International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 12 | December - 2023 SJIF Rating: 8.176 ISSN: 2582-3930

Deep Learning and Internet of Things based Animal Intrusion Prevention System

Mandhara B G[#1], Chandrala P Deshpande[#2], Megha Arun Talekar[#3], Deepthi B S[#4]

[#1]Student, Dept. of Computer Science Engg, SCE
Bangalore-560057, India
mandharagowda@gmail.com

[#2]Student, Dept. of Computer Science Engg, SCE
Bangalore-560057, India
chandraladeshpande237@gmail.com

[#3]Student, Dept. of Computer Science Engg, SCE
Bangalore-560057, India
meghatalekar04@gmail.com

[#4]Student, Dept. of Computer Science Engg, SCE
Bangalore-560057, India
deepthibs03@gmail.com

Under the Guidance of:
Dr. Kamalakshi Naganna
kamalakshinaganna@sapthagiri.edu.in
Professor & Head, Dept. of Computer Science Engg, SCEBangalore-560057, India

***

Abstract: One of the serious problem faced by the farmers all over world especially for the farmers cultivating in the forest regions and in remote areas are unintimated attacks of the animals into the farmland which leads to the destruction of the crops and plantation and overall leads to the loss of production. Sometimes it may also lead to human-animal conflict which is highly dangerous and may harm the lives of either humans or animals. With the latest developments of technologies in Artificial Intelligence and Machine Learning, developing the intelligent model using Neural networks to identity the animals entering the farmland more accurately and then sending some control signals to the microcontroller to produce the loud irritating sound according to the animal identified thereby intruding the animals away from the farmland without the human intervention.

Keywords – Deep Learning, Convolutional Neural Network, Image Processing, Internet of Things, Embedded Software.

I INTRODUCTION

In the recent times due to the modernization and urbanization, the frequency of the unintimated animals attacks over the cultivated land is increasing gradually. This has been a major predicament to the farmers all over the world. Animal attacks leads to various issues like damage to the crops and plantation, loss of the overall production and sometimes it may also lead to loss of life of either humans or animals due to the human-animal conflict. For countries like India, agriculture is the backbone of the economy and more than half of the population depends on the agriculture for their living. Due to the animal attacks there is high percentage of loss in the overall production and thus inturn it affects economy of the country. Traditionally, farmers used to follow some traditional practices for intrusion of the animals from the farmland like wire fencing the cultivated land, bursting the crackers, laying the traps and sometimes hunting the animals entered the farmalnd using poisoned arrow but there are not lethal.

There are many kinds of animals that cause harm to the farmland during the attacks. Elephants, wild Boars, Fox, Raccoons, Deer will cause considerable amount of damage to the crops. Considering few of the animals an intrusion system for animal attacks is designed using the sound sycology of the animals.

Most of the animals scare for the loud irritaing noise like noise of the gunshots or bombing sound. Many of the animals scare for the ultrasonic sounds and few animals have particular irritating sound like for Elephants buzzing sound of bees is irritating. Keping all this in mind, an ecofriendly intrusion system is implemented.

The proposed system is developed using the Deep Learning and Internet of Things by considering all the issues. Generally considering the most common animals that set foot into the farmland like Elephant, wild boar etc. An intelligent model is trained more accurately using dataset of the certain animals.The proposed system detects the animals invading the farmland at multiple locations using the IR sensors placed around the farmland and it captures the images of it. Then the image is fed into an intelligent model as an input to recognize the animal. The system uses Convolutional Neural Network to identify the animal and if the animal is identified by the training model, it sends a control signal to microcontroller. The microcontroller then sends the signal to LED lights to flash over and the buzzer to produce a loud irritating noise accordingly. If the animal is identified as a harmless animal then no signal will be sent to the microcontroller. Once the sensor detects the animal near the farmland it sends a notification to the farmer regarding the intrusion. If any humans enters the farmland then they are identified as humans and no action will be taken.

