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FIRE MONITORING UAV USING IMAGE PROCESSING

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Abstract: We know that a small fire in the forest eventually might lead to a forest fire in recent days we have seen many widely spread forest fires which might put wildlife in danger. Even in cities in some industries where there is a possibility of a fire outbreak. So we propose an idea of monitoring the defined area using an aerial vehicle i.e., a drone. If we use a drone equipped with low-cost cameras, memories, and suitable processing capabilities, it might be helpful in detecting the fire beforehand. Some of the remote sensing techniques can be used for providing much more accuracy in identifying the fire Image contains forest fires in real-time.

Keywords : UAV,**RPV,GPS,IC,CSI**

I. INTRODUCTION

Forest plays a vital role in all kinds of lives. It nurtures environments, provides homes for wildlife, offers abundant job opportunities, and also contributes to a significant proportion to economic wealth. Every year, however, millions and millions of hectares of forest are destroyed by forest fires, which severely damages ecological systems and the safety of wildlife, and cause hundreds of millions of dollars property loss. Wildfires are unwanted and unplanned fires, including lightning-caused fires, unauthorized human-caused fires, and escaped prescribed fire projects. If we see the statistics, we find that in 2019 there were 50,477 fire outbreaks and 58,083 in 2018, according to an article of National Interagency Fire Center (NIFC). About 4.7 million acres were burned in 2019 while there were 8.8 million acres burned in 2018.

There are many different technologies that are being used for forest fire detection and monitoring. These include satellite imaging, remotely piloted vehicles (RPV), or sensors. However, these methods do not provide real-time detection and monitoring of fire. Some drawbacks of these technologies include: i) forest fires are not detected in early stages, ii) satellites have longer time lags, and iii)sensors become an infeasible solution because of its small range. Even if we use spectral imaging, it might not give an accurate result at night or in adverse weather conditions. Nowadays, to stop forest fires at the right time, personnel are employed to guard the forest, pitting their life at risk.

Unmanned aerial vehicles (UAVs) with image processing and remote sensing is a better option to provide real-time monitoring and detection of forest fires. UAV is a faster and mobile solution, and at the same time, it is a low-cost solution to monitor forests. The calibration of UAVs with remote sensors will add more value to pre-existing methods. In addition, UAVs are able to operate in hazardous areas that cannot be safely reached by humans.

In this research paper, we propose to develop a real-time forest fire monitoring system using a UAV and remote sensing technique. The drone is equipped with sensors, a mini processor, camera, GPS module, and buzzer. Data from different sensors, GPS, and the images taken by the camera are processed by the Raspberry Pi 3, which acts as a processor. The results of the data processing are sent to a server to be accessible online.

II. LITERATURE SURVEY

Unmanned aerial vehicles (UAV) comes from a class of aircraft that can fly without the onboard presence of pilots. Unmanned aircraft systems consist of the aircraft component, sensor payloads, and a ground control station. UAVs are these days used for observation and tactical planning. This technology is nowadays available for use in the emergency response field to assist the crew members. In many cases, UAVs are used in rescue missions.

In different classes of UAV-based sensing systems, drones with onboard sensing systems are used. Generally, drones act as a bridge between a network of wireless sensors on the ground and a cloud-based processing unit. Single or multiple UAVs fly in pre-defined paths and collect information from a network of terrestrial sensors. Although this method works efficiently for the collection and processing of data offline, but is not suitable for critical situations like wildfire and floods. These events require instant, or we can say real-time detection so that a response mechanism can be started as soon as possible. One more major drawback is UAVs energy utilization, since the drone hover over a larger area, coming back to the ground stations for communication consumes a considerable portion of its energy. So to overcomes such problems, we can use autonomous UAVs so that they can independently plan their route or procedure of task completion would provide a feasible solution. A single UAV has limited capabilities such as limited flight time, payload, and communication range. So to enhance its capabilities, a network of multiple UAVs can be used so that they are able to cover a wide range and communicate to the stations without traveling a longer distance.

Thus, integrating the UAVs with remote sensing techniques can provide fast and low-cost, efficient solutions for forest fire monitoring tasks. Therefore, many researchers have advocated the use of UAVs.Using single and complex UAV with sophisticated sensors has been investigated in such a FiRE project. At the same time, the network of a more straightforward UAVs team was used in the European COMETS project and in several other projects too. Many different works related to the detection and forecasting of forest fires were carried out at the National University of Civil Protection (Kharkiv , Ukraine). A similar project has been undertaken at the Ukrainian Research Institute of Civil Protection (Kyiv, Ukraine) related to the monitoring of fires. Even though many projects have shown positive results, that there is a scope of using UAVs in the forest fire monitoring, many issues have cropped up. There are problems related to remote sensing and image processing techniques, remain insufficiently investigated, so they need further research.

