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IoT based Forest Tracker using RASPBERY PI MODEL

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Abstract: Over the last two decades, the forest fire has been increased dramatically, due to forest fire animals are not secure and moves out of the forest boundaries. In this system the Forest monitoring unit has been developed to provide a monitoring and communication solution for Forest protection. The system provides an intelligent forest environment monitoring solution based on the Raspberry pi, analogical and digital sensors.

The user's accessibility to the collected data is ensured via Internet and a mobile application that allows the user to receive notifications, whenever fire or animals are detected. This Forest monitoring solution is an IOT project, addressed to public and private forest owners as well as to national environmental and disaster response authorities.

The purpose of the IOT concept is to transform the real world and every day electronic devices, appliances, etc., into intelligent interconnected virtual objects. By keeping the user informed on the state of things and giving the users control of things, a better global humans- devices-humans communication can be achieved

Keywords: Camera, Sensor, Detection, Convolutional neural network, Image classification, Testing and Training, Predict performance, Accuracy.

I. INTRODUCTION

Over the last two decades, illegal deforestation in Romania increased dramatically. A Greenpeace study approximates that more than 500000 hm^2 of land have been illegally deforested since the year 2000.

At a national level, the area covered by forest fell dramatically reaching 28.95%, way below the EU average of 32.4% and far more below the optimum and possible capacity of 45%.

Nowadays, Wireless Sensor Networks (WSNs) are critical components of the increasingly common IOT (Internet of Things) systems. Such systems have a large applicability, and the environmental monitoring field can also benefit from their innovation.

The purpose of the IOT concept is to transform the real world and every day electronic devices, appliances, etc., into intelligent interconnected virtual objects. By keeping

the user informed on the state of things and giving the users control of things, a better global humans-devices-humans communication can be achieved.

The Forest monitoring system has been developed to provide a monitoring and communication solution for forest protection. Each Sea Forest unit is built with a series of sensors that monitor environmental parameters, a processing unit, and a protective case. Data acquired by the system, and subsequently processed, is sent to a dedicated server. Using a desktop, laptop or smart phone devices, the user is informed in real-time about the possible occurrence of dangerous events that may have a harmful effect on the environment. An artificial intelligence component was developed to identify the noises specific to potential illegal

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deforestation, and to classify the received noises in three classes: chainsaw, vehicle and forest noise.

The same artificial intelligence component can be trained and configured to identify other types of hazards, such as landslide- specific sounds. To alert the user in the event of fire, deforestation, or technical issues related to the drive, an Android notification application has been developed. Section 2 presents a research of similar projects, while in Section 3 the proposed system is described. In Section 4, the fire and deforestation detection methods and results are presented, while Section 5 draws the conclusions and envisions future work.

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The main scope of this project is for betterment of forest and animals life. As we all know that the forest plays a very important role in human life.

II. SYSTEM ARCHITECTURE AND DESIGN

To obtain (correct) predictions from deep neural networks you first need to preprocess your data. In the context of deep learning and image classification, these preprocessing tasks normally involve:

1. Mean subtraction &
2. Scaling by some factor.

21 Capturing Phase

To detect motion we first have to capture live images of the area to be monitored and kept under surveillance. This is done by using camera

