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Arduino based Fire Detection and Water Sprinkler

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Abstract: *In this project, a Arduino-based automatic fire detection and water sprinkler system that can keep an eye on a building, an industry, and a residence is described. This project is crucial to the upkeep and supervision of all environments that are safe, including anything destroyed by fire. However, the numerous fire detection (fire extinguisher) systems that are now in use are both expensive and outmoded. As a result, it is not within the means of the people with low incomes. Making a low-cost fire control system is the primary goal of this project. The system was created as a result of inspiration to create a small system that was built on the core principles of control, security, and safety.*

Keywords: Arduino, a microcontroller, an environmental Siren, and sensor voltage are used in fire control and fire detection

I. INTRODUCTION

Due to inadequate fire protection and inadequate fire alarm systems, fire accidents are a typical occurrence in industries, homes, markets, and other establishments. Because a fire can be extremely threatening to our lives, we attempt to build an automatic fire detection system that includes water sprinklers. A good firefighting system is one that limits other harm produced by the firefighting system itself while simultaneously minimising the fire damage. The fire detection, notification, and fire protection systems are the three key phases of the desire procedures. The system's primary objective is to identify fire accidents, hence it can recognise three different types of fire. Heat, flame, and smoke are these. The system's microcontroller recognises when a fire has occurred. According to the Centre of Fire Statistics of the International Technical Committee for the Prevention and Extinction of Fire (CTIF), since the start of the twenty-first century, 70,000 to 80,000 people have perished annually as a result of fire outbreaks. It is challenging to detect fires using commercial fire detection systems because they typically use simple sensors with limited accuracy and are subject to sensor failure and malfunction. Additionally, due to the sensor's detection limitations, defects may still develop in the system even when it is functioning normally. Due to a smoke sensor's inaccurate identification of heavy dust as smoke, false warnings may be sent Another illustration is gas leaks. Liquefied petroleum gas (LPG) is the gas that is most frequently used in homes for cooking. It is utilised in cylinders and could explode if there is a leak. Many times, locals are unaware that gas is leaking. They might start a fire that creates a blast as a result. Installing a gas leak detection system will help to prevent this scenario. This strategy depends on the identification of many fire signatures as opposed to fire detection methods that only use smoke. The employment of several factors and sensors in the detecting method is an increasing feature in fire detection. Data fusion algorithms are one type of multisensor fire detection approach now in use. These methods enable the simultaneous collection and processing of various fire signatures for the most effective fire detection. An ATCAV control system (Addressable Controllable Technical Alarm of the Vega range) is part of the fire safety system installed at the level of Moroccan University Hospital Centres (CHU). This system can only regulate the siren during a fire and does not have a monitoring system. Additionally, if there is a fire at the university hospital and the siren malfunctions simultaneously, As a result, there are more hazards involved in the evacuation procedure to protect the medical staff and patients who are staying at the university hospital because the Control and Signalling Equipment (ECS) is unable to trigger and find the issue. In order to address this issue, we have developed a new Fire Safety System that will be installed between the ATCAV control system and the siren. This system will operate the siren during a fire and send its status (functioning, corrupted, etc.) to the Control and Signalling Equipment (ECS). Around the world, fire dangers are a major source of tragic accidents, particularly in underdeveloped nations where fire safety precautions are sometimes insufficient and precarious. Bangladesh, which has

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seen a string of high-profile industrial and residential fires in recent years, particularly in the ready-to-wear industry, is in desperate need of a tenable, dependable, and easily accessible fire security system that would also be cost-effective. Although a number of cutting-edge systems are employed in real-world situations, developing nations lack access to an automated fire alarm system that is trustworthy, simple to operate, and affordable. As a result, in this work, an evaluation of available fire detectors is conducted, and then one of those detectors is used in the design and implementation of a low-cost, quick-response fire/smoke detection and alarm system. The system has the ability to activate the siren at the location and transmit alarm messages via the Arduino network. The introduction and background information required for multisensor fire detection using Arduino technology and water sprinklers are provided in Section 1. The system block diagram and methodology, comprising the concepts and flowcharts, are provided in Section 2. It displays numerous modules along with their implementation design process. A simulation and hardware realisation of the suggested fire safety system are shown in section 3. The experimental verification and accompanying findings of the generated modules are the main topics of Section 4. The testing and performance assessment of the suggested system are well covered in this section. Section 5 concludes by summarising the system architecture and methodology and offering pertinent suggestions for future improvements.

