BioGecko

Vol 12 Issue 03 2023
ISSN NO: 2230-5807

Protecting Agricultural Lands against Animal Invasion

Sumathi R[1], Eniyan E S[2], Ajay Kumar B[3], Abisheik C K[4]

[1]Professor, Department of EEE, Sri Krishna College of Engineering and Technology, Coimbatore, India

Email: [1]sumathir@skcet.ac.in

Abstract
Animal related crop vandalism is a growing topic of concern nowadays. Farmers lose their cattle, properties and crops when an animal invade the land. Since, surveillance over the fields is necessary. Farmers' time and efforts are being diminished by it. The loss of crops also has an economic impact on them. Conflicts between people and animals continue to endanger lives. Animals experience severe discomfort from techniques like electrocution, which can occasionally result in their demise. There is an increasing need for a reliable animal infiltration prevention system. We create a flawless and adaptable system to enable real-time view of farmlands in response to this issue Farmlands are observed, and when animals are spotted, they are identified using the YOLO algorithm, numbered, and saved in a database that appears to be beneficial to forest authorities, after which the proper repellent is applied depending on the type of invader present. Farmers and forest officials are then sent the geo-locations and images of the encroachment. If animals are discovered after a short while, powerful repellents are used as a backup. The proposed device successfully drives animals away without killing them and reduces human-animal conflict because no human intervention is required.

Keywords: Farmland, Endanger Lives, Surveillance, Anaconda3, YOLO Algorithm, Crop Vandalization.

1. INTRODUCTION

India is mostly a farming nation. India's agriculture industry is crucial. India's agricultural sector has expanded significantly in recent years. Every single person is dependent on agriculture. Simply put, the farmers are struggling to keep animals from damaging their crops. Crop Vandalism occurs as a result, and farmers suffer revenue damage. Huge amounts of resources are lost as a consequence of animal intervention in fields, and human life is also endangered as a result of human-animal conflict [1], [2]. These types of violent confrontations have been on the rise in recent years. Some common methods for protecting crops from animals include the use of agricultural fences such as wire and plastic fences, but these are ineffective. Chemical repellents and fatal toxins are not preferred as they also cause harm to the ecology.

Some people use organic deterrents like beehive fences, which are non-adaptable and pose a substantial hazard to humans. The use of barriers like human-shaped scarecrows are unreliable and not popularly accepted [3], [4]. Electric fencing is a technique that is more popular today for removing animals from farms. Electrocution poses a threat to human life. It is suggested to modify the loss function in a neural network.

The inclusion of a spatial pyramid pooling layer is also included. Combined deep learning categorization with active background displaying to develop a quick and precise method forrecognizing humans and other animals in really messed up camera trap photographs. Foundation modeling is important to provide location suggestions for closure view objects, which are then, identified using the DCNN, leading to improved efficiency and increased accuracy [5]. With all the strategies discussed above, there are still some issues.

