Journal of Nonlinear Analysis and Optimization Vol. 15, Issue. 1, No.15 : 2024 ISSN : **1906-9685**  Journal of Nonlinear Analysis and Optimization : Theory & Applications ISSN - 1900-100 Sector - 1900-1

Paper ID: ICRTEM24\_137

**ICRTEM-2024 Conference Paper** 

# IOT BASED CROP MONITORING AND PROTECTION FROM WILD ANIMALS

# <sup>#1</sup>Dr V. S. R. KUMARI, *Professor& PRINCIPAL*, <sup>#2</sup>K. NAGA VARSHA, UG Student, <sup>#3</sup>M. NAVYA, UG Student, <sup>#4</sup>MD. AZGAR SHARIF, UG Student, Department of ECE,

#### SAI SPURTHI INSTITUTE OF TECHNOLOGY, SATHUPALLI, KHAMMAM

**ABSTRACT:** Animals' attacks in farmers land are common now a days. Due to unavailability of any detection system. There is a proper detection system could help to preservation of crops. Also, the crops of farmers are destroyed due to frequent interference of animals. The crops and paddy fields cannot be always fenced. So, the possibility of crops being eaten away by cows and goats are very much present. This could result in huge wastage of crops produced by the farmers. To make the best use advanced technology. This system helps us to keep away such animals from the farmlands. Hence, we created a device that might be very helpful for farmers; it boosts production, prevents crop loss, and safeguards the property from intruders.

Farm crops are frequently destroyed by neighborhood animals including buffalo, cows, goats, birds, etc. For the farmers, this results in enormous losses. Farmers cannot block entire fields or remain on the field all day to secure it. Hence, we suggest a mechanism for automatically protecting crops from animals. This system is microcontroller-based and uses microcontrollers from the Arduino family. A motion sensor is used by this system to identify approaching wild animals close to the field. The sensor instructs the microcontroller to operate in this situation. The microcontroller now plays an alarm to tempt the animals out of the field and sends an ALERT to the farmer using IOT module so that he is aware of the issue and may react by being present at the scene in case the animals don't flee after hearing the alarm. This completely protects the crops from animals, preventing loss to the farmer.

# I. INTRODUCTION

India is an agricultural land. Farming has unendingly been India's most critical economical

sector. While the greater part of India's population is indulged into farming, the farmers still experience numerous issues. Accordingly, interruption of creatures in local locations is being raised step by step which is influencing the human existence, property that makes struggle among human and creatures. Agriculture is the foundation of the economy, nevertheless, would bring about gigantic harvest misfortune due to creature interruption in agricultural land. Elephants and other creatures entering into people's place of residence has bought adverse consequence in different ways, for example, crop annihilation, harm to food stores, water supply, homes and other properties, injury and human demise. Struggle between human creatures may likewise be a difficult issue where huge amounts of cash are squandered and life is in danger. Farmers in India have been confronting genuine dangers from natural calamity, bugs and harm by creatures prompting lower yields. Conventional techniques trailed by farmers aren't much viable and it's not achievable to recruit monitors to focus an eye on the yields and prevent nature creatures. Consequently, this zone is to be checked consistently to forestall section of this sort of creatures or the other undesirable.

In the world, the economy of many countries is dependent upon agriculture. In spite of economic development agriculture is the backbone of the economy. Agriculture is the main stay of economy. It contributes to the gross domestic product. Agriculture meets food requirements of the people and produces several raw materials for industries. But because of animal interference and fire in agricultural lands, there will be huge loss of crops. Crop will be totally getting destroyed. There will be large amount of loss of farmer. To avoid these financial losses it is very important to protect agricultural field or farms from animal and fire. To overcome this problem, in our proposed work we shall design a system to prevent the entry of animals into the farm. Our main purpose of project is to develop intruder alert to the farm, to avoid losses due to animals and fire. These intruder alerts protect the crop from damaging that indirectly increase yield of the crop. The develop system will not harmful and injurious to animal as well as human beings. Theme of project is to design an intelligent security system for farm protection by using embedded system. Animal intrusion is a major threat to the productivity of the crops, which affects food security and reduces the profit to the farmers. This proposed model presents the development of the Internet of Things and Machine learning technique-based solutions to overcome this problem. Raspberry Pi runs the machine algorithm, which is interfaced with the ESP8266 Wireless Fidelity module, Pi Camera, Buzzer, and LED. Machine learning algorithms like Region-based Convolutional Neural Network and Single Shot Detection technology plays an important role to detect the object in the images and classify the animals. The experimentation reveals that the Single Shot Detection algorithm outperforms than Region-based Convolution Neural Network algorithm. Finally, the Twilit API interfaced software decimates the information to the farmers to take decisive action in their farm field.

