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Final Year Project Report

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Project Title: Highway Fire Controller and Alert System

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Project Title: Highway Fire Controller and Alert System

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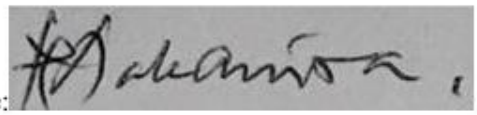
Supervisor's Signature:  11/10/2024.....

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DECLARATION FORM

I, Kudzanai Chiwara declare that this is my work and has not been copied or lied from any source without acknowledging the source.

Signed…….

Date……11/10/2024……..

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It has been long overdue to provide this report in conjunction with the practical implementation. I would like to thank God the creator for being my Leader and rear Guard during the preparation of this project. Having an energetic supervisor Eng Takawira was an aided advantage he waited patiently for months and sending new updates on my email to inquire about my progress over the project. The experience i carried from Engineer Komichi project did not disappoint not even once. It was quite assured that this will come to pass as the coordinator Eng. Malindi collected everyone's project titles it gave most of us surety that there was no reason to back off but to go for it. I was also corrected with Eng. Marufu and Eng. Chiminya several times. Our workshop technicians also worked tirelessly with us to provide and improvise what we needed went as far as exhausting their knowledge in trying to help us out. My parents as always listened to me whenever i asked them money to buy food but this time they had transferred their priority to buying me project components. The Hofisi, Ravasingadi and Magedhe family never stopped to support me financially and emotionally as well. And of course the BUSE Engineering department staff is accommodating when it comes to school work, they offered us the access to workshop 3 for 24/7 such that we were left with no room for excuse. Doc. Shonhiwa our chairman stood up as always on our behalf to revise the stiffness our lecturer sometimes imposes on us. In addition, I had emotional and inspiration from Tesla Company owner by the name Mr. E. Musk who once said and I quote "I will never give up", he said this after his first spaceship launch that failed and ended up in an explosion and attracted a loss of several millions. Arnold always held my back as well, there is a common thing between me and this former Californian governor, finest movie star of his time, Mr. Olympian that is weight lifting champ which is the fact that he originated from a the farms of Austria, grew up poor but now he is an unstoppable citizen of America. Kudakwashe, Panashe, Abiot, Andreas, Tashinga, Liberty, Darlington, Brenda, Shelbum the list is endless all these sacrificed their precious time to help me. Lastly, I would like to appreciate my seniors who were stream ahead of us and are now graduates for sharing their idea on how the project is done.

Abstract

Fire outbreak has almost become a daily occurrence in our day to day lives. It often results in accidents leading to loss of lives, injuries and properties that are worth in millions. Therefore early reporting of fire is a key factor in successful handling of fire breakouts along the highway. However the main challenge for the firefighters is successfully locating the right route where fire is there is fire. So with the advancement in technology, it is now possible to receive alert of fire outbreak along with its route using GSM technology. This paper proposed makes use of various sensors like flame, smoke, etc. along with GSM system in reporting of fire occurrence, with its specific route and place where fire detection took place in a real time mode. This proposed system also makes use of water sprinklers for on-site control of fire. The proposed system is also cost effective and apart from being used along the highways can be used at various Petrol stations, Forests (in case of forest fires), Industries, Malls, and Hospitals etc.

Contents

CHAPTER I: INTRODUCTION

1.1 BACKGROUND OF STUDY

Veld fires are also referred to as wild fires these are bush fires both within and outside urban areas that have the potential to spread out of control. Veld fires are a challenge to the eco system and human health since they produce high volumes of fumes. Most of veld fires are as result of human misconduct compared to a small amount which is started by natural occurrences for instance lightning and some are self-excited as science proves that when sunrays are exposed to the glass material for a long period of time, provided that under the glass there is burnable grass a fire may arise due to that. Bearing that in mind it can be seen that veld fires are an unbearable problem since they start in forests where nobody resides from, with that being a reason that such fires are recognized when it has grown wild and people can now visualize from afar that there comes a problem. [1]

1.1.1 Research base and methods of investigation.

Recent investigations on veld fire management rarely mention fire control on fixed systems. In order to provide a research on specific features of different project implementation and management that are aimed at increasing safety of traffic on highways we used a method of complex and comparative analysis of analytical reports (Safe Driving near Veld and Forest Fires report, Arrive Alive reports, Suzuki How To Drive Safely in veld fires) as well as foreign news concerning peculiarities of theoretical and practical aspects of fire management using fire engines usually after being notified by drivers.

1.1.2 Most Affected Areas By Veld-fires

Africa is considered as the most fire-prone continent in the world and has been referred to as the ‘fire continent’ primarily because much of Sub-Saharan Africa, once consisted of a vast landscape of tropical and subtropical fire-prone savannas, and fire-influenced woodlands and shrub-lands that have been shaped by the longest history of human involvement with fire in the world. In Zimbabwe, the current fire management can be traced to the arrival of the white settlers. Regulations and legislation put in place to protect natural resources included the Natural Resources Act (No. 9) of 1941. The current fire protection system in Zimbabwe was developed in the 1960s and is based on early detection, quick reaction and suppression. The present system was put in place after realizing that it is difficult

to prevent veld fires, but strategies that aim at mitigating the negative effects of wild fires were more sustainable. [3]

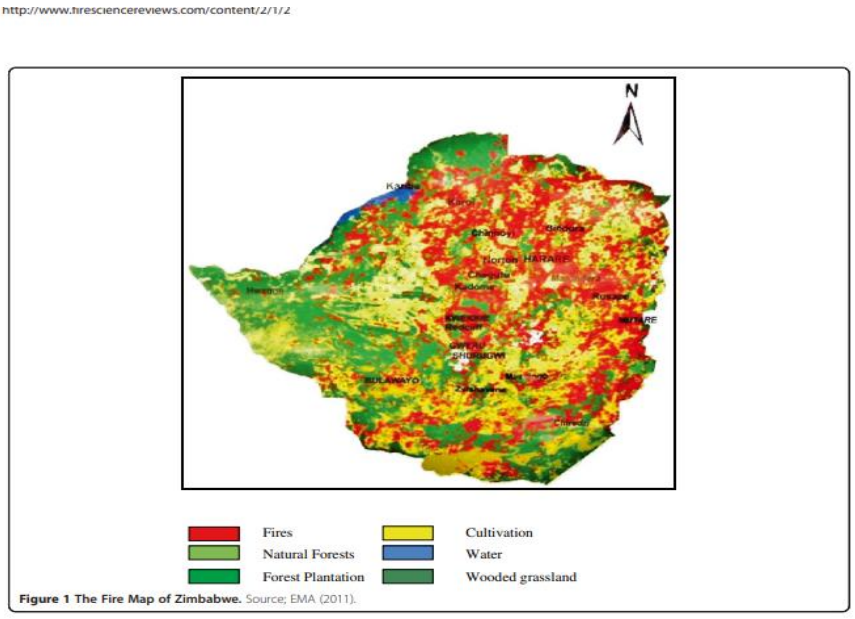

Figure 1.1 [4]

Figure 1 shows variations of areas largely and least affected by veld fires.

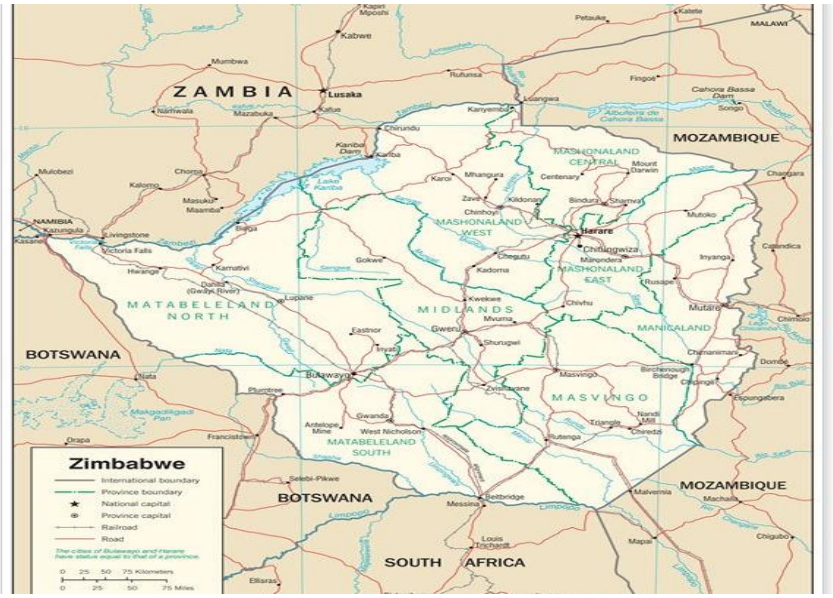

Fig. 1.2 [5]

On figure 2 is a Zimbabwe map showing main road interconnections.

1.2 PROBLEM STATEMENT

Cars are inconvenienced so badly by wild-fire burning near the roadsides such that large volumes of cars congest on the road. As we get to winter and other dry seasons, we are likely to see more veld-fires, especially in the dry high veld areas. Veld fires are a regular menace on our roads, and drivers have to drive through an area where fires may be burning right up to the road. A driver, who has once driven through an extended veld fire, will know that it can quickly become scary and disorientating. If it is a large fire, you will not be able to quickly get through it, and in such cases, one needs to adhere to expert advice which is not accessible or common to all drivers and car owners. At times the smoke gets thicker, but the driver has to remember that they are still operating a vehicle on an official road. In such cases where the smoke is very thick drivers are forced to slowdown, which inconvenience them towards reaching their destination as expected. Due to blurred vision on the road caused by smoke a driver may decide to stop on the side of the road and is now in danger of being hit by cars coming from behind, being drove by a driver who decides to keep moving and navigating their way out of the fire zone using their instincts. [6]

Fig 1.3a

Fig 1.3 b [7]

Figure above shows a highway that is congested with traffic due to a roadside veld-fire that is now under control by the fire engine that is on the far right of the picture.

1.3 AIM

To design draw and model a highway roadside endangered by wild-fire and a fire control system that can open its sprinklers when fire is coming right up to the road and blink LEDs on the risk of fire traffic safety sign.

1.4 OBJECTIVES

1) Whenever fire sensor (at the input pin of the microcontroller) detects fire:
    - Blink the traffic sign LEDs to warn drivers that fire has been detected.
    - Sound buzzer.
    - Relay is triggered to turn ON pump.

2) When both smoke and fire is detected:
    - Send SMS to fire Brigade team through GSM.
        - Text should comprise of co-ordinates in order to specify the location where fire took place.
    - Relay is triggered to turn ON pump.
    - Blink the traffic sign LEDs to warn drivers that fire has been detected.
    - Sound buzzer.

