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FIRE DETECTION &

AUTOMATIC WATER SPRINKLER SYSTEM

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FIRE DETECTION AND AUTOMATIC WATER SPRINKLER SYSTEM

ABSTRACT:

Fire presents significant threat to life due to its severe hazards and ability to spread rapidly. fire poses a huge threat to human life. Fire detection systems, particularly vision-based systems, identify flames before any loss or destruction occurs. In this model, a novel vision-based technology is created that uses a camera to detect flames (the visible part of a fire) over long distances. An immediate alert is generated on android application. The goal of the proposed system is to notify the remote user when a fire accident occurs. This system can be installed in any remote area where there is a risk of fire. Using this system, we can detect a fire by using a fire sensor beside the camera. After detection of fire the camera is used to take the fire photo and it goes to micro controller. By using camera method, the report is automatically generated and delivered to the person immediately following the fire is detected in any part of the frame using Wi-Fi/GSM. To prevent major damage, the detector will detect flames caused by a fire accident and activate the water sprinkler. The appliance system includes components such as a buzzer for alarming, displaying temperature, humidity and to put out the fire, we use a motor pump.

Keywords: Fire Detection System, Internet of Things, Smart Water System, Flame Sensor.

I. INTRODUCTION

Fire is considered as a Serious danger to life and property in worldwide. It is usually caused by combustion of materials which releases heat and light in large amount. Fire accident is common feature in factories, house, markets etc. due to inadequate fire protection and a lack of adequate fire alarm

system. we try to design automate fire detection with water sprinkler system because the event is very dangerous in our life A good firefighting system is one that reduces fire damage while also limiting the harm caused by the firefighting system itself.

Fires have become a serious issue in recent years, and they must be dealt with quickly and sufficiently to avoid the loss of lives and property. When the observed temperature exceeds 50degrees, it is considered a fire situation. It takes about 15 minutes for personnel to arrive for help in the event of fire threats in vital places such as hospitals, schools, and banks.

- ❖ Appropriately allocating fire alarms with proactive warnings could save lives and prevent property loss.

IOT: Internet of things (IoT) is the network of programmable software, sensors, electronics and communication facility that helps to gather and transfer data. The objective of the designed system is to alert the remote user while the fire accidents occur.

The concept of Internet of things (IoT) nowadays is applied in many applications ranging from the smart industry smart agriculture to smart healthcare and smart home application Home automation is an area where IoT has several advantages remote plant locations, for example, will benefit from technology that allows for remote operation and maintenance; autonomous inter appliance, in which devices communicate with one another aware of the information interchange, lowering engineering costs in the handling of all involved devices. Nowadays, fires can spread rapidly because people prefer to save money over investing in appropriate fire alarm systems. Some issues, such as affordability, effectiveness, and response, remain unsolved.

II. RESEARCH METHOD

Smart Fire Detection System with Automatic Water sprinkler has been developed to solve the slow response issue of fire accidents. The inputs provide readings for the system to analyze, such as sensors and Wi-Fi module that works as a transmitter for the sensor readings. Flame sensors are inputs. Output is Buzzer that is used to indicate a fire. The water system is lunched with a 12V water pump powered by Arduino UNO R3 and Controlled by a 5V single channel relay. The sprinkler head is the outer of the water output. Moreover, batteries are suppling the circuitry and the pump. The pump is 12V that cannot get powered by an Arduino. Relay is used as a switch to control the 12v motor that pumps water required from the tank. In addition to the microcontroller used, a Multiplexer is also used to deal with Analog and Digital lack of pins.

III. PROPOSED METHODOLOGY

- ✓ We identify the fire in our suggested fire detection system using multiple characteristics and situations. Following the detection of a fire, our technology will take real-time photos of the surrounding area. The flame sensor determines whether or not there is a fire or flame present.

- ✓ It works using an infrared flame flash technology. A photo transistor is used in this explicit flame detector. The infrared spectral band is used by flame detection systems. Carbon dioxide, which is produced by the combustion of organic compound materials, has a resonance frequency in this range. Put anything that can catch fire in front of the flame sensor.

- ✓ The flame sensor is triggered when it detects a fire or flame. This sensing relies on variables such as humidity and temperature. After detecting fire the camera will capture the image of the fire, it will be sent to android application with the help of microcontroller through wireless network.

- ✓ As temperature increases the temperature sensor will detect and it will trigger the buzzer and buzzer will blow. The water pump is connected to a IC. If a flame is detected, IC activates the DC motor and water pump. The sprinklers connected to the pump will sprinkle the water throughout the fire affected area.

BLOCK DIAGRAM:

