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Prototype for Forest Fire Detection and Alerting System

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ABSTRACT: Forest Fires rated as terrible environmental catastrophe. This will shatter the bionetwork and causes the imbalance in the ecosystem.
The tact's are needed to tame at the seedbed. In the interest of this, we proposed alerting system which sends SMS as well as E-mail. We put forward two self-sustaining modules with deep learning and IoT techniques. Dataset bottled up with fire and non-fire images is pre-trained with the InceptionV3 model. If the fire prediction is high, alert is immediately sent to the respective department whereas on the other hand flame sensor is adjusted with arduino to trace fire. We made use of ESP8266 wifi module to show messages on webpage and bluetooth module to transmit SMS.
keywords: Deep learning, InceptionV3, ESP8266, bluetooth module**.**

I. INTRODUCTION

A forest fire is an uncontrolled fire occurring in nature. Sometimes, the forest fire spreads so fast and causes lots of damage to wildlife. It can begin with a lightning strike, or people carelessly starting it, or accidentally, or even arson, that went unnoticed and got out of hand. These fires sometimes burn for days and weeks. They can wipe out the entire forest and destroy almost every organic matter in it. Wildfires can also be termed forest fires, grass fires, peat fires and bushfires depending on the type of vegetation being burnt. These fires tend to flourish in exceptionally warm and dry climates, instead of the thick, wet rainforest types. They can destroy biotic(animal, tree, bacteria) and abiotic (climate, rocks, soil) factors of a forest ecosystem. Sometimes unexpectedly, if a forest fire occurs, It takes a long time for the fire fighting team to gain control over the situation. Therefore, in our model we have taken this scenario in mind and we built the prototype for the forest fire alert system by sending the alert message through e-mail , sms and by alarm to convey the information regarding forest fire to the nearby forest department.

II. LITERATURE SURVEY

In Paper [1], they worked on a model called DFWAE (Deep forest wildfire auto encoder) using the methodology LSTM (long short term memory). Basically this LSTM is an extension of recurrent neural network and this works on input considering previous outputs. DFWAE is mainly built to new behavior so that it can be tested by any number of changes.

Paper [2] focuses on the case-based reasoning technique which mainly works on solving new problems by knowing previous situations. Thermal imaging cameras are used to know the heat transition of the fire and Light Detection and Ranging System is used to measure the laser light back scattered by the smoke particles.

Paper [3] deals with wireless sensor networks. This complete system was developed by the Canadian Forest Service. Radio transceivers are used here. The signal is sent from the sensor node to the central node and then to the main center and then to the control center. By integrating information from various nodes, an alarm is provided.

III. METHODOLOGY

Deep learning emulates the notion of the human brain to create patterns and processing from the data and IoT is a network of things connected to sensors, software and others for the communication of data .
In our proposed system sensors are used which work as an alarm system which will send an email

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notification to forest department using Iot, if any fire outbreak has occurred .The prototype of our system uses camera to detect fire using deep learning .The role of a sensor is to sense the environment, transferring and exchange sensory data with system. Our work plays a major role in detecting the fire .This will reduce the manpower working towards the forest. With the help of this prototype an alert a message can be sent easily to the nearest forest department .

The intention is to train the model without overfitting. A DataGenerator is used for InceptionV3 with 200 and 1800 images for validation and training respectively. This model includes 2 spatial average pooling layers with 2 dense and pooling layers each respectively and softmax layer is used as an activation layer.

The dataset is fed into the model where Rmsprop and SGD is used as optimizer with learning rate of 0.0001. The model is trained and compiled to save in a file with .h5 as extension to avoid the intricacy in re-usage of the model .

Our work uses an Arduino mega microcontroller based on Atmega2560 works at 16MHz. It has 54 digital i/o pins, with 15 pins for pulse width module(PWM) output ,16 analog and 4 UARTs pins. It holds 3 RX, 3 TX, 1 SDA and 1 SCL pin. A flame sensor which monitors around 3 feet if fire is encountered. A HC-05 is casted for full-duplex communication and operates at the baud rate of 9600. We made use of an LCD display since it is a prototype. ESP8266 has 17 GPIO pins associated with the glimmer memory chip, interfacing protocol is serial. It is associated with SPI , I2C and a regulator which is built on board utilizing pin VIN.

