Forest Fire Detection using Wireless Sensor Network

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Abstract— **Development of real time fire detection system is the main target of this research using unmanned aerial vehicle. Sensors, Raspberry Pi and Camera are used for capturing and processing the images of the fire in the forest. This system uses two sensors, namely flame sensor and smoke sensor. Flame sensor is used to detect the fire using infrared light, whereas a smoke sensor is sensitive to gases and smoke. Data collected by the sensors and camera is processed by Raspberry Pi which is the micro controller. The result of the data that is processed is sent to the cloud and can be accessible in ThingSpeak. A prediction algorithm is used to detect fire based on the comparison of pixels. All this hardware is integrated together and mounted on the drone.[1][3]**

Keywords— Raspberry Pi, Flame sensor, Smoke sensor, Camera, Drone, Image Processing.

I. INTRODUCTION

Nature is balanced mainly due to the forests which play an important role. About one third surface of the earth is covered with forests. Forests are homes for many species and birds on earth. Millions of forests are burnt due to fire everyday across the world. These fires can be natural or due to human intervention. When the temperature of a particular area is too high, then there is a possibility for natural fires to occur. In case of human beings, they burn the forests for construction purpose and to convert them into agricultural lands. Sometimes, the fire may spread rapidly to adjacent areas causing huge damage to the environment and for the species living nearby. This has become a serious problem as it causes deforestation and helps in producing many greenhouse gases which in turn leads to global warming.

Therefore, we need a viable solution to detect the fire well before it starts spreading to other places and causes damage at a large scale. There are several methods to control or detect fire. Here are two common approaches used: (1) A group of people can monitor the forests working in different shifts or (2) the fire can be detected using an unmanned aerial vehicle which is operated by a person at a particular place outside the forest. The first method is not used in this modern era because it is time taking and unreliable process. It requires a huge staff for monitoring the entire forest every 24 hours. Also, by the time they report the fire to the department, the fire must have been spread to all the areas surrounding it. This is a traditional approach. It is costly and not at all safe for humans. To overcome all these difficulties of the traditional approach, we use unmanned aerial vehicles (UAV). In the modern approach, we use a drone which carries all necessary equipment used to detect the fire in the forests.

Drones have become very popular and also prove to be effective in many areas. Though these vehicles are large and expensive, it provides the results immediately. One of the advantages of using these UAVs is that they can operate in hazardous areas that cannot be monitored safely by humans. Flame sensor, smoke sensor, camera and raspberry pi are integrated within the drone for capturing and processing of the data collected.

In addition, it can also send the location of the area affected using GPS. It sends the coordinates to the server. The idea is to send an alert immediately when a fire threat is detected, henceforth necessary actions can be taken.[2]

II. OBJECTIVES

The primary objective is to detect forest fires right at the very beginning so as to prevent it at an early stage.

The UAV will function with two processors, one for its mechanical operation and one for the image processing part. It will scout the marked areas of the forest at a safe distance taking images at regular intervals (real-time).

Whenever an image after processing algorithms gives an alert about a possible fire in an area, the sensors already activated will come into use.

First at the given distance the smoke sensor will check and send a signal, again to ensure it is smoke from fire and not smog. For this, the UAV must move closer towards the suspected area. Now, the flame sensor is used to check for significant elevation in the temperature to ensure it is a fire.

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Here, it is noted that certain damage might be caused to the drone in the process of getting closer to the problematic area. But it will be considered negligible considering the prevention of a wildfire has much higher priority than the loss of the machine-drone.

The existing system of manual driving requires valuable resources, manual labour and skill set for driving the drone.[4]

III. EXISTING SYSTEM

The Forest Reservoirs in India are currently monitored with manual efforts most of which are insufficient and ineffective. It results in uncontrolled damage. Few traditional methods are, manual human walking/jeep surveys (visual ways), few watch towers in the entire forest, rare ground patrolling and aerial patrolling, long distance video monitoring etc.

1)European Forest Fire Information System (EFFIS):

This system is by the JRC (Joint Research Centre). It basically gives a danger forecast, say a forest fire event occurs, it is detected, the areas burnt are mapped, the damage area is estimated, all the emission due to it and possible soil erosion is estimated. The effects are neutralized, methods to regenerate vegetation are implemented. The cycle repeats.[5]

2)Canadian Wildland Fire Information System (CWFIS)

It's a computer-based system where weather related data is collected daily and conditions for the next 6 months in Canada are predicted using fire behavior maps.