1.6 JUSTIFICATION

Fire sensors will be connected to the input pin of the microcontroller, to enable the system to detect fires and sends an electrical signal to the microcontroller when there is fire detected and in turn blink the LEDs on sign post to warn drivers that there is fire ahead and can send message to the Traffic Safety Council. Smoke sensors will be suspended few meters away from the ground to detect smoke (persistent enough to get thick on the road) and connected to the input pin of the microcontroller to blink the LEDs of the sign post and send a message to the Traffic Safety council. Connecting a pump to the microcontroller via a relay switch, that will trip right away when fire is detected and in turn switch on the pump. The pump drives water along a metal pipe that drips water on the edges of the road creating a barrier to fire progress towards the road shoulders. Connect the traffic sign LEDs to the microcontroller, which will blink whenever fire or intense smoke is detected to alert the drivers of the veld fire ahead. The system includes a AND gate, if both fire and smoke sensors sends a true signal the AND logic gate sends a true output to the microcontroller which is able through the GSM module to send a notification message to the fire brigade and traffic safety council when both the fire and

smoke is detected this is made possible by the use of would come to monitor the rest of the fires which is out of the reach and beyond ability of the system.

Fig 1.4 [8]

Figure 1.4 shows Kariba veld fires that kept on burning for days and was very close by the highway road, it is evident enough that system like this has been long awaited for.

The system can be used to act as a fire guard on a specific area where fire is not tolerated at all like gas and fuel station situated in a region prone to veld fires. The system does not sprinkle water to the guarded facility since the type of water discharge is drip type and the drip-pipe is at near the ground level or right on the ground .

1.5 Chapter Summary

This chapter focuses on the background study of the proposed project topic which has been drawn from local and international cases studied. Through analysis of damages caused by fire and risk brought about by fires in this project it has been found necessary to work on designing a fixed system to control and monitor fires in highly haunted highways. It was also found that the woodlands of savanna vegetation provides fuel for fires and can become uncontrollable in a very short time especially in dry seasons where green is scarce.

CHAPTER II: LITERATURE REVIEW

2.1 ZIMBABWE'S CLIMATE AND VEGETATION IS VULNERABLE TO FIRES

The system functionality is similar to that of a fire guard, fire guards are not as efficient as this system concept which uses water to shield and put of close by fires. Zimbabwe is located in southern Africa between 19° and 30° south of the Equator. The country has a total land area of 39 million ha. Annual rainfall ranges from 500–1500 mm, with a rainy season from November to March. The average annual temperature is 18.6°C. Approximately 15.6 million ha (40%) of Zimbabwe is under forests and woodlands. The miombo woodlands, are composed primarily of Brachystegia species with Julbernadia globiflora, cover approximately 60% of the forest areas in Zimbabwe. In these woodlands, both grasses and woody plants are characteristic components and this ensures enough fuel for fires especially during the dry winter months. Exotic forest plantation mainly under Eucalyptus and pines grown on a commercial basis also form part of the forest cover. [10]

Fig 2.1 [14]

Fig 2.4 shows an area being devastated by an uncontrolled fire.

Fig 2.2 [8]

Figure shows Kariba Road haunted by a veld fire and thick smoke emerging as a result of continuous uninterrupted burning of the fire. [34]

2.2 Existing fire control organizations

1.2.1 NIFCA (National Industrial Fire Control Association)

The National Industrial Fire Control Association (NIFCA) is a non-profit making organization established in 1992 for the purpose of helping the industry to promote fire safety and to be adequately prepared for fire and related emergencies. NIFCA is an affiliate member of the Civil Protection Unit and the director of the Department Of Civil Protection under the Ministry of Local Government is its patron. The activities of NIFCA are concentrated in the private sector being among other things; fire prevention advocacy, fire safety promotion, fire incident management, fire research and human resource development.[10]

Fig 2.3

The above figure shows NIFCA in action of trying to put out fire with potential of massively destroying infrastructure. [9]

1.2.2 Harare Fire Brigade

The **Zimbabwe Fire Brigade** plays a crucial role in emergency response and fire safety within the country.

1. **Harare Fire Brigade**:
    - The Harare Fire Brigade is responsible for fire prevention, firefighting, and rescue operations within the city of Harare, the capital of Zimbabwe.
    - It usually handles incidents such as house fires, traffic accidents, and other emergencies.
2. **Certification and Standards**:
    - Companies or individuals involved in installing and servicing fire alarms must be registered with the Chief Fire Officer.
    - Certificates of competence are required for specific roles, and holders must renew them annually.
3. **Emergency Preparedness**:

- The fire brigade's readiness and effectiveness are critical for public safety.
- They respond promptly to incidents, conduct fire safety education, and enforce regulations to prevent fire-related disasters.

Fig 2.4

Figure above shows fire engines for Zimbabwe Fire Brigade meant to operate in in Harare Metropolitan Province. [10]

1.2.3 Fire Monitoring Systems | AMPTEC Fire & Safety

Fire monitoring systems are crucial components of any fire safety strategy you may think of. The systems are designed to detect and respond to potential fire hazards with immediate effect, so as to minimize the risk of property damage, injuries, and even loss of life. At AMPTEC Fire & Safety understands the importance of reliable fire monitoring solutions in safeguarding homes, businesses, and public spaces.

Fig 2.5

The above figure shows the pipe and sprinklers part of fire suppression system designed by AMPTEC fire and safety. [11]

2.2 GSM

A customized Global System for Mobile communication (GSM) module is designed for wireless radiation monitoring through SMS (Short Messaging Service). This module is able to receive serial data from radiation monitoring devices such as survey meter or area monitor and transmit the data as text SMS to a host server. It provides two-way communication for data transmission, status query, and configuration setup. The module hardware consists of GSM module, voltage level shifter, SIM circuit and Atmega328P microcontroller. Microcontroller provides control for sending, receiving and AT command processing to GSM module. The firmware is responsible to handle task related to communication between device and host server. It process all incoming SMS, extract, and store new configuration from Host, transmits alert/notification SMS when the radiation data reach/exceed threshold value, and transmits SMS data at every fixed interval according to configuration. Integration of this module with radiation survey/monitoring device will create mobile and wireless radiation monitoring system with prompt emergency alert at high-level radiation. [12]

Fig 2.6 [13] Figure shows a Global System for Mobile communication (GSM) module.

2.4 SENSORS

Sensors are electronic devices used for interacting with the physical conditions from the environment. There are various types of sensors available which can detect light, noise, smoke, flame, temperature change etc. Due to advent in technology, sensors are found in both analog and digital forms. Besides setting a communication link with the outer environment, sensors are also crucial in safety systems. Fire sensors are used to check for presence of fires and precautionary measures are taken as quickly as possible. For smooth function of control systems and sensitive electronics, humidity sensors are used for maintaining humidity in the unit and checking for humid status at certain instance. One of such sensors used in safety systems to detect harmful gases is MQ2 Gas sensor. [33]

2.4.1 MQ2 Gas Sensor

MQ2 is a gas sensor typically made to accept concentration of gases in the air such as LPG, propane, methane, hydrogen, smoke etc. and sent an electrical signal as its output. MQ2 gas sensor has another name by chemiresistor. It comprises of a sensing material whose resistance changes when it comes in contact with the gas. This change is the value of resistance is manipulated in the detection of gas.

MQ2 Gas Sensor

Fig 2.8

Figure 2.8 shows an MQ2 gas sensor. [18]

2.4.2 Flame Sensor

A flame sensor is one kind of detector which is designed for detecting as well as responding to the occurrence of a fire or flame as its main functions. The flame detection response can depend on its sensitivity to light i.e. flames. The response of these sensors is a quick one as well as accurate compared to heat or smoke sensors because of its mechanism while detecting the flame. [32]

flame-sensor

Fig 2.9 [20]

Figure 2.9 shows a flame sensor module fabricated including the nob for adjusting the threshold.

The pin configuration is clearly shown on the figure above that comprise of four pins. The four pins are **Pin 1** (VCC pin): Voltage supply falls in the range 3.3-5.3V. **Pin 2** (GND) this is simply the ground pin. **Pin 3** (AOUT) this is an analog output pin. **Pin 4** (DOUT) this is a digital output pin. [31]

2.5 Esp32 WROOM

ESP32-WROOM-32 is a powerful, generic Wi-Fi, BT and BLE MCU module that targets a wide variety of applications, ranging from low-power sensor networks to the most demanding tasks, such as voice encoding, music streaming and MP3 decoding. At the core of this module is the ESP32-D0WDQ6 chip. The chip embedded is designed to be scalable and adaptive. There are two CPU cores that can be individually controlled, and the CPU clock frequency is adjustable from 80 MHz to 240 Megahertz. The user may also power off the CPU and make use of the low-power co-processor to constantly monitor the peripherals for changes or crossing of thresholds. [21]

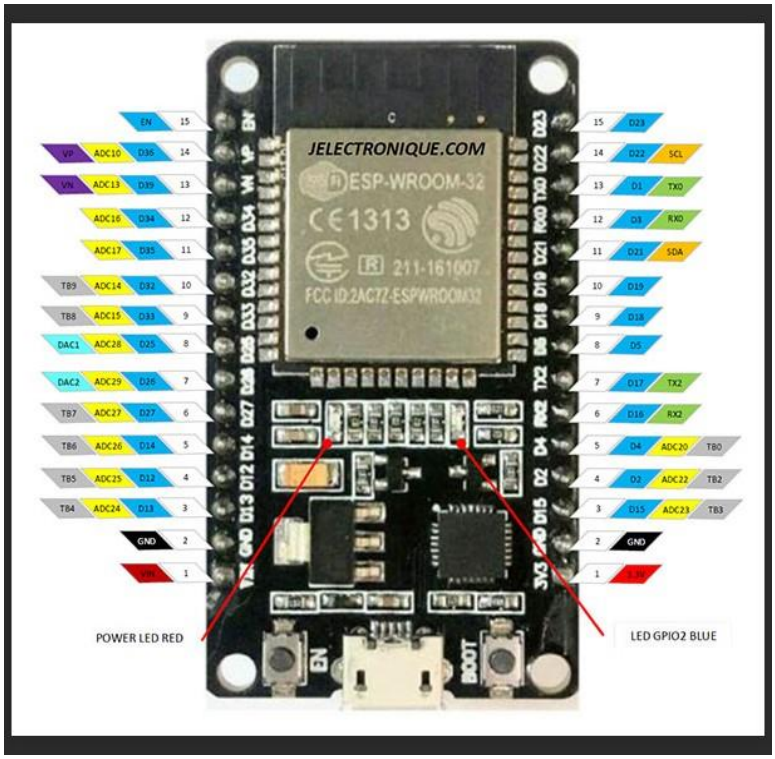

Fig 2.10 [21]

Figure 2.10 shows an Esp32-WROOM-32 with labeled pin configuration as shown.