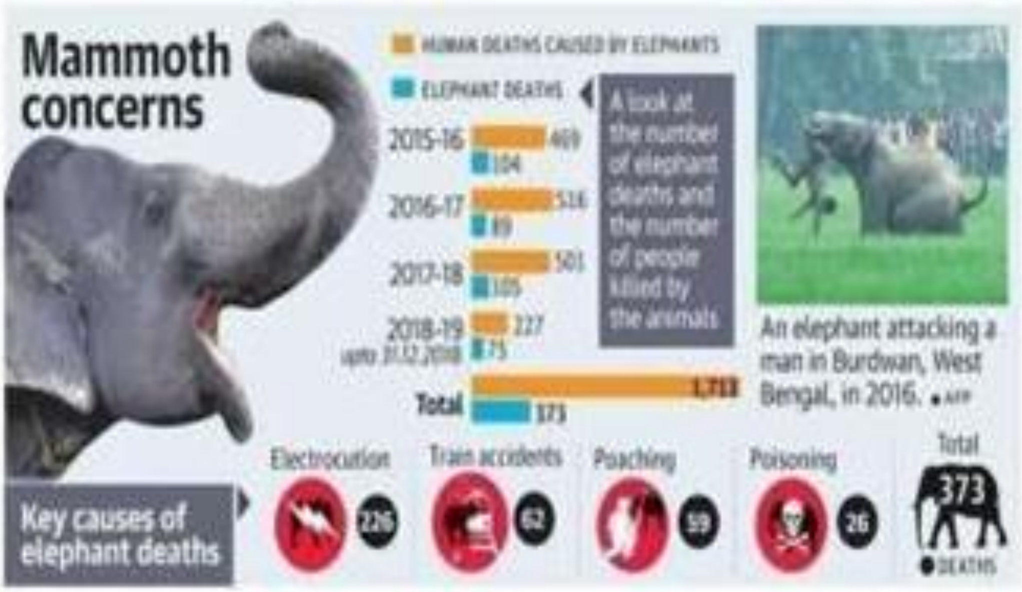

Fig.1. Survey on Human-Animal Conflict

The frameworks created for creature interruption finding, in particular, ought to guarantee the correct species acknowledgment. Jolts cause remarkable responses in creatures; making raucous noises may discourage wild boars but may cause an elephant passing by to become enraged. It is not enough to simply identify the creature; it is also necessary to have as many assurances as possible, especially recently, to reduce the likelihood of false positives [6]. The system's primary goal is to isolate animals from other objects and living things so that the proper repellent method may be used precisely to keep them away from the fieldAll of this must be done in close to real-time. Because the layout must also be economical, it would be necessary to use small computing devices that may be placed in certain locations. The issue proposed in the paper endeavors to address all of these challenges The measures outlined above are not very efficient at keeping animals away from crops. Here, the research is intended to monitor the farmland constantly for 24 hours a day, seven days a week, and drive away animals humanely. The warding off animals from the field is done with the support of aided camera and assisted by backend running YOLO algorithm [7], which speculates the animal apart from all other objects visually spotted.

2. PROPOSED SYSTEM

The old methods provide only the surveillance capability. Additionally, these systems do not offer protection against wild animals, particularly in such a field of application.

In the proposed method, the buzzer is activated when our suggested model correctly detects the presence of animals in the fields. It employs the YOLO (You Only Look Once) algorithm, which prevents the buzzer [8] from sounding in response to human presence or random motion. To find animals in the fields, this technology operates in real-time.

YOLO models move quickly. As a result, you may process video streams at a high frames-per-second rate using YOLO models. If you want to utilize live inference on a video camera to track something that changes fast, this is helpful and also in terms of accuracy, YOLO models remain at the top. As of November 2022, the YOLOv7 model, the most recent member [9] of the family of models, performs at the cutting edge when evaluated against the MS COCO object identification dataset. Even though there are many excellent models available, YOLO is well known for being accurate.

The device can switch on the buzzers automatically and scare away the animals, preventing any harm to the crops. The device offers manual buzzer controls in case they are required and even allows the farmer to watch his fields in real-time online from anywhere. We suggest to farmers that our embedded system is an effective, cutting-edge method of keeping animals off their farms [10] and that it is built in accordance with governmental standards.

2.1 Software Tools Used:

The project's brain is Node MCU, uses embedded C language to function. Anaconda3 is used to detect images and videos. With the goal of streamlining package management and deployment, Anaconda3 is a distribution of the Python and R computer languages for scientific computing. The task is carried out by YOLO, which is implemented in the anaconda3 code.

2.2 Animal Detection:

The YOLO technique is employed to recognize and classify animals. To enable real-time object recognition, the YOLO method makes use of neural network technology. The YOLO method is used for identifying and categorizing animals because of its speed, high precision, and excellent learning capabilities.

The YOLO algorithm employs the following methods: Since it sees the entire image during training and testing, YOLO implicitly incorporates contextual information about classes in addition to their outer appearance [11]. When trained on real-world photographs and tested against creative works, YOLO generates generalizable representations of things that beat the top detection approaches previously available. S x S grids are used in the residual block approach to breaking up frames. Each grid cell will be responsible for finding any object that occurs within it. A grid cell is in charge of detecting an item if the object centre slips inside of that grid cell. Forecasting the bounding boxes and their confidence ratings is the responsibility of each grid cell. Bounding boxes are outlines that draw attention to certain items in an image and specify their width, height, centre, and class.

