JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Innovative Approach to Protect Crops Using Deep Learning

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Abstract— **Farmers face a huge number of issues, for example, insufficiency of water for irrigation, crops withering because of climatic changes, soils lacking in nutrients, and harm to crops because of pests and wildlife. In any case, the protection of farm wild creatures has not been adequately tended to till now. Elephants, monkeys, wild boars, etc. cause serious damage to the fields. The productivity is decreased by the wild creatures trampling over harvests and eating them. This project provides a solution for these problems without hurting creatures or setting human life at stake. In this project, we use Raspberry Pi to protect the farmland from animals. Farmland intrusions are detected utilizing PIR sensors and photos are taken utilizing a Pi camera. Classification of the intruded animals as local or wild animals is done using the photos taken utilizing a Convolutional Neural Network. CNN a special architecture of artificial neural networks model is mainly used for the classification of images. After classification is done accordingly, sounds are used to ward off the creature, and an Email is sent to the landowner on account of the wild creature. Data regarding these intrusions of wild and domestic creatures are sent to the cloud by means of the web. This way it is easy to arrive at useful information regarding the intrusions and take action against them.**

Keywords— **Image Classification, Convolution Neural Networks, Image Processing, Raspberry Pi, IR Sensors, Pi Camera**

I. INTRODUCTION

In relevance and research towards the topic of Smart Crop Protection using Deep Learning Approach, this review contains a detailed study of various smart crop protection system and discuss the various technologies used, various features, and limitations of smart crop protection technique. As this literature reviews aims to bring a clear understanding of previous smart crop protection techniques and we are using previously proposed theories for the purpose of learning and for better understating of the environment around the system. This survey research will summarize the various research approaches and the results obtained from the various systems and by studying this we will try to improve and will aim to meet the objectives of the system.

II. LITERATURE SURVEY

In this paper the remote monitoring of the Long-tailed Ducks which is an Artic species and in recent years is considered an endangered species, was proposed by means of a WSN with fixed sensors placed in large areas and in polar regions, that turn ON and OFF in order to reduce energy consumption and effectively detect the animal. A mathematical model was established to calculate the success detection probability, based on a Discrete Time Markov Chain developed and numerically solved. To this end, we proposed two main approximations to make the model tractable: First, a random walk based model is derived considering phase-type distributions that closely match the real animal's trajectories. This approximation allows the use of Markovian models in future

research works in the area. Second, a single sensor approach is used in order to consider only the activity of one node instead of all nodes in the system. This single sensor approximation, also allows the model to easily scale with the number of nodes. This approximation also closely matches results from the complete network perspective. These approximations were validated by comparing to extensive simulation results. It is important to note that the single sensor approximation provides very accurate results. [1]

Compared to the previous fencing systems, Smart fencing system gives us a wider range of accessibility and increased invulnerability to the external agents. At the same time the ability to control the voltage passing through the fence increases results in less causalities while farming to humans and farm animals. The sensor and buzzer combo act as an own brain scare crow that will ward off any birds swooping down to grab a bite on the crop. The future holds a possibility in the development of this project. The fencing voltage can be dropped to 110 Volts and can be used so that it is more humane in approach to wild animals. More than one Raspberry Pi can be connected to one another using Master Slave mechanism enabling us to cover a large field area and to protect it. [2]

In this paper, we presented an integrative approach in the field of Internet of Things for smart Agriculture based on low power devices and open source systems. The goal of this work is to provide a repelling and monitoring system for crop protection against animal attacks and weather conditions. In our future work, we will extend the current functionalities of our system and investigate the chance of incorporating the features of our system to other sectors. [3]

This paper makes the research on the invasion of human and animal. Firstly, the collected signal is reconstructed to the phase space, the source signal is mapped to the phase space to show its characteristics, and then automatic feature extraction of CNN is used to find out the difference between the different intrusions species. Finally, the characteristics are automatically found out and put into the different classifiers to realize intrusion detection. Experimental results show that the method proposed in this paper can detect human and animal invasion very effectively and improve the accuracy of detection by nearly 16% compared to the traditional manual extraction. At the end of this article, we also do some invasive experiments on different animals. The same method can distinguish different dogs and sheep, but the traditional methods of artificial extraction can hardly distinguish different animals. [4]