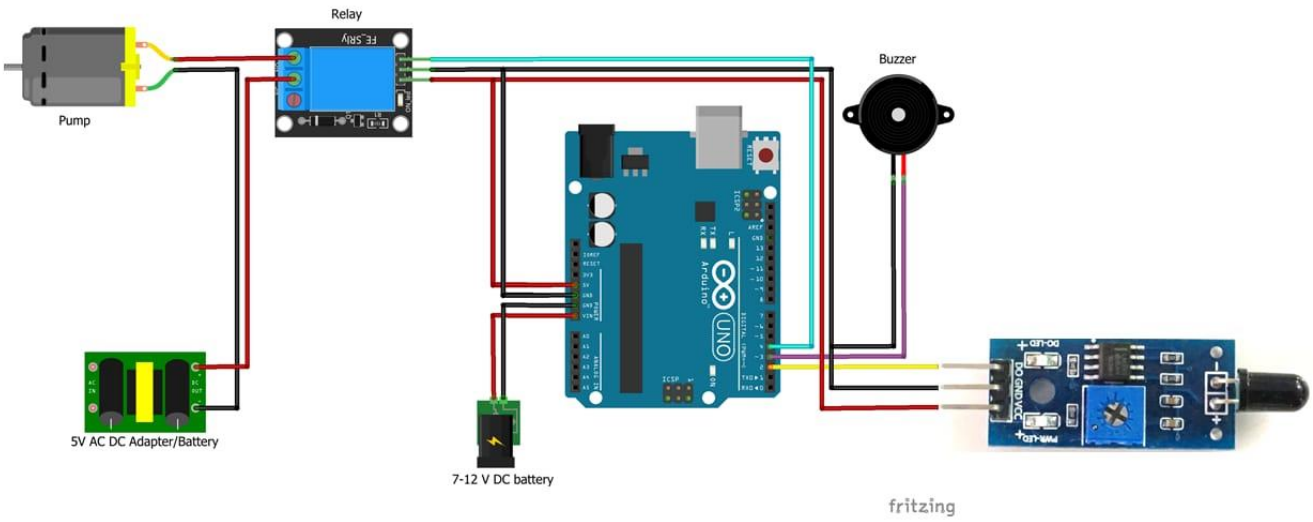
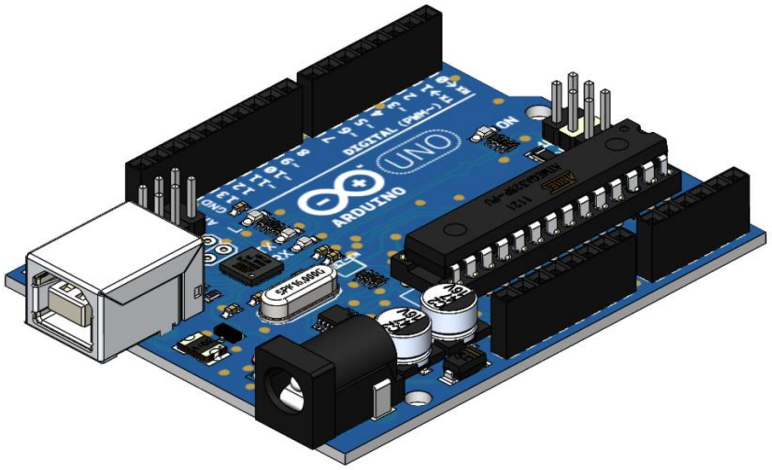


Fig : Fire Detection and Automatic water sprinkler system

A. ARDUINO UNO R3 MICROCONTROLLER:



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

It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, Worst case scenario you can replace the chip for a few dollars and start over again. It can be powered by a USB cable or a barrel connector that accepts voltages between 7 and 20 volts, such as a rectangular 9-volt battery. It has the same microcontroller as the Arduino Nano board, and the same headers as the Leonardo board The hardware reference design is distributed under a Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino website. Layout and production files for some versions of the hardware are also available.

A. BUZZER:

A buzzer is similar to an alarm clock. It produces an output that sounds like an alarm and then turns on the machine. Two pins make up the buzzer. The micro controller's data pin is attached to the negative end. The micro controller's VCC is connected to the positive end.

Piezo Buzzer 5V (Wire type) is a loud continues type Piezo Buzzer. It has two wires for connection and can work on 3 to 7 V DC. Just connect with power supply and it will give loud sound.

The piezo buzzer produces sound based on reverse of the piezoelectric effect. The generation of pressure variation or strain by the application of electric potential across a piezoelectric material is the underlying principle. These buzzers can be used alert a user of an

event corresponding to a switching action, counter signal or sensor input. They are also used in alarm circuits.

The buzzer produces a same noisy sound irrespective of the voltage variation applied to it. It consists of piezo crystals between two conductors. When a potential is applied across these crystals, they push on one conductor and pull on the other. This, push and pull action, results in a sound wave. Most buzzers produce sound in the range of 2 to 4 kHz.

Specifications

The **specifications of the buzzer** include the following.

- Color is black
- The frequency range is 3,300Hz
- Operating Temperature ranges from – 20° C to +60°C
- Operating voltage ranges from 3V to 24V DC
- The sound pressure level is 85dBA or 10cm
- The supply current is below 15mA

Types of buzzer

A buzzer is available in different types which include the following.

- Piezoelectric
- Electromagnetic
- Mechanical
- Electromechanical
- Magnetic

Fig : Buzzer

C. 5V DC WATER PUMP

This is Micro Submersible Water Pump DC 3V-5V, can be easily integrate to your water system project. The water pump works using water suction method which drain the water through its inlet and released it through the outlet. You can use the water pump as exhaust system for your aqurium and controlled water flow fountain.

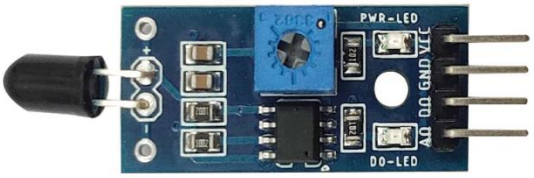
Fig : 5v DC Water pump

Specification:

Input Voltage: DC 3V-5V
Flow Rate: 1.2-1.6 L/min
Operation Temperature: 80 Deg.C

Operating Current: 0.1-0.2A
Suction Distance: 0.8 meter (Max)
Outside diameter of water outlet: 7.5mm
Inside diameter of water outlet: 5.0 mm
Diameter of water Inlet : 5.0 mm
Wire Length: 200 mm
Size: 45 x 30 x 25 mm
Weight: 30g

D. FLAME SENSOR :



A flame-sensor is one kind of detector which is mainly designed for detecting as well as responding to the occurrence of a fire or flame. The flame detection response can depend on its fitting. It includes an alarm system, a natural gas line, propane & a fire suppression system. This sensor is used in industrial boilers. The main function of this is to give authentication whether the boiler is properly working or not. The response of these sensors is faster as well as more accurate compare with a heat/smoke detector because of its mechanism while detecting the flame.

