Smart fire extinguishing device

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ABSTRACT

Fires is one of the most important issues leaves disastrous effects across the globe and fires crisis reaches a level that may lead to the loss of human life. So, the correct handling of fires is gaining a significant prominence. Mostly, At the present time there are many devices available that deal with fires. The biggest impediment of these devices system is the false and inaccurate fire alarms and delay in extinguishing the fire. Hence, in this project, is design an automatic smart fire extinguishing system, which ensures diverse service. In the system, the different type of sensor devices is used to detects the location of the actual fire without paying attention to the sources of smoke without fire. As per the fire sensor results, Signals are sent about the location of the fire to the Arduino and the signals are used for These signals are used to direct the extinguishing material towards the source of the fire directly, set an audible and visual alarm, and absorbing harmful gases

INTRODUCTION

The inexpensive smart fire extinguishing device technology is of wide importance for both domestic and industrial applications. As it was noted that other fire devices have deficiencies in giving the required results.Recently, fires have become inevitable and are increasing. The prices of extinguishing materials are expensive, and the losses caused by fires are very costly and dire. There are several fire alarms devices, but these devices contain many defects. Regular alarms often issue false notifications, so alarms are often not integrated into firefighting devices. Considering that most alarms are sensitive to smoke, and we in an Arab country use smoke as an aromatic source, and in other countries smoke is produced by smoking. Therefore, an alarm and extinguishing device was designed that detects the real fire from the false fire, tracks the source of the fire location and extinguishes it from its source (Extinguishing materials are not sprayed randomly), opens windows and exits automatically, draws smoke and emits fresh air, and emits an alarm sound and light to alert all people, including people with special needs. Any of the mentioned features can be excluded according to the requirements of the environment.

Detailed Description of Proposed Solution

The continued increase in the outbreak of fires is a clear indication of the failure of other devices to reduce fire accidents and detect fires. In fact, all the faults of each fire detector are clearly mentioned by simply searching for defects in the search engines or asking the seller when buying, so the seller will mention the features and defects of each detector type, but most of the detectors have many failures, so this device was designed to fill that gap in the detection of fires. Most of the detectors share the problem of false alarms as well as the problem of late detection of fire. In this project, these defects were converted into advantages. In this device, the fire is detected early, and it is extinguished from the sources of its outbreak, as the smoke is absorbed during an actual fire outbreak and an alarm sound is issued to warn all those present that there is fire.

The YG1006 flame sensor is a thermal sensor that detects infrared rays of frequencies from 760 to 1100 nm from 100 cm with an inclination of up to 60 degrees. A flame sensor with digital output type was used to detect the presence of the infrared spectrum. The principle of the flame sensor works by using a silicon phototransistor NPN junction coated with black epoxy to sense the infrared waves. The YG1006 flame sensor is adjustable for its sensing range and sensitivity. It operates at a voltage of 3.3 to 5 volts, has a light weight of 0.01 kg, and has a length of 3.2 cm x 1.4 cm.

The MQ2 Smoke / Gas Sensor is an Ionization sensor that detects smoke / gas of the fire. The Sensor sense the Molecules of the smoke / gas, the sensor power is about from 200 to 10000 ppm. The principle of the Smoke / Gas Sensor works by using a tin dioxide with Aluminum Oxide to sense the Oxygen density. The device works by attracting oxygen molecules to the electrons in tin dioxide when heat the device and prepare it, thus the oxygen impedes the flow of electric current. When the outbreak of fire, the oxygen decreases in the surface, the smoke

density, and gases increase, so the current obstruction (resistance to current) decreases, and the device works. The device detects gases such as carbon dioxide, carbon monoxide, propane gas, methane, smoke, hydrogen, alcohol, and liquefied petroleum gas. It operates at a voltage of 5 volts, the sensor resistance ranges from 10 to 60K and works in temperatures from 20 to 50 degrees Celsius.
The flame and smoke sensor are connected to the UNO Arduino board, which is a board that contains microcontrollers (ATmega328) that are programmed to use them to perform operations that serve the human being. The UNO Arduino board contains 16 pins, 6 inputs and 6 outputs. It works at a voltage of 5 flutes, it contains flash memory with a capacity of 32 KB. The device detects the low currents exposed in this project and sends orders to operate the Absorber fan circuits, the fire extinguishing tube, and the buzzer. In this project, the 11th pin works as the input pin and the 12th pin as the output pin.