In order to produce an output box that accurately surrounds the items, YOLO employs Intersection over Union (IoU). With this method, bounding boxes that do not match the highlights of the objects will be removed. If the intersection above the union rises to one, the predicted bounding box and the actual box are the same [12]. The final location features unique bounding boxes that exactly match items. It provides precise and trustworthy object detection. If the identical item is discovered in more than one grid, the grid with the intruder's centre point will be held responsible. As a result, it is assumed that the item is present in the grid with the object's centre point. The methodology to detect the animals using YOLO algorithm is illustrated in the Fig. 2.

The animal detected using YOLO algorithm is shown in Fig. 3. Fig.3.illustrates how the YOLO algorithm is used in the suggested technique to identify and categorize animals. Along with the animal type recognized, the likelihood of that class and the inference time is reported. Inference time is the amount of time needed to find and categorize the creatures.

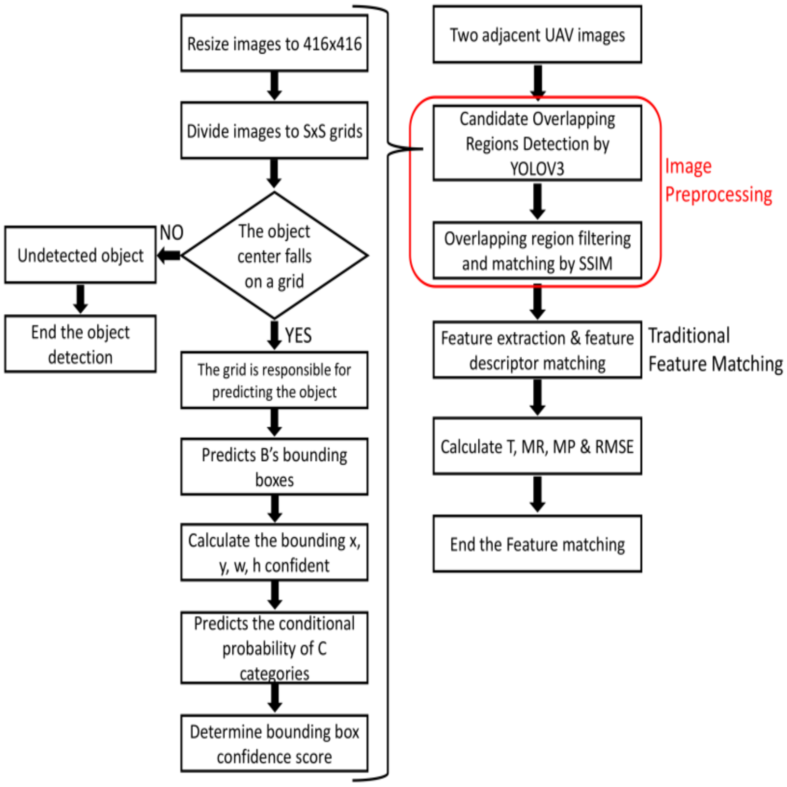

Fig .2.Animal Detection Flowchart using YOLO Algorithm

Fig.3. Animal Detection Using YOLO Algorithm

2.3Repellent Technique:

Depending on the sort of animal that has trespassed, appropriate repellent tactics are applied when it has been discovered and classified. Utilized repellant methods include making noise, and applying gases, liquids, and smoke. Bee sounds are made for elephants in order to frighten them away [13]. After a few seconds, if the presence of animals is still detected, stronger repellents are released as a backup. Farmers also receive notifications that include the animal's photograph, type, and location.