WORKING PRINCIPLE

This sensor/detector can be built with an electronic circuit using a receiver like electromagnetic radiation. This sensor uses the infrared flame flash method, which allows the sensor to work through a coating of oil, dust, water vapor, otherwise ice. The pin configuration of this sensor is shown below. It includes four pins which include the following. When this module works with a microcontroller unit then the pins are,

- Pin1 (VCC pin): Voltage supply rages from 3.3V to 5.3V
- Pin2 (GND): This is a ground pin
- Pin3 (AOUT): This is an analog output pin (MCU.IO)
- Pin4 (DOUT): This is a digital output pin (MCU.IO)

DIFFERENT TYPES

Flame-sensors are classified into four types

- IR single frequency
- IR multi-spectrum
- UV flame detectors
- UV/ IR flame detectors

FEATURES

- Product Name: Flame Sensor Module
- Output Channel: 1
- Power Supply: 3.3/5V
- PCB Board Size: 32 x 14mm(L*W
- Hole Size: 3mm
- Material: Electric Part
- Net Weight 3g
- indicator light: a green one for the switch, a red one for power.
- Built in a potentiometer for sensitivity control.
- Onboard signal output indication, output effective signal is high, at the same time the indicator light up, the output signal can directly connect to microcontroller IO.
- Can detect fire or wavelength in 760 ~ 1100 nm nano within the scope of the light source.
- Detection angle about 60 degrees, the flame spectrum especially sensitive.
- The flame of the most sensitive sensors flame, the regular light is also a response, generally used for fire alarm purposes.

APPLICATIONS

- Flame sensor interfacing with arduino for fire detection
- Car or Automobile
- Fire Fighting Robots
- Garage Safety Equipment
- Warehouses

