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Real-time Smart Fire Safety Management and Notification System

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Abstract

Fire management is mainly related to the Safety purpose. Thus, the fire monitoring and management system are preventing in any places such as household and organizational premises. Fire is kind of disaster destroying the social wealth and human's safety. Water sprinklers plays important role in Fire management but some traditional water sprinklers are glass bulb sprinklers. These sprinklers can be used only once and should be replaced after wards and sometimes very costly in terms of money and time. In proposed system, the automatic water sprinklers which will be turned off automatically after extinguishing fire. These systems based on Internet of Things and to automatically manage procedures, improve scalability, safety and user experience and contribute to human's wealth and health [1][5].

Keywords: *Raspberry PI-3 Microcontroller, Sensors, Water Sprinkler, Solenoid valve, Exhaust fan.*

INTRODUCTION

The temperature, quality of air, humidity of indoor climate is highly related to the human health. The quality of indoor system plays very important role for people's live and health [1].Fire is a rapid chemical reaction of oxidant with fuel accompanied by the release of energy, indicated by incandescence or flame. For a fire to happen, some elements are responsible that is Oxidizer to sustain combustion, Heat to reach ignition temperature, Fuel or combustible material. This results in a chemical chain reaction which starts a fire. Removing any of these elements will extinguish the fire.

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The development of urbanization that increases construction of various kinds of large buildings, chemical companies all over the cities day by day, somehow these all things are responsible for fire to happen. Likewise, electrically powered equipment like Arcing, damaged wiring, over heating of cables due to excess loads, loose electrical connections, heat from electric bulbs etc. Also, Open flame like hot surfaces, Sparks from welding operations, Chemical reaction between incompatible chemicals, Smoking, Batteries, etc. The conventional fire detection equipment and the traditional water sprinklers those are inappropriate in use. This equipment has limited detection capabilities that lead to associated issues such as inaccurate fire positioning, delayed water spraying and no automatic switch on or off facility. The proposed system can overcome the shortcomings of the traditional fire and water sprinklers [2].

In this paper, there are implementing the system in which the use of automatic water sprinklers which will be turned off automatically after extinguishing the fire and also more efficient than the traditional water sprinklers. Also, there are doing the modification such as notifying the user by message [3] and send video of affected area [4]. Also, automatic call system to fire brigade if fire condition occurs out of control.

EXISTING SYSTEM

The fire detection and extinguishing systems need to have a higher accuracy and smarter ways of fire detection and extinguishing. The automatic fire alarm system, fire extinguishing system, automatically sends notification to user and the water sprinklers system are plays important role in preventing or extinguishing the fire. Previous system is time consuming process and it is also limited for particular geographical area. Some devices have to change after one use, for example, traditional sprinklers [2].

Existing system works well but there are some disadvantages of this system as follows:

1. When fire occurs, smoke detector and flame detector detect the smoke and fire respectively and automatically starts all the sprinklers, this leads to great wastage of water.

2. As sprinklers starts, they have to switch off manually not automatically that also causes wastage of water even after extinguishing fire.

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3. Water sprinklers activated when the flame reaches the surface of sprinklers which are fixed on the ceiling. This may take the lot of time and this may lead to widespread of fire, leading to greater property damage.

4. Various failures in the system that effects on cost and time.

PROPOSED SYSTEM

The real time smart fire safety management and Notification system is totally based on the sensors. It improves the response time of sprinklers, user experience and control the fire and damaging.

Proposed system contains various advantages and solution for existing work:

1. When fire detected, water sprinklers will be starts automatically only on that particular area where fire detect. So, it will save the water.

2. Water sprinklers will be switched off automatically after Distinguishing fire.

3. Notifying the user by sending message and video of affected areas.

4. Automatic call to Fire brigade if fire occurs out of control.

5. Reducing cost, better performance, reliable, timely response and automatic control.

DESIGN ARCHITECTURE

Real-time smart Fire safety management and notification system is shown in following figure. There are two parts in system one is local control unit and device connectivity and another is data processing and server part. In first part, the online inverter system has been used as power supply source. The Raspberrypi-3 has been employed to detect the flame and gas leakage using IR flame sensors along with temperature sensor and the smoke detector and light sensor, respectively. The sensors including temperature, IR-Flame sensor, smoke sensor and light sensors are connected to micro controller that is Raspberry-pi3.Collected sensor's signals are periodically send to microcontroller.

The all sensors and the relays are controlled by the Raspberry-pi. Water pipe opening or closing depend upon the activation of the solenoid valves after detection of flame. Relays are performed as a switch between the+12V power supply and the solenoid valves. The

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Raspberry pi also monitors the status of gas leakage. If there will be gas leakage then sensor sends high signal to Raspberry pi 3, then it turns on the exhaust fan and sends the message to user regarding gas leakage. When the IR-flame sensors detect the flame and smoke by smoke sensor then both sensors send the signal to the controller through the relay. Controller compares the temperature value to the normal room temperature value; if it is greater than the 30ºC then Raspberry pi switch off the power supply and starts the water sprinklers through water pipes after activation of automatic solenoid valves. The water pipes should be connected to any water source, for example, Water tank

In Second part which is data processing and server part, if fire spread out of control and the temperature will greater than 50ºC then system send the notification message to the user and also send video of affected area[4]. Also do emergency call to the Fire brigade.