They also use satellites for this process. It basically consists of 3 main sections Background Information which deals with how to derive the data required ,Current conditions consisting of fire weather and fire behavior maps which help in locating the fire-prone area and historical analysis which tells about the previous incidents that have occurred on the basis of which it is easier to predict the patterns. [5]

Such ways of monitoring lead to lack of awareness, communication gap, delayed actions, complete human attention, time consuming, hard to reach dense areas and lead to huge losses.

IV. PROPOSED SYSTEM

The natural wealth and wildlife can be protected by implementing the modern technologies like Image Processing, Wireless Sensor Network which makes it an easy and accurate, frequent surveillance with a camera mounted on UAV and highly sensitive sensors to correctly detect and diagnose the accidents and generate alerts. The system can be viewed in three modules: monitoring using UAV, data collection using sensors, analyse using Image Processing.

This type of approach requires less human intervention, easy detection of fire. It is a one-time hardware setup. It can differentiate between smoke/fog and actual fire thereby giving exact information and help quicker responses. High resolution camera and sensors can be equally effective even in dark. Hence such frequent operations help in conserving forests from wildfires.

V. SYSTEM IMPLEMENTATION

Fig.1 contains various sensors such as camera, flame, smoke sensors which collects data from the environment and transmit it to a power enabled micro controller [7]. The micro controller interprets the data and draws conclusions based on the data it collected.

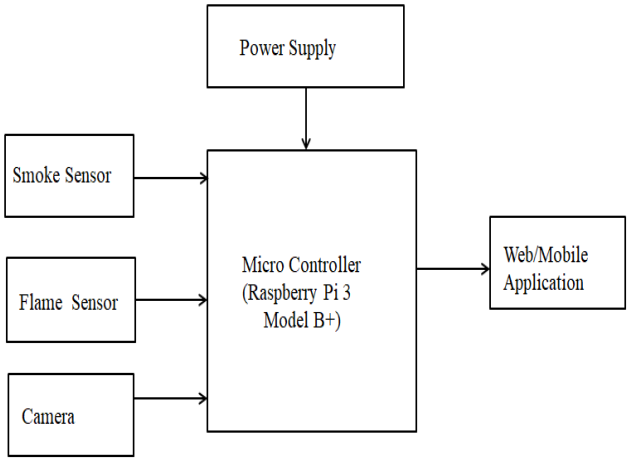

Fig 1

Fig.2 shows the Fire Detecting Architecture.

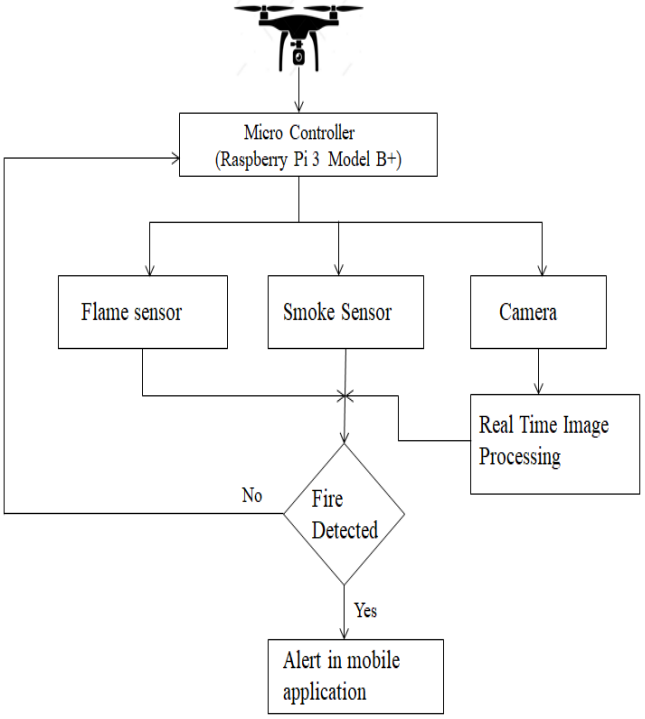

Fig 2

The system consists of a drone (UAV) which detects fire when occurred during its flight across the forest area while monitoring. To detect fire a flame sensor is mounted on the Raspberry Pi. A flame sensor detects Infrared Rays which has a wavelength between 760nm-1100nm. A smoke sensor is also mounted on the Raspberry Pi. Smoke sensor is

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sensitive H_2, LPG, CH_4, CO, alcohol and propane. It has built in potentiometer which is responsible for the smoke detection part. Here, the voltage is proportional to the concentration of gas. For precise results a camera is also mounted on the drone, which is connected to micro controller. The camera captures the real time images, which are processed using image processing algorithms [6]. If the output of the flame sensor, smoke sensor and image processing give a combined positive result that fire is present then an immediate alert is sent to the concerned authorities using a text message. The text message is sent using GSM Module.