The proposed system uses cameras, sensors to identify the animals around the farmland and it uses buzzer, LED lights for a mechanism to intrude the animals from the farmland. The system also uses GSM module inorder to notify the farmer with any kind of intrusion through email or message. The system is designed in such a way that it not only provides a real time survelliance but alsoecofriendly. The intrusion mechanism is designed such a way that human intervention is not required and it does not even harm the animals. Neither animals nor humans are affected as there is no chance for human-animal conflict. The system can be trained with as many as animal dataset inorder toidentify the large number of animals andConvolutional Neural Network plays a major role in identifying the animal more preciously and accurately.

i Problem Statement

The need to protect farmlands from animal intrusions that can cause significant losses to crops. Traditional methods of animal intrusion detection, such as manual surveillance and physical barriers, are not always effective, efficient, or cost-effective. Therefore, there is a need for a system that can detect animal intrusions in real-time, accurately identify the type of animal, and trigger an alert to the farmer or farm manager to take appropriate action.
The system should be able to detect animal intrusions in multiple locations across a farmland, which can be a challenge due to the vast area to be covered. Additionally, the system should be able to accurately identify different types of animals, which can be challenging due to the variety of animals that can cause damage to farmlands. The system should also be reliable and easy to use, requiring minimal maintenance.

ii Objectives

The main objective is to design a ecofriendly system that minimize the production loss by protecting the crops from animal attacks without harming their life. Secondly, to detect the intrusion of animals at multiple locations of the farmland. The system should also provide the continuous monitoring of the farmland with the real time alerts and an automatic secured system for repelling the animals away from the farmland. The system should be able to provide accurate detection and identification of animals to avoid false alarms and minimize the risk of damage to crops. Finally The system should be cost-effective and provide a viable solution for intrusion compared to traditional methods.

II LITERATURE REVIEWS

In [1] the proposed method is to protect farms

from wild animals via wired network devices, which is applied to farm along with traditional methods to improve the protection performance. Operational amplifier circuits are utilized here. The wire fence acts as the sensor to detect the animals in the farms. Since cables are used in handling it the physical arrangement becomes very complex and maintenance cost increases.

In [2] the surveillance plays a major role. Here they have used the digital camera to capture the images and runs the image processing algorithms on the captured images to recognize the animals. Then the system notifies the farmer with the message regarding the animal intrusion. In this the major issue is farmer has to have the knowledge of surveillance functionality. Secondly, it requiresthe physical presence of farmer to some extent.

In [3] the proposed work utilizes machine learning technology for detection of wild animals,entering into the field by using deep neural network concept.. In this work, we will monitor the entire farm at regular intervals through camerawhich will be recording the surroundingthroughout the day. A major drawback is that thissystem checks the farmland on basis of a regular time interval. Hence any damage incurred between that interval causes harm to the farmland.In [4], the Animal intrusion detection system is designed to detect the presence of animal and senda warning. In this proposed work we use a combination of PIR and ultrasonic sensors to detect the movement of the animal . And send signal to the controller. It diverts the animal by producing sound and this signal is transmittedfurther to notify the farmers. The PIR sensors havelower sensitivity and less coverage. It does not operate at temperature greater than 35degree C. Itwill have problems in the detection in corner regions. It is insensitive to very slow movements.In [5] a work is proposed to determine a real-time as well as a accurate detection of surface defects by using deep learning technology. Thus , the only Shot MultiBox Detector (SSD) organize were received sice the metastructure joined with the bottom convolution system (CNN) .MobileNet into the MobileNet - SSD . It utilizes a combination of parallel camera, advanced camera, and charge- coupled gadget (CCD) camera to collect target pictures. Extricate includes and sets up a relating scientific models, and to end the MobileNetSSD .Most important part, utilizes a paired camera, computerized camera, a profundity camera, and charge-coupled gadget.

In [6] a method is proposed for the implementation of SSD(Single Shot Detection) . The important job for any object detection algorithm is to make training data sets, approximatelyhaving 500 objects over 450 images. The label image creates a.xml file which contains the detailed information such as location, height, and width about the objects. Before we presenting the labelled dataset SSD generates a TensorFlow which is the base model for MobileNet-SSD. The MobileNet architecture has the MobileNet stored which is employed to cross-train the MobileNet architecture . This processes are often utilized in TensorFlow for object detection.