1. **GPIO Pins**: The module has **32 GPIO pins** that can be configured for various functions, including digital-only, analog-enabled, and capacitive-touch-enabled. Some pins have specific behaviors during boot, so be cautious. For example:
    - **GPIO0** must be **HIGH** during boot and **LOW** for programming.

- **GPIO2** must be **LOW** during boot and is connected to the onboard LED.
- **GPIO15** must be **HIGH** during boot to prevent startup logs if pulled LOW.
- **GPIO14** must be **LOW** during boot.
- **GPIO13** and **GPIO12** are safe to use.
- **GPIO34**, **GPIO35**, **GPIO36**, **GPIO39**, and others have specific limitations.

2. **Other Features**: The ESP32-WROOM-32 also supports ADC, DAC, touch, I2C, SPI, UART, and more. If you're designing a custom PCB, understanding the pin out is crucial for successful integration. [21]

2.6 Relay Switch

Relay is an electromechanical device that uses an electric current to open or close the contacts of a switch. The single-channel relay module is much more than just a plain relay, it comprises of components that make switching and connection easier and act as indicators to show if the module is powered and if the relay is active or not.

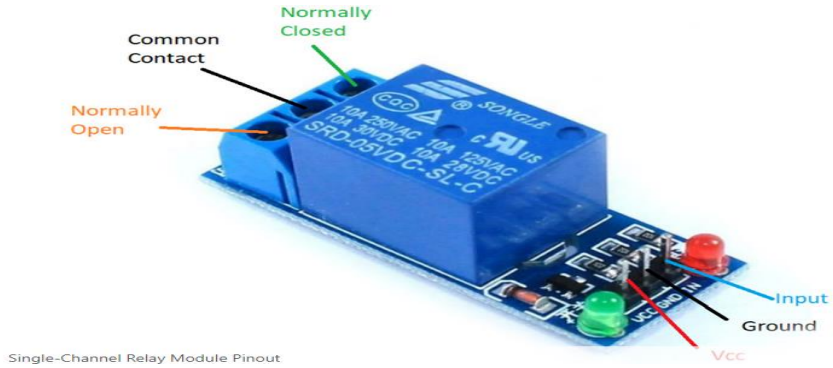

Fig 2.12

Fig 2.12 shows a relay switch in the single channel mode. [22]

2.6.1 Single-Channel Relay Module Specifications

- Supply voltage – 3.75V to 6V
- Quiescent current: 2mA

- Current when the relay is active: ~70mA
- Relay maximum contact voltage – 250VAC or 30VDC
- Relay maximum current – 10A [30]

2.7 Chapter Summary

Fig 2.13 [23]

Fig 2.13 shows common electronic components.

In short, most of the electronic components work with DC power supply. We can make use of some electronic components to convert AC to DC power. [29]

A Light Emitting Diode or LED in short – is a small component that lights up when current flows through it. We use the resistors to control the voltages and the currents in our circuit. The switch is a component that connects one pin to another. For current to flow through a circuit, there needs to be a path from the plus of the battery to the negative of the battery. Capacitors come as polarized and non-polarized capacitors. The biggest difference is that with the polarized capacitor, you have a positive and a negative pin and you need to make sure to connect them correctly. One can connect non-polarized capacitors any way you want. It has three pins named base, collector, and emitter. For a transistor if you have a small current flowing from base to emitter, you turn it on. With no current, it is off. To get current flow you need about 0.7V from base to emitter (for this type of transistor). A transformer is a component made up of two inductors wound around the same magnetic core. The

general overview of how a microcontroller works is that, we need input signal this is possible by use of sensors and then the controller accepts the input processes it to send appropriate commands to actuators and any other output devices. By this phenomenal linking of input and output devices with a microcontroller programmed to conduct a certain task, we can say we have a system. [24]

CHAPTER III: DESIGN

3.1 Chapter Introduction

In this design chapter a staged series of interfacing I/O peripherals to the central processor (PIC16F877A) of the system will be shown shall be demonstrated. The setup of the system is supposed to have the ability of suppressing fire through the use of an automatically triggered pump and it should also have a feature known as Global Service for Mobile Communication which gives the system its uniqueness to send a message to the nearest fire Brigade to take care of the rest of veld fires.[28]

3.1.1 Block Diagram A

The first block diagram is a part that is showing the first objective of the project as stated in the chapter 1.

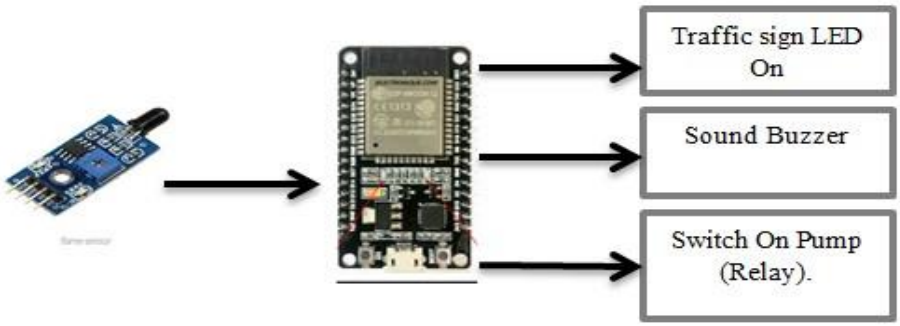

Fig 3.1

The figure above is a block diagram of a PIC controller interfaced to an IR flame sensor. The block diagram shows that when flame is detected traffic safety sign lights blinks, the buzzer sounds and a message is send to the Fire Brigade.

3.1.2 Block Diagram B

This sub section of the design phase shows a block diagram that summarizes what takes places when both sensors sends an input to the controller.

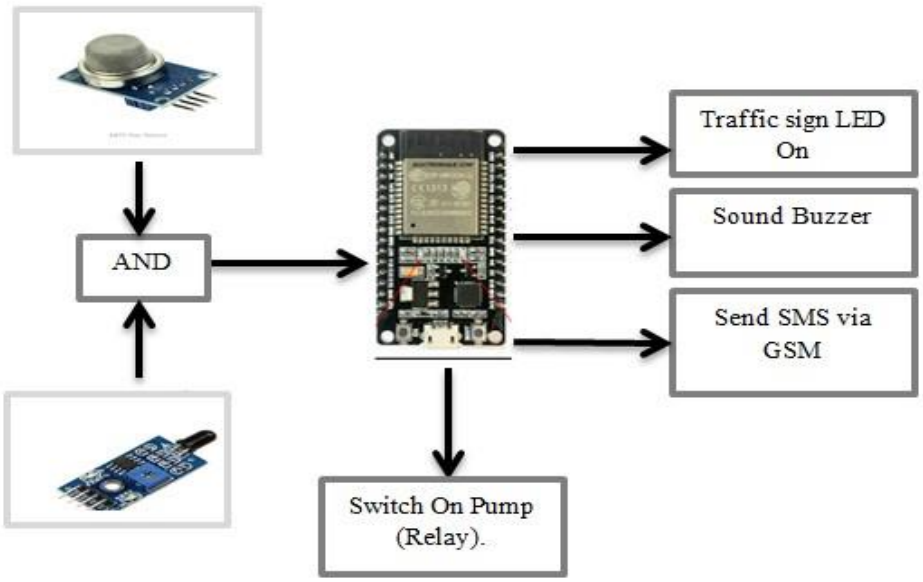

Fig 3.2

The above figure shows a block diagram with two sensors with their combined effect that turn on pump to control fire progression.

3.1.3 Overall Block Diagram

Below is a block diagram of the fire control system and alert system along the highways along with the power supply section. The inputs are two sensors the IR flame sensor and MQ2 gas sensor all have capability to detect presence of fire.

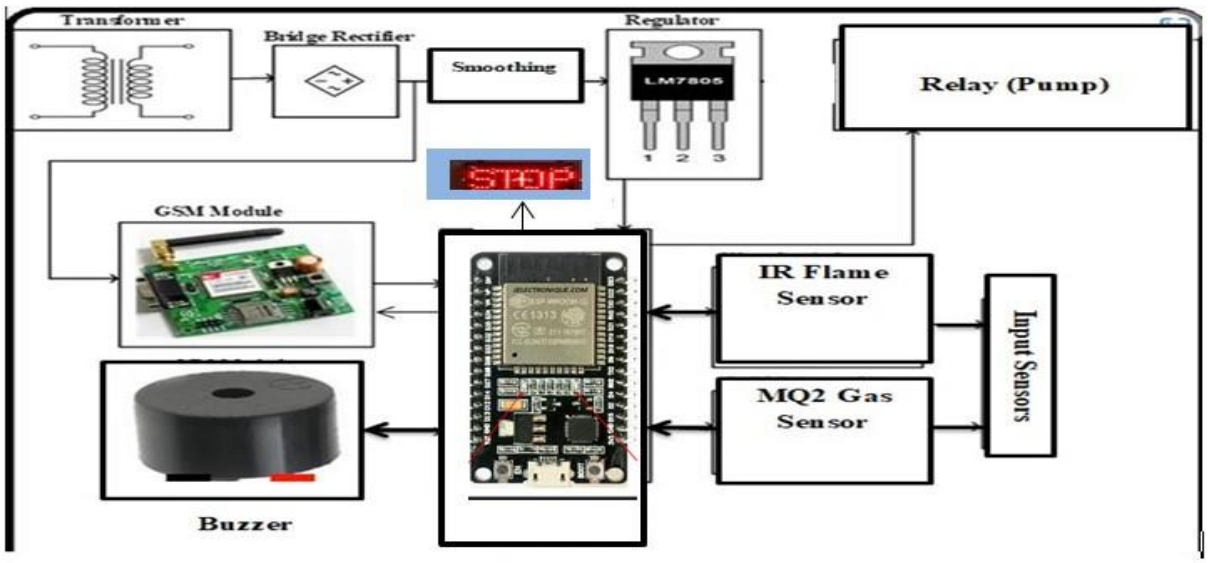

Fig 3.3

Figure above shows a block diagram with summarizing the system's sections from power source, output and input peripherals as well as the micro-controller.

3.2 Flow Chart

Under this sub heading a design of the software's algorithm showing a step-by-step representation of the system's operation will be carried out.