The smoke sensor is also linked to the UNO Arduino board which have a microcontroller (ATmega328) board in the center . The ATmega328-PU microcontroller is an integrated circuit containing 28 pins, 8 pins of port B, 8 pins of port D, 7 pins of port C, pin 7 is the VCC, pin 8 and 22 is the ground, pin20 is AVCC and pin 21 is the AREF. The speed of this controller reaches 20MHz. The controller in this project works to control the direction of the device, as it is programmed to go to the direction of the temperature sensor with the lowest resistance to know the direction of the fire, where the controller gives orders to the servo motor to move the device towards the sensor with the lowest resistance. The atmega328-pu programmable integrated circuit operates at a voltage of 1.8 to 5.5 volts, has a RAM Size 2 kB. The IC has a length of 34.79mm, width 7.49 mm and Height 4.06mm.
The Arduino gives orders to the servo motor to move towards the source of the fire. The servo motor is connected to the Arduino via the PMW pin. This servo motor is considered an electromechanical object that does not rotate continuously but rather moves from direction to direction according to the orders of the Arduino. The number of motor movements can be controlled in each time by programming the Arduino. The servo motor operates at a voltage of 4.8 to 6 volts, has a weight of 14.7 g.
Using a Arduino to control window opening and exits.

Detailed Work Description

A smoke sensor was attached to the UNO Arduino board at pins (9,10,11,12), and the Arduino was programmed and configured to transmit a data rate of (6,900) bits per second(bPs). The Servo.h library is included to control the movement of the servo motor towards the lower resistance smoke sensor. The data is sent in four batches(statements), between each batch and the last 10 seconds of delay at 5 VCC voltage.

The flame sensor was connected to the UNO Arduino board in pin 11, and the UNO Arduino was programmed and configured to send a data rate of (6,900) bits per second(bPs).

The MQ2 Smoke/Gas Sensor must be heated before starting the operation at 5 volts to prepare it to receive oxygen and sense tin dioxide for gases and smoke, making sure not to touch the sensor during operation due to the amount of heat of the heating coil during its operation.
Initializing the Potentiometer in the smoke detector circuit and adjust it in proportion to the sensitivity of the natural gases in the place.
Using a uno Arduino board to control window opening and exits.

Methods

This device aims to give notification of an actual fire while tracking the source of fire and extinguishing the fire by pointing the water pump device towards the source of the fire. The sensor part of this project includes two types of sensors, which are a MQ2 Smoke/Gas sensor and a YG1006 flame sensor. The sensor results are sent signals to the UNO Arduino board.

Four flame sensors were placed in four different coordinates. Arduino Uno board is programmed in a way so that make the device of the water pump rotate towards the place that have more of Infrared waves which detected by the flame sensors. On the Arduino board, the water pump was programmed to move by the servo motor in eight directions.

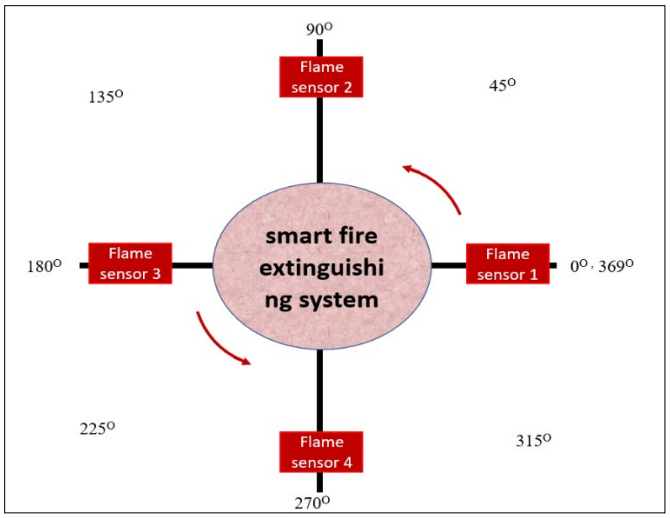

Figure 1 locations of the four flame sensors

The figure 1 shows the locations of the four flame sensors and the readout locations that the Arduino board takes to point the motor towards the flame source of the motor.
When a flame senses a fire at a single flame sensor, the programmed servo motor directs the water pump towards the location of the flame sensor that sensed the fire, but if the flame is detected at two different sensors, the programmed servo motor directs the water pump in the direction between the two sensors.