II. METHODOLOGY

2.1 Block Diagram

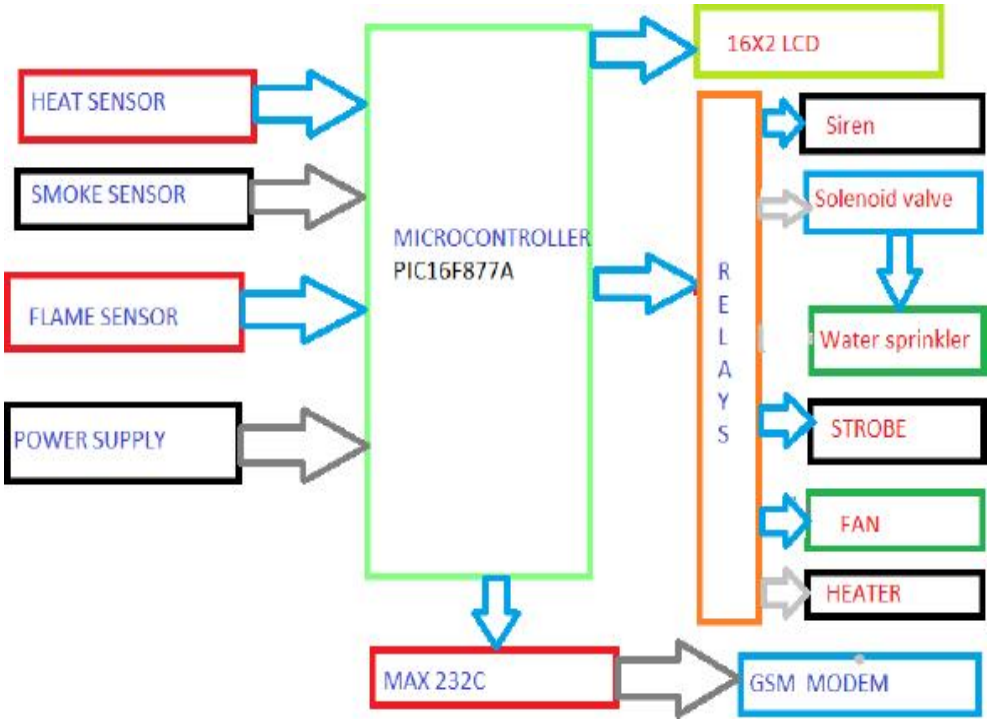

Fig1. Block Diagram of Arduino Based Automatic Fire Detection and Control With Water Sprinkler

The technique we used to build this project, from choosing the project title to submitting the entire project, is illustrated diagrammatically in the following section. The hardware and software designs are created independently because the system consists of both. The hardware and software designs are created separately and combined in the end. By consulting a variety of sources, including journals, articles, reference books, lecture notes, and data sheets, this project was thoroughly explored. The software and hardware designs will be combined once they have been finished separately. The system will be prepared for experimental testing by that point. Any problems encountered, flaws or inadequacies, and necessary changes will be communicated back to the earlier phases throughout the designing and debugging phase. If the result is not what was anticipated, techniques for redesign and troubleshooting will be used. This approach will keep going until a solution that satisfies the project's goals is found. The project would then be completed and prepared for presentation to the panel for approval.

