Automatic Fire Prevention and Extinguishing System for Fireworks Industry

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Abstract **- Almost 90% of Fire accidents are due to gunpowder and it is explosive even at low temperature. In our proposed system, Arduino and various sensors are employed to monitor the temperature, flame, gas and if any sensor exceeds a threshold value, alarm is used for alerting the people under work. People's safety is thereby ensured by suppressing fire with crusher dust.**

Keywords: Arduino, Temperature sensor, Gas sensor, Flame sensor, Crusher dust.

1. INTRODUCTION

India, second largest producer of fireworks after China, is affected periodically by tremendous fire accidents. India's firework capital is Sivakasi, which is also known for its matchbox and printing industries, contributes more than 90% to India's overall fireworks production. Moreover 100 workers die each year in fire accidents in this industry which boasts of an estimated annual turnover of more than 225 million rupees each year .The industry is criticized for observing poor safety standards and paying as low as 100-150 rupees (1.50$) a day to workers. Thus it is an open science lab with an array of dangerous chemicals and explosives. Government officials lack technical qualification required to monitor the process. The recent research on Fire work accidents deals only with manual preventions and lack of awareness. But these people not yet tried any engineering appliances for prevention. So, we proposed the proper chemical balancing indications on misbalance of raw materials through recent engineering technique to monitor and extinguish the fire to save our own people from these kinds of accidents.

2. LITERATURE REVIEW:

The review on latest fire accident detection technologies and intelligent prevention system are discussed. It is clear that due to advancement in sensors and microcontrollers, the progress on fire detection technologies has been substantial over the last years [1]. In [2] a review of progress in various emerging sensor technologies for fire detection and monitoring is elaborated. In [3], it gives an idea that prevents fire from spreading by breaking electric circuits of the affected area and releases the extinguishing gas pointing to the exact fire locations. In [4], a detailed report on wireless sensor network based fire monitoring and CO2 based extinguishing system is given.

3. FIELD SURVEY

In order to identify the nature of explosion hazards in fireworks and match works industries, a questionnaire survey was conducted by the authors wherein firework products are manufactured. The survey was conducted to collect data regarding the number of workers, construction aspects and manufacturing sheds in authorized industries to identify the explosion hazards in the Sivakasi region.

Fig 1.STORAGE AREA

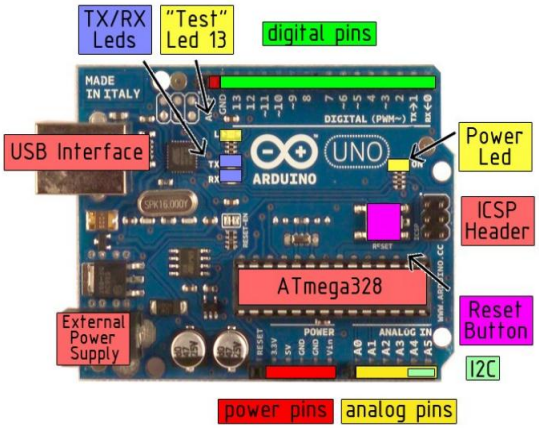
The present construction practice of fireworks industries is reported. The room size is 3.6m (length), 3 m (breadth) and 3 m (height). At the top, a lean-to roof is provided using galvanized iron (GI) or tar coated light roofing sheets. Generally three doors are provided without any windows, ventilators, or electrical fittings. The three doors are provided for safe exit in the event of an unexpected fire or explosion. For safety reasons, windows, ventilators, and electrical fittings are not provided, and a distance of 15 m is provided between the units in all four directions.

Fig 2.WORKING AREA

4. SYSTEM DESCRIPTION

4.1. ARDUINO

Arduino is an easy-to-use hardware and software. It is an open-source prototyping platform. Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing is used for sending a set of instructions to the microcontroller on the board. It has been used in thousands of different projects and applications because of its simple and accessible user experience. The Arduino software is flexible for beginners and easy to use for advanced users. It runs on Mac, Windows, and Linux. It is used for transferring the control signal which allows to enable the alarm system, giving people an opportunity to leave and simultaneously send signals to the tank containing the crusher dust as well. It has been programmed in such a way that it can monitor the temperature, gas levels in the atmosphere .If any of these increases in the atmosphere, automatically the alarm is triggered and the crusher dust gets sprayed in the room to extinguish or stop any proceeding of fire. The detailed configuration is shown in the figure.