In [7] a method is proposed on object detection system. The CNN application takes image of leafy foods and organic products in an alternate class and provides nourishment estimate after you take an image of the plate. The application uses the photographs to make the comparison. It provides a stock of things that are present in unit the premier for nourishment. Instead, the known items are listed separately. Example a statement that oranges are round. Object class detection uses these properties and attributes of object. When looking at orange, it states its characteristics like shape, color, texture,size etc.

In [8] the proposed system will detect intrusion of elephants to determine agricultural losses. Multiple types of vibration sensors are used and supported with the number of triggered sensors.

A camera trap acquires a photograph, and Google Vision API is employed to determine whether elephant is accessible. A camera is used that's connected to a Raspberry Pi device that continuously captures images of the location and checks if the pictures contain an elephant. Both of these methods contain deterrence mechanisms, example playing sounds and switching on bright lights to chase away from the approaching elephants.

In [9] the work proposes a method that makes use of the Internet of Things. It assists in the detection of wild animal intrusions in agricultural plots by monitoring the field in order to address this issue. At the field's corners, sensors are used to detect intrusions. A camera photographs the intruder to help with field surveillance. The proposed method only detects the intrusion but does not have the repelling mechanism.

In [10] we have used the motion detection PIR sensor to detect the animal movement near fields and the ANN. After the movement has been detected the object recognition algorithm is run . It recognizes whether the movement was due to any wild animals or other factors. In this proposed work ANN is used which is computationally inefficient. And training parameters become extremely large.

In [11] the proposed method is to detect movements with a combination of various types of sensors. Once any sort of movement is detected the system will activate an alarm to alert and the lights will be glown located at every corner of the farm. This will not harm the wild animals and the crops will also stay protected. In the proposed work it detects every small movements including human beings. It alerts in a similar manner for intrusion by human beings as well.

In [12] the device proposed will works as follows. Once the animal is detected by the PIR motion detection sensor, the Arduino gets activated and an alarm will sound to get rid of animal entering the field .Along with which LED lights will flash and intimate the farmer at the most within 10 seconds of the detection of the animal. The proposed method is implemented with many expensive devices. Also whose maintenance requires the farmer to be educated. And thirdly it is not cost effective for large farmlands.

In [13] the proposal involves animal movement detection in fields using OpenCV and motion detection algorithm. The safety mechanisms are activated once the keyword is spoken. It alerts the voice assistant and thus help is requested by sending messages to people whose information is already provided as input to take possible measures.

In [14] proposed work is capable of detecting different large wild animals from traffic images. Visual data is provided through camera having monocular color vision. It aims to analyze the traffic images, to determine the regions of interest, and to appropriately classify them fordetermining the animals that were on the road . And endangered of an accident. A graph is generated from the traffic using input such asintensity, color, and orientation features. These areas are considered as locations of high importance . A database is generated for wildanimals based on these.

In [15] work proposes an Animal recognition and identification system with deep convolutional neural networks along with CNN for automating the wildlife monitoring. The major problem being for the scientists and the ecologists is to monitor wildlife in an open environment. Leveraging on developments in deep learning technology and computer vision, guidelines are laid for creating an automated animal recognition system.

In [16] work can be implemented only for fenced fields. The system only alerts the farmers but does not take any automated action to drive away the animals. In this the proposed work emphasizes on a Smart Agriculture system that determines to

protect crops from ungulate attacks. And thus to reduce production losses on a large scale. An innovative device is capable of generating ultrasound to drive away ungulates and thus protect crops from their attack. In this proposed work it detects and also repels the animal from causing harm to the farmland, but it drives away only single animal at one time.

