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FIRE DETECTION AND PREVENTION FOR SUBSTATIONS

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Abstract: **- Internet of things (IoT) is the network of entities that consists of electronics, programmable software, sensors, and communication facility that enables these entities to gather and transfer data. The objective of the proposed system is to alert the remote user while the fire accidents occur. This system can be installed at any remote premise which has threat of fire accidents. Using this system, we can detect the fire by camera. So, sensors are not required to detect fire. The Arduino controller processes the camera input and detects fire. The report is automatically generated and sends to the person immediately after the fire is detected in any part of the frame using GSM. On detecting fire, the system will go into emergency mode. The major advantages in this method are: sending the information to the person at any time, any place and remote monitoring for immediate actions**

Index Terms **– Arduino, Python, Web camera, GSM, Relay, Water pumping motor etc.**

1. INTRODUCTION

There are so many natural and unnatural disasters which may cause harm to humans and other living things. Of these fire is one of the major threat, which may cause huge damages [6]. Forest fire, short circuits and other situations creates large amount of fire and explosions. The major reasons of fire accidents are due to malfunctions of electrical equipment and wiring, improper handling of flammable materials, human errors and carelessness. The delayed actions and prevention against fire accidents may lead to large economic losses and even deaths to many. Older sensor based systems needs close proximity for detection and preventive measures like water spraying [3].

Then some more accurate systems like optical sensors to detect light and flame came. Advanced techniques like image processing, pattern recognition, transfer learning [20], computer vision, neural network etc. made it possible to detect images with most accuracy from images and even videos now. Thus CNN based fire detection provides a cost effective and accurate fire detection and it even gives possibilities to early stage prediction of fire which helps to prevent forest fires. Ever since human being started building structures by using of wood rather than stone, fire has become the part of the total process. In actual case, there are many examples of fire outbreaks which causes a huge destruction latest example in india as capital New delhi where 27 peoples have to lose their life and more than 12 peoples got heavily injured as well as in lucknow city more than 12 fire incidents happen not as large a fire as the one in Chicago the year before or the fire that was ravage San Francisco just over three decades later Firefighting calls for capabilities in combating, extinguishing, and stopping hearth place, working and retaining hearth place branch device and quarters, and vast education in acting firefighting activities. Nowadays, many industries and residential have installed related fire safety and control arrangements such as fire alarm, fire extinguisher, water sprinkling supply system. But in actual practice these all-fire alarm and controlling systems they are not that much capable enough to take necessary action when fire is started that's why to protect life. The new way to avoid all the losses is to respond to emergency situations as quickly as possible. So, at that point comes the need of a upgraded fire detection systems. This project therefore look for to design an Arduino Fire Alarm and Controlling systems that will monitor the presence of significant quantity of tempreture and smoke and activate alarms and along with that switch off the mains of the building, send an SMS to respective send an SMS alert and location and extinguish the fire as a safety measure to contain the situation

The organizational framework of this study divides the research work in the different sections. The Literature survey is presented in section 2. Further, in section 3 shown Existing System is discussed and in section 4 shown in proposed system, In section 5 Experimental Results work is shown. Conclusion and future work are presented by last sections 6.

2. LITERATURE SURVEY

A number of existing models were studied and their effectiveness was compared.

- **Ahmed Imteaj et.al.** Studied the problems faced by factory workers in times when fire breaks out. They proposed a system using Raspberry Pi 3 which is capable of detecting fire and providing information about area of fire. The Raspberry Pi controls multiple Arduino boards which are connected with several motors and cameras to capture the fire incident. In

this, they discussed about the modern technology that can be used to reduce extremely unfortunate accidents caused by fire. We designed the whole system and calculated its effectiveness. [2]

- **Ondrej Krejcar** proposed a model for location enhancement and personnel tracking using Wi-Fi networks. In this, he has represented the control system concept that is used in handling information of location and control unit operations. The location of the user present in the building, is obtained through Wi-Fi access points [3]. We have studied this to understand the usability of the Wi-Fi networks in live tracking and then have utilized this functionality to track fire and give information about location of fire to various devices intimating people about the mishap.
- **Authors in [4]** have studied the safety features in home and industrial areas. They have designed new model using WSN. Not only have they incorporated temperature and humidity sensors but also included fire and smoke sensors while developing the model. They present a preceding study of WSN is able to detect fire alarm. It is for setting up a wireless sensor network with three sensors. An application was developed for getting home information.
- **Azka Ihsan Nurrahman, Kusprasapta Mutijarsa** have proposed a prototype for a centralized management system for homes or offices which helps better in managing the safety features. In this, home management system is required. This system controls the room lights by turning on and off automatically, it keeps the record of use of electronic device status, turning on and off the ac regulator automatically, it displays the room temperature in home. If fire is detected in the house, it turn on sprinkler at home, it supervises at home via surveillance cameras, take photos and store them including recordings of surveillance at home, it detects the movements of people at home, and provide notification when someone enters the house[5]

3. EXISTING SYSTEM

In existing system, we have manual fire detection and controlling of fire. In that no automatic notification of fire and smoke is not available. Detecting the fire and extinguishing it is a dangerous job and that puts lives of fire fighters at risk. There are number of fire accidents in which fire fighter had to lose their lives in the line of duty each year throughout the world. Increase in the number fire accidents are due to expanding human population and growing industrialization. The physical limitations of humans to deal with these kinds of destructive fires make fire extinguishing a complicated task.