#### **II. LITERATURE SURVEY**

Agriculture is the backbone of the Indian economy, where more than 60% of the country's population is directly or indirectly depends on this sector. Where they need to feed this huge increasing population year by year with the decreasing land cultivating size. In near future, it is expected to have around 15-20% of food commodities to get increased within 5 years [1].

Even though a huge number of the population dependent on this sector, they are still in uncertainty to lead their life in this sector. The reason for this may be inter and intra farm field variability's such due environment, seed selection, fertilization inputs, irrigation, etc [1]. Nowadays, one more important factor causing crop loss is an animal intrusion into the farm field. The conflict between the animal and farmers is becoming common all over the region. That too in hill station area and adjacent to the forest area have major issues and the farmers suffer a huge loss. To date, they use some traditional and current methods to overcome this issue like Hell kites, Shot Gun, String and Stone, use of electrified welding mesh fence etc, but not up to the expectation of protecting their crops. Also, few attempts were tried to solve this conflict by using technology such as IoT and Machine learning, which is called IoT (Artificial Intelligence for the Infrastructure of Internet of Things). Our proposed model uses IoT and Machine learning concepts- b a s e d solution to it. IoT (Internet of Things) controls the Things that are connected to it and transfers the data over the network. The IoT technology enables the collection of real- time data from the farm field using Sensors and various electronic components [2].

In this work, we present the coordination of Pi Camera, LED, and Buzzer interacting with the cloud a new service in the domain. The peripheral part adopted wireless technologies such as WiFi for cooperating with the data center by an advanced IoT gateway. Pi Camera is used to capture real- time images in a farm field  $24 \times 7$  i.e., day and night. The low cost and ease of programming controller Raspberry Pi for coordination of hardware part and data transferred through ESP8266 WiFi module, which uses TCP/IP protocol [3].

Machine learning is a branch of artificial intelligence used for data analysis to automate the analytical model building, which identifies the pattern and objects to make a decision [4].

In this work, a deep machine learning algorithm for object detection and classification model is trained and tested. Twilit communication is API interface software which used to communicate throughout globally by creating its own/private network [5]. It is used to forward the decisive information to the framers, which has control through the Raspberry Pi controller. Here from all this motivated to propose an effective model to protect the crop from animal intrusion through modern technology.

S.Giordano et al., [6] worked and developed an IoT application for the protection of crops from animal intrusion in the crop field. To collect or monitor the crop field, authors used the wireless technologies such as 6LoWPAN, WiFi, and ZigBee with the advanced IoT gateway. An ultrasound repelled device was developed to work even in partial and total darkness using the solar panel along with LiPo batteries. To improve the efficiency of this device used PIR (Passive Infrared) sensor, which takes care of the frequency transmission and networking operation by transmitting a small size frame at a distance of 50m. This communication happens using the RIOT-OS software, when the animal is detected it produces a sound of 120dB.

The performance of this device reduces below 90% if the distance from the gateway is above 60m and it will never work if the distance crosses 100m.Mukesh Mahajan et al., [7] worked on protecting the crop in the farm field from animals such as buffaloes, cows, goats, and birds using a PIC microcontroller. The developed model uses the motion sensor to detect the animals that are near to farm field and the sensor signals the microcontroller to take appropriate action by farmers. The PIR-based motion sensor is used to detect the animals and the buzzer is used to notify the farmers based on the microcontroller instruction. Here authors claim that this model avoids the farmers staying for 24 hours in the farm field and barricade their crops.