III PROPOSED SYSTEM

3.1 ANIMAL DETECTION:

Certain images of various animals would have undergone preprocessing stages like image compression and augmentation like imageresolution, rotation, flipping and cropping for the better identification of the animal by the recognitionmodel. In the proposed system, the sensors willdetect the animal movement near the farmland. Oncethe animal is detected, the camera will be triggered to take the picture of the animal and the bright light glows. The image captured from the camera is received by the classification model which runs Convolutional Neural Network algorithm for the recognizing the animal. Once the animal is recognized. The buzzer in turn produces a loud irritating noise to repel the animal away from the farmland. In the meantime, the system also sends the notification regarding the animal intrusion to thefarmer. In previous work since cables are used in handling it the physical arrangement becomes very complex and maintenance cost increases. In this the major issue is farmer has to have the knowledge of surveillance functionality. Secondly, it requires the physical presence of farmer to some extent. The proposed method only detects the intrusion but doesnot have the repelling mechanism. In this proposed work it detects and also repels the animal from causing harm to the farmland, but it drives away onlysingle animal at one time. The proposed systemdetects the animal intrusion using the various IR Sensors located at various places. And a camera is used to capture the images which are processed using image detection algorithm. Upon detection of wild animal a irritating sound is automatically produced to drive away the animals without harming them. This system saves lot of time and cost , and also need of human is eliminated. The farmer can monitor the field remotely. It works in real time to detect the type of animal's intrusion and count of animal can also be given. This system is eco-friendly which does not cause any harm to human or animals. It requires very low voltage to operate. There is no risk of electric shock. The places where continuous monitoring is required, is provided by this flexible system.

3.2 ARDUINO UNO:

Arduino board is an open source electronic platform designed to make electronics more accessible to potterers, contrivers, artists and any one interested in creating interactive objects or surroundings and a software used to program it. An Arduino board can be bought pre-assembled or, because the tackle design is open source, erected by hand. Either way, druggies can acclimatize the boards to their requirements, as well as update and distribute their own performances. The variety of microprocessors and regulators are used by Arduino board designs use. The colorful expansion boards or Breadboards(securities) and other circuits are equipped with sets of digital and analog input/ affair(I/ O).

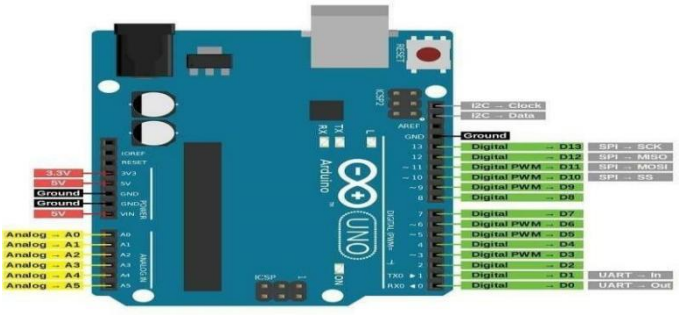

Fig 3.2.1: Arduino Uno board

3.3 IR SENSOR:

An infrared detector is an electronic instrument that's used to smell certain characteristics of its surroundings. Infrared detectors are also able of measuring the heat being emitted by an object and detecting stir. Infrared swells aren't visible to the mortal eye. In the electromagnetic diapason, infrared radiation can be set up between the visible and microwave oven regions. The infrared swells generally have wavelengths between0.75 and 1000µm. The infrared diapason can be resolve into near IR, medial IR and far IR. The near infrared region have wavelength region from 0.75 to 3µm. The mid-infrared region have wavelength regionfrom 3 and 6µm , and the region which has wavelength more than 6µm is known as far infrared.