When the fire is detected, the Arduino board sends messages to the visual and audio alarm devices, and here the buzzer alarm was used as a audio alarm and the LED as a visual alarm device.

When fire is detected, the Arduino board sends messages to activate the harmful smoke absorber by a 12-volt fan with activated carbon drying agent that removes the toxic smoke that obstructs vision.

The following absorption law is used to measure the percentage of adsorption of active carbon drying agent for gases:

$$\text{Adsorption percentage} = \frac{CO_0 - CO_{20}}{CO_0} \times 100\%$$

Where CO_0 is the initial concentration of the gases, and CO_{20} is the concentration of the gases after 20 minutes (Wang,2017).

Results

After performing the experiments on the device, the following results were obtained:

1) Results of the study of the movement of the fire pump by the servo motor towards the fire.

In the beginning, a source of fire was placed in place 1 as the figure 2 to study the servo motor rotation behavior, the studies are taken according to the table 1.

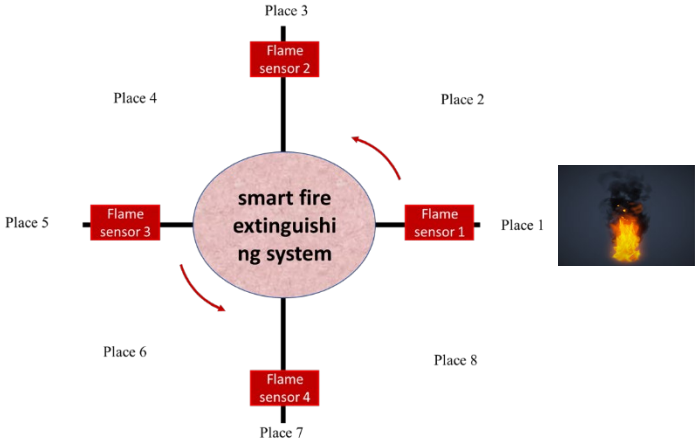

Figure 2 fire placed

Table 1 Results of the study of the movement of the servo motor towards the fire

Flame place	The sensor that sensed the flame	Servo motor rotation in degree
Place 1	Flame 1	0
Place 2	Flame 1 and 2	45
Place 3	Flame 2	90
Place 4	Flame 2 and 3	135
Place 5	Flame 3	180
Place 6	Flame 3 and 4	220
Place 7	Flame 4	270
Place 8	Flame 5 and 6	315

2) To increase the absorption rate in the device, the activated carbon was attached to a fan that operates on the reverse mode. The relationship of the absorption ratio to the fan speed is a direct relationship. Figure 3 represents the relationship between the propeller velocity in the x-axis and the density of the active carbon material in the x-axis, and the slope represents the absorption ratio.

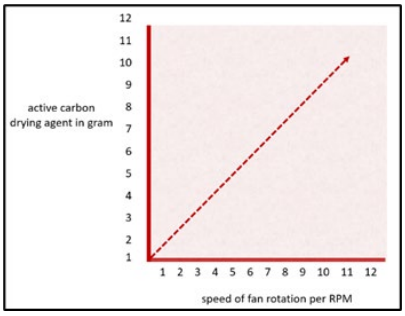

Figure 3 the absorption ratio

Discussion

When a fire breaks out, smoke and infrared rays are produced. the smoke and flame sensor detects the fire produce and sends signals to the Arduino board. The Arduino locating the coordinates of the fire and sends output signals to move the servo motor, which carries the water pump towards the source of the fire, at the same time the fan and the

active carbon absorbs the harmful smoke and purifies the air. Taking into account that the fire department will not work unless the fire gases in addition to the infrared rays are detected.

Conclusion

The application of the smart extinguishing device is used in order to decrease the human intervention and time to complete the process of extinguish the fire. We also discussed fire damage and the failure of other fire devices to satisfy the aspirations of users of devices for alarm and fire extinguishing. We have also detailed the importance of the smart fire extinguishing device in enhancing the features of fire extinguishers and reducing defects.

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Limitations

- Ceiling fires are not covered by the project
- The device does not work as well as it does in the exposed locations

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