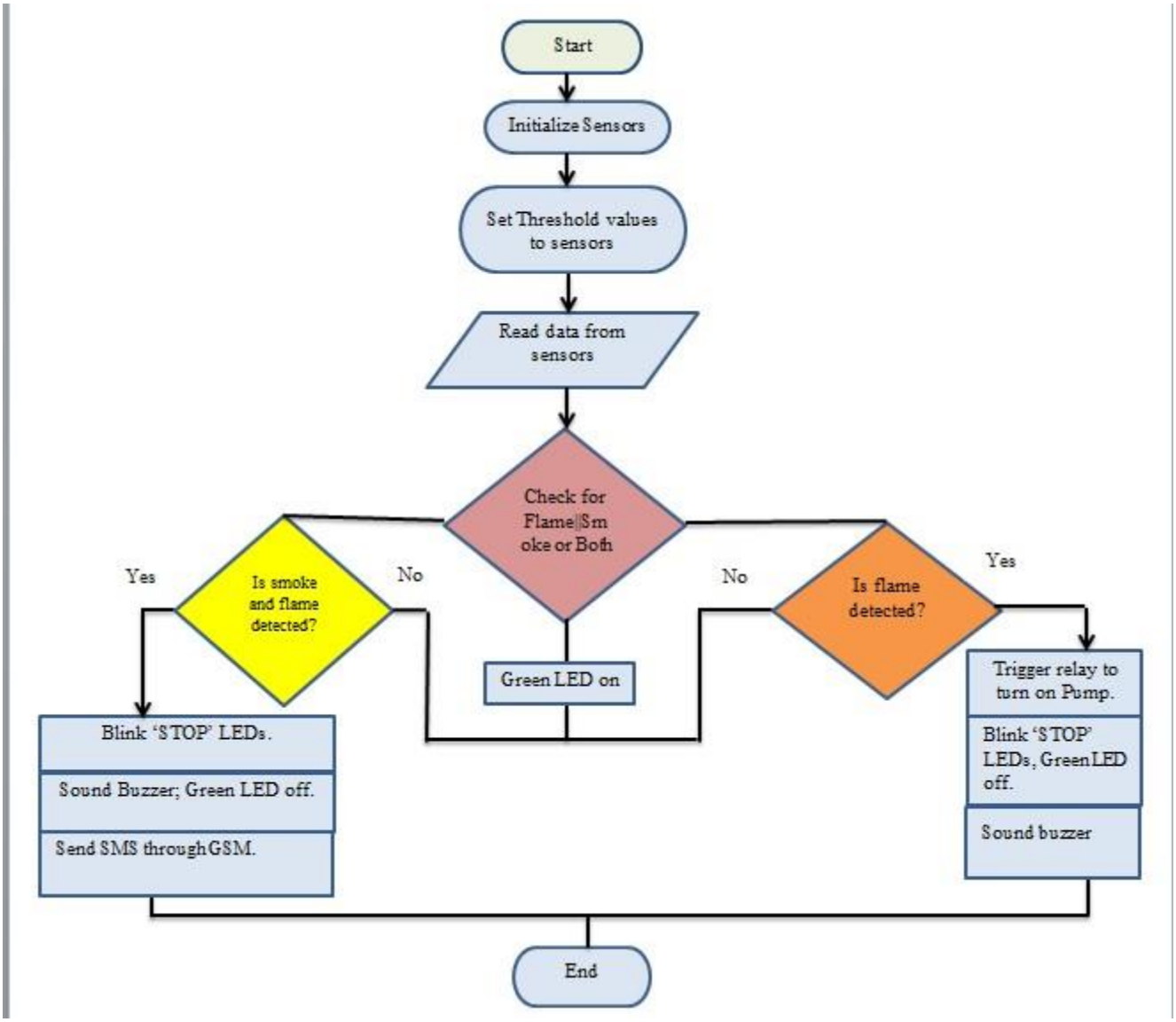

Fig 3.4

Figure 3.4 shows a flow chart of the systems software (algorithm) design to run on the hardware of the system's components.

3.3 Chapter Summary

In summary, to this chapter the idea of designing is to separately mold the hardware's relationship to have a raw idea of how the electronic components should be connected to have the desired results addressed to by the objectives from chapter 1 of this document. Thereafter the flow chart has been produced after several tries and errors. Thus through the effort in trying to minimize some concepts

behind the system functionality and after suppressing some parameters we have successfully came up the step-by-step algorithm that will summarize the operation of the software that will be running the system. [27]

CHAPTER IV: SIMULATIONS

4.1 Chapter Introduction

In this design chapter schematic circuit will be carried out by software known as Proteus Design Suite. This software is capable of providing with soft components which can be interconnected and ran to check for correct circuitry design. It can also allow the user to redo the circuit with limited guidance; the rest is individual know how. Schematic capture in the Proteus Design Suite is used for both the simulation of designs and as the design phase of a PCB layout project. It is therefore a core component and is included with all product configurations. [25]

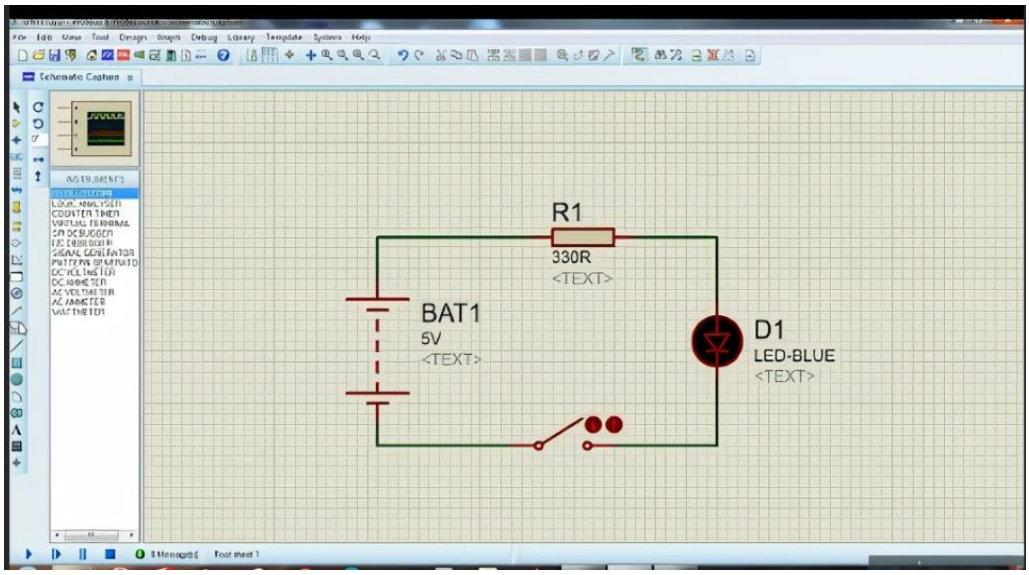

Fig 4.1

Fig 4.1 shows a basic schematic circuit on a Proteus Design Suite.

4.1 .1 Microcontroller Simulation on Proteus

The micro-controller simulation in Proteus works by applying either a hex file or a debug file to the microcontroller part on the schematic. It is then co-simulated along with any analog and digital electronics connected to it. This enables its use in a broad spectrum of project prototyping in areas such as motor control, temperature control and user interface design. It also finds use in the general hobbyist community and, since no hardware is required, is convenient to use as training or teaching tool. [25]

4.1.2 PCB Design

The PCB Layout module is automatically given connectivity information in the form of a netlist from the schematic capture module. It applies this information, together with the user specified design rules and various design automation tools, to assist with error free board design. PCB's of up to 16 copper layers can be produced with design size limited by product configuration. [26]

4.2 Interfacing Controller with Infra-Red Sensor

Since more than 90% of the flame's total radiation is infrared, IR detectors receive ample radiation of quite high intensity and will operate with either very weak or very hot flames.

$$F = \frac{L}{\gamma}$$

Where;

F- Frequency

L- Speed of Light, γ- wavelength (760-1100nm range of Infra-Red)

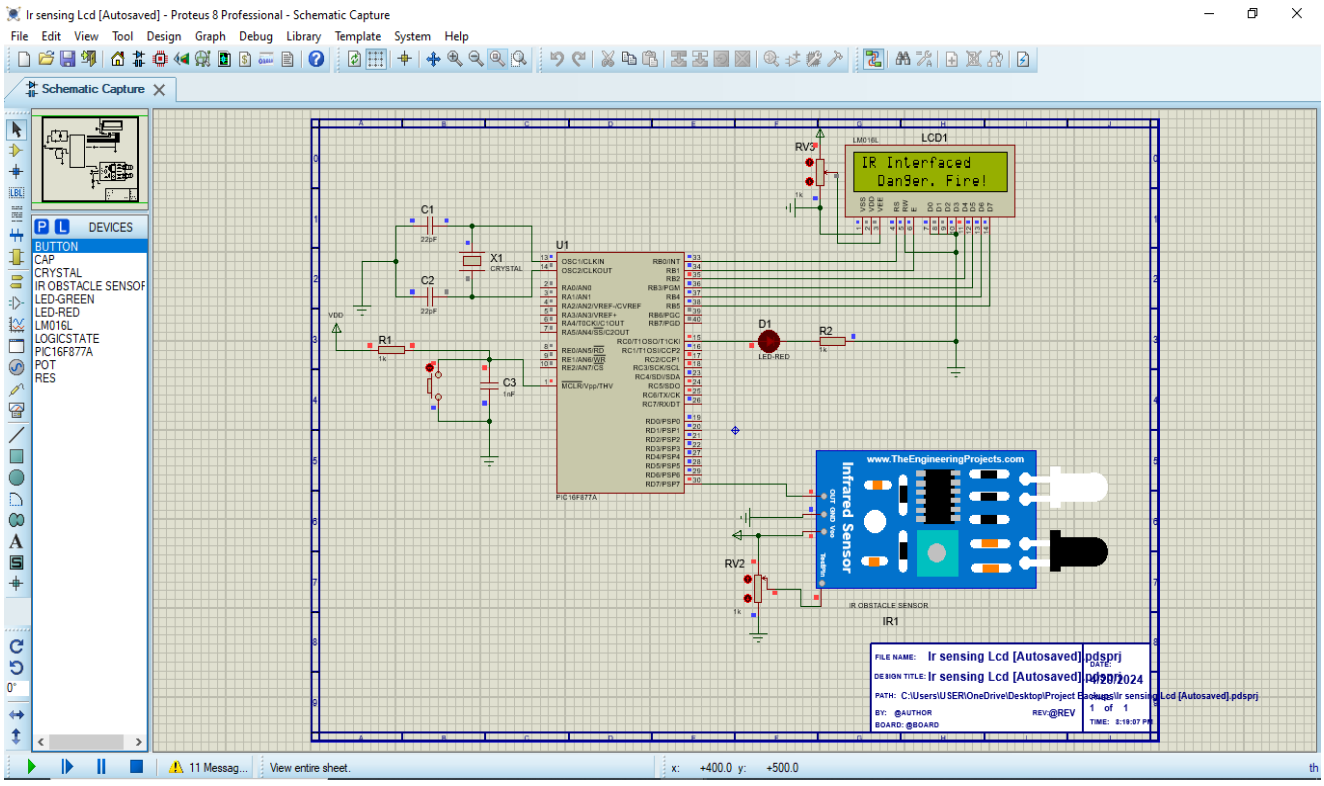

Fig 4.2

The Fig above shows IR sensor interfaced to a PIC micro-controller, when output of sensor is relatively high.