FLOW CHART

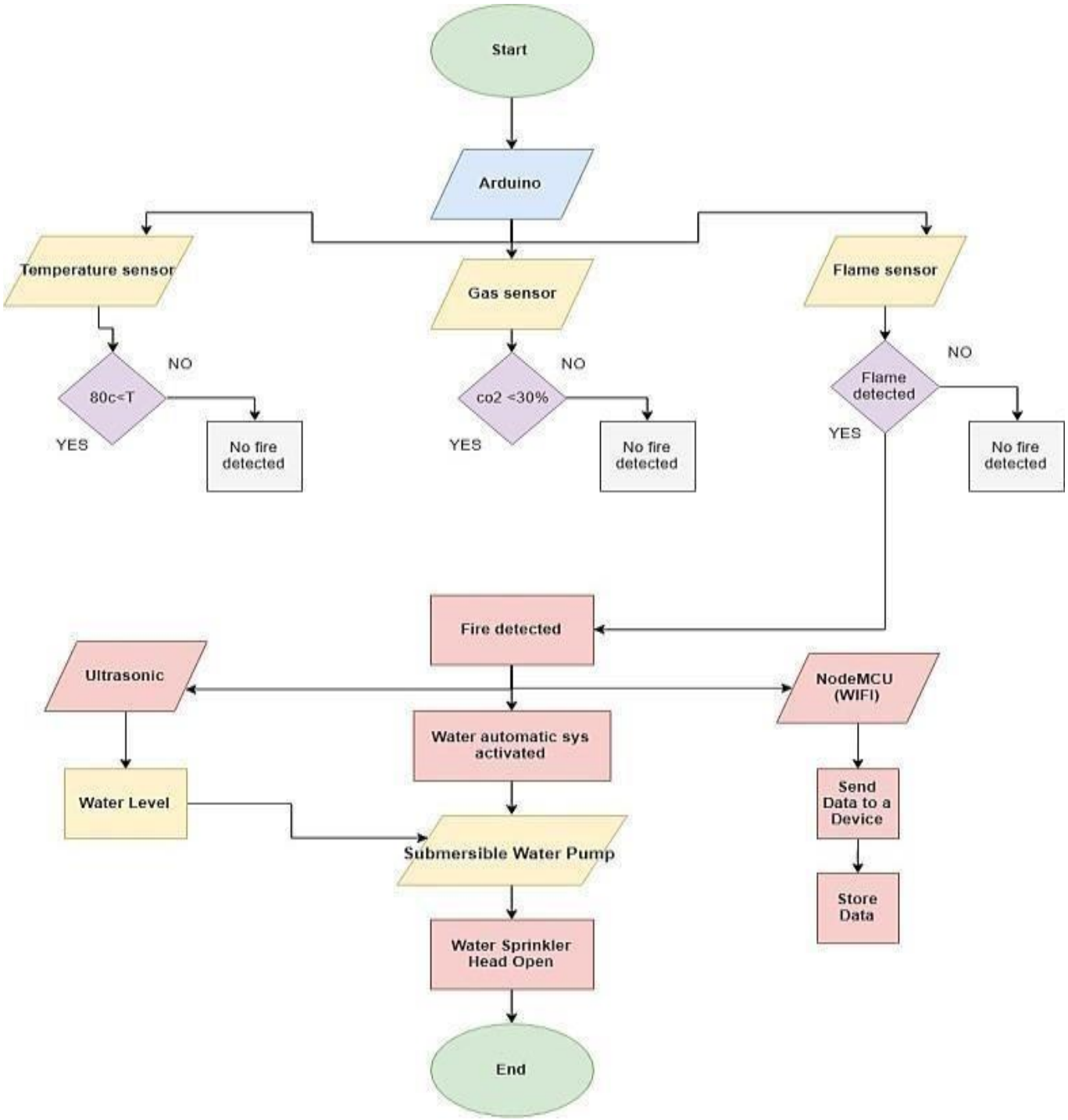


Fig : Flowchart of the Proposed System

PROGRAM CODE :

```
#define SENSOR_PIN 2
#define BUZZER_PIN 3
#define RELAY_PIN 4
#define SPRINKLER_START_DELAY 5000  //5 seconds
#define SPRINKLER_ON_TIME 3000      //3 seconds Sprinkler on time

unsigned long previousTime = millis();

void setup()
{
  pinMode(RELAY_PIN, OUTPUT);
  pinMode(SENSOR_PIN, INPUT);
}

void loop()
{
  //If there is fire then the sensor value will be LOW else the value will be HIGH
  int sensorValue = digitalRead(SENSOR_PIN);

  //There is fire
  if (sensorValue == LOW)
  {
    analogWrite(BUZZER_PIN, 50);                    //Turn on buzzer

    if (millis() - previousTime > SPRINKLER_START_DELAY)  //We will wait for few seconds before sprinkler can be started once fire is detected.

    {
      digitalWrite(RELAY_PIN, LOW);                 //Relay is low level triggered relay so we need to write LOW to switch on the light
      delay(SPRINKLER_ON_TIME);                     //Keep sprinkler on for sometime.
    }
  }
```

```
 else
  {
    analogWrite(BUZZER_PIN, 0);
    digitalWrite(RELAY_PIN, HIGH);
    previousTime = millis();
  }
}
```

PROBLEM STATEMENT

- Many houses don't have a fire alarm system so we need to design a fire alarm system using the digital logic system that all family members can use in single-family residences.

- It must be able to detect fires at all locations, residents must be able to activate it from convenient locations themselves, and it must alert residents in all portions of the house.

PROJECT OBJECTIVE

- To study the working principle of fire alarm and smoke detecting system.

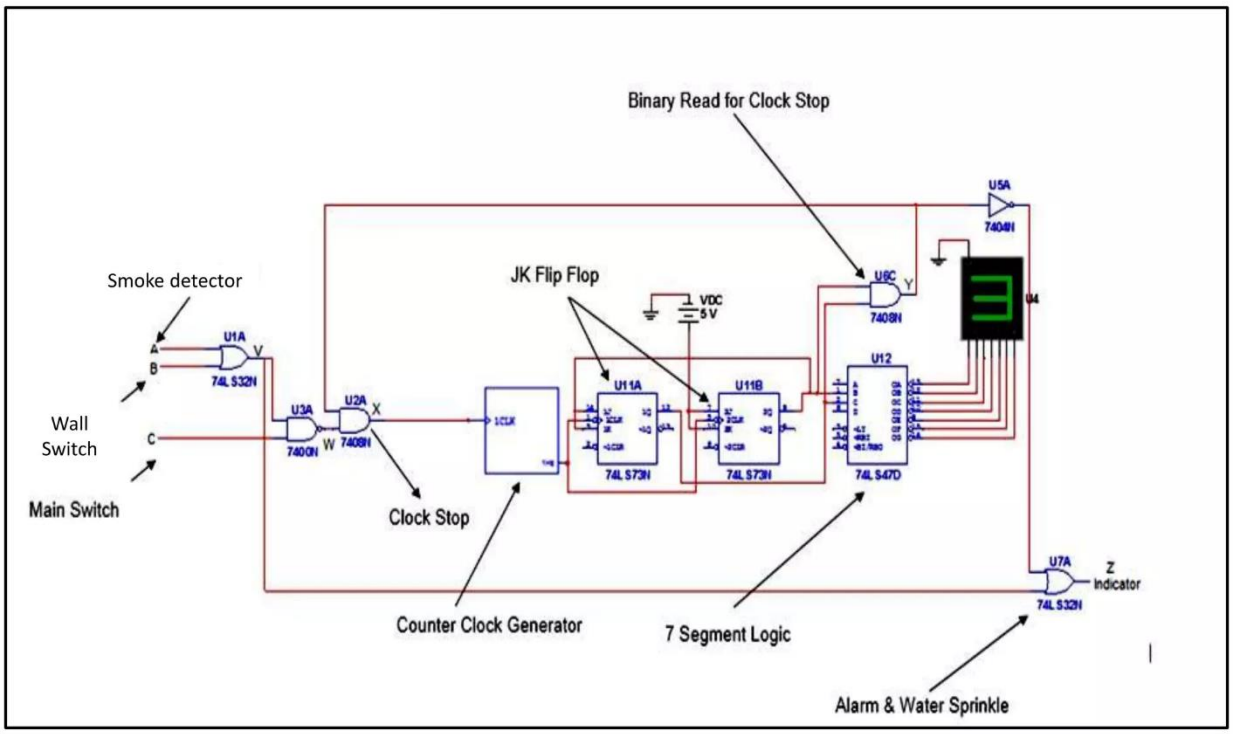
- To design, construct and fire alarm system and smoke detector using digital system.

- To implement digital logic design in the project.