III. ARCHITECTURAL MODEL

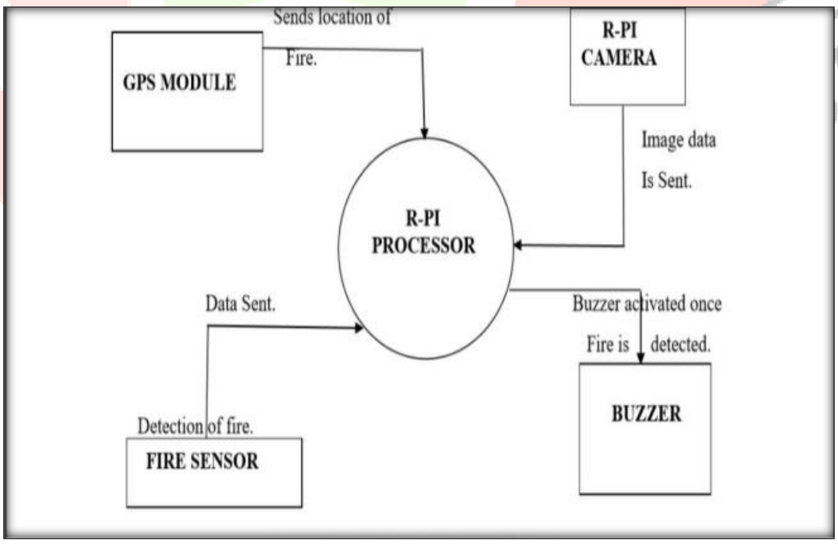

FIG 1. MODEL ARCHITECTURE

The system consists of the following components, and their functions are given below:

GPS MODULE: The GPS module will help in sending the location of the fire-affected region, and it will send the exact longitude and latitude of the fire-affected region. With the help of this, we can easily track the location area, and we can control the fire.

RASPBERRY-PI CAMERA: The camera will help us to provide a picture of the fire-affected region. It provides high sensitivity, low crosstalk, and low noise image capture in an ultra-small and lightweight design. The camera module used is connected to the Raspberry Pi board via the CSI connector explicitly designed for interfacing with cameras..

FIRE SENSOR: A fire sensor module that consists of a fire sensor, comparator LM393, resistor, potentiometer, and capacitor in an IC. It is capable of detecting infrared light with a wavelength ranging from 700nm to 1000nm. The far-infrared flame probe converts the light detected in the form of infrared light into current changes. Sensitivity is adjusted through the onboard variable resistor with a detection angle of 60 degrees. It will help to know the temperature of the fire-affected region.

PIEZO BUZZER: Piezo buzzer is an electronic device commonly used to produce sound. If the fire is detected, then it sends the signal to the user by making a beeping sound. By this, the user can come to know there is a fire detected in some area, and they easily track it using the GPS module.

WI-FI MODULE: here, we use Wi-Fi technology for creating a local network and providing Internet access to all those devices that are within the Wi-Fi range of routers that are connected to the Internet.

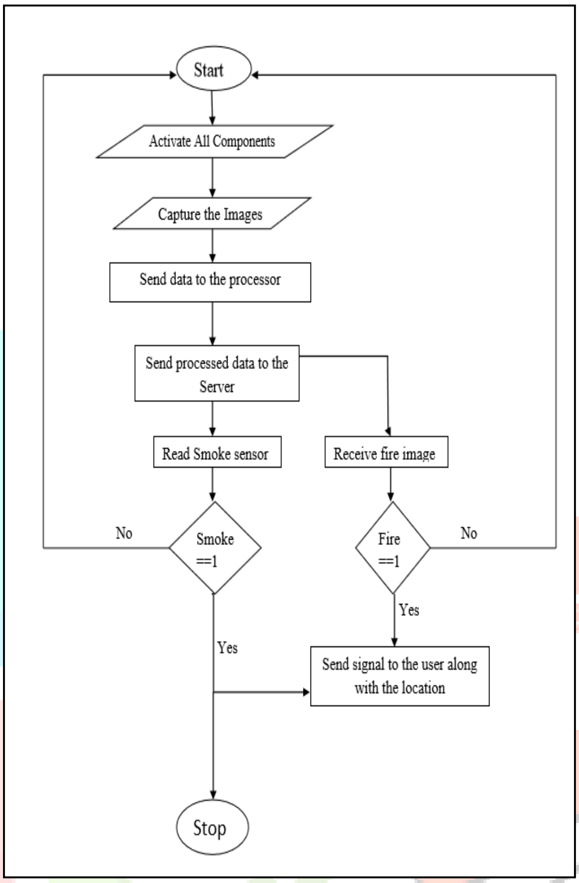

FIG 2. DATA FLOW DIAGRAM

In our proposed system

- The R-PI camera will send the image to the R-PI processor.
- The processor will compare the image with the other datasets available in the list; if it matches the dataset, then it will send the message as fire detected.
- The GPS module helps in sending the exact location of the fire-affected region to the processor.
- The fire sensor will detect the intensity of the fire and send data to the processor. Then by considering all the data, if the fire is detected, the processor will activate the buzzer and gives information to the user.

