CHENNAI INSTITUTE OF TECHNOLOGY
(Autonomous)

VISION BASED FIRE FIGHTING SYSTEM

NAME OF THE SUPERVISOR

PROJECT GUIDE:

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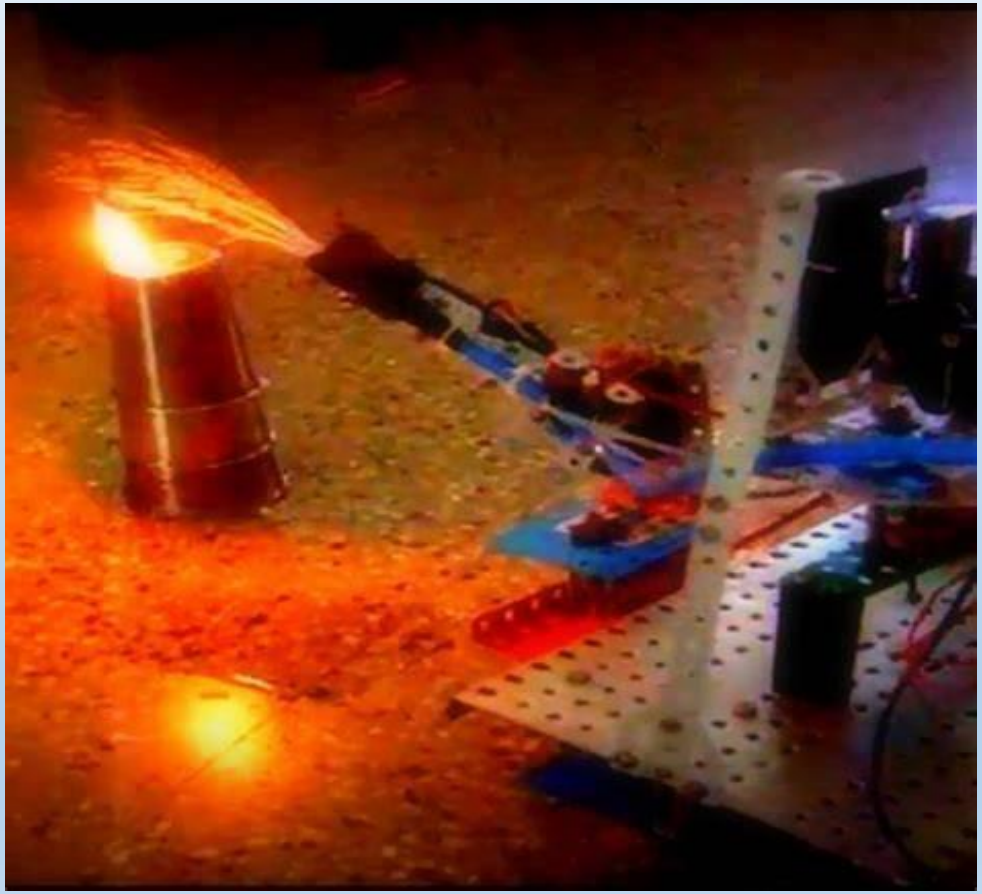
INTRODUCTION

- A vision-based fire fighter system uses image processing and computer vision technologies to detect and extinguish fires automatically.
- whereas ordinary fire detection systems-where smoke or heat sensors are usually found have many drawbacks:
    - delayed detection
    - false alarms
- In contrast, this project provides the advanced and efficient response technology with the help of thermal imaging and image processing technologies.
- Fire safety is a critical aspect of building management and industrial operations.