Deep Learning has emerged as a new area in machine learning and is applied to a number of signal and image applications. The main purpose of the work presented in this paper, is to apply the concept of a Deep Learning algorithm namely, Convolutional neural networks (CNN) in image classification. The algorithm is tested on various standard datasets, like remote sensing data of aerial images (UC Merced Land Use Dataset) and scene images from SUN database. The performance of the algorithm is evaluated based on the quality metric known as Mean Squared Error (MSE) and classification accuracy. The graphical representation of the experimental results is given on the basis of MSE against the number of training epochs. The experimental result analysis based on the quality metrics and the graphical representation proves that the algorithm (CNN) gives fairly good classification accuracy for all the tested datasets. [5]

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In this paper, here we propose automatic crop protection system from animals. This is a microcontroller-based system using PIC family microcontroller. These systems use a motion sensor to detect wild animal approaching near the field. In such a case the sensor signal the microcontroller to take action. Traditional methods used by farmers are given below. The problem of crop vandalization by wild animals and fire has become a major social problem in current time. It requires urgent attention as no effective solution exists till date for this problem. Thus, this project carries a great social relevance as it aims to address this problem. This project will help farmers in protecting their orchards and fields and save them from significant financial losses and will save them from the unproductive efforts that they endure for the protection their fields. This will also help them in achieving better crop yields thus leading to their economic wellbeing. [7]

Here in this paper proposed automatic crop protection system from animals. This is a microcontroller based system using PIC family microcontroller. This system uses a motion sensor to detect wild animals approaching near the field. In such a case the sensor signals the microcontroller to take action. The microcontroller now sounds an alarm to woo the animals away from the field as well as sends SMS to the farmer so that he may know about the issue and come to the spot in case the animals don't turn away by the alarm. This ensures complete safety of crops from animals thus protecting the farmer's loss. We have designed a system in which sound is played and by using LDR it detects light intensity, if it is less, it will focus the light. So that wild animals will not enter into the farm. It will run away. GSM module sends message to the farmer to alert him. From this it is concluded that the design system is very useful and affordable to the farmer. The design system will not be dangerous to animal and human being, and it protects farm. [8]

Crops in the farms are many times devastated by the wild as well as domestic animals and low productivity of crops is one of the reasons for this. It is not possible to stay 24 hours in the farm to sentinel the crops. So to surmount this issue an automated perspicacious crop aegis system is proposed utilizing Internet of Things (IOT). The system consists of esp8266 (nodeMCU), soil moisture sensor, dihydrogen monoxide sensor, GPRS and GSM module, servo motor, dihydrogen monoxide pump, etc. to obtain the required output. As soon as any kineticism is detected the system will engender an alarm to be taken and the lights will glow up implemented at every corner of the farm. This will not harm any animal and the crops will stay forfended. [9]
The proposed system, Crop monitoring is done where sensors are used to collect information in the agricultural field. In our proposed work, PIR, Smoke sensor and GSM is used. When animals come near to the PIR sensor and it detects the animal movement. After getting that initial input signal, it is passed for further processing. Then it will be given to the microcontroller. Our system will be activated, immediately buzzer will be on, at the same time it sends an SMS and makes call to the owner. Microcontroller Block is used for reading the inputs from PIR and Smoke sensor. Whole process is controlled by microcontroller. The GSM module is used for sending SMS and making call to farmer when movement or smoke is detected. It also turns ON the motor, when smoke is detected. It alerts the farmer that some animals try to enter into the farm. Our LCD data will be display for SMS sending. [10]

III. HARDWARE CONNECTIONS

The main components of this Innovative approach to smart crop protection using deep learning are the following:

A. RASPBERRY PI

The Raspberry Pi 3 is equipped with a quad-core 64-bit Broadcom BCM2837 ARM Cortex-A53 SoC processor running at 1.2 GHz, making it about **50% more powerful than the Pi 2.** This means the new Raspberry Pi 3 can be used for office applications and web browsing.
The great innovation in this third version is undoubtedly the addition of a **WiFi** chip and **Bluetooth** Low Energy. This not only saves space (you no longer need to connect WiFi and Bluetooth dongles) but also frees up more USB ports for connecting other devices.
By adding these two features, Raspberry Pi has made it clear that this new version is geared toward the **Internet of Things (IoT)** and **home automation**. The Raspberry Pi 3 is also compatible with **Windows 10 IoT Core**, an operating system designed for creating and developing applications destined for home automation, robotics, and connected objects.

B. IR SENSOR

PIR sensor is used for add-on protection which is used to detect the animals through their body heat. The range of PIR sensor is up to 10m. / 32 feet. PIR sensors are used in thermal sensing applications, such as security and motion detection. They are commonly used in security alarms, motion detection alarms, and automatic lighting applications.

C. BUZZER

The speaker / Buzzer is triggered along with the fog machine, which needs input 5V, and the minimum sound output will be 85 dB.