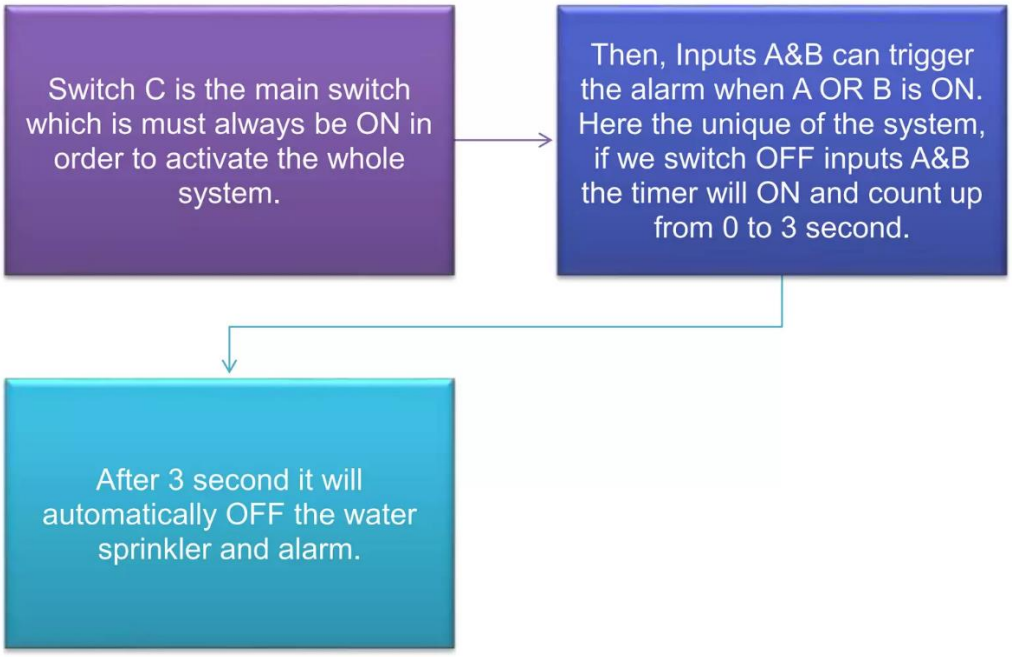
PROJECT SPECIFICATIONS

Name of Project	Fire Alarm & Smoke Detector System
Main Functions/Objective	To discover fires early in their development when time will still be available for the safe evacuation of occupants.
Voltage Supply	5VDC
Input	Emergency Switch, Smoke Detector and Main Switch.
Output	Fire Alarm and Automatic Sprinkler
Logic Type	i. OR Gates ii. AND Gates iii. JK Flip Flop (For timer 3 Seconds) iv. Clock 1Hz Output v. 7 Segment vi. Inverter vii. Indicator

