ISSN (Print) : 0974-6846
ISSN (Online) : 0974-5645
Indian Journal of Science and Technology, *Vol 12(48), DOI: 10.17485/ijst/2019/v12i48/149384, December 2019*

Design and Implementation of an Automatic Forest Fire Extinguisher Using Sprinklers

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Abstract

Objectives/methods: Recent forest fires have damaged many acres of forest, not only do they harm the forest, but they are also a major threat to plant and animal life. It is more difficult to extinguish such fires. Rather than regretting injuries, it is better to take care. This study provides a one-time solution for an automatic fire extinguisher that requires a sprinkler to drowse the fire. **Findings/application:** Sensors used are a smoke detector, a digital humidity and temperature (DHT), and a buzzer warning. There is a centrifugal pump which gives the necessary pressure to the water. When a forest fire is in operation, the smoke detector detects the smoke, the relay turns on the pump, and the sprinkler begins to turn 360 degrees and drowses the fire.

Keywords: Recent Forest Fires, Sprinkler, Injuries, Automatic fire extinguisher

1. Introduction

Every country is confronted with this common issue of forest fire, which has many adverse effects on human, plant, and animal life. Many developing countries are constantly working to find a solution to this problem. India, being one of them, has no modern technology to solve this problem. There are a few drawbacks in the execution of this, but these weaknesses can be solved. Until the fire engines or the military forces arrive and drowse the flame, it will be very late and the fire will spread quickly. So in this situation, the automatic fire extinguisher will be of great help, as it does not require man's energy, because it is completely automatic.

Forest fires and other forms of fires cause enormous damage to the environment and also cause enormous economic losses to the country. The fire-spreading algorithm helps us to understand and forecast the evolution of forest and urban fires. Virtual simulation of virtual scenarios is used to train firefighters and controllers as required and to achieve the main objective of drowsing fire.[1]

Here, the new fire extinguisher software, the self-controlled smart fire extinguisher Safe from Fire (SFF) device, uses multiple sensors as well as actuators powered by a micro-controller unit (MCU) using a fuzzy logic. When a fire breaks out, the sensors placed at different locations send signals in the form of text messages and call alerts the officials and the alarms start ringing. A similar type of technology is used to extinguish forest fires.[2]

Fire identification, tracking, and estimation are a very important aspect of forest fire extinguishing. The aerial network, such aerial systems with the aid of detectors, infrared cameras, and visual cameras, are one such way of achieving such processes and the necessary studies were done on the basis of these results. Upon taking note of all the factors, they take the necessary steps to drowse the fires.[3]

Forest fire extinguishing, a wireless sensor can be used. The wireless sensor network can identify and anticipate forest fire more rapidly than the conventional satellite-based detection method. From this article, we will learn about data collection and storage in the network of

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wireless sensors for real-time forest fire detection. The neural network model is used to detect fire and alert the fire of the forest guards. We test the quality of our method through fire stimulation.[4]

A centrifugal pump that is used to pump fluids that are called a rotating plate. The impeller, which is pumped by means of a dc motor, which moves the water with more force, which helps to lift the water. The centrifugal pump has the inlet and the outlet. The inlet is immersed in a source of water and let out to its death. When the engine is turned on, the impeller rotates and generates a pressure due to which the water flows inside the impeller cavity, and this movement will cause the water to pass through the outlet.[5]

Arduino Uno used in fire alarms is an interface to a temperature sensor, a smoke detector, and a buzzer. The temperature sensor detects the heat and smoke generated during the fire, which is connected to the Arduino Uno, which responds to the fire condition and helps to cause alarm. It has a buzzer that also beeps to signify fire. If there is a little smoke, the buzzer that is attached to the Arduino Uno will soon be gone.[6]

Forest fire identification based on satellite, which can be achieved on a large scale. Forest fire can be identified in satellite imagery. Using the infrared radiation called the heat wave, it produces fire images that will be used to alarm forest officers. In the satellite system, we can know where the fire is spreading and where the spread can be stopped to protect the rest of the forest that has not caught fire.[7]

Here, we have a clear idea of how sprinkler systems have played an effective role in extinguishing fires in homes, apartments, etc. Such sprinkler systems have shown more than 91% effectiveness in extinguishing fires in buildings with a few exceptions where the building is under renovation or where adequate sprinklers are not used. In the same way that our project uses a sprinkler system to extinguish forest fires.[8]

Environmental degradation in Mediterranean countries is mainly caused by forest and rural fires. The fire detection system focuses only on fire detection, but not on fire verification. However, almost all of them are mere simulations; very few implementations have been identified. Besides, there is a lack of scalability in the literature system. The measures taken to complete the project are shown in this document.[9]

Research and development of the wireless network used to detect fire in forest areas has been fully explained. The number of sensors required to cover the entire forest has also been studied. The scalability of the system has also been studied. Multi-sensors are being developed which send a sensor alarm through the wireless network to the central server when fire is detected.[10]

Environmental monitor, home or factory automation, logistics are all based on wireless sensor networks (WSNs). Important trees are destroyed and forest animals, which are very important natural resources due to these wild fires, have been killed. Satellite network, surveillance systems that use cameras, infrared detectors that cannot support real-time surveillance, tracking, and automatic alarms. The WSN works by sensing smoke, calculating temperature, and humidity.[11]

The author introduced a wireless network model for real-time forest fire detection. Compared to the satellite-based detection method, this wireless sensor network can detect forest fire more quickly and precisely in a much shorter time. This article primarily discusses information on the operation and storage of wireless sensor networks for the real-time forest fire detection system. Performance evaluations of our approach are carried out by simulations.[12,13]

However, the implementation of these systems is very important because they should be placed in almost all forests, which will be very economical. Moreover, the availability of water is a key issue that needs to be addressed. There is also a question of injury, such as rusting the connecting pipes. A lot of human power is required to operate such machines, so power supply is also one of the main issues.