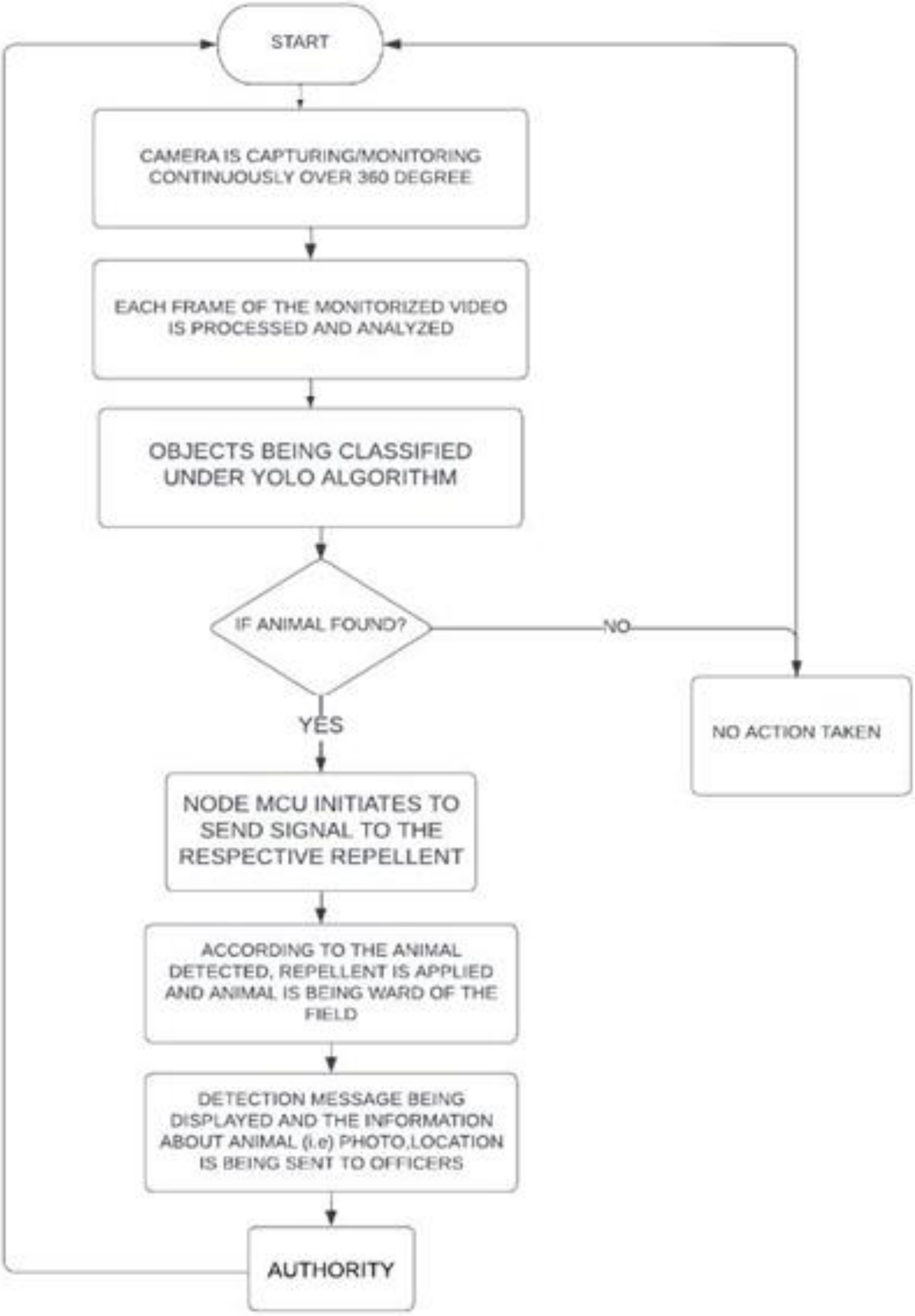

Fig.4. Flow Chart of Repellent Technique

2.4 Block Diagram Description:

The block diagram of the proposed method is shown in Fig.5 and the specifications of hardware components utilized are indicated in the Table 1. And Table. 2 gives the information about the various sounds suggested for the different animal detection.

The YOLO algorithm in Anaconda3 receives the image from the ESP32CAM and transmits it to Node MCU with input based on the animal. Node MCU receives an input that varies depending on the kind of animal found in the farmlands. The APR Voice Playback Module receives input from the Node MCU, which in turn triggers the appropriate sound to frighten away the animal.