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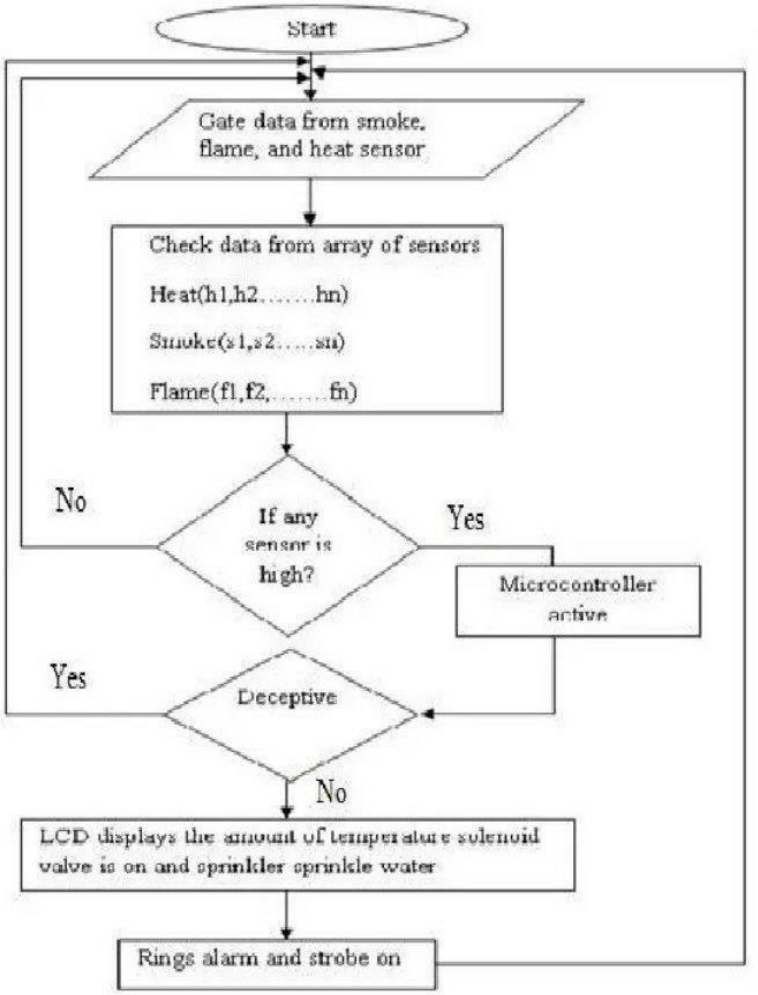
2.2 Flowchart of the system:



2.3 Model Implementation

Simulation;

Fig.2 shows the schematic of our proposed Fire detection and control system in proteus software. The detectors are arranged parallel to one another at various levels. A monitoring system is used to keep track of every signal coming from any detector at any level. The appliance system includes parts for alarming, such as buzzers and sirens, LCD displays for temperature and text, and a motor pump to put out fires. The technique that is suggested in this study makes advantage of contemporary technology to quickly alert the appropriate authorities and detect fire accidents. To detect fire incidents, three different types of sensors are used: heat, smoke, and fire sensors. The microprocessor is activated by the signals from these sensors, and the microcontroller in turn activates the message transfer system, alarm system, sprinkler system, and motor to open the emergency door of the bogie where the accident occurred. The PIC16F877A microcontroller, Arduino technology, and sensors are all used in the creation of the suggested system. The microcontroller in the system is in charge of everything.