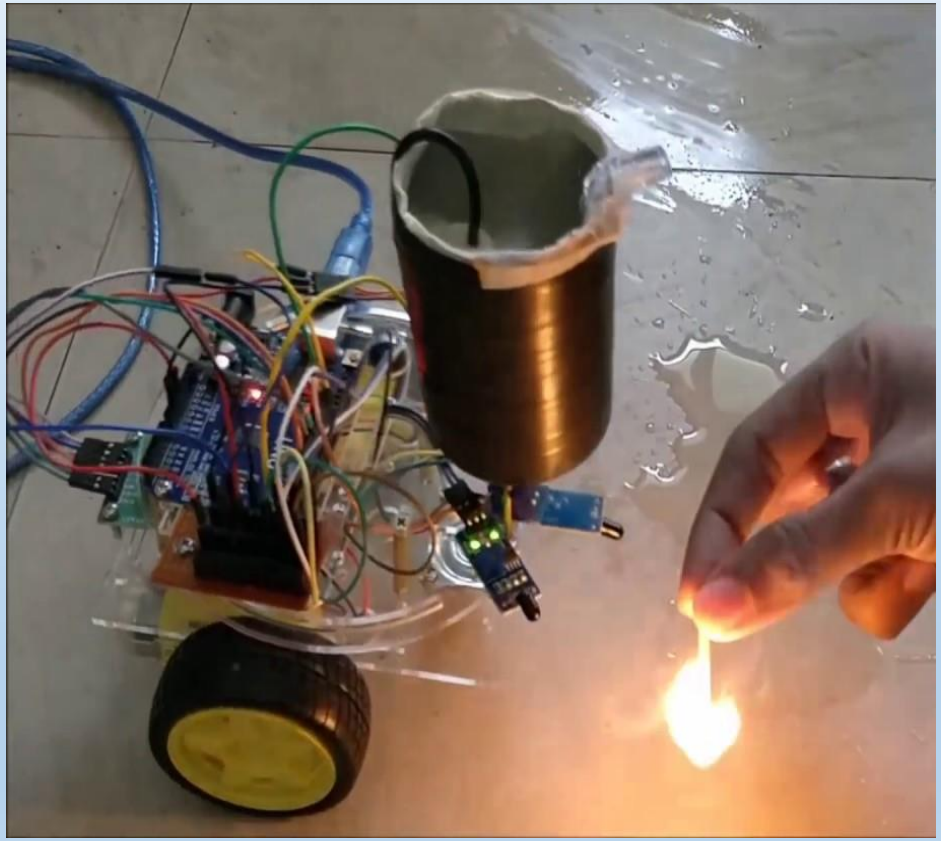
ABSTRACT

➢Fire hazards are becoming prominent in industrial, commercial, and residential sites. Advanced firefighting systems thus need to be prepared for the growing fire hazards.

➢This research presents a vision-based fire fighting system based on camera-based image processing for real-time detection of fire outbreaks and their response.

➢The cameras used by the system enable fires to be precisely detected by dealing with temperature anomalies and differentiation between the fire and other sources of heat.

➢This design modularity allows it to scale from the small to large-scale settings



LITERATURE REVIEW

Sl. No	Author Name	Title of the paper	Year of Publication	Findings
1	Prof. Amit Hatekar	Fire Detection on a Surveillance System using Image Processing	2017	Fire Detection via Image Processing, Colorbased detection
2	Shin-Juh Chen	Fire detection using smoke and gas sensors	2018	Fire Detectors Based on Smoke Detection
3	Maria João Sousa	Thermal Infrared Sensing	2020	Heat detection
4	Yun-Cheol Namand and Yunyoung Nam	A Low-cost Fire Detection System using a Thermal Camera	2018	Extraction of Candidate Fire Regions, Temperature Calculation.

LITERATURE REVIEW

Sl. No	Author Name	Title of the paper	Year of Publication	Findings
5	Chien, H. & Chen, K.	Research on Fire Detection Technologies	2010	There are challenges with false alarms.
6	Chen, J., Wu, Z., & Liu, Y.	Vision-Based Flame Detection Using Image Processing	2014	Vision systems can be reliable for detecting fires.
7	Jiang, L., Zhang, Z., & Sun, X.	Challenges in Fire Detection Using Visual Systems	2015	Vision systems struggle in low light and smoke.
8	Lu, J., Chen, Y., & Wang, L.	Integration of Multi-Sensor Systems for Fire Detection	2016	Combining different sensors improves detection.

PROBLEM STATEMENT

- Existing fire detection systems often rely on smoke or heat sensors, which can Trigger false alarms and Take too long to detect the fire.

- Manual firefighting efforts are often delayed and less accurate.