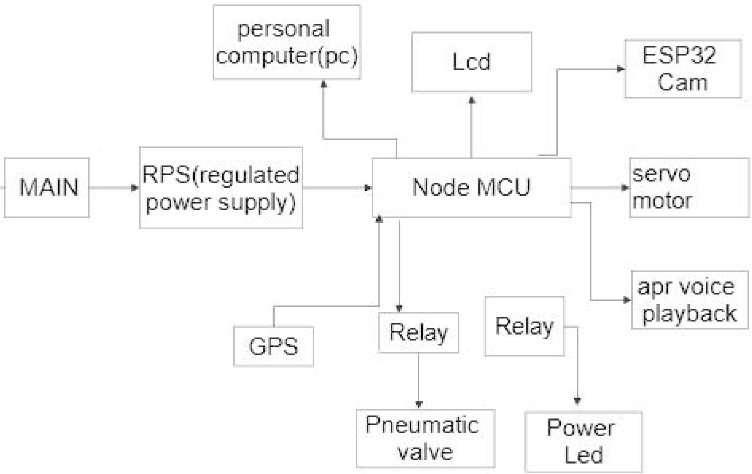

Fig.5. Block Diagram

Farmers and forest officials are informed of the animal's whereabouts using a GPS module. In order to drive animals away from farms, the appropriate gases and liquid repellents are discharged using a solenoid valve[14], [15]. Power lights are also utilized to dissuade animals in addition to these repellents, where the lights are used to trick animals into thinking humans are around.

The LCD shows the type of animal that was discovered. As a result, the project provides farmlands with real-time visibility. Repellants are administered more vigorously when the animals are still visible. Farmers also receive images of the animals that are detected.

After a few seconds, if the presence of animals is still detected, stronger repellents are released as a backup measure. Farmers also receive messages that include the animal's location, species, and photograph.

Table. 1. HardwareSpecifications

Component	**Range**
NodeMCU(ESP8266)	4.5-10V,32bit
SolenoidValve(3V21008)	12VDC,3.0W,200MA
Neo-6MGPSModule	2.7-6V
Relay	12V
APRVoicePlayback	3v~6.5v(680 seconds voice playback length)
Lcd display	200-390 nits
Power light	2000-2500 nits
Camera	Computing power 600 DMIPS, Bluetooth 4.2 with BLE
Buzzer	Frequency 3300 HZ,3v-24v DC
Servo motor	5v
Regulated power supply	220 v -12 v

Table. 2. Suitable sounds to drive animals

Component	**Range**
Elephant	Buzzing Noise of Bee
Horse	Lion Roar
Wild Pig/Wild Boar	Clanging of Metals
Bison/Cow	Bus Horn

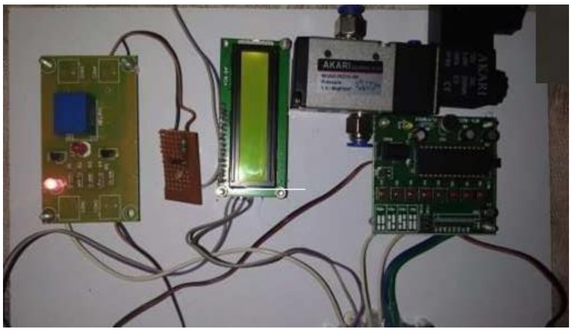

Fig. 6 Solenoid Valve connected to Relay

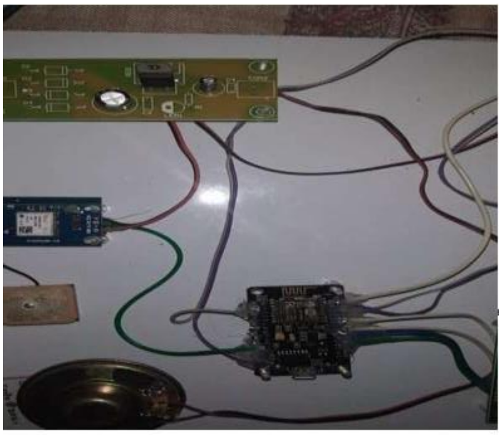

Fig. 7. Node MCU with GPS Module

3. RESULT AND DISCUSSION

Establishing what is truly being forecasted is crucial to comprehend the YOLO algorithm. In the end, our goal is to forecast an item's class and the bounding box that specifies where the object is located. The bear identified above using following descriptors characterize each bounding box: centre of a box's boundaries (bxby), Height (bw) and width (bh).