Fig: Components set-up secured in a box

IV. IMPLEMENTATION

Our work is implied as a stand-alone system with two different modules .First the dataset is analysed where the dataset contains fire and non-fire outdoor images. The detection of fire is done by using the “InceptionV3” model. The model is loaded from the .h5 extension file for deployment.

Our work includes a login page where only the registered user has the ability to switch on and switch off the camera. OpenCV is used to access the webcam and whether each frame contains fire or not. If the fire is detected the frame color turns to B&W color . The mail is sent to the recipient mail address which is provided. The mail is sent with a warning message only when the prediction rate is above 70% and an alarm will be set in which the sound lasts for 11s .

fig: Frame color before and after fire detection.

Likewise, at first we need to connect the ESP8266 to an access point(router). After connecting we need to get the IP address. It will check the availability of IP address and is displayed on the serial monitor if found.

Multiple connections can be maintained so we made ESP8266 connect to the server as a TCP client. By this ESP8266 and the PC are connected to the same router.

Now if the fire is detected the SMS is sent to the device which is connected to bluetooth and is displayed on the webpage.

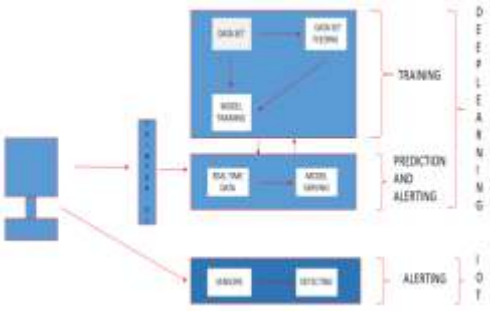

Fig: Flow diagram

V. RESULTS

The fire and non fire images are collected from the internet from various resources..

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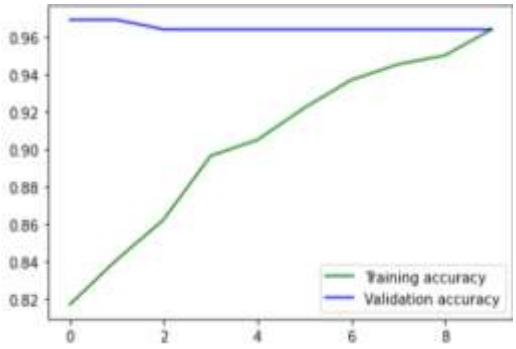

Fig: Training and testing

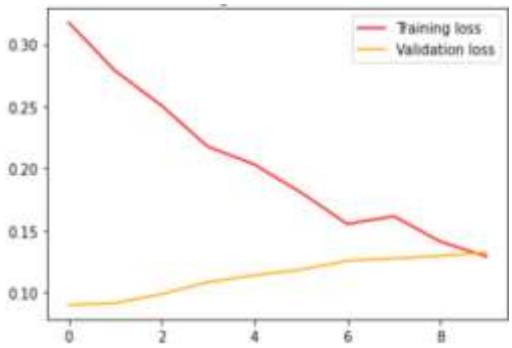

Fig: Training and testing loss

From the above figures training and testing accuracies for both is 96.43% and the loss for both the cases are 0.1288 and 0.1321 respectively .


(a)


(b)

The above figures shows how a message is displayed on a web page.(a) is the default page, (b) is screen after the fire is detected.

VI. CONCLUSION AND FUTURE WORKS

Forests are the backbone of ecosystems and conservation of these forests is our duty as part of this ecosystem. Forest systems are complex as well as dynamic. One of the threats to imbalance the system is fire. In this paper, the method has developed a methodology to overcome the drawback of previous methods. In this method, detection of fire by monitoring the forest using the camera and sensors to detect the flame.

Continuous monitoring using the camera and the sensors helps us to detect the occurrence of wildfire. The method has included a sensor network to transfer the information. This network has included short range communication via bluetooth and long range communication via email notification. Short range communication has been included for data exchange between different areas of the forest and to process this data, whereas long term communication has been used to send the alert messages.

Alarm is also used for the alerting purpose when the system fails to send the notifications this could be helpful. This method is less complex and needs low maintenance, and useful in low power applications and requires less memory space.

In the future works GPS can be implemented to detect the exact location of the forest fire and also by using the wireless connections between the sensors to transfer the data. Simple arduino is used inspite we can use Raspberry pi for advanced deployment. Vulnerability of fire can be calculated by using wind speed and temperature.

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