There are many drawbacks, but the implementation of this system is not impossible, as these issues can be addressed by placing the system in maximum fire-prone areas, as surveyed by the forest department, and the water can be used by the bore wells dug earlier. In order to avoid the rusting of the connecting pipes, the connection of these pipes will be underground and the body of this device will be made of fireproof material. The issue of power supply can be dealt with by the use of solar cells. Talking about cost and manpower is a one-time investment to make the future better.

The main objective of this article is to provide an automatic fire extinguisher by removing all of the disadvantages listed in these systems and successful deployment by bringing all of this technology in fire-prone areas for optimal use without any complications or major issues being resolved.

2. Working Principle of Proposed System

The smoke sensor and the temperature sensor are internally connected to the power supply, the buzzer, and the relay switch. When these sensors are activated, the pump is switched on to provide the required pressure to the water taken from the water tank. The water is coming out of the sprinkler, and the fire is drowses as shown in Figure 1.

This automatic fire-extinguishing sprinkler system uses bore well water, which has already been dug in many forests for various other purposes. This water gets a lot of pressure from the centrifugal pumps. The water is passing through the sprinkler. This sprinkler rotates 360 degrees and the nozzles of this sprinkler are aligned in concentric circles covering a range of fire-prone areas. With the aid of the detectors, smoke is sensed so that the sprinkler efficiently drowses the flame immediately and this also activates the ringing warning to alert forest officials.

Sprinklers used for fire extinguishing may also be used for irrigation purposes in summer.

We can create small ponds for water storage. Such rainwater reservoirs can be collected from which water can be guided to the automatic fire extinguisher, and the animals can also be provided with water. During summer, when these ponds are drained, the water from the bore well can be refilled. So that the species will thrive in the summer without water scarcity. The engine that we use for the automatic fire extinguisher can also be used to pump water to the ponds. By using these devices, we can save the forest and keep it clean.

3. Flow Diagram of Proposed System

3.1. Algorithm

STEP 1: Smoke is detected by smoke detector

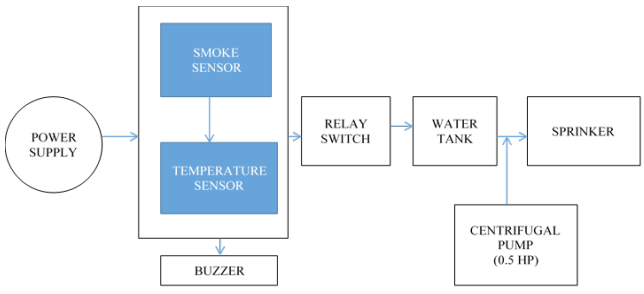

Figure 1. Architecture diagram of proposed system.

STEP 2: The internally connected sensors like DHT sensor and buzzer get activated

STEP 3: The relay switch connected to Arduino Uno sends the signal

STEP 4: The pump gets switched on

STEP 5: The sprinkler rotates 360 degrees and drowses the fire

If fire is found in the forest, the automatic fire extinguisher is triggered as shown in Figure 2. This consists of three types of sensors, such as a smoke sensor, a digital humidity and temperature (DHT) sensor, and a buzzer. Therefore, in the initial condition when smoke emerges out of the fire, smoke is identified by the smoke detector as shown in Figure 3.

If the smoke sensor fails to detect the smoke, the DHT will be activated and the surrounding temperature and humidity will be detected. As the forest fire increases the temperature and the humidity decreases.

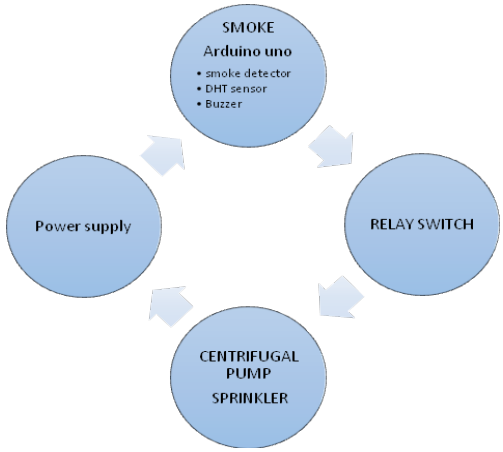

Figure 2. Flow diagram of proposed system.

Figure 3. Implementation of proposed system automatic forest fire extinguisher using sprinklers.

All sensors are connected to a buzzer that creates a sound to warn nearby forest officials. If the sensors malfunction, the buzzer will aid in the drowse forest fire.

Once the fire is detected, the motor connected to the sensor turns on. Which will be connected to the water source like the bore well, which is normally drilled in the forest, and the motor will be connected to the sprinkler, which rotates 360 degrees. When sensing is completed, the motor pump draws the water from the water source and supplies the sprinkler which sprays the water through 360 degrees and drowses the fire forests.

4. Conclusion

An automatic forest fire extinguishing system has been put in place. Via experimental results, we can infer that the forest fire extinguishing process is one of the most reliable methods for preventing forest fires. This system is applicable to the elimination of fire in the forest with its sprinkling ability. The simple design allows a minimum of maintenance work. Since there are no moving parts, the risk of device failure is also minimized by the risk of false alarm. The quality of this system is dependent on the following factors: Smoke detector DHT sensor Buzzer Centrifugal pump Arduino Uno Sprinkler Accuracy and stability of the unit are controlled. Although having a narrow range of difficulties, the popularity of automatic forest fire extinguisher development is growing day by day; in addition to improved and advanced technology, older versions are being replaced that continue to improve system performance.

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