SYSTEM DESIGN



PROCESS FLOW



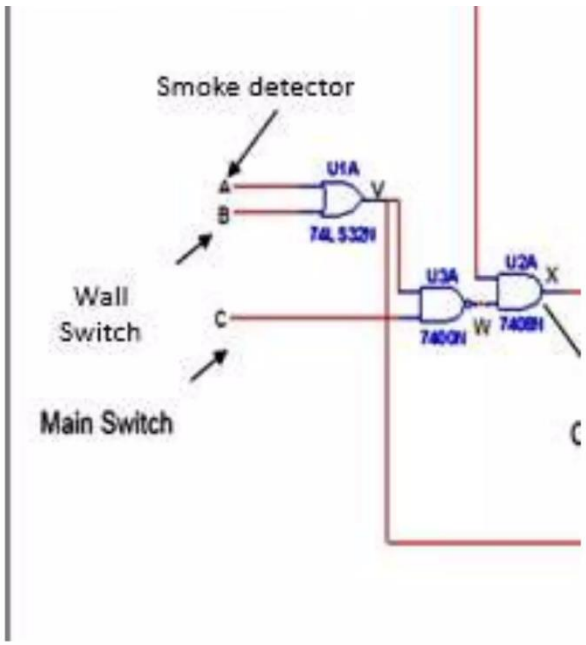
TRUTH TABLE & K-MAP

Truth Table A+B=V

A	B	V
0	0	0
0	1	1
1	0	1
1	1	1

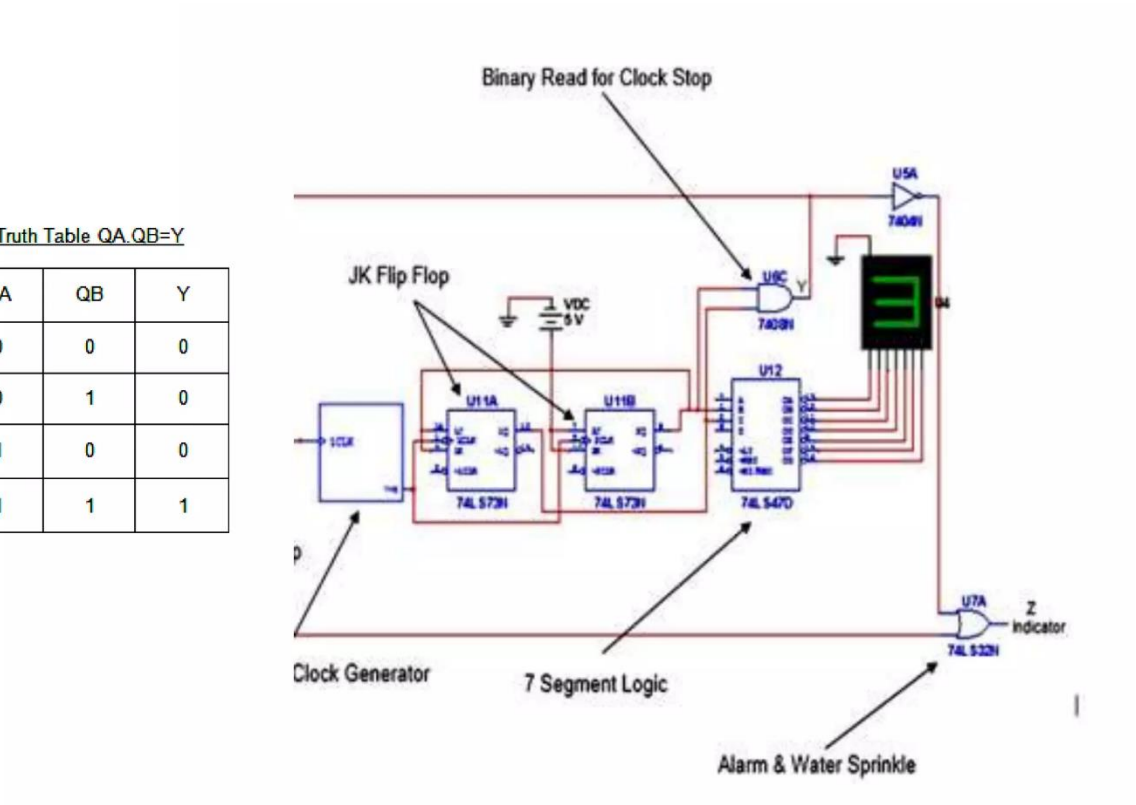
Truth Table $\overline{C.V}$=W

C	V	W
0	0	1
0	1	1
1	0	1
1	1	0



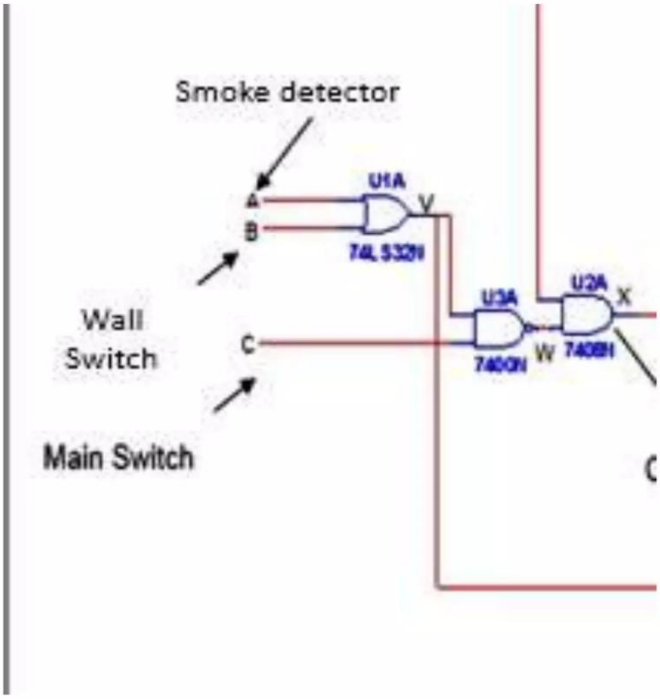
Truth Table QA.QB=Y

QA	QB	Y
0	0	0
0	1	0
1	0	0
1	1	1



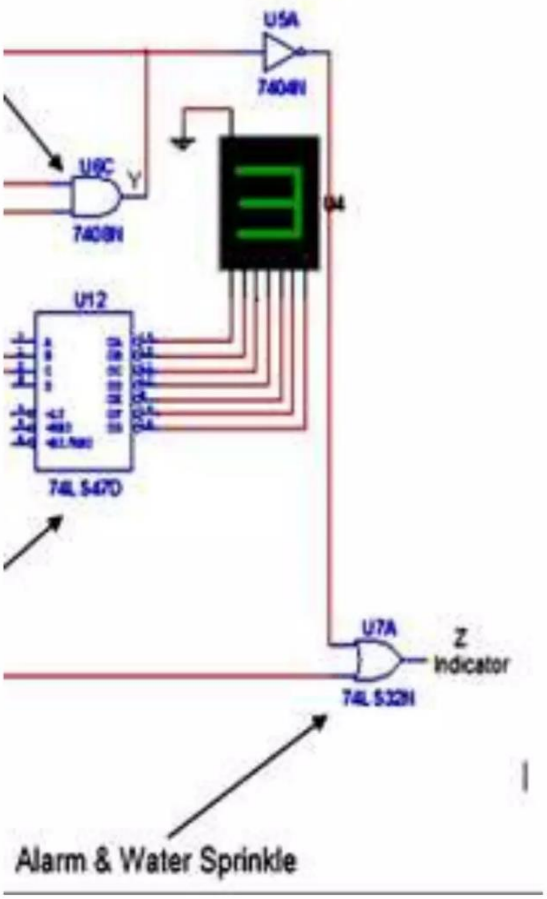
Truth Table $\overline{Y}.W=X$

Y	W	X
0	0	0
0	1	0
1	0	0
1	1	1



Truth Table $\bar{Y}.V=Z$

$\bar{Y}$	V	Z
0	0	0
0	1	0
1	0	0
1	1	1



2 BITS JK FLIP FLOP		J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

K-MAP for JA:

A\B	0	1
0	0	1
1	X	X

JA = QB

K-MAP for KA:

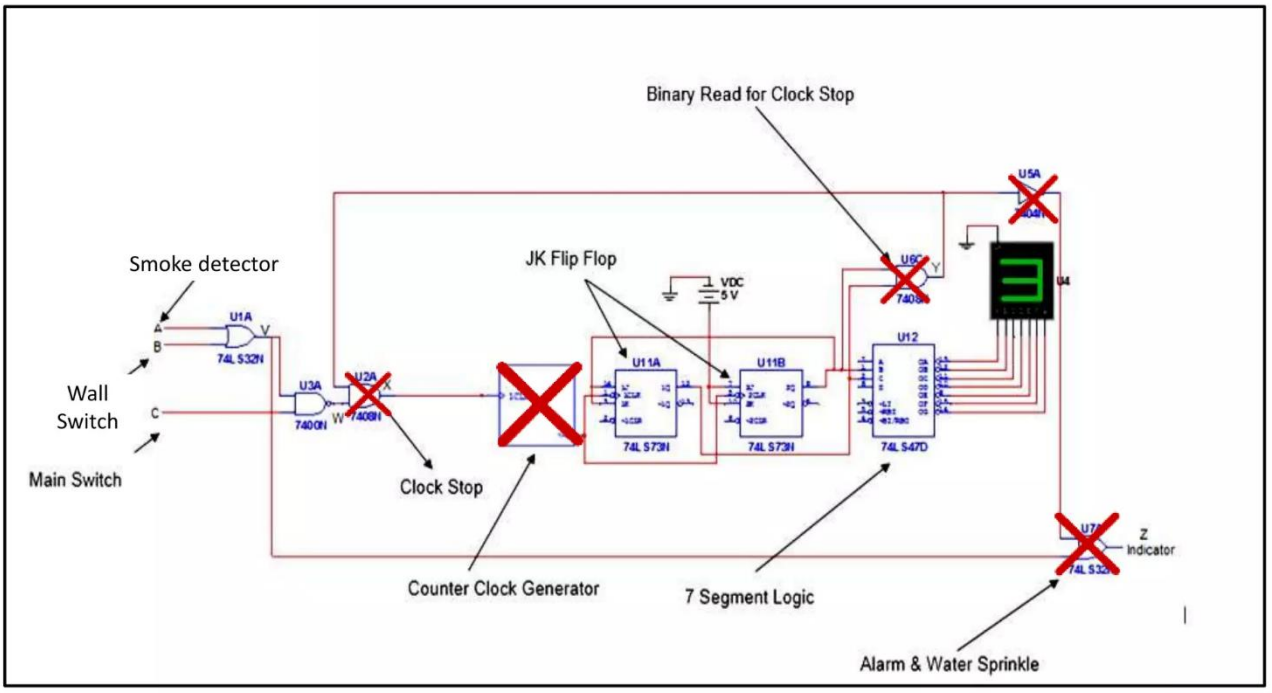
A\B	0	1
0	X	X
1	0	1

KA = QB

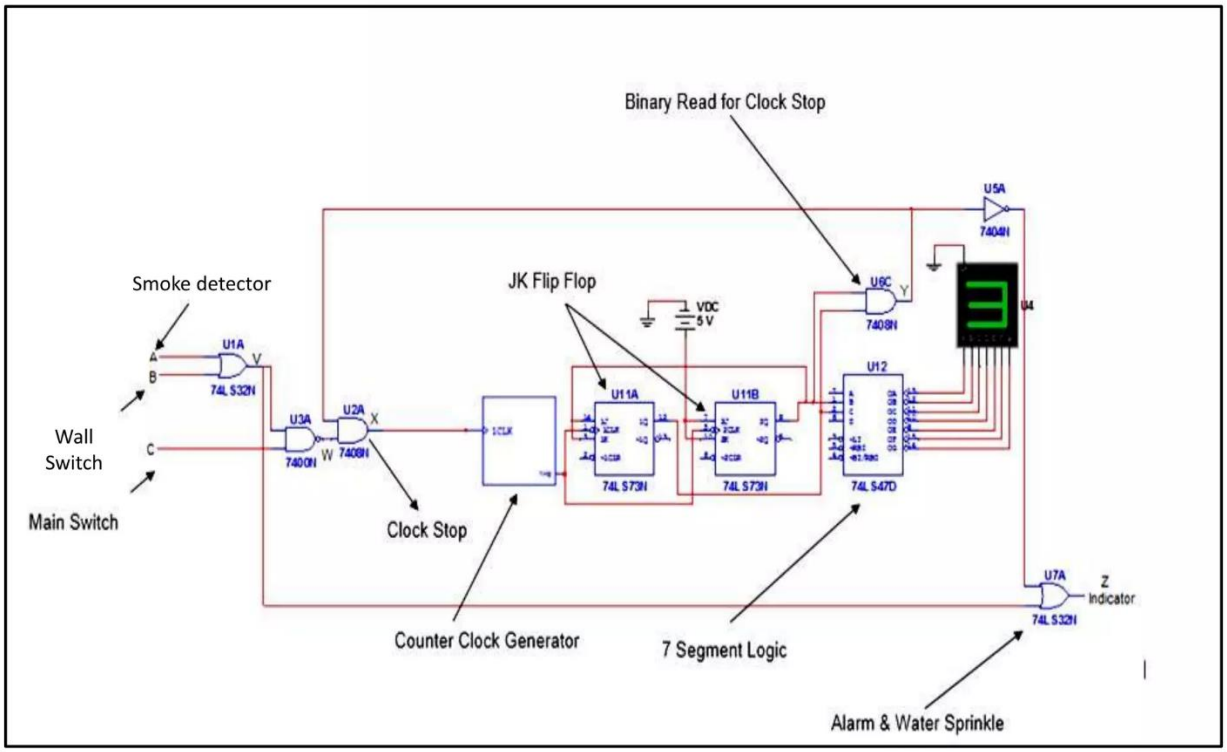
For timer 3 second: JB,KB = 1 = 5V

PRESENT		NEXT		JA	KA	JB	KB
0	0	0	1	0	X	1	X
0	1	1	0	1	X	X	1
1	0	1	1	X	0	1	X
1	1	0	0	X	1	X	1

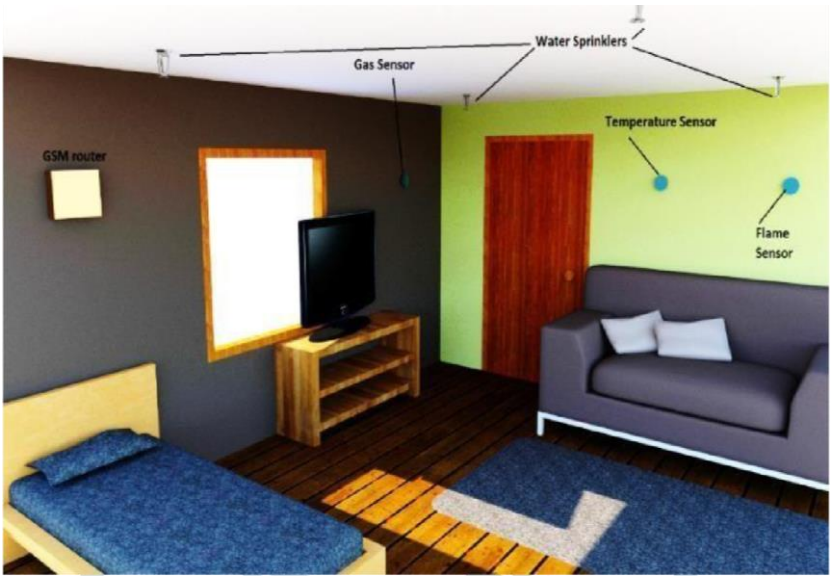
PROBLEM ENCOUNTERED



COUNTER MEASURE



PLACEMENTS OF THE SENSORS (Real life application)



The proposed prototype of a fire detector system in which a room is equipped with Gas, Temperature, and flame sensors propagated to ensure fast readings, water sprinklers are equally distributed, a router of the Global System for Mobile Communications (GSM) module is added, and accessories such as LED and Buzzer. The prototype is a testing stand for fire with an emergency backup of the water system.

GRAPHICAL REPRESENTATION

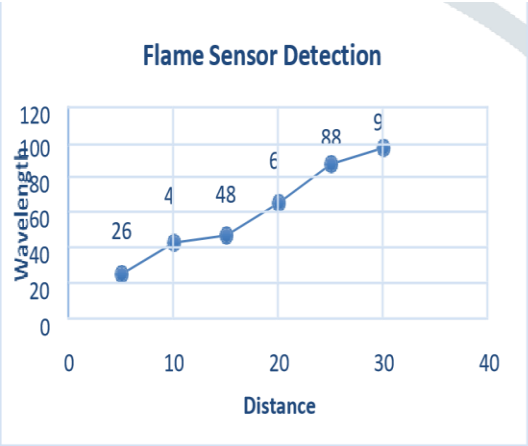


Figure . Flame Sensor Detection results.

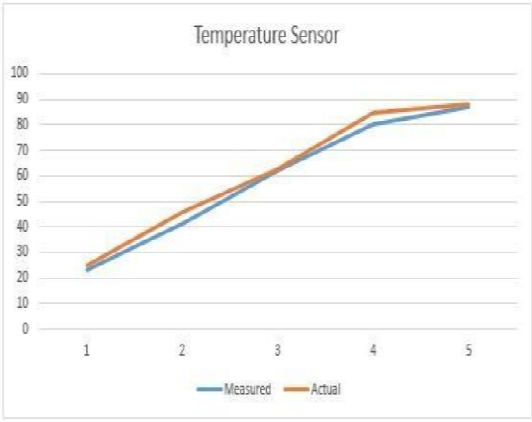


Figure . Result of temperature sensor accuracy

