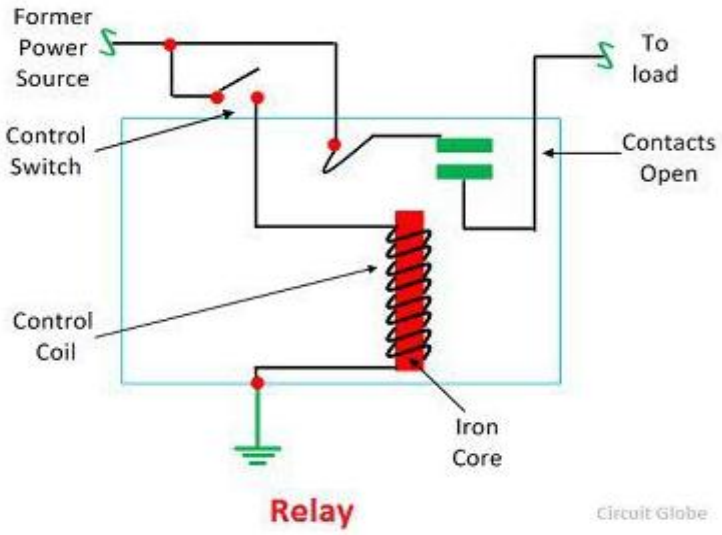



Figure 4. 11 Relay Circuit

This magnetic field moves the relay armature for opening or closing switch.The inner section of the relay is shown in the figure below. It has an iron core which is wound by a control coil. The power supply is given to the coil through the contacts of the load and the control switch. The current flows through the coil produces the magnetic field around it.Due to this magnetic field, the upper arm of the magnet attracts the lower arm. Hence close the circuit, which makes the current flow through the load. If the contact is already closed, then it moves oppositely and hence open the contacts.

### 3.13.1 Pole and Throw

The pole and throws are the configurations of the relay, where the pole is the switch, and the throw is the number of connections. The single pole, the single throw is the simplest type of relay which has only one switch and only one possible connection. Similarly, the single pole double throw relay has a one switch and two possible connections.

### 3.13.2 Tempreture sensor

Temperature_sensors are devices that provide readable temperature measurements via an electrical signal. The most basic way to measure temperature is using a thermometer; this measure how hot or cold something is. With advances in technology, we now have access to a variety of temperature sensors that are much more accurate. Temperature sensors measure temperature readings via electrical signals. They contain two metals that generate an electrical voltage or resistance when a temperature change occurs. The sensor plays a vital role in maintaining a specific temperature for a variety of industries, including medical applications, HVAC systems, and electrical appliances in our homes. Temperature sensors are critical for accuracy and temperature control in industries like these. Temperature sensors work by measuring the voltage across the diode terminals. When the voltage increases, the temperature also increases, which is then followed by a voltage drop between the transistor terminals and the emitter (in a diode). The sensors come in different types, which are categorized based on their connection

Figure 4. 12 Temperature Sensor

### 3.13.3 Boilar

Boiler, also called Steam Generator, apparatus designed to convert a liquid to vapour. In a conventional steam power plant, a boiler consists of a furnace in which fuel is burned, surfaces to transmit heat from the combustion products to the water, and a space where steam can form and collect. A conventional boiler has a furnace that burns a fossil fuel or, in some installations, waste fuels. A nuclear reactor can also serve as a source of heat for generating steam under pressure. Boilers were built as early as the 1st century AD by Hero of Alexandria but were used only as toys. Not until the 17th century was serious consideration given to the potential of steam power for practical work. The first boiler with a safety valve was designed by Denis Papin of France in 1679; boilers were made and used in England by the turn of the 18th century. Early boilers were made of wrought iron; as the advantages of high pressure and temperature were realized, manufacturers turned to steel. Modern boilers are made of alloy steel to withstand high pressures and extremely high temperatures