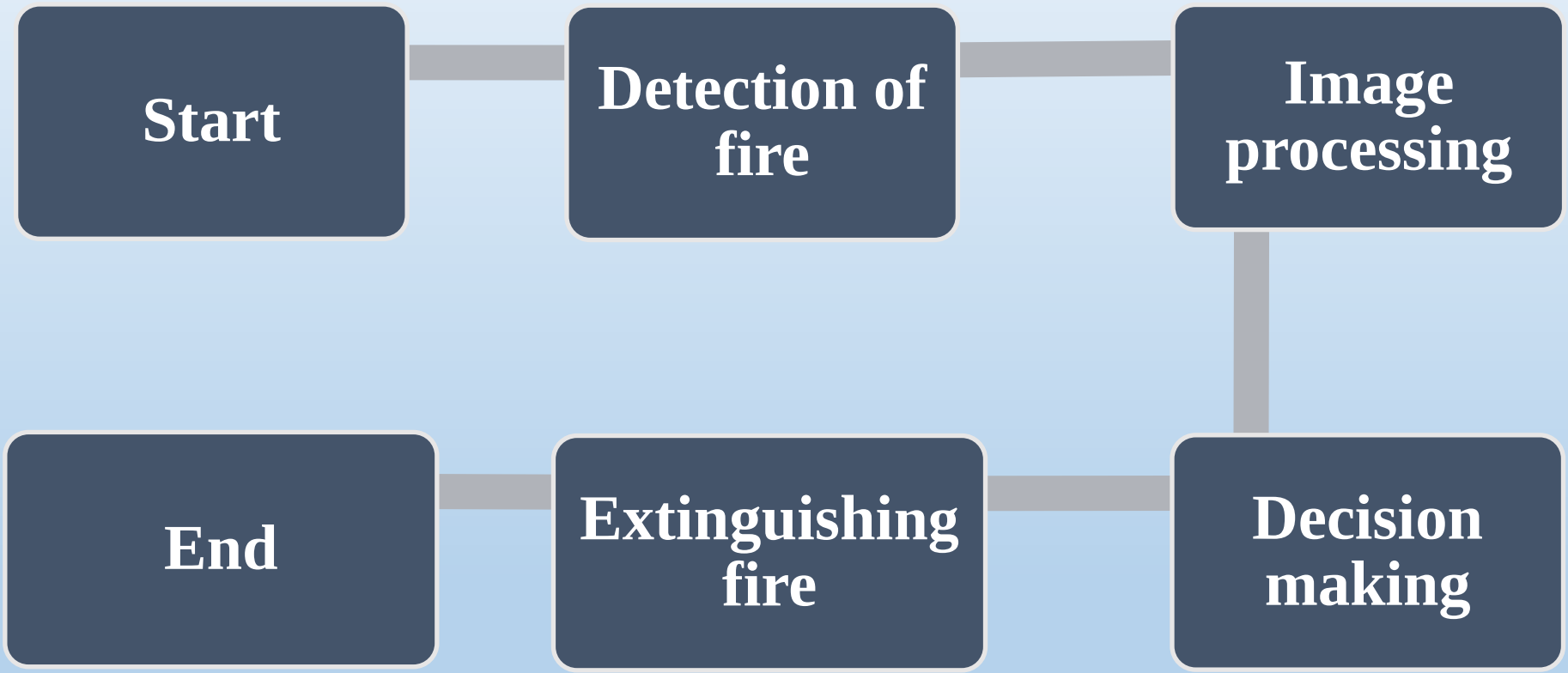
- Traditional fire detection systems often trigger false alarms due to non-fire-related smoke, leading to unnecessary disruptions and delays in response.

- These systems are limited in accurately locating fires, especially in large or complex environments, making firefighting less efficient.

OBJECTIVES

- Enhanced Accuracy and Reliability: Ensure the system accurately distinguishes between fire and non-fire scenarios to avoid false alarms and ensure reliable operation.
- Integration with Existing Systems: Ensure the vision-based system can be seamlessly integrated with current fire safety infrastructure and protocols for coordinated emergency response.
- Automated Response Mechanism: Design a mechanism that can automatically activate fire suppression systems (like sprinklers) based on the visual analysis of the fire, minimizing the need for human intervention.
- Adaptability to Different Environments: Design the system to be adaptable to various settings, such as industrial facilities, commercial buildings, and residential areas, to ensure broad applicability.

