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Design and Implementation of Sonic based Fire Extinguisher System

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***Abstract*: Technology advancement has vastly improved lifestyle of mankind. But the point of using it sustainably remains a concern. Right from early developments in science there have been many instances where people have preferred traditional and conventional techniques over newly developing one. Fire accidents are one such thing where common methods are used to put off fires. Many instances from the past indicate that these conventional methods are only partially effective and also various grades of fire requires different extinguishing materials ranging from sand to many chemical substances to eliminate fires. We propose a method in which we use a low power consuming sonic fire extinguisher which uses low frequency sound waves to eliminate fires.**

***Keywords*: Fire, low frequency sonic waves, fire extinguisher**

1. Introduction

Fires can be classified into various grades based on the combustible material and the environment it occurs. Many industrial application and commercial activities store and use various raw materials in their storage facilities in bulk quantities. Although many safe guarding measures are undertaken to prevent accidents, there are chances that fire accidents may occur through short circuit or spark from any source. Conventional sprinkler system that are installed in facilities like these uses water to control fire. Even though these methods partially succeed in its purpose, it may cause damage to the materials as well as economically. The proposed method intends to overcome those difficulties and drawbacks by using a resource less but an effective solution to control fires. Deep bass sounds are typical low frequency sound waves that are capable of infiltrating fires. Combustion usually takes place due to the presence of oxygen and combustible material. The purpose of the system is to separate the contact between the combustible material and the oxygen using sonic waves. By doing so we will be able to reduce the fire intensity and gradually eliminate it. We use an Arduino microcontroller based setup to generate sound waves of desired frequency range of 30-60Hz. It uses a two stage FET amplification to maintain the range.

2. Objective

Our main objective is to provide an effective system that is capable of extinguishing fires. This setup can be used in remote areas as well as rough inaccessible high altitude terrains. Considering the need to conserve the available resources and many inhabited regions where water is a scarcely available resource it may not be a suitable solution in the long run. There arises a need to find a desirable alternative. Our model helps to offer that solution that may act as a viable replacement to existing systems The setup is easily portable, consumes less power and operates on batteries. Many industrial applications and space missions uses very sensitive equipment's that needs to be handled with care. In case of a fire emergency our setup will provide a comprehensive method to put off those fires that also safeguards the equipment's.

3. Literature survey

[1] Xianyi Qian, Jing Guan, Yujun Bao, "Multistoried Building Community's Automatic Spinkler Fire Control System", China 2009 designed an automatic sprinkler system that self-activates upon detection of fire in high rise buildings like malls, schools and offices using water.

[2] Hayato Takahashi, Yuhki Kitazono, "Improvement Of Automatic Fire Extinguisher System For Residential Use", Japan 2010 designed an image processing system to detect fire in a localized area. it alerts the user through sms in case of fire emergencies.

[3] Abdel Ilah N. Alshbatat, "Fire Extinguishing Systems for High Rise Buildings and Rugged Mountain Terrain Utilizing Quadrotor Unmanned Aerial Vehicle" 2018 designed a quadcopter that spots fire and then the extinguishing ball is dropped from the drone. once balls are exhausted then it needs to be reloaded by some fire personnel.

[4] Yasushi Iwatani, Hiroyuki Torikai, "Improvement of Fire Extinguishing Performance by decentralized Supply of Fire-Fighting Agents", Japan 2017 proposed a helium inert gas capsule to extinguish fire. rubber capsule filled with inert gas is burst near the fire which extinguishes the fire.

[5] Joyanth Suresh M.S,"Fire-Fighting Robot", New York US 2017 designed an automated robot that is used to detect fire in a localized area. robot senses the fire using flame sensor and sends feedback to controller. then the robot faces itself towards the fire and extinguishes it using $C0_2$ foam.

4. Block diagram

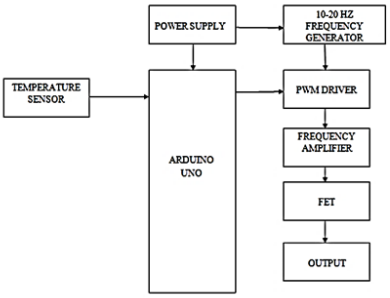

Fig. 1. Block diagram

5. Methodology

Interfacing of Arduino microcontroller is done between temperature sensor and frequency generator. Whenever temperature variation crosses threshold limit the microcontroller activates the relay switch, which in turn gives an input to the DDS signal synthesizer. It produces the required low frequency signal that is required by the setup. Then the signal is amplified and sonic wave output is produced by a loudspeaker in the desired range.