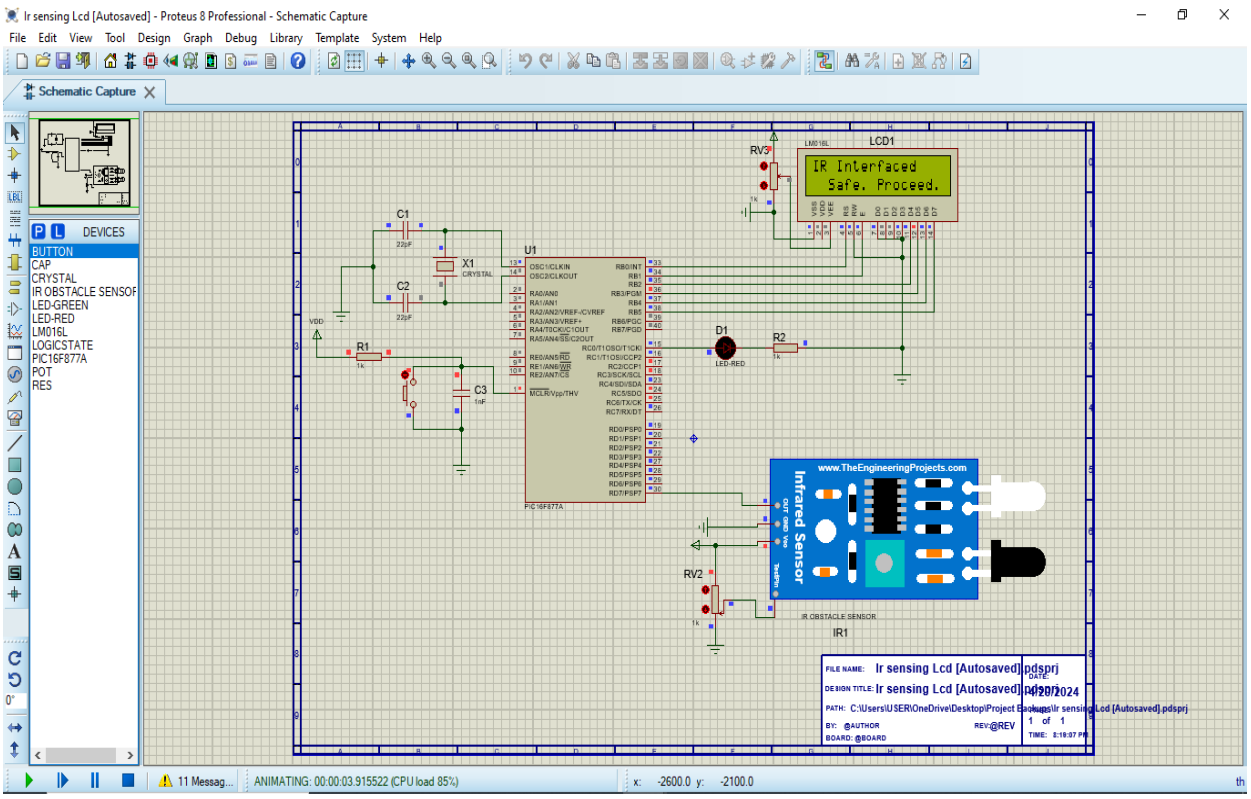

Fig 4.3

The figure above shows a PIC controller to IR sensor connection, when sensor output low.

When IR sensor detects flame it sends a signal to the micro-controller and it turns on warning LEDs, in this circuit an LCD has also been made use of to track visibility of the system.

4.3 Interfacing Controller with MQ2 gas sensor.

To interface this sensor with pic microcontroller, we only need to connect analog output pin of smoke sensor with analog input pin of pic microcontroller. PIC16F877A microcontroller has built in 8 analog input channels. So an analog channel is needed to measure the output voltage of sensor.

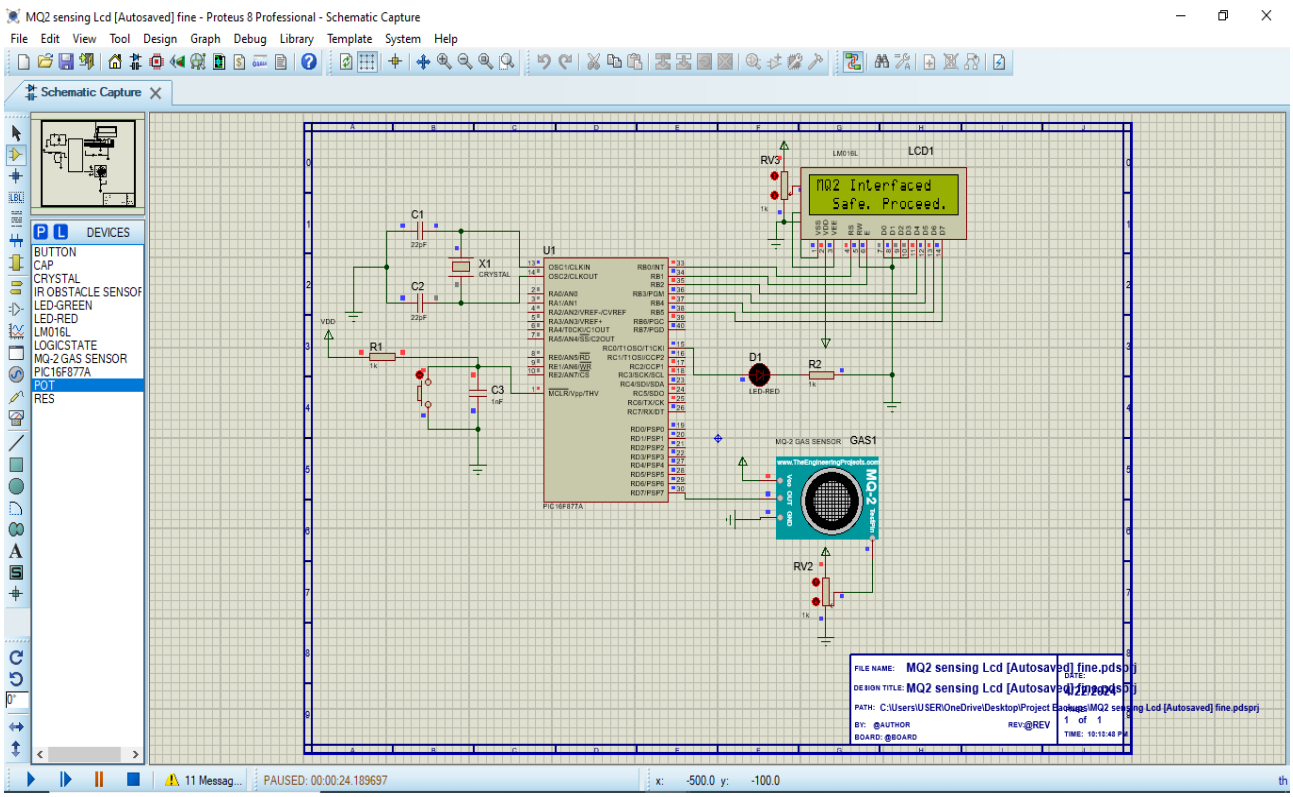

Fig 4.4

Figure above shows interfaced to the controller with LED and LCD as its outputs.

4.4 Controller to IR and Gas Sensor interface with Pump as Output.

In this component objective the pump is only turned ON when both outputs of the two sensors IR and MQ2 gas sensor is high. In the case of one sensor's output high and the other one low there the pump stays OFF. The reason being when smoke is detected and no flame is detected the smoke might be coming from a harmless fire. In the case of flame and smoke being detected then we have a big problem to attend to with sprinkled water that's the only scenario when the pump is put ON.

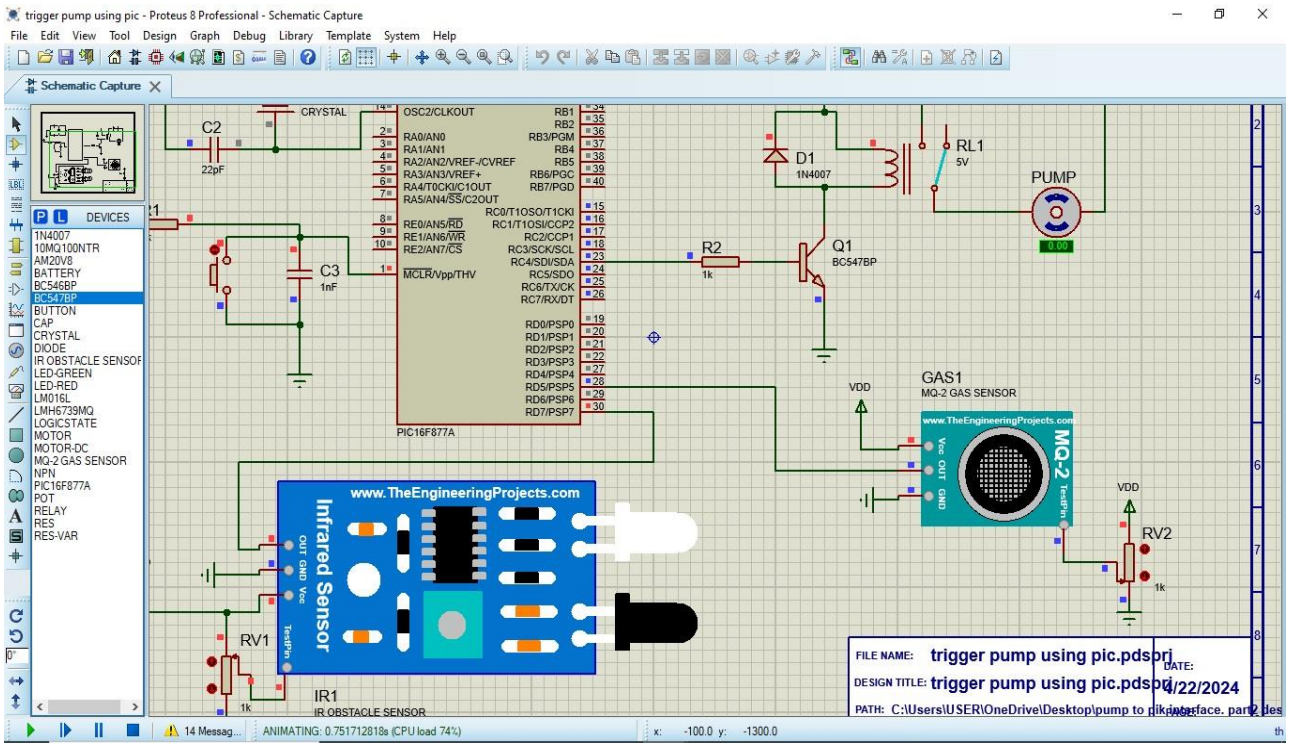

Fig 4.5

The figure above shows high IR output and low Gas Sensor output the relay switch remains off.