Iniyaa K K et al., [8] worked on protecting crops by animals using deep machine learning and Convolutional neural network algorithm. The author aims to protect the crops from animals and not harm both animals as well as humans in the conflict. Due to this, the authors developed a model to divert the animals nearer to the crop fields. The machine-learning algorithm-based model is developed to detect the animals coming nearer to the farm field using the neural network concept through the computer vision technique. In this model, the farm field is monitored using a camera placed at the farm field at a regular interval of time. The algorithm detects the animal's movement through the camera frames using various libraries function and concepts of neural networks and plays appropriate sound to divert the animals away from the farm fielded.

Kalra et al., [9] worked and developed a model to protect the crop from insects and small animals through the sensor and also for control irrigation using the IoT technologies. The Arduino UNO microcontroller works like a heart for the proposed model in managing proper irrigation and crop protection. The irrigation is managed automatically on/off water siphons depending on the dampness parameters of the farm field. The crops are protected by insects, animals, etc through the use of deliberate sensors connected in the farm field; sensors estimate the motion of insects and animals nearer to the crop and sent the signal to the Arduino Uno microcontroller for calculation of distance and all. Based on the calculated distance values, the microcontroller enables high-frequency sound.

Raksha R and Surekha P, [10] worked and developed a prototype to monitor the crops and warning the wild animals based on two emerging technologies such as IoT and Machine learning. The IoT components used are like PTZ (Pan-Tilt-Zoom) camera, GSM module, Sensors, and Arduino UNO microcontroller and Machine learning algorithm for classification of the animals are done using KNN (K-Nearest Neighbor) Algorithm, Logistic Regression, and SVM (Support Vector Machine) Algorithm. Datasets of elephants, horses, Zebra, etc are taken in total in some 605 images. SVM provides an accuracy of 89.6% compared to the KNN and Logistic Regression model for the iterated regularization parameter of C=100.Several states of the art from the above-proposed prototype and classifier models work on IoT and detect the animals using machine learning algorithms. But still lack in achieving the expected performance, so this application is still in infancy for real- time. So here we are proposing a better model based on IoT and Machine learning algorithms to protect the farm field from intruders. The alternating current of 12V is converted into a direct current of 5V through a bridge rectifier circuit and 7805 voltage regulator to operate Raspberry pi. ESP8266 is interfaced with a Raspberry pi board to provide firebase cloud connectivity to the system [11].

Raspberry pi4 is used to run a machine learning algorithm. Pi cam is used to capture the intruder images entering the agricultural field. The images are then analyzed by the machine learning algorithm running on the Raspberry pi board and conclusions are drawn as an output of machine learning algorithm. If any danger is sensed the Raspberry pi generates sounds of different frequencies with the help of a buzzer and an input signal is sent to ESP8266 nodemcu which is in communication with the firebase IoT cloud which sends messages to the farmer through the android application [12]. If the intruder is detected at night, the LED lights and buzzer are triggered simultaneously to divert the intruder away from the field. The proposed model consists of two parts as Hardware and Software. Raspberry pi acts like a heart for the hardware part and it is interfaced with components like a voltage regulator, Pi Camera, LED lights, WiFi, and Buzzer. The software part for the hardware is done through embedded C and for computer vision prediction used machine learning models like R-CNN and SSD for object detection and predicts the animals.

# **III. EXISTING SYSTEM**

In the existing system there is no automated system for crop protection from animals. Usually because of the animal's former getting huge loss of agriculture. To protect the crop from animals they used electrical shock-based fencing system that very harmful to wild animals. To avoid this limitation, we proposed gsm based automatically animal detection and auto voice alert system and post information into GSM alerts.