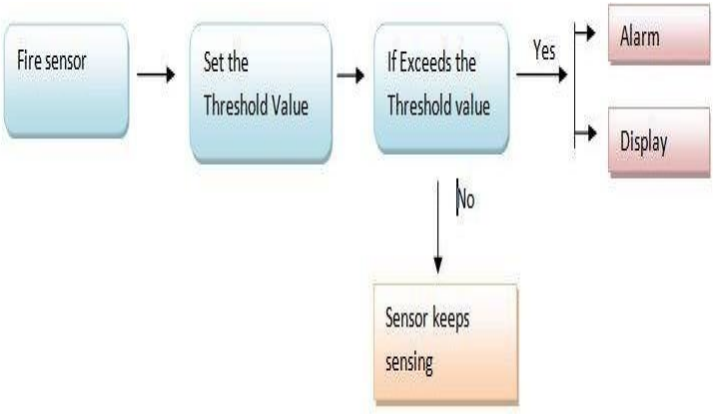

Fig 1: System Architecture for Animal Detection

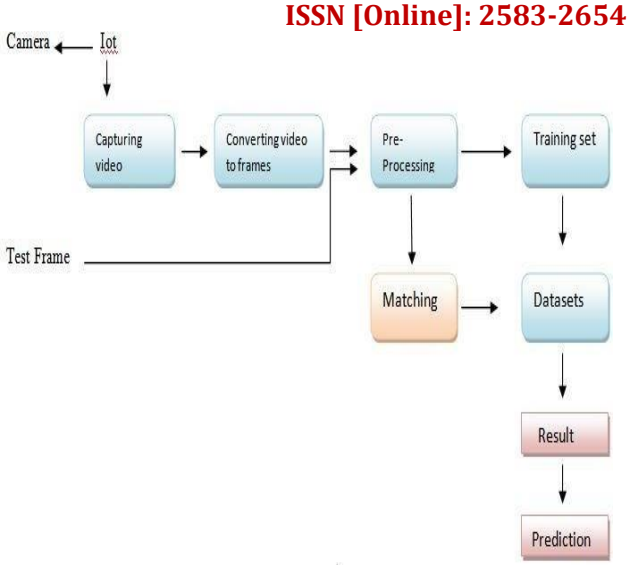

Fig 2: System Architecture for Fire Detection

22 Comparing Phase

Comparing the current frames captured with previous frames to detect motion: for checking whether any motion is present in the live images, we compare the live images being provided by the web cam with each other so that we can detect changes in these frames and hence predict the occurrence of some motion.

23 PRE-PROCESSING

Pre – Processing is heavily dependent on feature extraction method and input image type. Some common methods are :

Denoising applying a Gaussian or simple box filter for denoising, Contrast enhancement: if gray level image is too dark or bright, Down sampling to increase speed, Morphological operations for binary images, Scaling by some factor.

24 Image Segmentation

In the images research and application, images are often only interested in certain parts. These parts are often referred to as goals or foreground (as other parts of the background). In order to identify and analyze the target in the image, we need to isolate them from the image. The image segmentation refers to the image is divided into regions, each

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with characteristics and to extract the target of interest in the process.

The image segmentation used in this is a threshold segmentation. To put it simply, the threshold of the grey scale image segmentation is to identify a range in the image of the compared with the threshold and accordingly to the results to the corresponding pixel is divided into two categories, the foreground and background. Threshold segmentation has two main steps:

1. Determine the threshold T
2. Pixel value will be compared with the

threshold value T In the above steps to determine the threshold value is the most critical step in partition. In the threshold selection, there is a best threshold based on different goals of image segmentation. If we can determine an appropriate threshold, we can correct the image for segmentation.

III. ALGORITHM

In this method, deep convolution neural network based classification algorithm is devised to detect animals both in video and images. Proposed approach is a classification model based on different features and classifiers. The different features like color, features and body shape are extracted from the segmented animal images.

Possibilities of fusing the features for improving the performance of the classification have also been explored. Classification of animals is accomplished using CNN and symbolic classifiers. Initially, features are extracted from images/frames pre-trained convolution neural network. Later the extracted features are fed into multi-class CNN classifier for the purpose of classification.

3.1 Algorithm Architecture

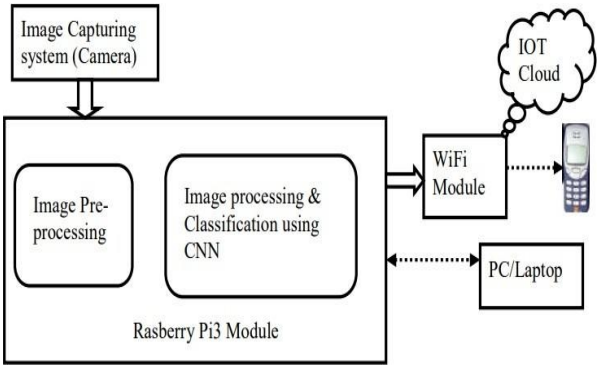

Fig 3.1 : Algorithm Architecture for animal detection

From the above figure (3.1) we will be explaining about feature extraction and its classification as follows:

3.1.1 Image Capturing System

High resolution video camera is used for capturing the image of animals in the background of nature. Both image and video pictures are able to capture and send the signals to the hardware system. Specifications and features of the camera are 1). 16MP interpolated Resolution 2).High quality CMOS sensor 3). Clear, sharp still picture & motion video 4).Support external microphone 5).

Auto white balance & exposure 6). Adjustable lens 7). 640×480;
352×288; 320×240; 176×144; 160×120; image

resolution Frame rate upto 30 Fps 8). AC power frequency: 50Hz, 60Hz 9). Focus distance: 4cm~infinity and 10). USB 2.0 I/O interface.