The PIR sensor acts as a trigger to the camera which captures the image of the intruded animal when motion detection is sensed. This image is then classified using the model created and a sound is generated to ward off if the animal detected is a wild animal. An alert Email is sent to the owner about the intrusion of wild animals and the data is sent into the cloud for statistics.

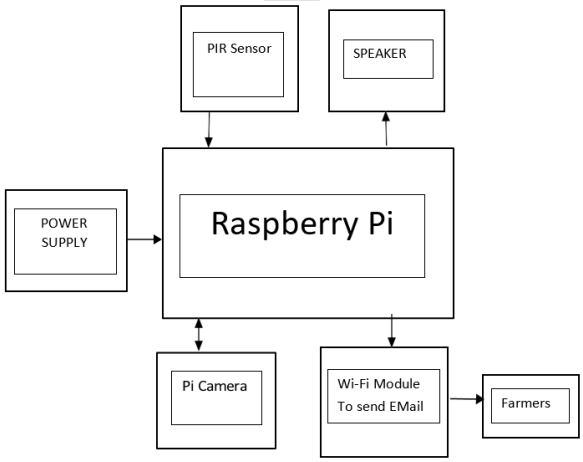

Fig. 1. Block diagram of Innovative approach to protect crops using deep learning

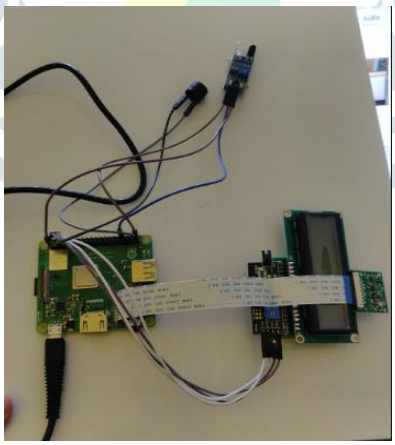

Fig. 2. Hardware connections with Raspberry PI

IV. METHODOLOGIES

A. ARCHITECTURE

The prototype gives a trigger when there is motion detection, captures an image, and is classified. Then an alert is given if there is a wild animal intrusion. Once the intrusion had been detected using PIR sensors, the camera was triggered to capture an image. The harvests are harmed by two sorts of animals which would be elephants and dogs. Hence, the dataset which consisted of 1000 pictures of these both animals, was used as a development set for CNN.

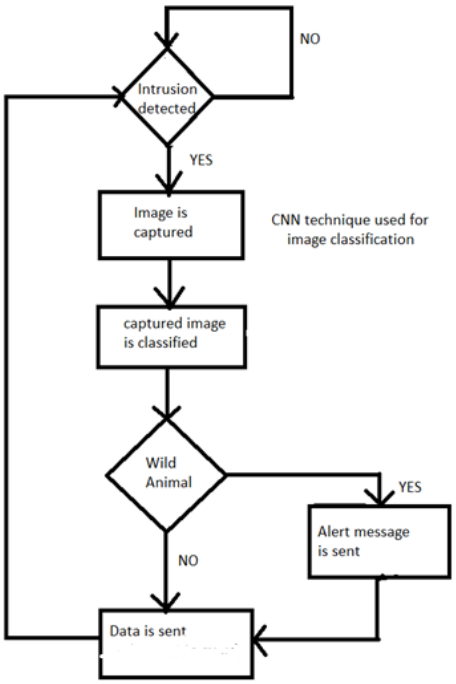

Fig. 3. Flow chart of Innovative approach to protect crops using deep learning

The CNN was tested with various test images including images taken by mobile cameras and also by the Pi camera. CNN was able to classify more than 90% of the images. The testing accuracy of the system is more than 90%. Depending on the classification, the ward-off system was activated to play the appropriate sound using a Bluetooth audio system. On detection of the animal under the class wild animals, a monophonic sound of a siren was played, and an alert message was sent and received immediately. Two variables representing the two classes were created and updated in the cloud once the ward-off system was activated. When an animal corresponding to a particular class has intruded, the corresponding variable was stored with the value "1" and the other variable was stored with the value "0" in Ubidots. Since the message and details of the intrusion were sent over the internet, the Raspberry Pi should be connected to the internet via Wi-Fi. For the prototype version, Soft toys were used and for real-time implementation, a pi camera was used to capture the images of elephants and dogs. Both the images of soft toys and real-time images were perfectly classified by the system.