6. Components

A. *Microcontroller*

Fig. 2. Arduino UNO Microcontroller

Arduino UNO microcontroller is used for this system. It is a Atmega 328 based board. Arduino is an open source platform. It has 14 Input/Output pins. It is the latest version in the series of USB arduino boards. It is low cost compared to other arduino boards. The Embedded-c language is used in this micro-controller using some software's like Arduino IDE 1.8.6 and Proteus 8 professional. microprocessor based systems, programs were developed using assemblers and fused into the EPROMs. there used to be no mechanism to find what the program was doing. LED's, switches, etc. were used to check for correct execution of the program. But they were too costly and were not quite reliable as well. As time progressed, use of microprocessor-specific assembly-only as the programming language reduced and embedded systems moved onto C as the embedded programming language of language for embedded processors/controllers. Embedded C uses most of the syntax and semantics of standard C, e.g., main() function, variable definition, data type declaration, conditional choice. C is the most widely used programming statements (if, switch, case), loops (while, for), functions, arrays and strings, structures and union, bit operations, macros, etc.

B. *Temperature sensor*

LM35 temperature sensor is capable of working in a low power setup and has a high gain which is used to detect temperature variations

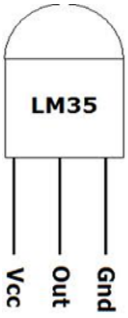

Fig. 3. LM35

C. *DDS frequency generator*

The DDS frequency generator is capable of acting as a signal synthesizer for a range of 1Hz-20KHz used for generation of sonic waves. The frequency generator has a dual knob that is used to adjust for the desired frequency range also it has a LCD display the parameters. It can operate from a preconfigured setup even after a restart, hence eliminating the need for frequent programming.

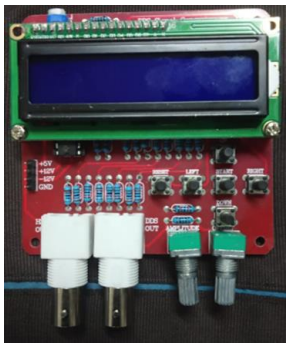

Fig. 4. DDS Signal Generator

D. *Driver*

Relays are simple switches which are operated both electrically and mechanically. Relays consist of an electromagnet and also a set of contacts. The switching mechanism is carried out with the help of the electromagnet. The main operation of a relay comes in places where only a low-power signal can be used to control a circuit. It is also used in places where only one signal can be used to control a lot of circuits. They were used to switch the signal coming from one source to another destination. The high end applications of relays require high power to be driven by electric motors and so on. Such relays are called contactors.

Fig. 5. Relay

E. Amplifier

An amplifier can either be a separate piece of equipment or an electrical circuit contained within another device. Amplification is fundamental to modern electronics, and amplifiers are widely used in almost all electronic equipment. Amplifiers can be categorized in different ways. One is by the frequency of the electronic signal being amplified. For example, audio amplifiers amplify signals in the audio (sound) range of less than 20 kHz, RF amplifiers amplify frequencies in the radio frequency range between 20 kHz and 300 GHz, and servo amplifiers and instrumentation amplifiers may work with very low frequencies down to direct current.

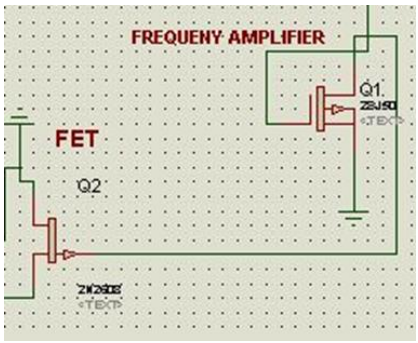

Fig. 6. FET Amplifier

F. Advantage

- Efficient and low power usage
- No residual waste
- Flexible usage
- Wastage of resources is avoided

G. Future scope

The proposed system is promises to be an effective replacement for existing method. If developed and deployed on a larger scale, it would serve as an effective solution.

7. Conclusion

Adoption to more improved methods as contributed to improvisation in lifestyle it is also very important to conserve resources. The proposed system fulfills the agenda by providing effective replacement for conventional methods that use resources that are depleting soon like water.

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