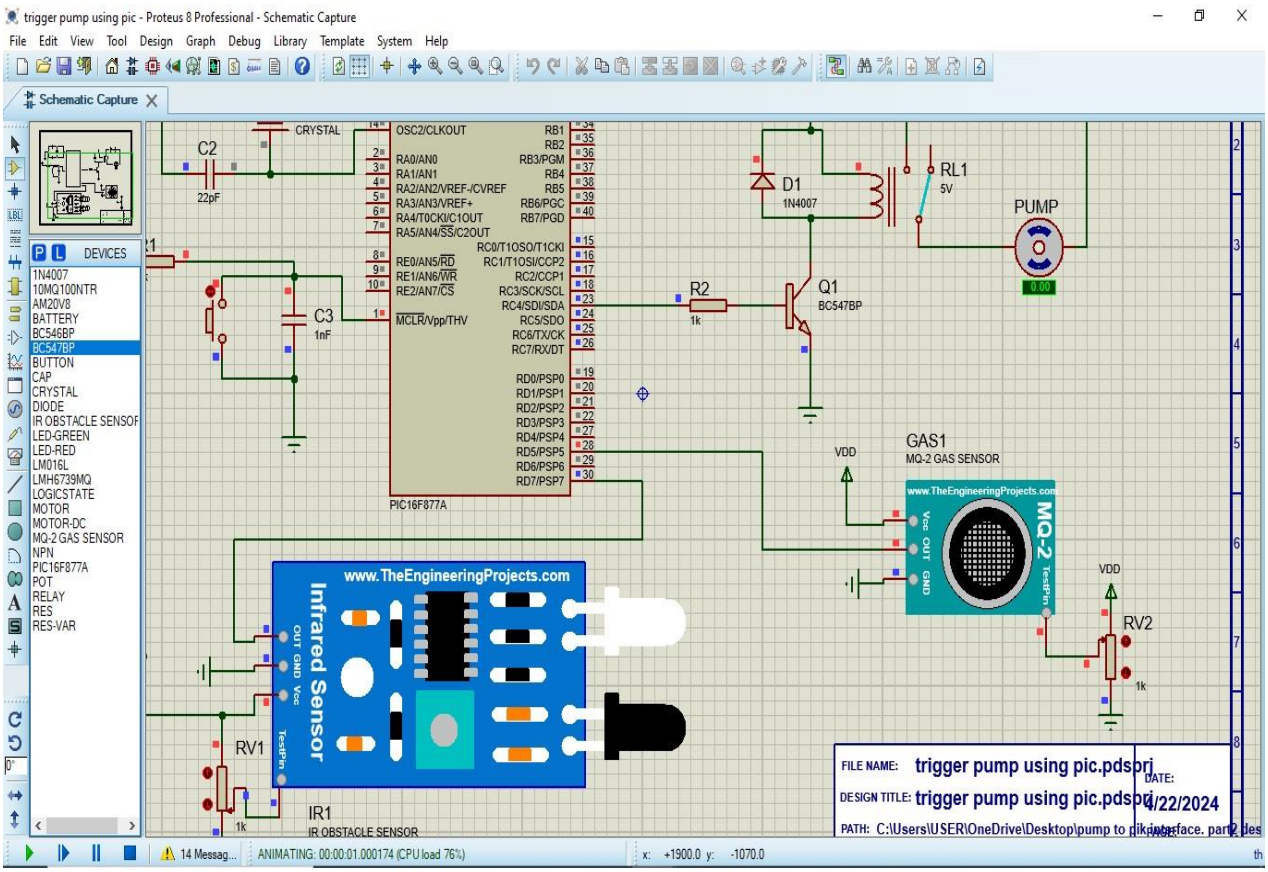

Fig 4.6

The figure above shows low IR output and high Gas Sensor output the relay switch remains off.

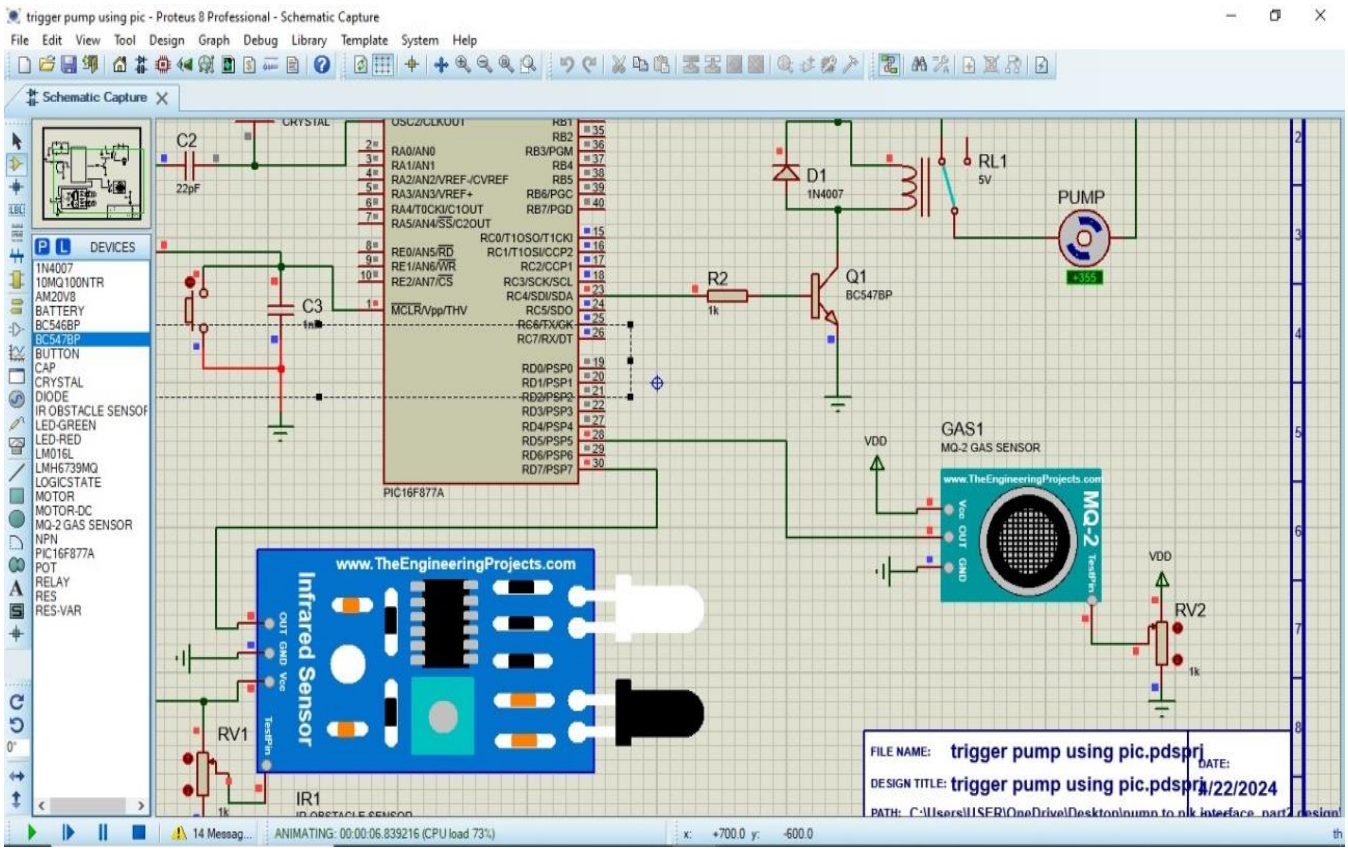

Fig 4.7

Figure above shows high outputs of IR and Gas Sensor being fed to the micro-controller; the relay has been triggered to an ON state to switch ON the pump.

4.5 Send SMS with GSM when both sensors output are HIGH

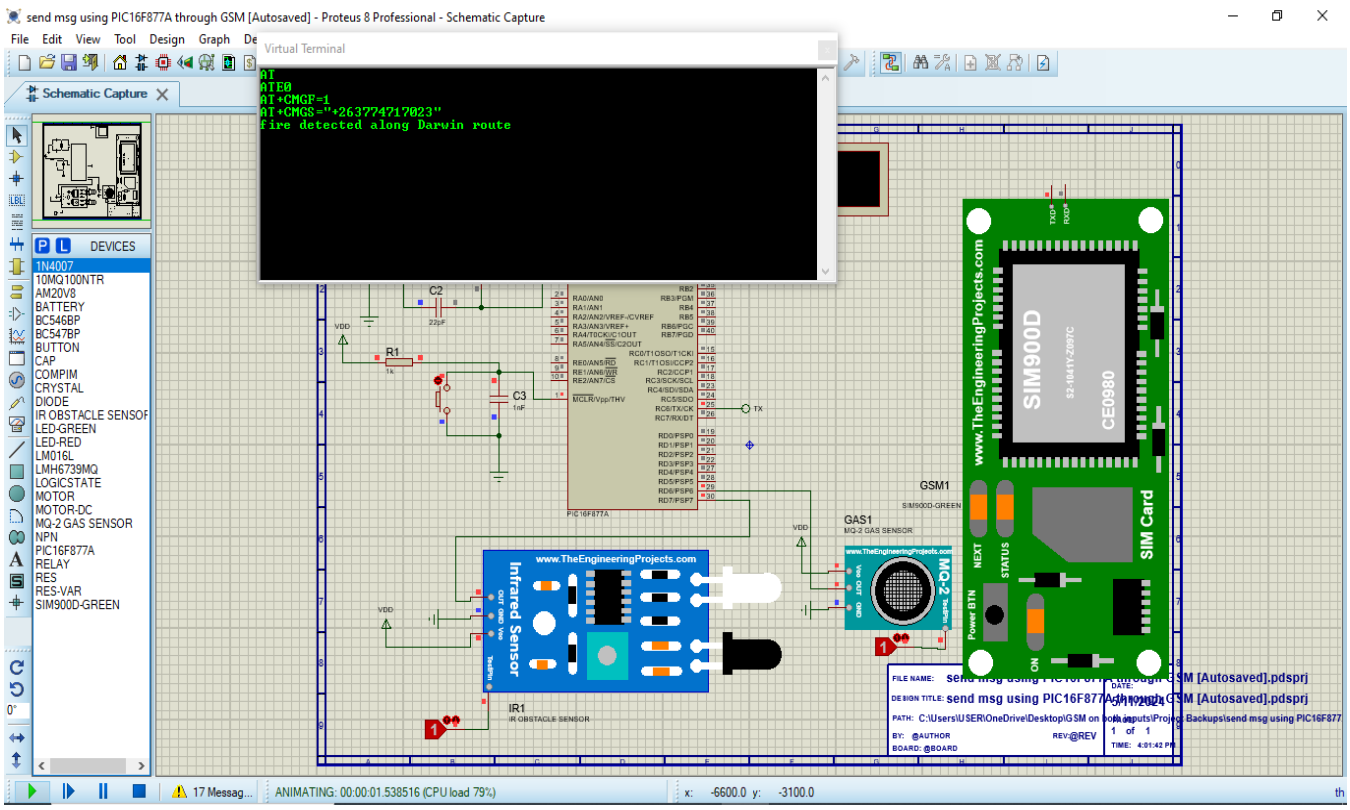

Fig 4.8

Figure above shows both sensor MQ2 and IR sensor high and virtual terminal displaying the ongoing AT commands as well “Fire detected along Darwin route” text which is supposed to be sent.

