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Forest Monitoring System with Virtual Fencing

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Abstract: Wildlife observation is one of the most challenging jobs in the world. The major challenge arises in security and safe guarding of the forest. The objective of this paper is to make an autonomous system for wildlife observation which would easily capture and transfer the picture based on IoT platform. Virtual fencing is an active electronic protection system that prevents animals from crossing the borders of forest and further entering the city roads. Virtual fencing device is activated causing it to emit sound and/or light stimuli which alert, repel and prevent animals from restricted areas. The system will provide alerts on website in terms of messages of spotting wild animals and would also notify the proximity of the animal from human habitat which makes it one of its kinds to help out warning natives residing alongside the forest and also avoiding animal road accidents. It has been found in a survey that 80% losses caused due to forest fire would have been avoided if the fire was detected immediately. Whenever the fire occurs our system would automatically sense and alert the user by sending an alert to webpage accessible through internet.

Keywords: Forest monitoring, IOT, Deforestation, Web Server, Local website

I. INTRODUCTION

Virtual fencing is a method of controlling animals without ground-based fencing. Control occurs by altering an animal's behaviour through one or more sensory cues administered to the animal after it has attempted to penetrate an electronically-generated boundary. This boundary can be of any geometrical shape, and unseen by the human eye. The first commercial virtual fencing system was patented in 1973 for controlling domestic dogs. Virtual fencing was used for the first time to control livestock in 1987. Since then proof-of-concept research using commercial, as well as custom designed systems have demonstrated that virtual fencing can successfully hold as well as move livestock over the landscape. Commercial virtual livestock control systems do not yet exist but research continues towards this goal. Globally, every 20 minutes 1200 acres of forest are destroyed. Forest degradation is characterized by a reduction in forest quality and biomass by an opening up of a canopy. Global deforestation sharply accelerated around 1852. It has been estimated that about half of the Earth's mature tropical forests—between 7.5 million and 8 million km2 (2.9 million to 3 million sq. mi) of the original 15 million to 16 million km2 (5.8 million to 6.2 million sq. mi) that until 1947 covered the planet—have now been destroyed. Systematic aerial photography was developed for military surveillance and reconnaissance purposes beginning in World War I and reaching a climax during the Cold War with the use of modified combat aircraft. The development of artificial satellites in the latter half of the 20th century allowed remote sensing to progress to a global scale as of the end of the Cold War. The havoc due to forest fire has caused serious environmental problems and devastation of flora and fauna. Within the current turbulent global economic, demographic, social and ecologic context, governments, local administrative authorities, researchers and commercial companies or even individuals have to recognize the importance of the resources contained in the forest environment – not only from the perspective of the biodiversity, but also from the point of view of the economic resources which forests enclose. Therefore, any major threat posed to this essential component of the environment should be identified, studied and fought through the most efficient and modern economic policies and technological means. One of the most dangerous phenomena, which jeopardize forests, is represented by forest fires. A forest fire is any form of unrestrained fire that erupts in a forested area. Forest fires have proven to be a massive form of destruction for humankind, especially when not countered through appropriate measures and strategies. Therefore, an IoT-based Forest fire detection system is proposed to detect the fire by monitoring the flame. Whenever fire triggered, it burns objects nearby and produces smoke. Buzzer connected to Arduino gives us an alarm indication. With the help of IoT technology, In this paper we have made it smarter by connecting the whole monitoring process to the webpage and implemented the concepts of image progressing.

A. Objectives and Working Principle

A real-time monitoring control system of Human activities and animal movement in protected areas. Using Deep Neural Network and Artificial Intelligence to implement concept of Virtual fencing in forest areas. Developing sensor networks for Fire detection, temperature monitoring and motion detection. Interfacing Virtual fencing, Forest fire detection system and deforestation system to the local website and obtaining the alert message.

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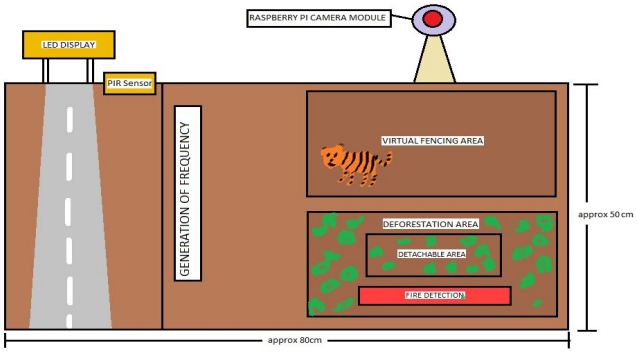