## **IV. PROPOSED SYSTEM**

This is the block diagram for the smart crop protection system. Here we are using different types of sensors like IR Sensor, LDR Sensor and ultrasonic sensor. The ultrasonic sensor is used for obstacle detection in the field and a buzzer is used to make the person alert. The ultrasonic sensor that we are using is HC-SR04. Which always measures the distance, and a buzzer that beeps when an obstacle is encountered. And IR Sensor senses whether there is an object near it or not. The LDR Sensor is used to detect the presence of light. GSM module helps them to give information to guardian where the person is located. The regulated power supply converts the 12v dc current into 5v dc current. The 3 inputs IR sensor, ultrasonic sensor, LDR Sensor is given to the controller then it process the output in the form of buzzer, LED and GSM. Input modules are LDRs sensor, IR Sensor, Ultrasonic Sensor. Output modules are Buzzer, GSM, LED indicator, LCD indicator. ARDUINO processor and regulated power supply.



#### Fig.1. Proposed block diagram WORKING MODEL

**IR Sensor:** - An infrared (IR) sensor a proximity sensor, or a 'nearness' sensor that senses whether there is an object near it or not. IR sensor has three pins are- VCC, GND, and Out. These sensors are good for detection between 100cm-500cm (1-5 meters / 3-15 feet). IR sensor is used to detect the short range of animals and give to the directly to the controller. Ultrasonic Sensor: - The device has an ultrasonic sensor that measures the distance, and a buzzer that beeps when an obstacle is encountered. Ultrasonic sensor has four pins are

VCC (Power), Trig (Trigger), Echo (Receive), and GND (Ground). These sensors are good for detection between 2cm to 400cm. Ultrasonic sensor is used to detect the longer range of animals and give to the directly to the controller. LDR SENSOR: - The LDR Sensor Module is used to detect the presence of light / measuring the intensity of light. The output of the module goes high in the presence of light and it becomes low in the absence of light. Output modules are Buzzer, GSM, LED indicator, LCD indicator. Buzzer: - The buzzer is a sounding device that can convert audio signals into sound signals. It is usually powered by DC voltage. It is widely used in alarms, and other electronic products

as sound devices. The main function of this is to convert the signal from audio to sound. LCD:- A liquid-crystal display (LCD) is a flat-panel display. Here we use 16\*2 LCD display. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. GSM module: A GSM modem or GSM module is a device that uses GSM mobile telephone technology to provide a wireless data link to a network. GSM modems are used in mobile telephones and other equipment that communicates with mobile telephone networks. LED: - A Light Emitting Diode (LED) is a semiconductor device, which can emit light when an electric current passes through it. In the absence of light LEDS will be ON and vice versa.



Fig.2. Proposed Circuit diagram PIN DESCRIPTION

This is the pin diagram where all the hardware components are been connected.

The D0 and D1 pins are connected to the GSM module. The D2, D3, D4, D5, D6, and D7 pins are used to connect the LCD module. The D8 pin is wired up to an IR sensor. The D10 pin is used to connect the LDR sensor. The D13 pin is used to connect the buzzer. One of the four pins of an ultrasonic sensor is linked to GND. While, another pin is connected to the voltage supply. Two additional pins are attached to the data pins A1, A2. One of the three pins on an IR sensor is wired to GND. The A0 pin is connected to the one of the pin, while another pin is connected to the voltage supply. 7<sup>th</sup> pin and 20<sup>th</sup> pin are connected to VCC and AVCC. Where VCC is used to power all Digital components and AVCC is used to power all Analog components. So like this there are total 28 pins in the ARDUINO UNO. We are using ARDUINO ATmega328p controller which is simple and low cost micro-controller. So in this way the circuit is connected for

# V. RESULTS

 $\geq$ 

the use crop protection system.



Fig.3. Proposed Output model

Here the circuit is turned ON by giving the regulated power supply of 12v which is then converted to 5v dc current. The LED is the indication for 5v current. The generated 5v dc current passes to every hardware component in the circuit. Here we are using the three sensors. The first of the three sensors we are employing here is the LDR sensor. In the presence of light, the output of the



module goes low, while in the absence of light, the output of the module goes low. And the second one is ultrasonic sensor. It will detect the long range of objects. And the third one is IR sensor it will detects the short range of objects. Then within seconds the person will received the message. And the person will take care of crop.