B. SOFTWARE IMPLEMENTATION

Python with OpenCV :

Python is a programming language that supports the creation of a wide range of applications. Developers regard it as a great choice for Artificial Intelligence (AI), Machine Learning, and Deep Learning projects. It has a huge number of libraries and frameworks. The Python language comes with many libraries and frameworks that make coding easy. This also saves a significant amount of time. OpenCV-Python is a library of Python bindings designed to solve computer vision problems. Python is a general purpose programming language started by Guido van Rossum that became very popular very quickly, mainly because of its simplicity and code readability. OpenCV is a huge open-source library for computer vision, machine learning, and image processing. OpenCV supports a wide variety of programming languages like Python, C++, Java, etc. It can process images and videos to identify objects,

faces, or even the handwriting of a human. When it is integrated with various libraries, such as Numpy which is a highly optimized library for numerical operations, then the number of weapons increases in your Arsenal i.e whatever operations one can do in Numpy can be combined with OpenCV. This OpenCV tutorial will help you learn the Image-processing from Basics to Advance, like operations on Images, Videos using a huge set of Opencv-programs and projects.

Proteus 8 Professional:

Proteus is used to simulate, design, and drawing of electronic circuits. It was invented by Labcenter Electronics. By using proteus you can make two-dimensional circuits designs as well. With the use of this engineering software, you can construct and simulate different electrical and electronic circuits on your personal computers or laptops.

V. RESULTS

Once the animals had been detected using Pi Camera while sensing its temperature by PIR sensor, the camera was triggered to capture an image. The harvest are harmed through any sorts of animals. It can be Cow, Horse, dog, Elephant, etc. Hence, the dataset which consisted of 1000 pictures of wild animals, was used as a development set for CNN. The CNN was tested testes with various test images including images taken by laptop camera and pi camera. The testing accuracy of the system is more than 90%. Depending on the classification, the ward off system was activated to play the appropriate sound using alarm. On detection of animal under the class wild animals, an alert message was sent and was received immediately. Two variables representing the two classes were created and updated in the cloud once the ward off system was activated. When an animal corresponding to a particular class has intruded, the corresponding variable was stored with the value '1' and the other variable was stored with value '0' in test pin of PIR sensors.

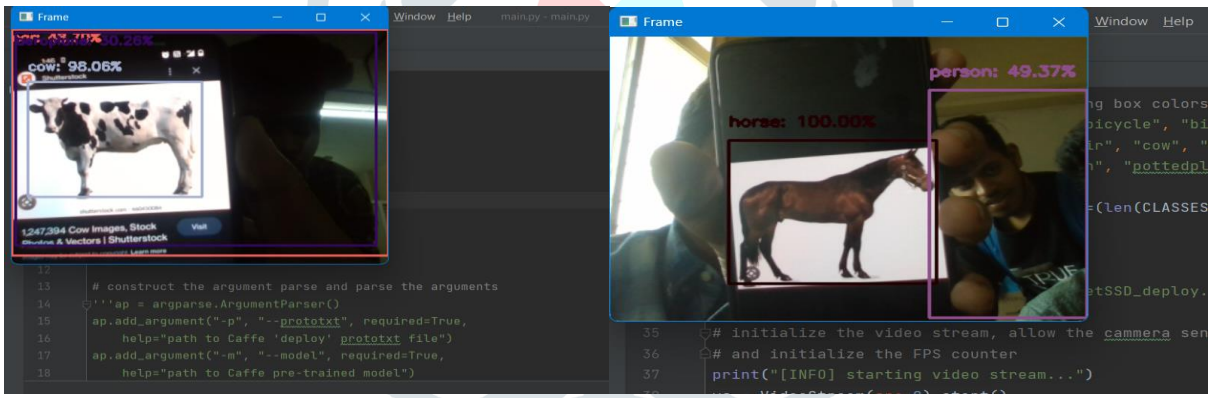

Fig. 4. Results

VI. CONCLUSIONS

The problem of damaging crops by wild animals has become a major social problem at the current time. It requires urgent attention and an effective solution. The proposed system based on Raspberry Pi is found to be more compact, user friendly, and less complex, which can readily be used in order to perform. In this project, the process is fully automated and it does not cause any hurt to animals during repellent. This method will be definitely beneficial for the farmers in terms of driving away the animals from the field, without hurting the animals physically.

VII. ACKNOWLEDGMENT

We want to specially thank our respected internal guide Prof. B. A. Patil for her guidance and encouragement which has helped us to achieve our goal. Her valuable advice helped us to complete our project successfully. Our Head of Department Dr .S .K. Jagtap has also been very helpful and we appreciate the support she provided us. We would like to convey our gratitude to Principal, Dr. A. V. Deshpande, and all the teaching and non-teaching staff members of the E&TC Engineering Department, our friends, and families for their valuable suggestions and support.

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