4. PROPOSED SYSTEM

In this project with the help of camera we will continuously monitor the places. The camera interfaced with PC which has Python software installed. The cable is connected to Arduino and PC so that the data will transfer between Arduino and Python. If any fire is detected it will be observed by the camera, then the command will send to Arduino. Arduino receives the command and then automatically it starts sprinkling of water and will send SMS using GSM to concerned authorities.

A. Block Diagram

This paper proposes a surveillance system for fire detection and prevention in substations using a camera, laptop, Arduino microcontroller, GSM module, buzzer, relay module, and DC water pump. The system continuously monitors the substation for any signs of fire, and in case of detection, it immediately sends an alert message to the responsible authorities through the GSM module. Additionally, the system activates a buzzer to alert nearby people and triggers the relay module to cut off the power supply to the substation. Finally, the DC water pump is activated to suppress the fire, preventing it from spreading to other areas. The proposed system is cost-effective and easy to install, making it an excellent solution for substation fire prevention and protection.

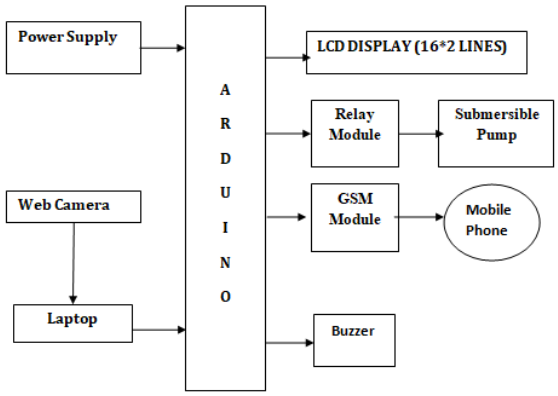

Fig.1: Proposed Block Diagram

A. METHDOLOGY

1. **Camera:** Install a high-quality camera that can cover the entire substation area. The camera should be connected to the laptop using a USB cable, and the camera feed should be continuously monitored.
2. **Laptop:** The laptop will be used to process the camera feed and run the software that will detect any signs of a fire outbreak. The software can be programmed using a language like Python or C++. It should detect the presence of fire by analyzing the video feed and checking for the presence of flames or smoke.
3. **Arduino Microcontroller:** The Arduino microcontroller will be used to interface the laptop with the other components of the system. The microcontroller should be programmed to receive signals from the laptop and control the other components of the system accordingly.
4. **GSM:** The GSM module will be used to send notifications to the relevant personnel in case of a fire outbreak. The module should be programmed to send SMS alerts to the designated phone numbers.
5. **Buzzer:** The buzzer will be used to sound an alarm in case of a fire outbreak. The Arduino microcontroller should be programmed to trigger the buzzer if the fire detection software detects any signs of fire.
6. **Relay Module:** The relay module will be used to control the DC water pump. The Arduino microcontroller should be

programmed to trigger the relay module to turn on the water pump if a fire outbreak is detected.

7. **Submersible Water Pump:** The Submersible water pump will be used to pump water onto the area where the fire outbreak has been detected. The pump should be connected to a water source and should be powerful enough to quickly extinguish any fire outbreak.

B. HARDWARE DESCRIPTION

1. Arduino Uno

Arduino Uno shown in figure is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller shown in fig.2.

Fig.2: Arduino Micro Controller

2. *Fire Sensor:*

Once the surrounding temperature reach 37* this sensor starts working by providing necessary information to the user and if the fire detects the output would be 1 else 0. In case of forest fires, when the temperature of the surroundings increases its sensed by the flame sensor, through the relay switch the water pump is turned on. When there is no flame, the water pump stops functioning. Shown in figure 3.

Fig.3: Fire Sensor

3. Water pump

The DC 3-6V Mini Micro Submersible Water Pump shown in Figure 4 is a low cost, small size Submersible Pump Motor. It operates with a 2.5 to 6V power supply. It can pump up to 120 litres per hour with a very low current consumption of 220mA. Just connect the tube pipe to the motor outlet, submerge it in water, and power it.

Fig.4: Submersible Water Pump

4. Power Supply

Power Supply shown in figure 5 The system is powered by a battery source of 9 V that is connected to the input pin of voltage regulator (L7805) to get a proper output voltage at the output pin of voltage regulator equal to 5 V or to step down the voltage from 9 V to 5 V, which is required for Arduino microcontroller, one RFID readers and RFID Cards.