As was already indicated, while using the YOLO technique, we do not look for intriguing areas in our image that can perhaps contain an item. Instead, the bear captured using a 21x21 grid, we are dividing our image into cells. Five bounding boxes must be predicted by each cell (in case there is more than one object in this cell). As a result, we end up with 1805 bounding boxes for one image. We want to seize object probability rather than #YOLO and Carpe Diem's maxims of seizing the day. Accuracy for speed is a necessary trade-off for quicker real-time object recognition; it is not irresponsible conduct. Thus the object captured is identified as a bear by backend running “YOLO” algorithm. The Fig. 8 and Fig. 9 show the image outputs of animal detected using YOLO algorithm.

Vol 12 Issue 03 2023
ISSN NO: 2230-5807

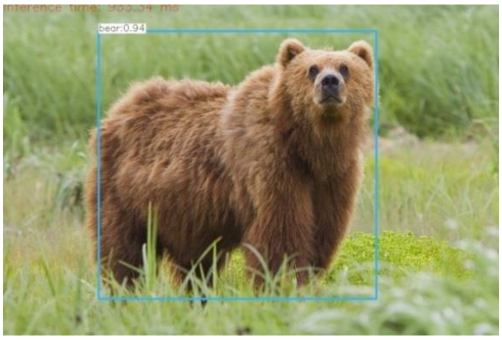

Fig. 8. Bear dedected using YOLO

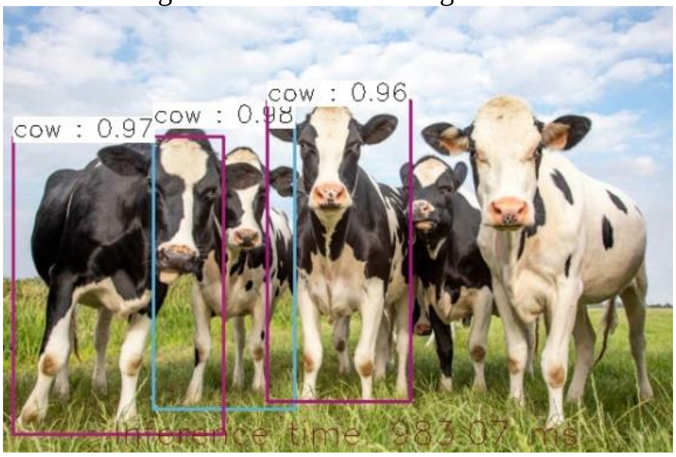

Fig. 9. Yolo Detection Output

Through a series of tests, it was discovered that the algorithm accurately categorized the intruder's acquired image within milliseconds of its acquisition. Multiple items in a frame can be detected and classified with ease. The YOLO algorithm is determined to be quick due to its straightforward architecture and processed roughly 45 frames per second. Using the YOLO technique, multiple-item detection is shown in Figure 8. As a result, Yolo Algorithm is trustworthy even when there are several objects in a single frame.
Fig. 10 shows the Hardware output of the proposed system. It will send the various sounds to the farmer depending upon the animal type.