Result: when a fire was lit the camera already capturing images in real time came across the section of the ground lit in fire. The image is processed, the smoke and flame sensor also send data confirming the fire and a msg is sent to the as an SMS. When the Image processing algorithm is run on a laptop through its inbuilt camera, it gives the following output.

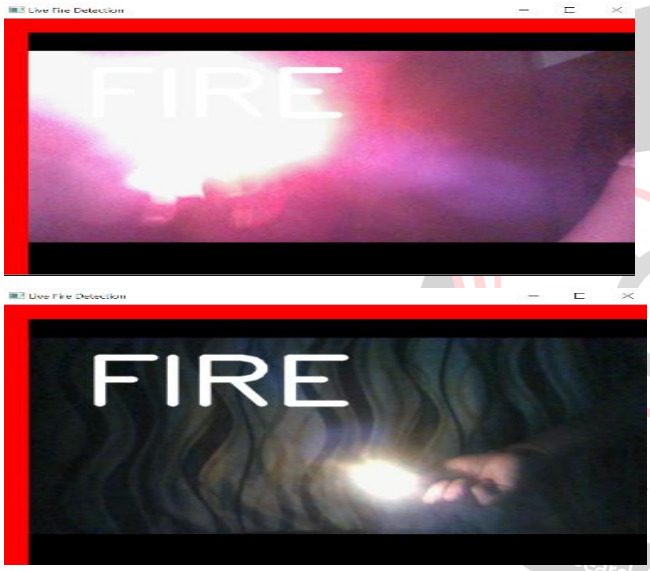

Fig 3 Fire detected due to a lit matchstick and corresponding alert shown based on real time video.

Fig 4 Image of the burning newspaper out in open captured in real time by the camera mounted on the pi

VI. CONCLUSION

A wireless communication system that replaces manual intervention when it comes to preventing major forest fires and a loss to wildlife.

The UAV mounted with image processing and wireless sensors network will aid in faster detection of even slight flames and send an alert to in the program. It's a reliable, cost effective and can be scaled accordingly using powerful drones with higher battery life and more rigidity.

The image processing algorithm distinguishes fire from the surrounding objects. This helps in preventing vast destruction to wildlands due to accidental fire. [8]

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REFERENCES

[1] G. Eason, B. Noble, and I.N. Sneddon, "On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," Phil. Trans. Roy. Soc. London, vol. A247, pp. 529-551, April 1955. (*references*)

[2] "Flame Luminance Enhancement using Chromaticity Pigmentation For Real Time Fire Detection" by Gokul Choudhary and Pankaj Pandey both from the Dept of Computer Science and Engineering, Oriental Institute of Science and Technology, Bhopal, India

[3] Hahid Karim,YeZhang on "Image Processing based proposed drone for detecting and controlling street crimes",2017 17th IEEE International Conference on Communication Technology

[4] "A study on smart srone using Quadcopter and object tracking techniques" Woo-Seok Yang,Myung-Hyun Chun,Gun-Woo Jang,Jong-Hwan Baek,Sang-Hoon Kim,HKNU,Republic of Korea

[5] "Case studies of forest fire detection systems" by Igorce Karafilovski, Vladimir Zdraveski and Dimitar Trajanov both faculty of Electrical Engineering and Information Technologies, "Ss. Cyril and Methodious" University, 1000 Skopje , Macedonia .

[6] "Experimentally defined convolutional neural network architecture variants for non-temporal real-time fire detection" by Adrew J. Dunnings and Toby p.Breckon both from Durham University, UK

[7] "Forest fire detection using IOI enabled Drone" by Vergin Raja Sarobin M,Simrandeep Singh,Abhay Khera,Lakshya Suri,Chhavi Gupta and Ayush Sharma all from Vellore Instirute of Technology.

[8] "Thingspeak Based Sensing and Monitring System for IOT with Matlab Analysis" by Sharmad Pasha

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