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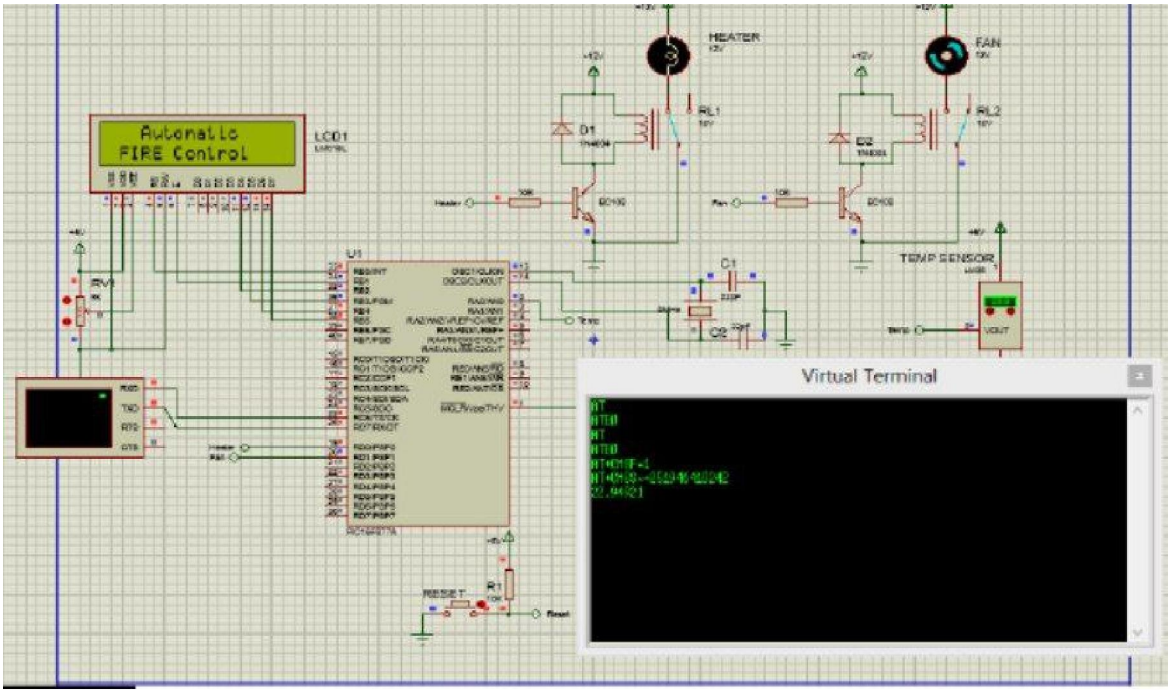

Fig 2. Model Implementation of Arduino Based Automatic Fire Detection and Control

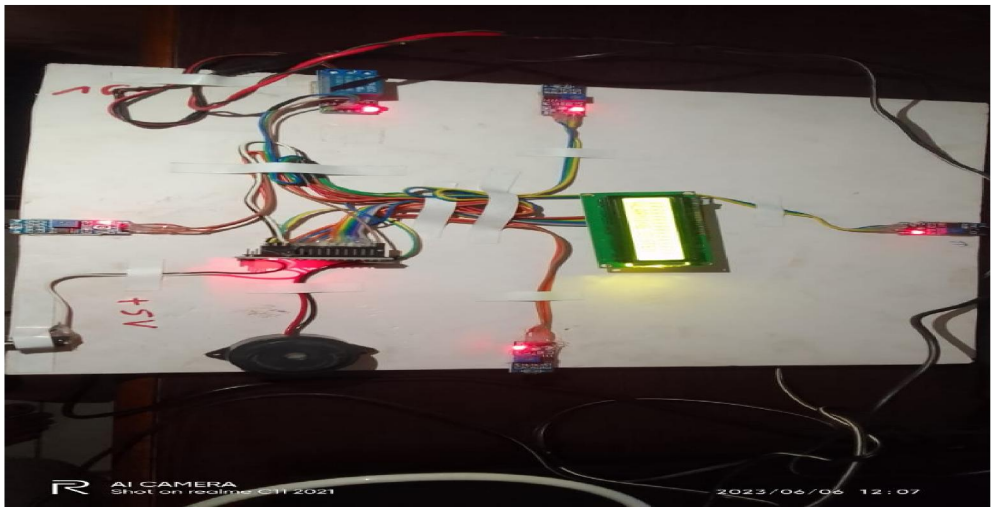

Fig3. Real Time Implementation of Proposed Concept

III. LITERATURE REVIEW

We had the opportunity to study a number of projects, journals, articles, and books relating to the topic of our project as it was being developed. We think that all of the reviewed resources have contributed positively to the overall development and design of the project we have selected. Several of the relevant projects we looked at are described in this section.