4.2 FIRE SENSOR:

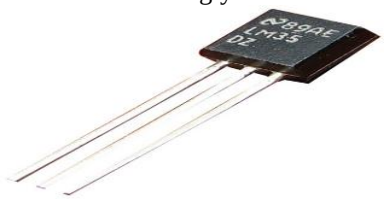
A fire sensor is designed to detect the flame and respond to its presence accordingly. Their role is to provide indication whenever it detects the flame in terms of signals to the Arduino. There are three pins available for source, output data and ground. A set of instructions that meets the criteria should be loaded in the Arduino and hence the system works instantly.

4.3 GAS SENSOR:

The presence of gases in a particular area is detected by using the gas sensor. This type of equipment is used for detecting a gas leak or other emissions. The process can be automatically triggered by interfacing with a control system. There are four pins available each available for source, digital output, analog output, ground. Arduino could be interfaced with analog or digital input as required. A set of instructions that meets the criteria should be loaded in the Arduino and hence the system works accordingly.

4.4 TEMPERATURE SENSOR:

The temperature sensor is used for measuring the temperature range in a particular area. LM35 is used in the proposed system. It can be interfaced with the controller in the system. There are three pins available for source, output data and ground. A set of instructions that meets the criteria should be loaded in the Arduino and hence the system works accordingly.



4.5 LCD:

Liquid Crystal Display is an electronic display module and has wide range of applications. A 16x2 LCD display is used in the proposed system. It is interfaced with the controller It displays the current temperature so that anyone in the room under work can monitor the level.

4.6 CRUSHER DUST:

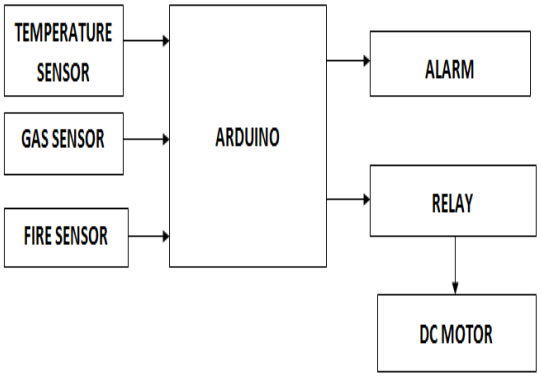
Crusher dust, a common by-product of mining and quarrying can be recycled rather than being discarded as a waste material . It is chemically inactive, non-plastic, heat and fire resistance and eco-friendly. With fine particles like soft sand, crusher dust can be used as a cost-effective fire extinguisher. The production costs of crusher dust are relatively low. Crusher dust is fire and heat resistant so that we selected crusher dust rather than sand to put off the fire. Crusher dust is available in large quantities at low cost.

6 PLAN OF ACTION:

The poor safety precautions have provoked us to create a new technique to avoid the causalities. To make sure that such accidents don't happen anywhere in the near future, the system with emerging technologies has been developed. In the proposed system, sand is not used as a fire extinguisher as it is not economic when compared to the crusher dust.

Consider a 10 by 10 room of the working area. The entire floor is connected with an array of temperature sensors, gas sensors and fire sensors. The PVC pipes of length 40-50cm are fixed at all sides of the entire room. These pipes have a cone shaped opening so that it can cover a wide area. The crusher dust is stored in a tank that is placed on the roof top of each room. All the sensors are interfaced with the Arduino.

The programs are loaded into Arduino such that it satisfies the criteria. There are three criteria to activate the proposed system. First is that, if the fire starts anywhere on the floor, the fire sensor will get triggered. Second is that, if the temperature level goes beyond the critical level, the temperature sensor will be triggered. Third is that, if there is presence of gas, then the gas sensor will be triggered. The supervisors will be able to monitor the temperature level in the working environment with the help of LCD. The signal will be sent to the Arduino, whenever the system meets any one of the criteria. The system gets initiated by pumping the crusher dust using PVC pipes with the help of DC motor from the storage tank. Simultaneously, the alarm gets activated and it alerts the people to leave the room immediately.



7. CONCLUSION:

Thus the fire in fireworks industries can be monitored using LCD, detected using sensors and extinguished using the crusher dust. Thereby, it ensures the safety of the people under work by the proposed automated system.

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