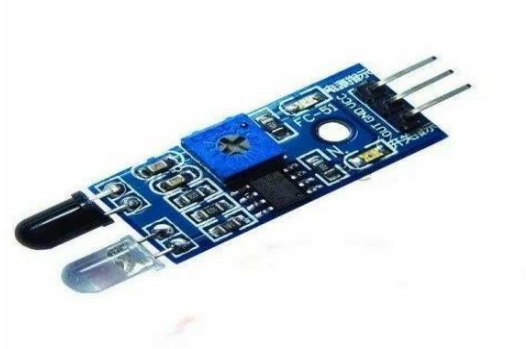

Fig 3.3.1: IR Sensor

3.4 BUZZER:

Buzzer is an electronic device to produce sound. Light weight, simple construction and low price make it usable in colorful operations like auto/ truck reversing index, computers, call bells etc. In 1880 by Jacques and Pierre Curie it was discovered that piezo buzzer is grounded on inverse principle of piezo electricity. It's the marvels of generating electricity when mechanical pressure is applied to certain accoutrements and the vice versa is also true. similar accoutrements are called piezo electric accoutrements . Piezo electric accoutrements are either naturally available or manmade. Piezo electric effect is produced by manmade material called piezoceramic and is extensively used to make slice, the heart of piezo buzzer. When subordinated to an interspersing electric field they stretch or compress, in agreement with the frequency of the signal thereby producing sound. The piezo buzzer produces sound grounded on reverse of the piezoelectric effect. The generation of pressure variation or strain by the operation of electric eventuality across a piezoelectric material is the underpinning principle. These buzzers can be used alert a stoner of an event corresponding to a switching action, counter signal or detector input. They're also used in alarm circuits. It produces harsh sounds irrespective of voltages. It consists of piezo chargers Plagiarised Unique Total Words: 742 Total Characters: 4622 Plagiarized Sentences: 0 Unique Sentences: 39 (100%) 0% 100% Page 1 of 2 between two operators. When a eventuality is applied across these chargers, they push on one captain and pull on the other. This, push and pull action, results in a sound surge. The range of 2 to 4 kHz is produced by most of the buzzers.

Fig 3.4.1: Buzzer

3.5 GSM MODULE:

The GSM system is the most extensively used cellular technology in use in the world moment. It has been a particularly successful cellular phone technology for a variety of reasons including the capability to bat worldwide with the certainty of being suitable to be suitable to operate on GSM networks in exactly the same way- handed billing agreements are in place. The letters GSM firstlystood for the words Groupe Special Mobile, but as it

came clear this cellular technology was being used world-wide the meaning of GSM was changed to Global System for Mobile Dispatches.

Fig 3.5.1: GSM Module

3.6 LED LIGHT:

Generally light dependent resistors and photodiodes are used as light detectors to spark or kill circuits grounded on the presence or absence of light. But a LED can also be used in the place of an LDR or a photodiode. When red LED is in dark the simple circuit switches on a white LED that uses a transparent red LED. Ordinary transparent LEDs serve as light emitters and light sensors. These descry a narrow band of wavelengths of light and their p- n junction forward impulses to induce around 1V voltage with a minute current of0.030 mama when exposed to bright sun. So a transparent LED can also be used as a light detector like a photodiode. LEDs descry a important narrower band of light having peak perceptivity at a wavelength slightly lower than the wavelength these emit.

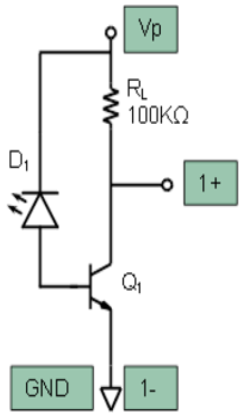

Fig 3.6.1: LED Light

IV WORKING

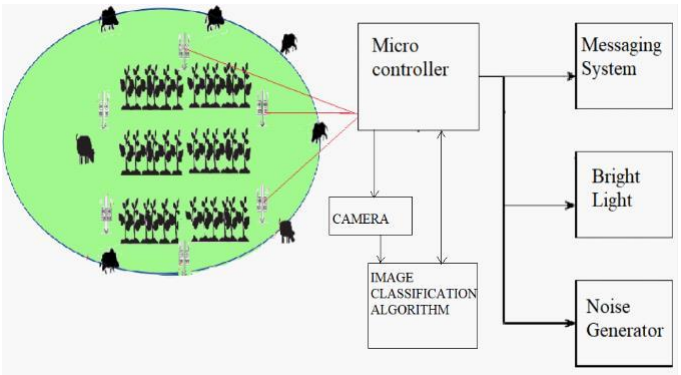

Fig 4.1: Architecture of Animal Intrusion DetectionSystem

The working of an animal intrusion detection system using CNN involves several stages, including data collection, data preprocessing, network architecture design, training, and testing. The IR sensors deployed in the field continuously transmits the Infrared radiations.The transmitted infrared rays interface the intruder and reflects back the radiations. The reflected rays are received by the IR sensors and sends the signal to the microcontroller.The LED light glows when IR detects any intruder.The system uses cameras installed at multiple locations in the farmland to capture images of the surrounding area. The camera will be triggered to capture the images. The captured image will undergo preprocessing stages like image resolution and augmentation.Th

images are also preprocessed to enhance their quality and remove any noise. Here the image is scaled interms of resizing and rotation.The finally scaled image is fed into the recognition system.The scaled image is received by the recognition system.This scaled image is given as an input to Convolutional Neural Network Algorithm.