Reg	
U:54-Animal Detected	
U:22-Animal Detected	
Text Message	⊳



#### Fig.5. GSM alerts animal detection

Once a SIM has been inserted into a GSM module. once a sim has been inserted in to a gsm module. We send a phone number to the registered number. We received a message as Reg. if any obstacle is happened for long distances ultrasonic sensor will detect an object immediately the GSM sends the SMS to the authorized person and it also appears on the LCD. Similarly, if any obstacle is happened for small distances IR sensor will detect an object immediately the GSM sends the SMS to the authorized person on the LCD. The person will be alerted and take care of the crop. In the project we take the maximum range is 70cm within the limit 70cm only it will detect the object. Beyond 70 cm it will not detect any object. For example, the ultrasonic sensor will detect the animal in the range of 22cm. we received a mug like U: 22-Animal Detected. For IR sensor will detect we received a mug like IR\_ON-Animal Detected. Within seconds we received a message to the person then the person will be alerted and take care of the crop.

Parameter	Existing Model	Proposed Model
Microcontroller	8051	Arduino
Speed	Low	High
Complexity	High	Low
Efficiency	LOW	HIGH

 Table.1 Results comparison Table

### **VI. CONCLUSION**

We design and implemented GSM based crop protection system from animals using IR, ULTRASONIC, GSM, ARDUINO components. The ultrasonic sensor that we are using is HC- SR04. This always measures the distance, and a buzzer that beeps when an obstacle is encountered. And IR Sensor senses whether there is an object near it or not. The LDR Sensor is used to detect the presence of light. GSM module helps them to give information to guardian where the person is located. We executed and got the satisfied results.

#### REFERENCES

1. Ms. SnehaNahatkar, Prof. Avinash Gaur, Prof. Tareek M. Pattewa "Design of a Home Embedded Surveillance System with Piezoelectric Infrared Sensor & Ultra-Low Alert Power" International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE) Volume 1, Issue 3,

September 2022.

2. M. Sathishkumar1, S.Rajini "Smart Surveillance System Using PIR Sensor Network and GSM" International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume4 Issue 1, January 2021] S. Sivagamasundari, S. Janani, "Home surveillance system based on MCU and GSM", International journal of communications and engineering, 2014, volume 06– no.6.

3. T.Gayathri, S.Ragul, S.Sudharshanan, Corn farmland monitoring using wireless sensor network, International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395-0056, Volume: 02 Issue: 08 | Nov-2023 4. A. V. Deshpande, "Design and implementation of an intelligent security system for farm protection from wild animals," International Journal of Science and Research, ISSN (Online), pp. 2319–7064, 2016.

5. S. Pandey and S. B. Bajracharya, "Crop protection and its effectiveness against wildlife: A case study of two villages of Shivpuri national park, Nepal," Nepal Journal of Science and Technology, vol. 16, no. 1, pp. 1–10, 2022.

6. K. Rao, R. Maikhuri, S. Nautiyal, and K. G. Saxena, "Crop damage and livestock depredation by wildlife: a case study from Nanda Devi biosphere reserve, India," Journal of Environmental Management, vol. 66, no. 3,

pp. 317–327, 2002.

7. V. Bavane, A. Raut, S. Sonune, A. Bawane, and P. Jawandhiya, "Protection of crops from wild animals using intelligent surveillance system."

8. R. Vigneshwar and R. Maheswari, "Development of embedded based system to monitor elephant intrusion in forest border areas using internet of things," International Journal of Engineering Research, vol. 5, no. 7, pp. 594–

598, 2016.

9. R. Bhardwaj, K. Bera, O. Jadhav, P. Gaikwad, and T. Gupta, "Intrusion detection through image processing and getting notified via SMS and image," 2018.