4.6 Simulation of the overall system

This is the final sub section of the simulation chapter where the objectives that has been ran partially are now combined.

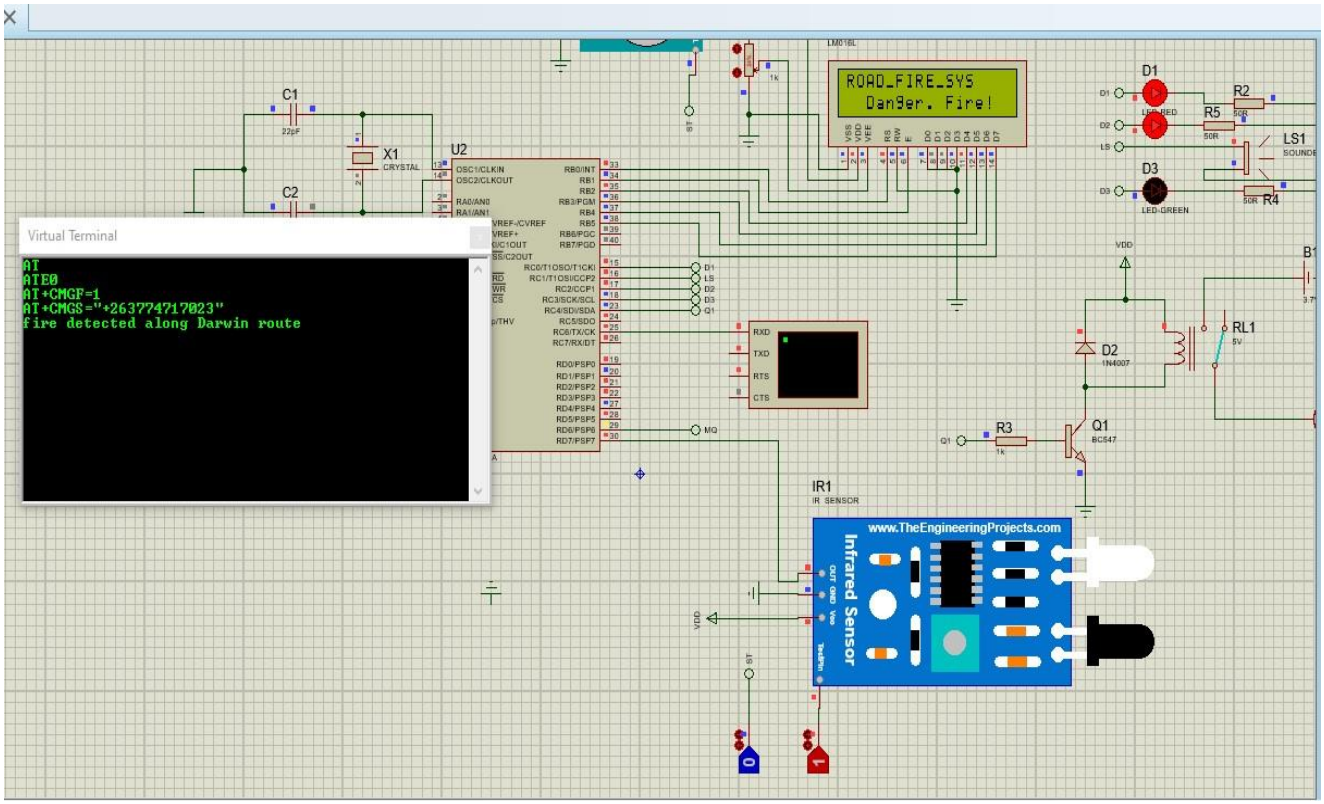

Fig 4.9

Figure 4.9 shows a simulation of the system when the flame sensor sends high signal to the micro-controller. The resulting output is the sounding of the buzzer, blink of red LEDs and SMS sent through the GSM in this case a virtual terminal is used to replace GSM but the pump stays off.

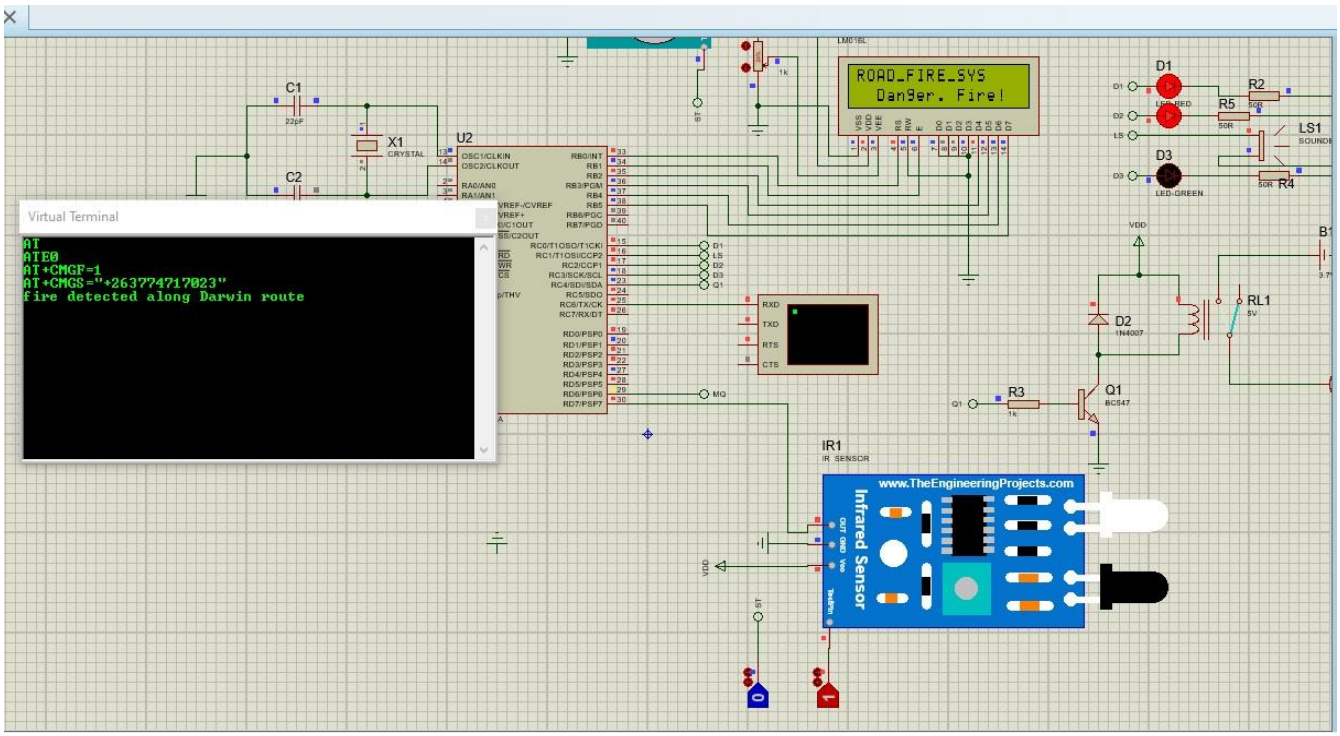

Fig 4.10

A figure 4.10 show the system's operation when both input from sensors are high the relay switch that turns ON the pump is ON.

4.7 Chapter Summary

In short, the simulation chapter has brought us the eligibility of checking how the hardware and the software then operate when they are combined. After having the objectives designed separately in the design chapter, it has also been considered right to combine the schematic circuitry describing the first objective with the code dedicated to operate on the circuitry. The second objectives that include the suppression of fire was done alone and later combined with the previous circuitry to come up with the system's circuitry. The final circuitry is then loaded with the instructions dedicated to control it and successfully the results were found with a little blemish of not operating in real time due to CPU load.

CHAPTER V: PRACTICAL IMPLEMENTATION

5.1 Chapter Introduction

In this chapter, hardware circuitry shall be presented in form of pictures to show how the components from simulation chapter look like in hardware presentation. At first they shall be fabricated temporarily on a breadboard and then later soldering and etching will be introduced for permanent circuitry. The real fight is in trying to transfer the circuitry on the Proteus 8 simulation to hardware and try to get the real results similar to those compared to the ideal results previously achieved in the previous chapter. We shall begin with the powerhouse of the project which is the power supply.

5.2 Dual Port Output Power Supply

Power supply is generally a well-known for stepping down 220-240V AC and produce a require DC power. It achieves this uniqueness of turning AC to DC through the use of a combination of rectifying diodes and the network is called Bridge Rectifier.