The input image is converted into the matrix form with values which inturn multiplied by the filter matrix taken from the training data.The output matrix will undergo multiple layers,to detect the different features of an input image.All the above identified features will be connected together in order to identify the image as a wild animal or not. If it is a wild animal, then it sends the signal to the microcontroller.The signal is received by the microcontroller from the image classification system.The microcontroller inturn sends the signal to the Buzzer to produce the irritating noise. The microcontroller also sends the signal to the GSM module to send the message to the farmers.

V RESULTS

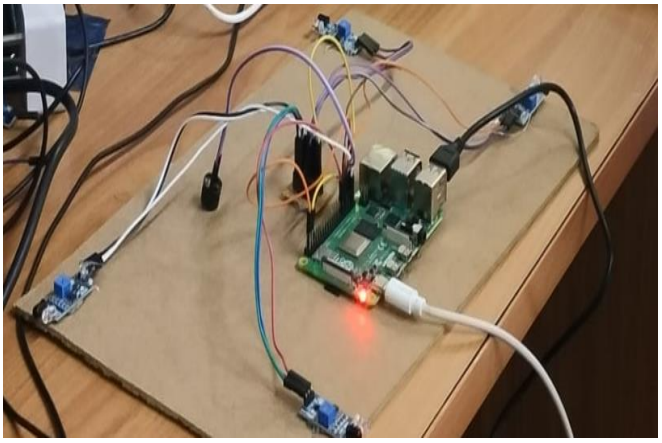

Fig 5.1: The Animal Repulsion System with the Hardware Connection

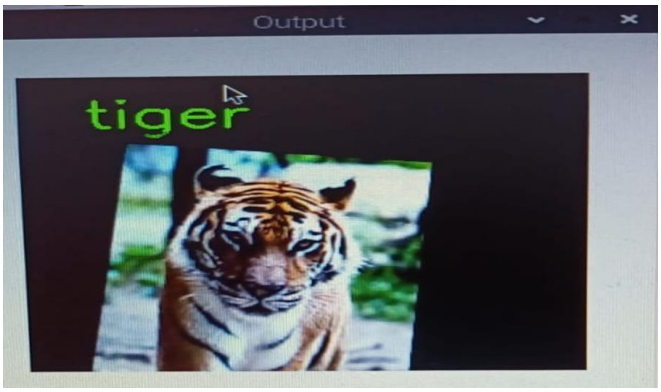

Fig 5.2: The Animal Repulsion System detection Tiger

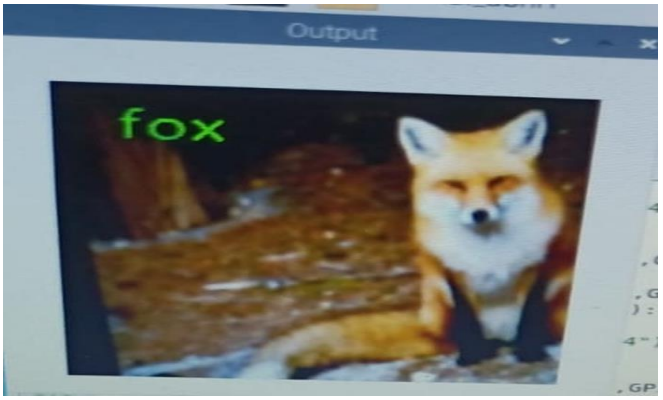

Fig 5.3: The Animal Repulsion System detection Fox

Fig 5.4: The Animal Repulsion System detection Elephant

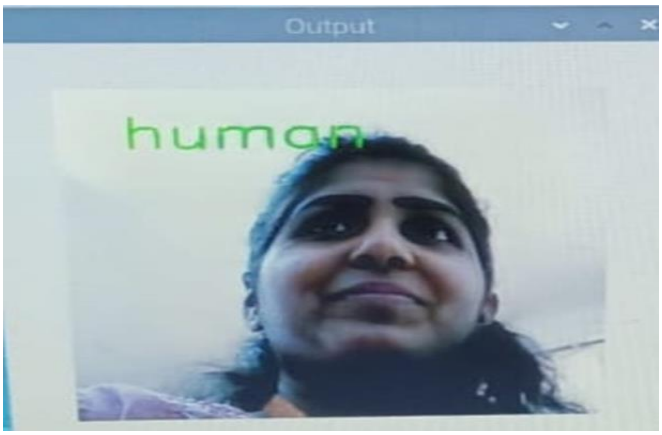

Fig 5.4: The Animal Repulsion System detection human

Vl CONCLUSION

Animal intrusion detection systems using CNNs are an effective tool for detecting and preventing crop damage in farmland. These systems provide farmers with an efficient and reliable means of detecting animal intrusions in real-time, enabling them to take proactive measures to prevent damage to crops. The networks have demonstrated high accuracy in detecting animals in farmland.The datasets used for training and testing these systems are crucial in ensuring their accuracy and effectiveness.In conclusion, animal intrusion detection systems usingCNNs have the potential to revolutionize agriculture and improve economic outcomes for farmers.

VII REFERENCES

[1]. Y. Liu, X. Ma, L. Shu, G. P. Hancke, and A. M.Abu-Mahfouz, ‘‘From industry 4.0 toagriculture 4.0: Current status, enabling technologies, and research challenges,’’ IEEE Trans. Ind. Informat., vol. 17, no. 6, pp. 4322–4334, Jun. 2021.

[2]. K. Kirkpatrick, ‘‘Technologizing agriculture,’’ Commun. ACM, vol. 62, no. 2, pp. 14–16, Jan. 2019.