Fig1: Basic Model of forest monitoring

B. Virtual Fencing

The virtual fencing will be implemented in two parts; first is detection of the animals and second is generation of frequency based on detected animal. The human intervention in the forest area is also detected. An area will be defined which will be monitored continuously through a camera module. This camera module is interfaced with raspberry pi. A Database has to be created to compare the captured images with reference images in the database. If the animal moves out of the defined area then the prevention technique will be activated. The prevention technique is generation of irritating frequency. This frequency will be inaudible to humans but will be audible as well as irritating to concerned animals. We particularly have decided to focus on Irritating frequency of wild cat family (tiger, lion, elephants, sheep, Guinea pigs, Giraffe etc.). If by any chance the animal is able to bypass even this arrangement then the next step is accident prevention technique. This structure comprises of a PIR sensor, Ultrasonic sensor and LED interfaced with microprocessor. If the animal crosses the boundary, it will be detected by the PIR sensor. The distance away from the system will be measured by ultrasonic sensor. Once it is detected by the PIR sensor, an animal alert message will be displayed on the LED screen. This screen will be placed along the roads in the vicinity of the forest areas or sanctuaries.

The Raspberry pi with Camera module is used to detect the movements in the forest area. The Raspberry pi is coded in python using the Tensor Flow Image Classifier, Open CV, Num Py based on concepts of deep neural networks more specific convolution neural network with staged pipeline. The trained model will identify the image and the Raspberry Pi will generate the irritating frequency based on detected animal using Astable Multivibrator circuit. The images will be capture using Python curl library and the images of detection of animals, human, objects, birds will be sent using Http Protocol on local website created using Xampp. Xampp is coded using Ajax, Php, MySQL. A PIR sensor is generally known to the world as a motion sensor or motion detector. So, in this we are going to use the **P**assive Infrared Sensor (PIR sensor) to detect movement of animal. If the animal is successful to escape the fencing then the Ultrasonic Sensor will measure the distance of animal away from the actual system. The distance and alert message will be displayed on the LCD using the Arduino Uno board. The purpose of this screen is that when an animal is detected then the LCD screen serves as an alert system for humans driving vehicles along roads or highways near forest areas and sanctuaries.

C. Deforestation Detection

Deforestation detection technique employ image processing. The time interval of capturing images will be relatively larger. The image will be compared with the previous image. If there is any drastic change detected then, a message will be sent to a created website/application. The captured image has to be comprised and converted into a gray scale image. The captured images have to be subtracted from the reference image.

D. Fire Detection

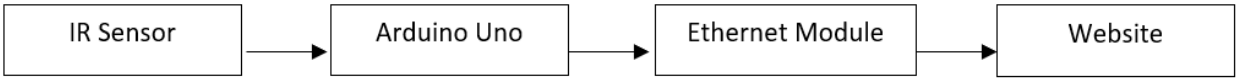

Fig2: Basic Model of fire detection

Flame sensor is used to detect the IR wavelength emitted by the fire. Once detected, the alert system will send message to the website/application.It gives logic 1 as output if flame is detected, otherwise it gives logic 0 as output. Arduino Uno checks the logic level on the output pin of the sensor and performs further tasks such as activating the buzzer and LED, sending an alert message.Flame sensor module has photodiode to detect the light and op-amp to control the sensitivity.Here the Ethernet Connection is set between Arduino and Website using the ENC28J60 Module using Cat5 LAN Cable.
The system is able to detect animals like Cat,Dog, Elephant,Sheep,Giraffe,Bear,Pigs,Horse etc along with Birds and Human Being.

Species	Approximate Range (Hz)
Dog	67-45,000
Cat	45-64,000
Cow	23-35,000
Horse	55-33,500
Sheep	100-30,000
Rabbit	360-42,000
Guinea pig	54-50,000
Hedgehog	250-45,000
Raccoon	100-40,000
Ferret	16-44,000
Opossum	500-64,000
Chinchilla	90-22,800
Elephant	16-12,000
Tiger	20-65000

Table 1: Hearing Frequency Range of Different Animals [1]