IV. IMAGE PROCESSING IN RECOGNITION

In this particular project, image processing is a very crucial part, as the whole outcome of the project depends upon the detection of fire using image processing. We are using Matlab for this purpose. Image processing is a technique an image is converted into a digital format and performs operations on the digital output to get an enhanced image or extract some useful information from it. This project uses the viola jones algorithm for the purpose of image processing. Image processing cannot be carried out without the image/object segmentation process. The below figure illustrates a working Matlab code using object segmentation..

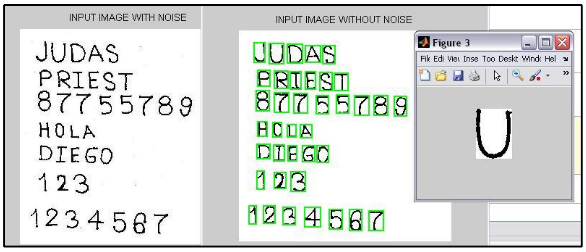

FIG 3. IMAGE RECOGNITION

It involves converting the image into a collection of regions of pixels and is represented by a labeled image. Only after dividing an image into segments, you can process only the important segments of the image instead of processing the entire image. It is used to detect the edges circles and lines of a provided image, which is basically of fire of different types. The code will produce the output only if there is a match of about 60% or more. It can also be used for text recognition, whose example is as given below. As you can see in the below picture that a flame is identified with the help of Matlab. This is done with the aid of region of interest(ROI), which filters the region of the image you want to operate on.

After both the processing are successfully carried out, and if the final match is not less than 60 percent, the fire region is successfully detected.

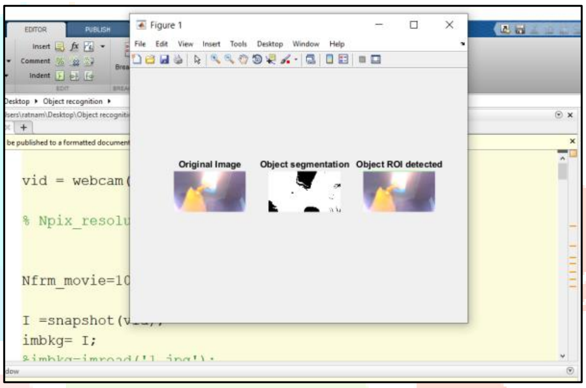

FIG 4. DETECTION OF FIRE

An infrared camera is used for the detection of the fire because the fire may be surrounded by smoke, which makes it difficult for the standard camera to capture, whereas infrared camera tracks the heat signature. Besides this, an infrared camera can work on any light condition. It returns the radiation intensities represented by cells. The appearance and increase of radiation change the pixel color from black to white. The camera takes the picture using infrared radiation and breaks it into blocks of pixels. When a specific cell doesn't have radiation, the pixel of that part of the image is black. .If there are no white pixels, we can conclude that there is no fire activity in the corresponding cell. Some pixels might be having a grey color.

We may also use an optical camera since various superheated or super cooled rocky areas, soils, and water surfaces can distort data. we define the discriminating interval in RGB space LG = [RGB(60%, 60%, 60%) - RGB(95%, 95%,95%)], which exclude some distortions caused by lighting conditions.

In nutshell we can say that,

For identification of fire we need to follow these steps:-

- Identify the color
- Movement of the fire

Procedural steps for the identification of fire:-

- Select the area which will also be known as area of alert
- take a tour of that area with the drone

Features of fire that should be considered are:-

- Color
- Movement of flames
- Shape or rather a geometrical shape

V. CONCLUSION

We have developed a real-time forest fire monitoring system using an Unmanned Aerial Vehicle (UAV). The drone should detect any abnormality in ground surface temperatures from a height minimum of 20 meters from the ground using remote sensing techniques. The drone flies at a constant speed. The drone can also send the measured data to a cloud server so that further processing can be done without the drone to return to the ground station. The location sent by the GPS module may have some deviation because the standard GPS have accuracy within 2.5 meter of range.

VI. REFERENCES

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