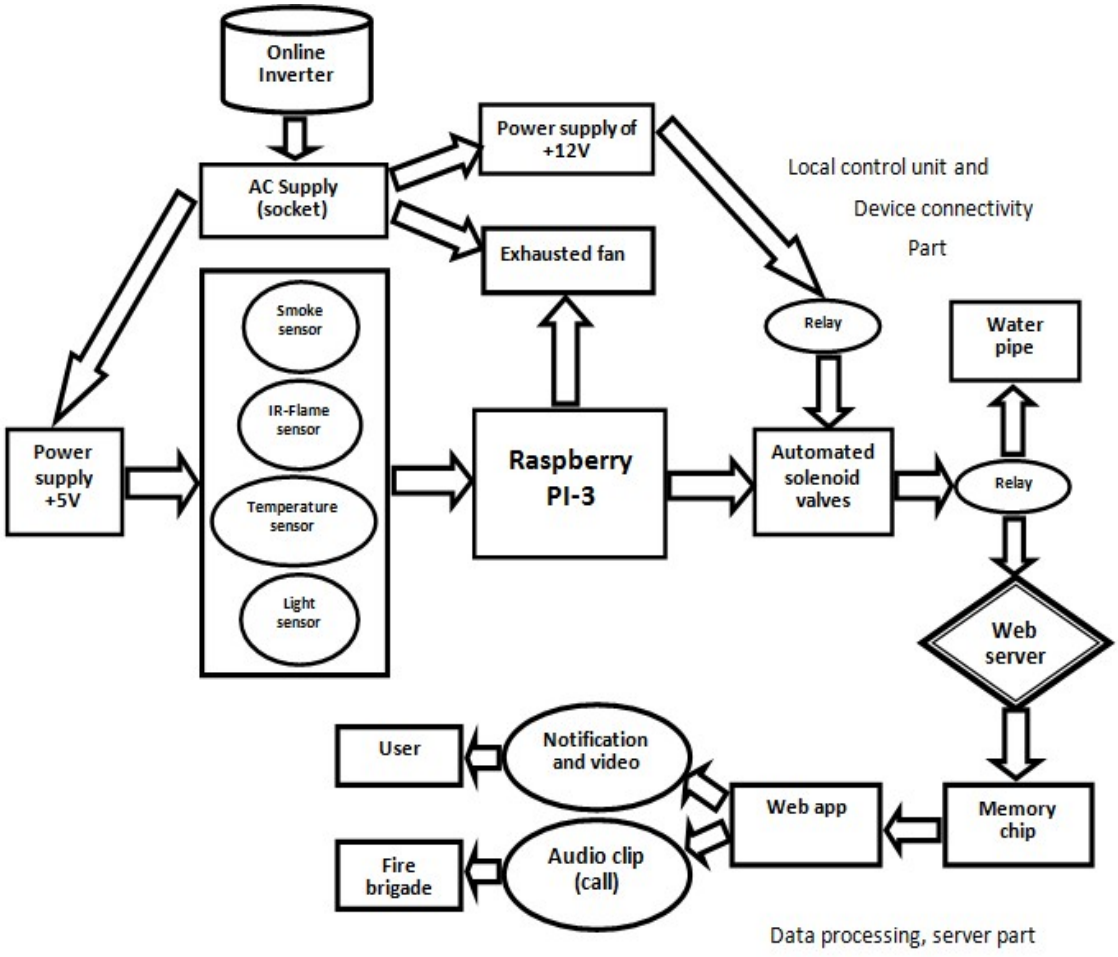


Figure:-1 Real- time fire management and notification system architecture

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SYSTEM DESIGN AND IMPLEMENTATION

Design and implementation of the solution are presented with Details and the connectivity of hardware.

Hardware Design

Microcontroller- The microcontroller in our solution is Raspberry-pi 3 powered by AC-to-DC converter with 5-20 V power supply. Raspberry-pi 3 is based on Broadcom BCM2837 system-on-chip. There are no analog pins on pi. A 40-pin GPIO (general purpose input/output) is found on all raspberry-pi boards.

Sensors-

1. ***Temperature sensor-*** Temperature sensor timely sense the temperature of indoor environment.

2. ***IR-Flame sensor-*** IR-Flame sensor detects the flame.

3. ***Smoke sensor-*** This sensor is used for sense the smoke in the air. This sensor uses a radioisotope that emits alpha particles into air.

4. ***Light sensor-*** Light sensor that controls the light source. Used for sense the light.

5. ***Actuators-*** Actuators in the system consist of water pipe, exhaust fans, lights. Water pipe is operated with 12V AC power supply. Also Lights and fans are supplied with 12V power supply.

Software Design

Microcontroller- The actual program is run in Raspberry pi-3 Microcontroller. It is responsible for getting the signals from the sensor and taking appropriate action. When program startup, necessary ports are initialized for communication with sensor and enable hardware interrupt.

CONCLUSION

The Real-time smart fire safety management and notification system is based on IoT services and web services. The system is completely developed from hardware and software. It is capable of performing fire functions like water sprinklers, exhaust fans for fire and gas prevention respectively. Sensors are integrated data and continuously transmitting to signal via relay for real time fire management and sending message to user and call to fire brigade. User and Fire brigade are able to perform real time monitoring and management.

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