II. RESULT

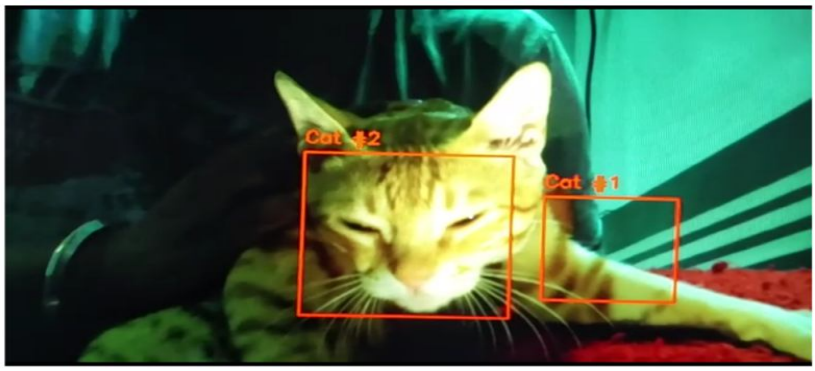

Fig4:Cat detected

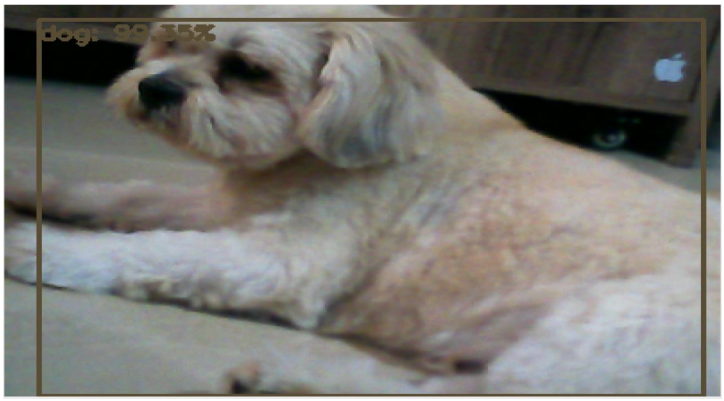

Fig5:Dog detected

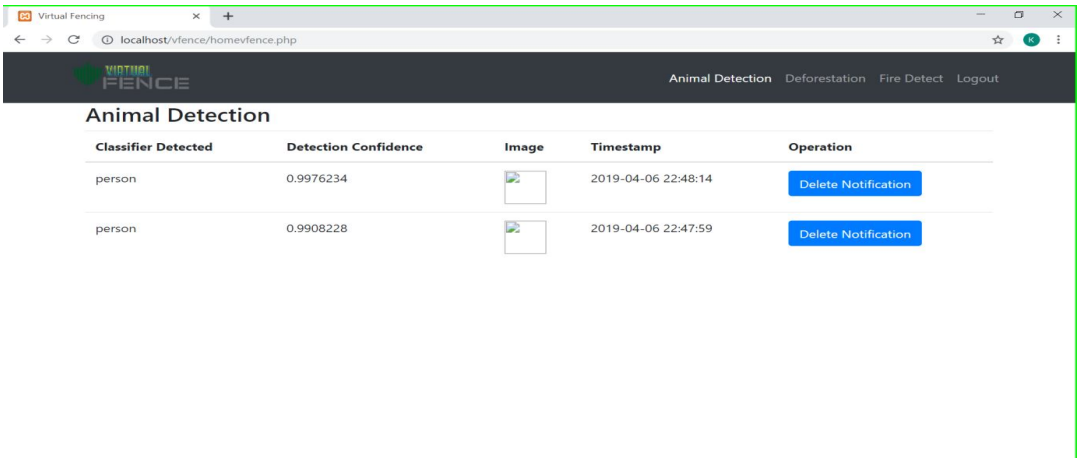

Fig6: Web Page for animal detection

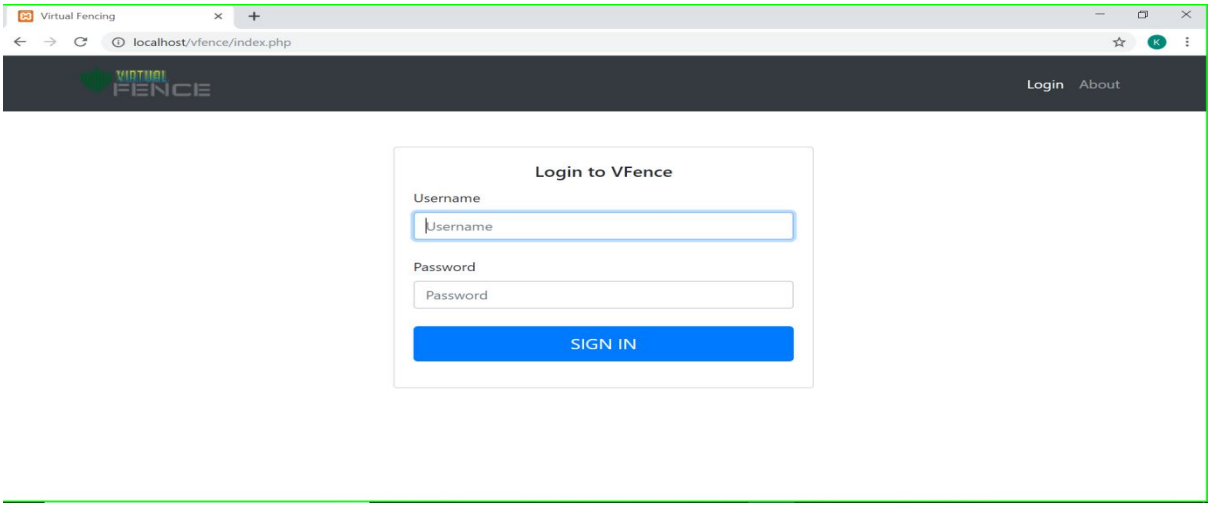

Fig7: Webpage for Login

III.CONCLUSION

With the help of this Forest Monitoring System we can easily monitor wildlife without disturbing its environment and detect the human intervention in restricted areas. This will also help to reduce the rate