METHODOLOGY



NOVELTY

Research Question:

"How can image processing and sensor integration enhance the efficiency and accuracy of fire detection and suppression in real-time scenarios?“

Objective:

- Fire Detection Using Image Processing
- Minimizing False Alarms
- Real-Time Fire Localization
- Automatic Fire Suppression

Vision:

- Enhanced Fire Safety through Technology
- Automated, Reliable Fire Detection and Response
- Cost-Effective and Scalable Solutions
- Safe and Efficient Fire Mitigation

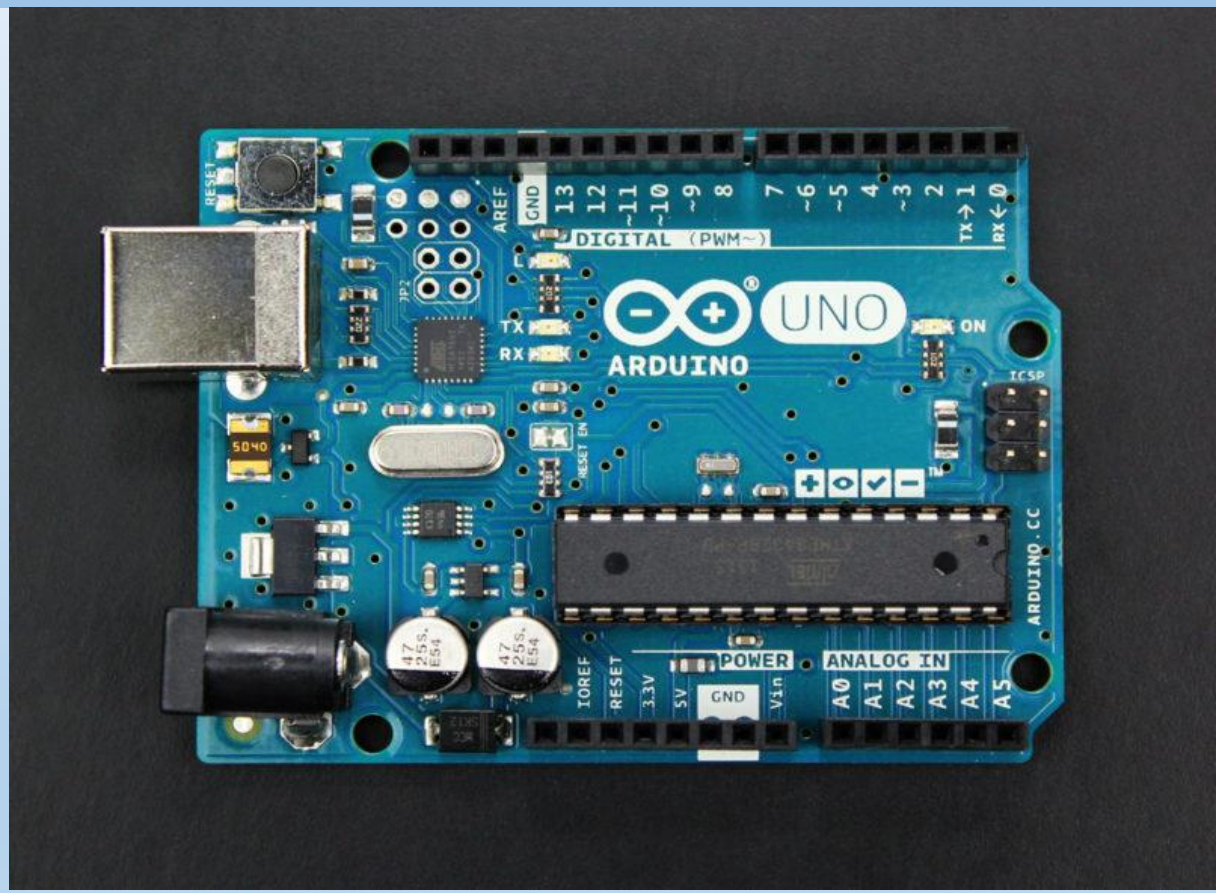
COMPONENTS AND COST

S/no	Components	Name of the component	Quantity Required	Cost Estimation
1	Microcontroller	Arduino UNO	1	350
2	Camera	RGB Camera	1	600
3	Sensors	Temperature sensor Smoke sensor	1 1	300 250
4	Suction Pump	Water Pump Servo motor	1 1	300 300
5	Switch	1ch Relay Module	1	150

S/no	Components	Name of the component	Quantity Required	Cost Estimation
6	Power Supply	Battery	1	200
7	Communication Modules	Bluetooth Module	1	500
8	Motor Driver	L298N	1	250
9	Connectors	Jumper cables	As required	200 **Total = Rs.3400**

MICROCONTROLLER

- The **Arduino Uno** serves as the central microcontroller in the vision-based fire fighting system, acting as the interface between the sensors, actuators, and the external image processing unit.
- It continuously monitors data from temperature and smoke/gas sensors to detect potential fire hazards.
- When the sensors detect abnormal conditions, such as a rise in temperature or smoke presence, the Arduino validates the fire event in conjunction with input from the image processing system, typically handled by an external device like a Raspberry Pi.