[3]. M. Apollonio, S. Ciuti, L. Pedrotti, and P. Banti, ‘‘Ungulates and their management in Italy,’’ in European Ungulates and Their Management in the 21th Century. Cambridge, U.K.: CambridgeUniv. Press.

[4]. A. Amici, F. Serrani, C. M. Rossi, and R. Primi,‘‘Increase in crop damage caused bywild boar (Sus scrofa L.): The ‘refuge effect,’’’ AgronomySustain. Develop., vol. 32.

[5]. Jaskó, G., Giosan, I., & Nedevschi, S. September. Animal detection from traffic scenarios supported monocular chromatic vision .In Intelligent Computer Communication andProcessing (ICCP), 2020

[6]. Debojit Biswasa, Hongbo Sua, Chengyi Wangb,Aleksandar Stevanovica, Weimin Wangc, “An automatic traffic density estimation using SingleShot Detection (SSD) and MobileNet-SSD”, pp. 3354–3361, Dec 2020.Tarun, C. “Human Crawl vs Animal Movement and Person with Object ClassificationsUsing CNN for Side view Images from Camera”, International Conference on Advances in Computing, Communications and Informatics.

[7]. Anita Chaudhari, Shraddha More, Sushil Khane,Hemali Mane, Pravin, “Object Detection using Convolutional Neural Network within the Application of Supplementary Nutrition Value of Fruits, International Journal of Innovative Technology and Explore Engineering, vol. 8, pp. 2278-3075, Sep. 2019.

[8]. E. Suganthi, N., Rajathi, N., M, F.I.: Elephant intrusion detection and repulsive system. International Journal of Recent Technology andEngineering 7(4S),307–310 2020

[9]. N. Rantanen and R. Ewing, ‘‘Principles ofultrasound application in animals,’’Vet. Radiol., vol. 22, no. 5, pp. 196–203, Sep. 1981.

[10]. Jeevitha, S., & Vengatesh Kumar, S., “AStudy on Sensor Based Animal Intrusion Alert System Using Image Processing Techniques”.

[11]. J. Wang, M. Shen, L. Liu, Y. Xu, and C. Okinda, ‘‘Recognition and classification of broiler droppings based on deep convolutional neural network,’’ J. Sensors, vol. 2019, pp. 1– 10, Nov. 2019.

[12]. M. O. Ojo, D. Adami, and S. Giordano, ‘‘Network performance evaluation of a LoRa-based IoT system for crop protection against ungulates,’’ in Proc. IEEE 25th Int. Workshop Comput. Aided Modeling Design Commun. Links Netw