of mortality of animals due to poaching, hunting and road accidents. It will also help to trigger alarm if animals like Tiger, Lion were spotted near village, and this system will also send its location so we can spot the actual. Live forest monitoring is the best feature implemented in the system. The website is made useful to trace the past data.

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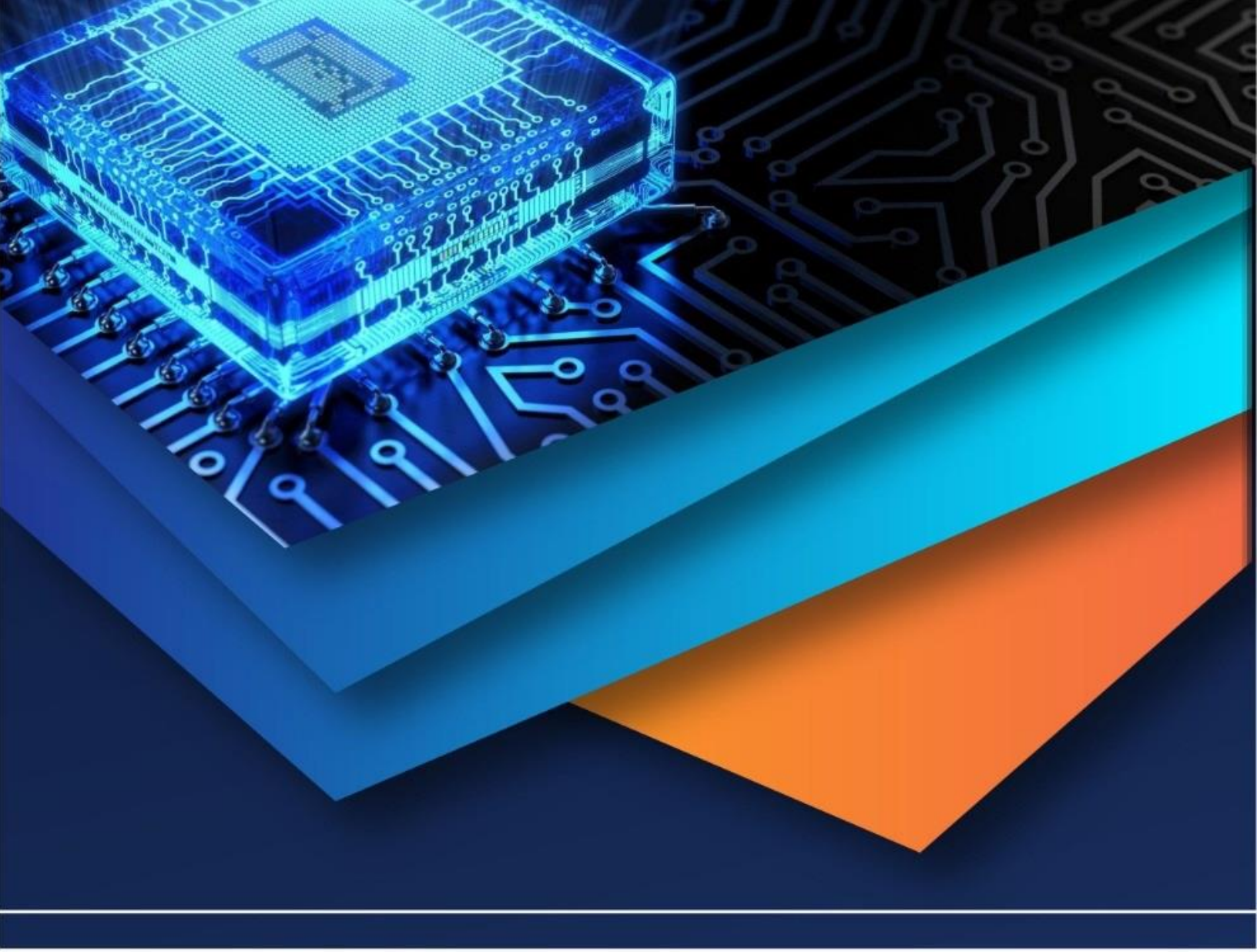

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