3.1.2 Image Processing System

The captured signals from the camera are processed in given sequence to detect the type of animals. Output signal from the camera is not suitable to process and hence the signals are allowed to pass through pre- processing system. Then the image signals are processed in deep convolution neural network based algorithm residing in raspberry pi hardware system.

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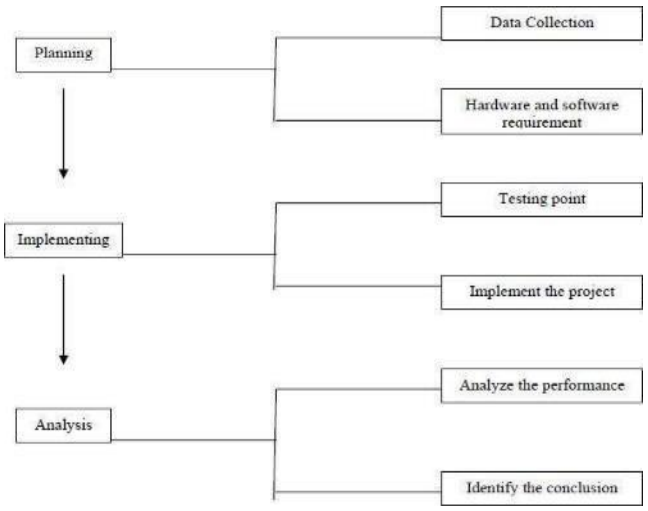
IV METHODOLOGY

Methodology is a collection of methods, practices, processes, techniques, procedures, and rules. It is contextual framework for research, a coherent and logical scheme based on views, believes and values, that guides the choices researchers or other users make.

There are generally three major steps as shown in the below figure (4.1):

Fig 4.1: Steps of Methodology



Planning Implementig Analysis

4.1 PLANNING

To identify all the information and requirement such as hardware and software, planning must be done in the proper manner. The planning phase has two main elements namely data collection and the requirements of hardware and the software as discussed above.

4.2 DATA COLLECTION

Machine learning needs two things to work, data (lots of it) and models. When acquiring the data, be sure to have enough features (aspect of data that can help for a prediction, like the surface of the house to predict its price) populated to train correctly your learning model. In general, the more data you have the better so make to come with enough rows.

The primary data collected from the online sources remains in the raw form of statements, digits and qualitative terms. The raw data contains error, omissions and inconsistencies. It requires corrections after careful scrutinizing the completed questionnaires.

The following steps are involved in the processing of primary data. A huge volume of raw data collected through field survey needs to be grouped for similar details of individual responses. Data Pre-processing is a technique that is used to convert the raw data into a clean data set. In other words, whenever the data is gathered from different sources it is collected in raw format which is not feasible for the analysis.

Therefore, certain steps are executed to convert the data into a small clean data set. This technique is performed before the execution of Iterative Analysis. The set of steps is known as Data Pre-processing. It includes –

Data Cleaning

Data Integration
Data Transformation

Data Reduction

Data Preprocessing is necessary because of the presence of unformatted real-world data. Mostly real-world data is composed of –

Inaccurate data (missing data) – There are many reasons for missing data such as data is not continuously collected, a mistake in data entry, technical problems with biometric and much more.

The presence of noisy data (erroneous data and outliers) - The reasons for the existence of noisy data could be a technological problem of gadget that gathers data, a human mistake during data entry and much more.

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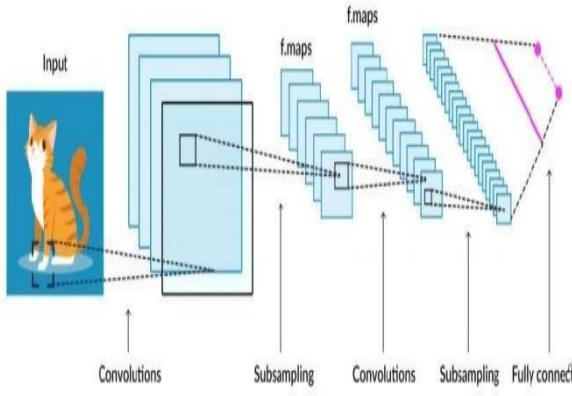
Inconsistent data - The presence of inconsistencies are due to the reasons such that existence of duplication within data, human data entry, containing mistakes in codes or names, i.e. violation of data constraints and much more.