Vol 12 Issue 03 2023
ISSN NO: 2230-5807

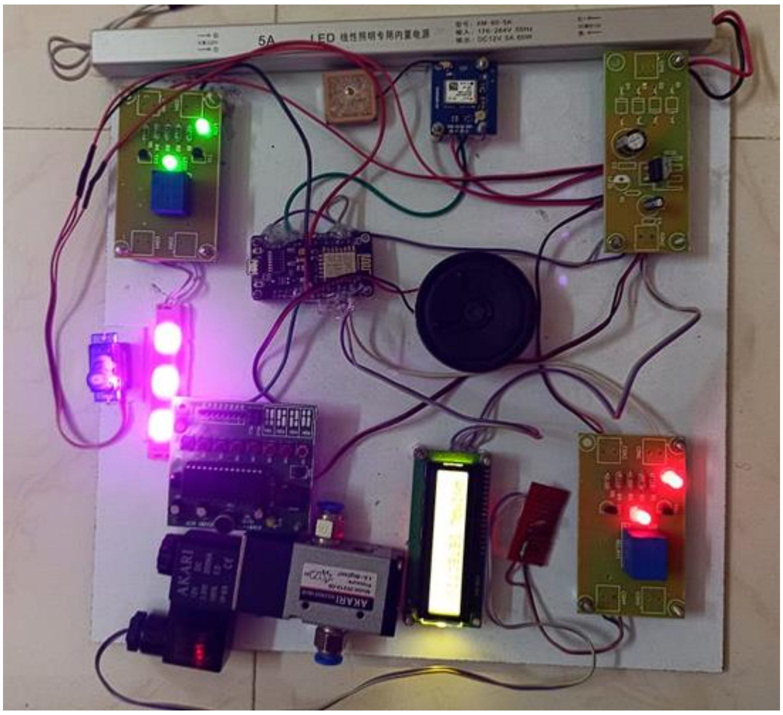

Fig. 10. Hardware Output

Low energy usage is accomplished by using Node MCU. Depending on the type of intruder, the Playback Module creates varied acoustic disturbances. The release of gases and appropriate repellents can be accomplished with solenoid valves. Node MCU receives an input that varies depending on the kind of animal found in the farmlands. The APR Voice Playback Module receives input from the Node MCU, which in turn triggers the appropriate sound to frighten away the animal.

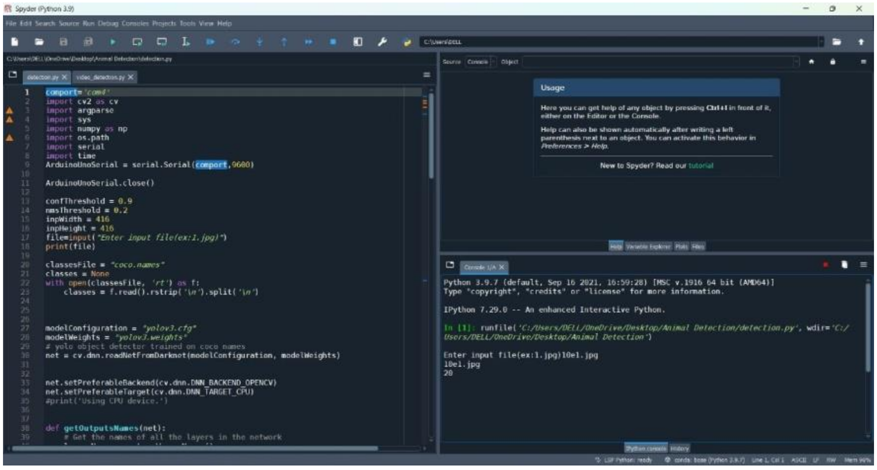

Fig. 11. Message in Blynk

Farmers and forest officials receive the notification, which is viewable via the Blynk app as like shown in the Fig. 11. The farmer will be alerted every 5 seconds until the animal is discovered, along with its location. He will also be informed when the animal is frightened of the farmland. Figure 10 depicts the notification farmers received when animals were found on their land. The configuration's threshold value, which can be modified to a value between 0 and 1, determines how accurately animals are detected. Setting the threshold to one improves the accuracy of animal recognition. As soon as the animal is trapped, it only takes a few seconds to locate and administer the proper repellents.

The output shown above illustrates how the controller processes the recorded video using the YOLO algorithm to determine which animal was actually caught. Each animal is assigned a number in the script that makes up the backend of the YOLO algorithm. In our situation, it displays the number 5, indicating the presence of cow.

4. CONCLUSION

One of the biggest issues at present is keeping animals out of farmlands. The problem mentioned above has a practical answer in this project. The goal of protecting farmland from animal intrusion without injuring them is accomplished. When humans or any other innocent creatures visit the fields, no appropriate actions are taken because this algorithm distinguishes between them well. The proposed approach will help farmers preserve their crops and prevent them from suffering major financial losses as a result of Vandalism because it is more precise and adaptable.