Fig.5: Power Supply

5. Relay

A relay is used as electrically operated switch which is shown in Figure 6. It has a set of input terminals for a single or multiple control signals and a set of operating contact terminals. The switch may contain number of contacts in multiple contact forms which make contacts or break contacts. Relay is used to turn on the water pump in order to maintain the moisture level of the crop.

Fig.6: Relay Module

6. Buzzer

A 5V Active Alarm Buzzer Module compatible with Arduino Uno is an audio based device , which can be mechanical, electromechanical, or piezoelectric. it's 5V DC Buzzer Module. Using high quality material, it's durable in use. Shown in figure7.

Fig.7: Buzzer

7. Web Camera

Web Camera is used to take the continuous images to get the traffic signs and signals from the real world that looks like in Fig.8. According to the images available through the camera we can send these images to the raspberry pi to perform car's control action.

Fig.8: Web Camera

8. LCD Display

LCD stands for liquid crystal display, which is used to show the status of an application, displaying values, debugging a program, etc.A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols.

This LCD has two registers, namely, Command and Data. Shown in fig.9.

Fig.9: 16x2 LCD Display

9.GSM

GSM shown in Fig.10 is a mobile communication modem; it is stands for global system for mobile communication (GSM). The idea of GSM was developed at Bell Laboratories in 1970. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.

Fig.10: GSM

5. EXPERIMENTAL RESULTS

The experimental results for surveillance fire detection and prevention for substations using camera, laptop, Arduino, LCD, relay module, submersible pump, and buzzer would depend on the specific setup and methodology used in the experiment. However, in general, the following components and functions can be expected:

The camera would capture visual data from the substation and transmit it to the laptop for analysis. laptop would process the visual data received from the camera and run the fire detection algorithm to detect any potential fire in the substation. The Arduino would receive signals from the laptop and control the operation of the relay module, submersible pump, and buzzer. The relay module would control the power supply to the submersible pump and buzzer based on the signals received from the Arduino. The submersible pump would be activated by the Arduino via the relay module to spray water in the area where the fire is detected. The buzzer would be activated by the Arduino via the relay module to alert the nearby personnel about the potential fire.

Based on the experiment results, it can be concluded that this system can be an effective tool for early fire detection and prevention in substations. The system can quickly detect any potential fire using visual data from the camera and activate the submersible pump and buzzer to prevent the fire from spreading. This can help in preventing major damages and losses in the substation. However, the system's effectiveness would depend on factors such as the quality of the camera, accuracy of the fire detection algorithm, and the response time of the submersible pump and buzzer. Further testing and optimization may be required to enhance the system's overall performance and reliability

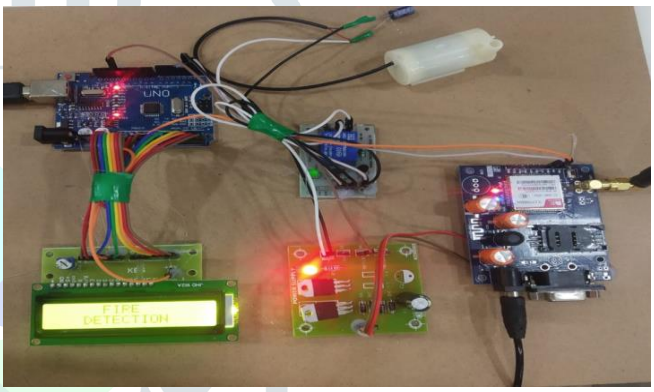

Fig.11 Experimental setup

The measured and monitored parameters like Fire, message sending Through GSM are shown in figures Figure 12 to Figure 15 respectively.

Fig.12: LCD Shows that name of fire detection

Fig.13: LCD Shows that fire detected

Fig.14: LCD Shows that message sent to concern department when fire detected

6. CONCLUSION

In conclusion, the use of surveillance for fire detection and prevention in substations using cameras, laptops, Arduino, LCDs, relay modules, submersible pumps, and buzzers is an effective way to prevent and detect fires in substations. With the integration of these devices, it becomes easier to monitor and detect fires before they escalate and cause significant damages. The cameras provide real-time footage that can be used to identify the source of the fire, while the Arduino and relay modules automate the process of turning off the power supply, activating the submersible pump, and sounding the alarm. The use of LCDs ensures that the system is easy to operate and monitor, while the buzzer alerts personnel on-site to take action. Overall, this system provides a comprehensive solution to the problem of fire prevention and detection in substations, ensuring the safety of both personnel and equipment.

Future Scope

The system can be integrated with various IoT devices such as smoke detectors, gas sensors, and temperature sensors to enhance its accuracy and efficiency in detecting fires. The footage and data collected by the cameras and other sensors can be stored in the cloud, making it more accessible and easier to analyze. This will help to identify patterns and trends that can be used to prevent future fires.

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