4.3 IMPLEMENTION

The project takes shape during the implementation phase. This phase involves the construction of the actual project result. Programmers are occupied with encoding, designers are involved in developing graphic material, the actual reorganisation takes place.

4.3.1 CONVOLUTIONAL NEURAL NETWORK

A convolutional neural network (CNN) is a subset of artificial neural networks which uses perceptron, a machine learning algorithm for supervised learning to analyze large amount of data. CNNs can be used for image processing and natural language processing (NLP) applications and any kind of cognitive tasks. A convolutional neural network (CNN) has an input layer, an output layer and many



numbers of hidden layers. Few of these layers are convolved, using mathematical models to carry on results to succeeding layers.

Fig 4. 3.1: Architecture of CNN of Animal detectionInput image will have the raw pixel values of color channels Red, Green, Blue.

a) The next layer is called, CONV layer. This layer will calculate the output of neurons that are connected to local regions to the input layer. Each calculates a point product between their weights and a small area connected to the input layer.

b) The next layer is called the POOL layer, which performs down sampling operation along the spatial dimensions (width and height) resulting in size such as [16x16x12].

c) Last layer is FC (i.e. fully-connected) layer; this layer will calculate the class scores, resulting in volume of size. Like traditional Neural Networks, each neuron in this layer is connected to all the weights in the previous set.

- **Convolutional Layer**

The Convolution layer is used as first layer of CNN made up of learnable filters placed spatially along width and height of input layer. Convolution is processed by sliding every filter across height and width of the input volume and calculate dot product of filter coefficient and input at any position.

While doing so for entire input volume, two dimensional activation amp is generated which is response from the filter at each position. Intuitively, a separate 2D activation map will be generated for each filter. At the end, all the entire activation map are put together and considered as the output of convolution layer.

- **Pooling Layer**

Pooling layers are helpful to decrease the quantity of parameters when the size of image is huge. Max pooling is applied where the greatest element is considered from the feature map. Dimension of the image is reduced by down sampling technique. Usually filter size of 2x2 is applied for pooling over both height and width and dimension is reduced by 75% while 25% is retained.

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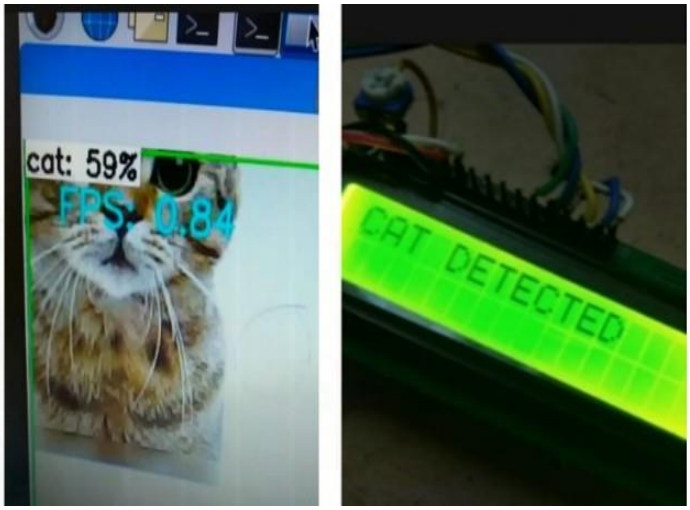
- **Fully connected layer**

Fully Connected Layers are specific type of hidden layer which must be used within the CNN. This is used to combine the features into more attributes that predict the output more accurately. In fully connected layer all the neurons are connected with previous layer. This is similar to conventional neural network. Matrix multiplication is applied to determine the activation of neurons.

V RESULT AND ANALYSIS

A result is the final consequence of actions or events expressed qualitatively or quantitatively. Performance analysis is an operational analysis, is a set of basic quantitative relationship between the performance quantities.

5.1 SCREENSHOTS



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VI CONCLUSION

The system designed shown in the block diagram performs the detection and counting of the Wild Animals. The raspberry pi is used to make the system portable and affordable by both small scale and large scale livestock producers. The existing systems like

bar code scanners and manually counting of livestock is not beneficial as it consumes a lot of time and the error margin becomes high so to overcome such hurdles we have designed a real time systemthat performs such a task with efficiency and is cost effective. More Precise sensors can be deployed. A sub server unit can be used in between the transmitter unit and main receiver unit to make the whole process take comparatively less time to alert the forest officer to take preventive action.

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