SENSORS

Temperature sensor:

- Temperature sensors like the LM35, KY-013, or DHT11 provide a second layer of detection. These detect the ambient temperature around them and will send an alarm signal once this temperature crosses the threshold.
- There is a high level of reliability associated with this type of sensor due to its ability to minimize false alarms while being quite inexpensive for the purpose of confirming the existence of fire.
- The Arduino Uno continuously reads data from temperature sensors to detect any abnormal rise in temperature, indicating a potential fire.

SENSORS

Smoke sensor:

- Smoke/Gas Sensors: These would be smoke and gas, such as MQ-2 or MQ-135, to detect the presence of smoke and hazardous gases like carbon monoxide and methane, typically emitted during a fire.

- It complements the camera and temperature sensors, making it more robust by detecting chemical indicators of fire.

ACTUATORS

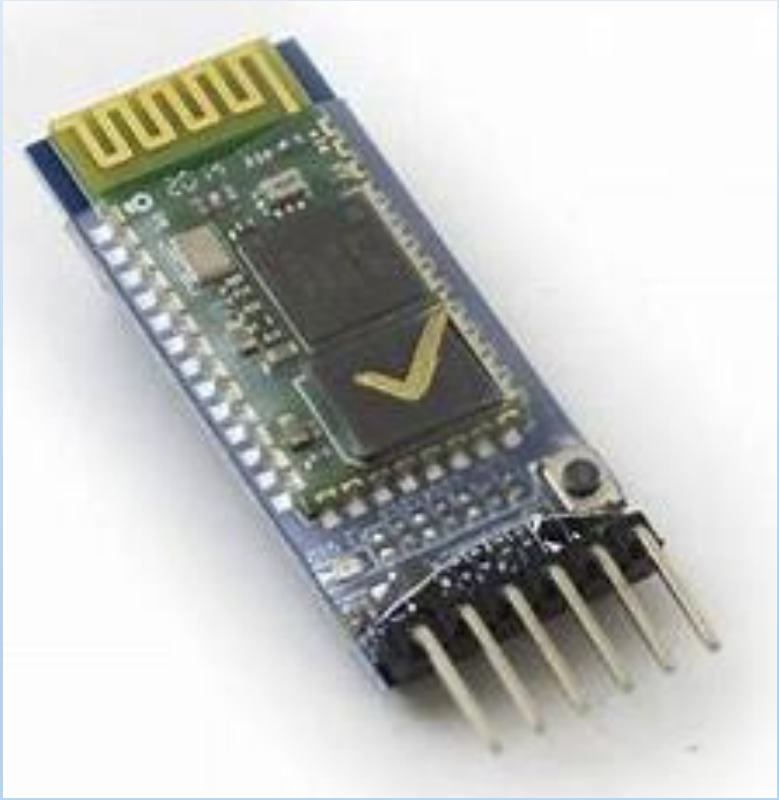
- In the vision-based fire fighting system, actuators are the devices responsible for converting electrical signals from the microcontroller into physical actions to suppress fires.
- The primary actuator used is the **water pump**, which is activated when the system detects fire through image processing and sensor data validation.
- The microcontroller, typically an Arduino Uno, sends signals to the pump via **motor drivers** or **relays**, which serve as intermediaries to handle the high-power demands of the pumps.

BATTERY

- The **battery** is a crucial component in the vision-based fire fighting system, providing the necessary power to operate the microcontroller, sensors, actuators, and other electronics.
- Typically, a **rechargeable Li-ion or Li-Po battery** is used due to its high energy density, long lifespan, and ability to deliver consistent voltage.
- The Arduino Uno and sensors typically operate at low voltage (5V), while higher-powered components like water pumps and motors require more substantial current.

BLUETOOTH MODULE

- If we want to monitor the system from another place or receive alarms through our phone or computer, then we can even include a communication module of this type as an HC-05 Bluetooth module for wireless communication.
- In this way, we may send alarms or control the system from other places on detecting fire.



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THANK YOU