3.1 Fire Extinguishing Systems

There are many different kinds of fire extinguishing systems, including those that use water, foam, sprays, or water jets. Others utilise inert gas. Every system complies with ISO.

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A. Fire Main Systems

A system of sea inlets, suction pipes, fire pumps, and distributed piping that supplies fire hydrants, hoses, and nozzles spread out around the ship makes up the fire main. Its function is to deliver an easily accessible supply of water to any location on the ship that can be used to fight a fire, and it is regarded as the foundation of the ship's firefighting systems. The fire main system offers the firefighter a dependable and adaptable system that can offer a variety of options with which to attack a fire. where fighting combustible liquid fires where cooling and little agitation are needed, water can be given as a straight stream, as a spray, or as a measure of personnel protection where cooling is the primary effect desired.

B. Fixed Gas Fire Extinguishing Systems

Fixed gas fire extinguishing systems typically put out fires by either lowering the amount of oxygen in the air to a level where combustion is no longer possible or by halting the chemical reaction that the fire needs to spread.

C. Fixed Water Fire Extinguishing Systems

For many shipboard uses, water makes an excellent extinguishing medium. It may be used on a variety of fires, is easily accessible, and is excellent at absorbing heat. The use of water to put out a fire involves a number of techniques. When water travels into the combustion zone and absorbs heat through evaporation, the flame temperature first begins to reduce. The quantity of radiant heat emitted by the fire is reduced as a result of cooling the flame temperature, which also reduces the amount of heat reflected back to the fuel surface. Second, water droplets on the fuel surface have the critical additional impact of cooling the surface and turning into steam when they evaporation.

IV. RESULTS

When the system detects a fire, an automatic firefighting operation is initiated. The outcomes of using the system are displayed in the table below. The table shows the actions taken in response to each occurrence. In this table, logic 1 indicates an active sensor, whereas logic 0 indicates a deactive sensor.

Table 1: System operating results

Temp. Sensor	Flame Sensor	Smoke Sensor	Hazard LED's & Buzzer	Action
0	0	0	OFF	No action
0	0	1	ON	Alarm LED ON
0	1	0	ON	Solenoid ON
1	0	0	OFF	Fan or heater & LED ON
1	0	1	ON	Solenoid OFF

Table 2 : Calculations for the power budget

Device	Max Current(mA)	Supply Voltage	Power in(mw)
Pic16f877A	40	5	200
Heat Sensor	5	5	25
Smoke Sensor	5	5	25
Flame Sensor	5	5	25
LED	3*120	5	1800
Fan	980	12	11760
Strobe	480	12	5760
Buzzer	960	12	11520
Heater	980	12	11760
Solenoid Valve	960	12	11520
LCD	400	5	2000
Total			56,395

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Discussion :

The alarm led turns on when the smoke sensor or temperature sensor is triggered, as mentioned in the above table 1. When the flame sensor, smoke sensor, temperature sensor, or all the sensors are activated, the solenoid valve, hazard led, and buzzer turn on.

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The planned firefighting system can recognise and respond to overheating, smoke, and flame. The autonomous firefighting system has successfully accomplished the tasks as anticipated and as described in the report after developing and testing the programme. The system has the ability to detect and put out fires in addition to buzzing and lighting an LED to show its condition. The Pic16f877a microcontroller processes the sensor circuitry input, manages the indicator panel, and, when flames are detected, also manages a firefighting pump. The system's simulation was made, and it performed well.

5.2 Recommendations

This project results in a number of recommendations regarding the issues with wireless firefighting systems while evaluating simulation and source code. The bullet points below list a few suggestions for future development and enhancements:

1. To text the temperature using a database or website
2. Including a solar cell as a backup power source for the system.
3. To use video cameras that are activated whenever an event takes place in a particular sector, and to provide a live video feed of whatever is taking place there.

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