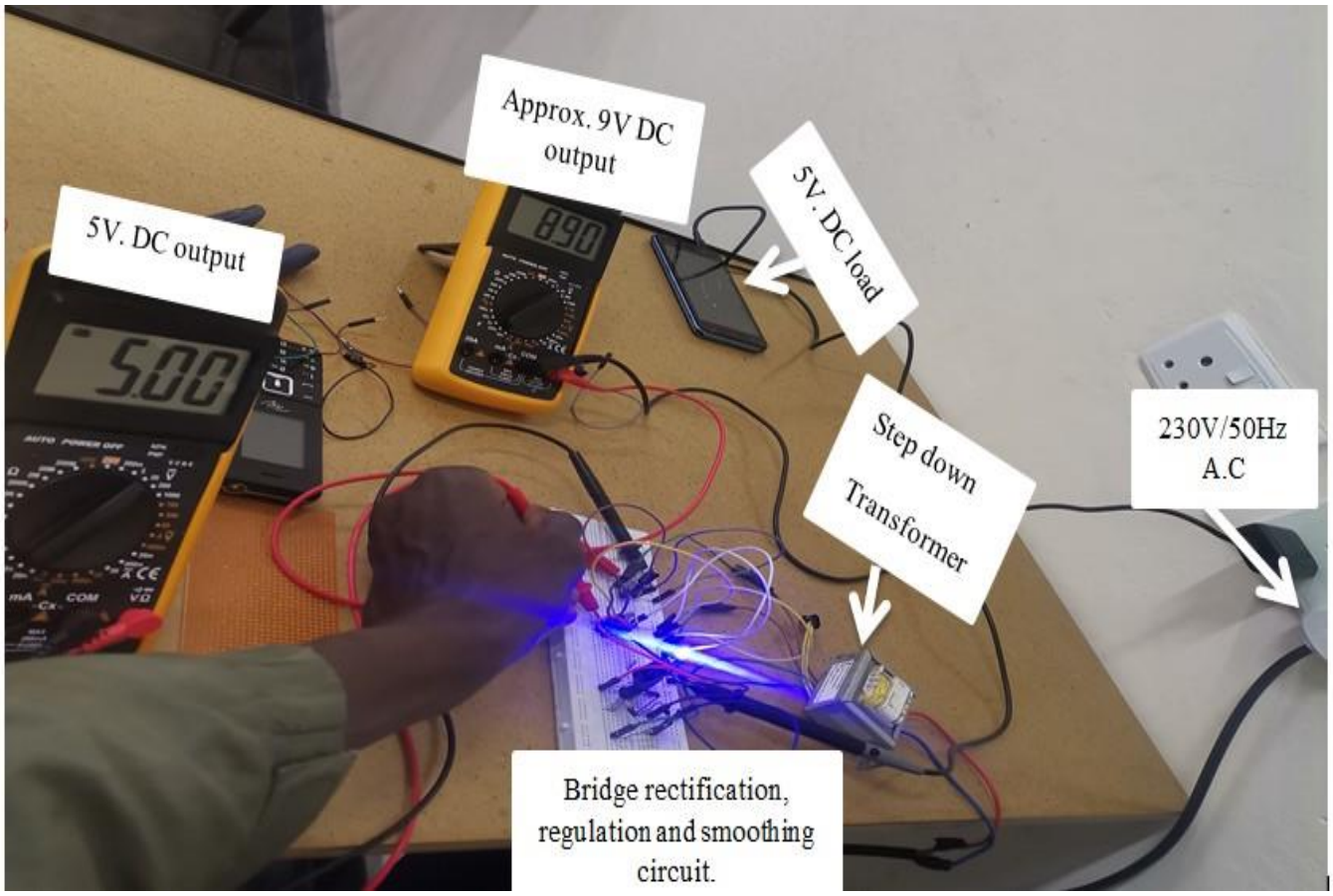

Fig 5.1

Figure 5.1 shows a power supply temporarily fabricated on a breadboard.

5.3 Micro-Controller to IR-Flame sensor interfacing.

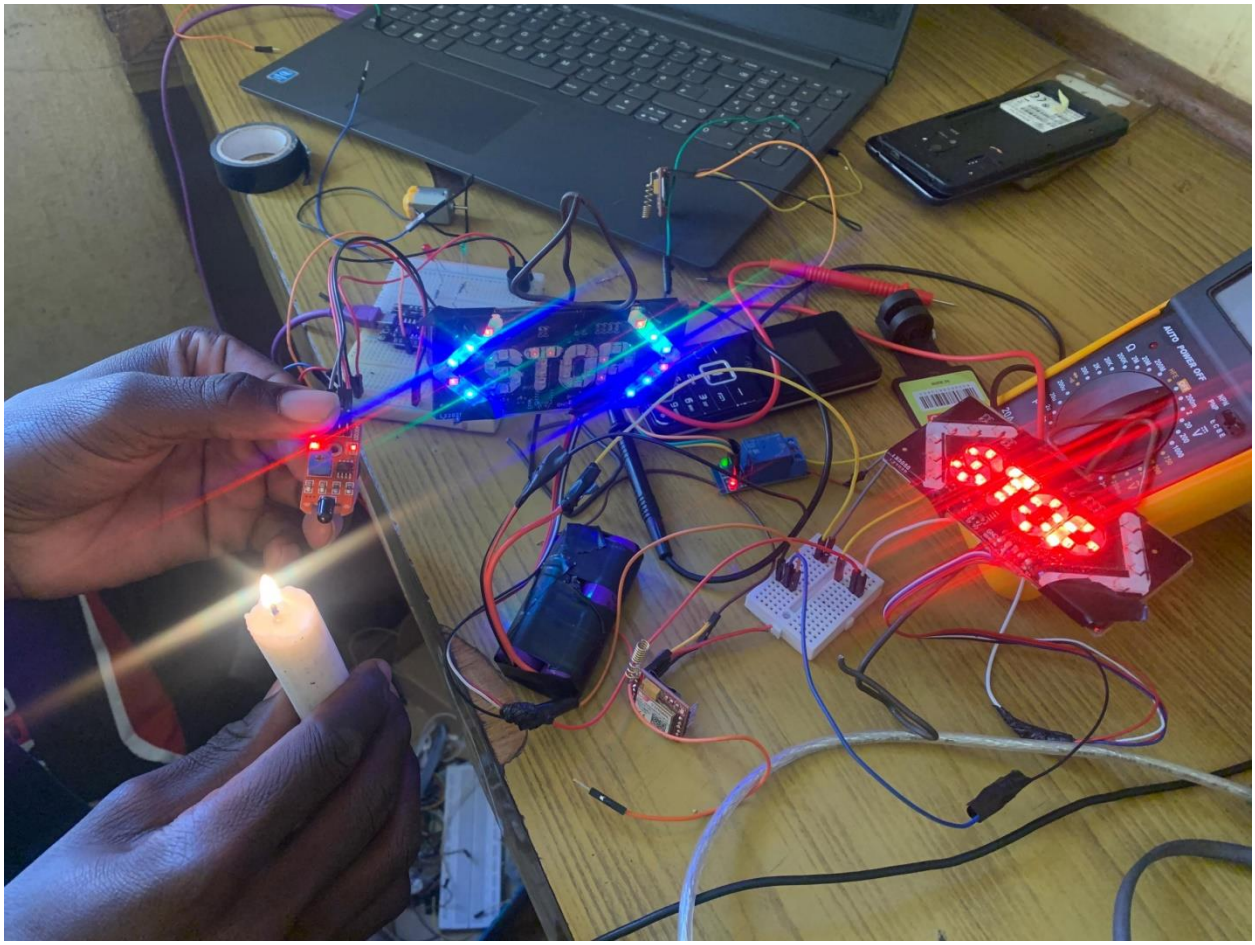

Fig 5.2

Figure 5.2 shows the sub systems circuitry on a breadboard showing us what happens when fire is detected, in the effort trying to achieve what we have attained from to the simulations.

5.3 Micro-Controller to MQ2-gas and IR-Flame Sensors interfacing.

Fig 5.3

Figure 5.3 shows the systems circuitry when both sensors of the system are shows their combined effect to the operation of the system.

5.4 Chapter Summary

This chapter's aim was to oversee the correctness of our chapter III design and chapter IV design by bringing them to the real circuitry where the components are vulnerable to heating effect, potential drops, ageing effect and so on. So as the process of transferring the simulations to hardware circuitry some non-polar capacitor where exchanged with the other of different manufacturing properties they had approximately equal capacitance but the voltage operation and power rating were by far different. In addition, trouble was encountered in trying to program the PIC controller using SP106 programmer the buffer ranges could not match with the one available in the default ranges. To get rid of this problem, a new PIC16F877A was injected to the projected costing the budget and capital inquired initially for the project. The fall backs that were encountered during the design of the circuitry using PIC controller provided us with experience and expertise necessary for use in the migrating from PIC to ESP32 controller.

CHAPTER VI: RECOMENDETIONS AND CONCLUTION

6.1 Chapter Introduction

Recommending ensures that the best product is attained through buying and substituting unavailable components in the market with the one available. Other activities are selected over their counterparts with lesser promise. As mentioned in the aim and objectives; decision on what to buy; what to present, and what to buy every procedure was monitored by the project's document. The project's recommendation report helps to easily know the pros and cons of the prototype that they will be made against the project objectives and the timeline set by Eng. Takawira my supervisor.

6.2 Conclusion of the Manuscript

In conclusion a successful fire control system prototype (model) that monitors and alerts of any fires along a specified route designed and implemented during the course of this project. We managed to use the electronic components and other materials available in the market of Bindura and Harare. The design proposed in this document is based on continuously monitoring the place prone to wild fire outbreaks and reporting of such fire incidents through GSM system. This system uses the GSM for sending SMS to fire stations, while the citation of the GSM used helps for getting actual location where the fire outbreak had taken place since it sends a message with the route that fire would have started. The idea behind making use of sensors is because of quick response time, easy deployment and time saving as well as cost reduction automation. Finally the objectives of the project are successfully achieved with the proper and desired results. Therefore this system provides a better and reliable way of monitoring, controlling and easy identification of the deceased route.

GSM-based fire monitoring is more convenient and more reliable than manual monitoring since it is impossible to manually monitor veld fire occurrence of different routes at the same time. We are also able to take prompt action after getting a notice of any fire status from the system detection ability as the system take immediate suppression through the use of sprinklers. There are several routes at risk of wild fires and by identifying each route with a system, we can quickly determine which route is deserted by fire and at risk which needs early response than the other which would have requested for attention at almost same time and experiencing fire outbreak as well on the message provided to mobile. In the case of relying on the system we don't need to inspect all roads or wait for complaints from road users, so the system may alert us where there is need of attention in less time. Although the time it takes to receive messages may vary owing to public GSM network traffic, it is still more effective than manual monitoring.

6.3 Chapter Summary

In real life this system will include a database of all routes and also stores route possibilities of being haunted by wild fires and be handed over to brigade team for use on which route to give priority to when attending to its request for attention. Analyses of the recorded data will assist the fire authorities in monitoring the functioning in its distribution of fire engines and identifying issues before they become catastrophic, resulting in considerable cost savings and improved system dependability.

All the tasks assigned to the system are vulnerable to certain compromises such as: theft, vandalism, costs of maintenance and equipment, fitting the system to a route cited on a mountain will be more costly as we would now need additional equipment to ensure safety of workers and so on.

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