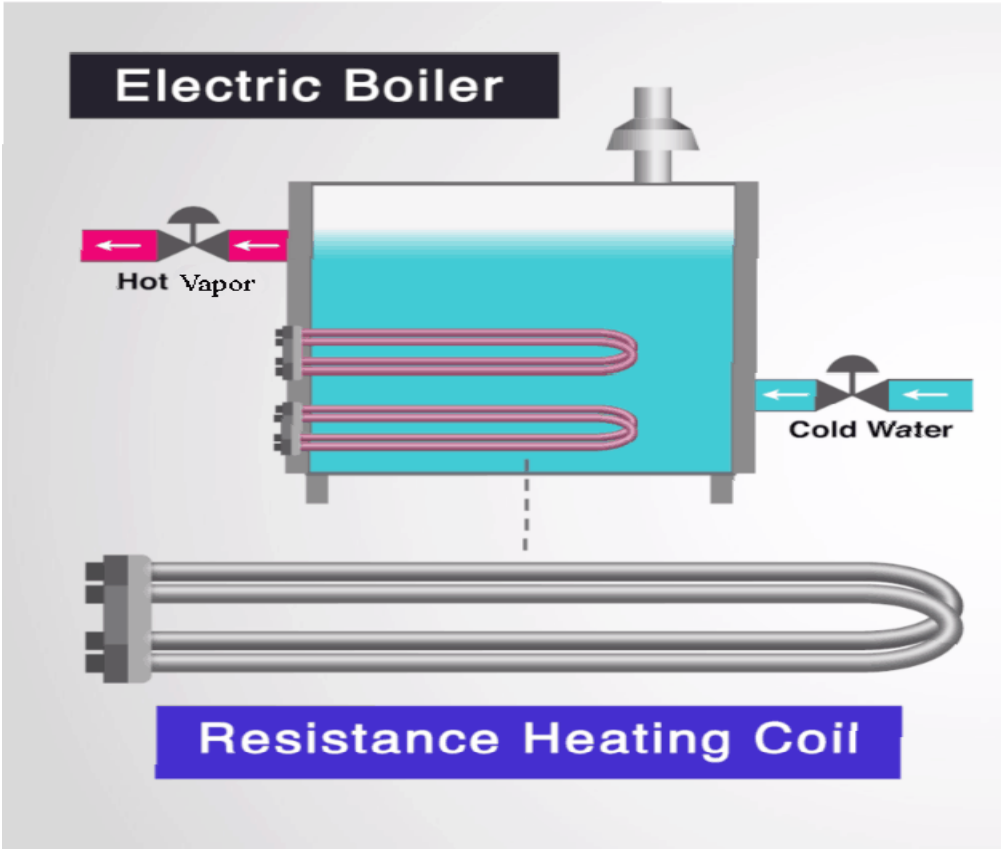



Figure 4. 13 Boilar

### 3.13.4 Feed Pump

A feed pump is a specific type of pump primarily used to pump feedwater into industrial boilers for steam generation. The steam can be used to rotate a turbine or other machine rotors. Feed pumps raise the pressure so feedwater can enter the boiler. Auxiliary boilers, requiring only small amounts of feedwater, may use a reciprocating positive displacement pump, which is driven by the steam produced from the boiler itself. Another type of feed pump often used for package boiler installations is an electro-feeder. This is a multi-stage centrifugal pump driven by a constant speed electric motor. The number of stages in these feed pumps is determined by the feed quantity and discharge pressure. Corrosion occurs when the pump age reacts with the pump's internal surface. Therefore, the usable life of a pump is dependent upon the corrosion or erosion resistance of the pump's materials. Corrosion in feed pumps can be general in nature

Figure 4. 14 Mini Water Pump

# Chapter 4

# Result and Discussion

## 4.1 Result:

Finally, we were able to create our project successfully. After making the Mechanical body, we designed a circuit to control it and when we operated it with mobile apps, we called it working pretty well. It is very well controlled and is again able to clean the drain dirt very well. Below is a picture of our successfully completed entire project.