The conflict between humans and animals will be lessened because there is no human intervention to chase the animals away. Future farmers will make more money when this proposal is implemented in real life and big agricultural lands are preserved. Additionally, it aids with the efficient transportation of agricultural goods around the cities. Past data are being gathered and kept in databases for each defined locality in the near future. These databases enable us to forecast the likelihood of an animal invading farm. We can combine databases with our project to reduce the waste of unwanted repellents.

5. REFERENCES

1. . Ayaz, M. Ammad-Uddin, Z. Sharif, A. Mansour and E. -H. M. Aggoune, "Internet-of-Things (IoT)-Based Smart Agriculture: Toward Making the Fields Talk," in IEEE Access, Vol. 7, pp. 129551-129583, 2019.
2. F. K. Shaikh, S. Karim, S. Zeadally and J. Nebhen, "Recent Trends in Internet-of-Things-Enabled Sensor Technologies for Smart Agriculture," in IEEE Internet of Things Journal, Vol. 9, No. 23, pp. 23583-23598, 2022.

3. Norouzzadeh, M.S., Nguyen, A., Kosmala, M., Swanson, A., Palmer, M.S.,Packer,C and Clune, J., "Automatically identifying, counting, and describing wild animals incamera-trap images with deep learning", Proceedings of the National Academy of Sciences, Vol. 115, No. 25, 2018
4. Muneera Begum H., D.A. Janeera and Aneesh Kumar. A.G, “Internet of Things based Wild Animal Infringement Identification, Diversion and Alert System”, IEEE International Conference on Inventive Computation Technologies, 2020.
5. Divya, Ushakiran and Praveen. M, "IOT-Based Wild Animal Intrusion Detection System", International Journal on Recent and Innovation Trends in Computing and Communication, Vol. 6, No. 7, 2022.
6. VikasBavane, ArtiRaut, SwapnilSonune and Bawane.A.P., "Protection of Crops from Wild Animals Using Intelligent Surveillance System", International Journal of Research in Advent Technology, 2018.
7. Ahmad , Yinglong Ma , Muhammad Yahya, Belal Ahmad, Shah Nazir , and Amin ulHaq , "Object Detection through Modified YOLO Neural Network", Hindawi Scientific Programming, 2020 .
8. Geethapriya.S, Duraimurugan.N and Chokkalingam.S.P, "Real-Time Object Detection with Yolo", International Journal of Engineering and Advanced Technology (IJEAT), Vol.8, No.3S, 2019.
9. Norouzzadeh, M.S., Nguyen, A., Kosmala, M., Swanson, A., Palmer, M.S., Packer,C and Clune, J., "Automatically identifying, counting, and describing wild animals in camera-trap images with deep learning", Proceedings of the National Academy of Sciences Vol. 115, No. 25, 2018.
10. Parham, J., Stewart, C., Crall, J., Rubenstein, D., Holmberg, J. and Berger- Wolf, T., "An animal detection pipeline for identification", IEEE Winter Conference on Applications of Computer Vision, pp.1075–1083, 2018.
11. Zhang, Z., He, Z., Cao, G. and Cao, W., "Animal detection from highly cluttered natural scenes using spatiotemporal object region proposals and patch verification", IEEE Transactions on Multimedia, Vol. 18, No. 10, pp. 2079–2092, 2016.
12. Yousif, H., Yuan, J., Kays, R. and He, Z., "Fast human-animal detection from highly cluttered camera-trap images using joint background modeling and deep learning classification", IEEE International Symposium on Circuits and Systems, pp. 1–4 2017.
13. HardikiPatil AND Namrata Ansari, “Automated Wild-Animal Intrusion Detection and Repellent System Using Artificial Intelligence of Things”, International Conference on Advances in Science & Technology, 2021.
14. Prabhat Kumar Panda, CherlopalliSrujan Kumar, BommuSaiVivek, MasuraBalachandra and Shashi Kant Dargar, “Implementation of a Wild Animal Intrusion Detection Model Based on Internet of Things”, IEEE International Conference on Artificial Intelligence and Smart Energy (ICAIS), 2022.
15. Muneera Begum H., D.A. Janeera and Aneesh Kumar. A.G, “Internet of Things based Wild Animal Infringement Identification, Diversion and Alert System”, IEEE International Conference on Inventive Computation Technologies), 2020.