AUTOMATIC WATER SYSTEM

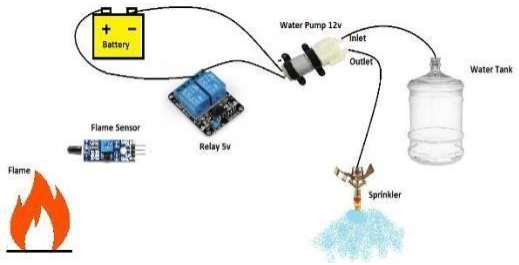


Fig: Automatic Water System Working Diagram

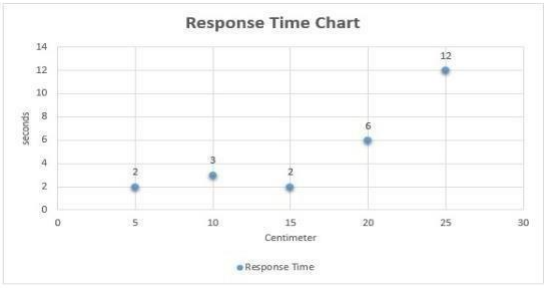


Fig: Response time Vs Distance

RESULTS AND PROTOTYPING

CONCLUSION

The fire detection systems proposed in the literature were designed to stop fires without regard for responsiveness. As a result, this research takes into account the existing issues and develops an efficient and a powerful fire detection system based on IoT technology, gas, temperature, and smoke sensors to collect data accurately and quickly. The structure of this system enhances the effectiveness and efficiency of fire detection. The water pump was activated, sucking water from the tank and releasing it into the water sprinkler to keep the fire from spreading until the property owners and emergency services arrived. As a result, the proposed system overcame the challenges of affordability, effectiveness, and responsiveness.