## 4.2 Temperature Data table:

| No | Set Heater on temperature | Set Heater off temperature | Heater on | Heater off |
|---|---|---|---|---|
| 01 | 80°F | 100°F | 79°F | 101°F |
| 02 | 85°F | 110°F | 84°F | 111°F |
| 03 | 90°F | 120°F | 89°F | 121°F |
| 04 | 95°F | 125°F | 194°F | 126°F |
| 05 | 100°F | 130°F | 99°F | 131°F |
| 06 | 100°F | 135°F | 99°F | 136°F |
| 07 | 100°F | 130°F | 99°F | 131°F |

## 4.3 Water level Data table:

| No | Set water pump on level % | Set water pump off level % | Water pump on | Water pump off |
|---|---|---|---|---|
| 01 | 10% | 100% | 10% | 100% |

## 4.4Discussion:

From the above displayed figures we can observe that the temperature monitoring & control portion as well as the level control portion is simulated successfully in using C-Program. The temperature monitoring & control portion is also experimentally verified using a prototype model.

## 4.5 FUTURE SCOPES

Fuzzy logic is a very emerging intelligent control method which can be applied successfully in nonlinear as well as in linear systems. Till now the conventional controllers like PID controllers are used in boiler temperature control applications but it has some disadvantages and errors when there is variation of load and nonlinearity arises in the system. But intelligent control system like fuzzy control works efficiently under these environments and can be easily implemented as observed in the experiment performed on the prototype model and using more ranged temperature sensors and level indicators and more powerful microcontrollers it can be implemented easily in industrial boiler and other steam temperature control applications as well as in other temperature and water level control applications

# Chapter 5

# Conclusion

## 5.1 Advantages:

- Production cost is very low.
- No need of purchase special machine.
- Its operated and maintenance is simple.
- It can be efficiently used.
- Totally wireless controlled.
- No Need for External Energy Sources
- Can be Used in Tall Buildings
- Cleaning and Maintenance is Simple
- Additions Can Easily Be Made

## 5.2 Limitation:

- **We fetching to done this work such as installing the sensor.**
- **Its takes some time to show the data on the display.**
- **No further safegurds are used here**

## 5.3 Applications:

This device finds place in.

- **Power generation plant**

  A steam power plant consists of a boiler, steam turbine and generator, and other auxiliaries. The boiler generates steam at high pressure and high temperature. The steam turbine converts the heat energy of steam into mechanical energy. The generator then converts the mechanical energy into electric power.Our highly efficient and environmental friendly power plants will contribute to the stable supply of electrical power and reduction of environmental impact.

- **Steel factory**

  In steel & industry, large amount of by product gases such as coke over gas, furnace gas and convertergas can be used as fuel in power plant boilars, which inturn providing the

industry steam and electricity. Not only dose it solve the provlems of exhaust gas, also it redusesthe industry running cost.

- **Garments factory**

  The main function of the boiler in Laundry, garment factory is to provide steam, which can be used to dry or iron clothes, the boiler also can be used to produce hot water, which can be used for heating.

- **Cement factory**

  It is reported that in cement plant about 90% of total energy is used as heat energy in the clinker calcination process. Out of total heat consumed in the clinker calcination process, more than 35% of heat is discharged as waste heat to the surroundings without utilization. So we choose a waste heat boiler for your cement plant to make full use of the waste heat**.**

- **Ceramic factory**

  The ceramic tile manufacturing industry uses the advantages of industrial steam boilers in various processes, which are always focused on optimization and energy savings. we know that the manufacturing processes are not the same in all companies, which is why we adapt the steam needs to each client's needs. Processes such as preparation, mixing and drying can involve different qualities of steam.

- And other factories where used boiler to produce energy.

## 5.3 Future Scope:

- In future we can developed these boiler systems for any industry
- In future It’s can help us to easily control the any type of boiler.
- In future It’s can help us to easily control the any other system
- In future It’s can developed more efficiently and safely.

## 5.6 Conclusion:

The boiler liquid level control system is designed based on the King view configuration software. The industrial control computer is used as host controller of the control system. The programmable logic controller (PLC) is used as slave controller of the control system. The normalized PID has been introduced for control algorithm. This method has the advantage of simplicity and is easy to implement. The results of the experiment and simulation show the design of system is feasible and effective.

The fuzzy logic based boiler temperature monitoring & control and Water level control inside the boiler chamber is simulated successfully and also the temperature monitoring & control portion is experimented successfully using a prototype model and the results are also verified verified. So, we can conclude that the fuzzy logic based boiler temperature and level control is working properly and the results obtained are very promising and satisfactory.

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