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AN INVISIBLE FENCE: LASER FENCING SYSTEM FOR PROTECTING CROPS

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Abstract

World population is increasing day-by-day and hence the feeding mouths are so. We need to find the ways of increasing the crop yields and at the same time protecting crop from being destructed is also required. Crop destruction has many factors such as flood, draught, animal-raiding, fire etc. In this research paper, we are proposing a system that can be used to prevent crop destruction from animal raiding using a novel LASER based security system. We are using a wireless sensor network based on nRF24L01 trans-receiver to communicate with the gateway and the sensors. LASER technology is one of the cheap and best techniques used for security fencing System. We have configured this technology in IoT to protect the crops in agricultural land. In this research paper, we are proposing a model that can prevent the animal-raiding in crop field efficiently.

Keyword: LASER, crop security, fencing field, nRF24L01 trans-receiver, Semiconductor laser, animal-raiding, IoT

1. INTRODUCTION

Precision farming or smart farming is an agricultural management approach centered on monitoring, assessing, and responding to crop variations between and within fields. Precision agriculture supports the concept of smart farming, which entails real-time data collection, processing, and analysis, as well as automation technologies in agricultural procedures, allowing for improved overall farming operations and management, as well as better informed decision-making by farmers. Due to its reliance on environmental and climatic factors (e.g. rain, temperature, humidity, hail), unforeseen events (e.g. animal diseases, pests), and price fluctuations in agricultural sector, farming is very

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uncertain. IoT technologies can assist us in more effectively securing our crops. The need for more settlements on the land is influenced by rapid population increase(Sandeep Kumar et al., 2018). Farmland is likely to be built as a result of considerable transition to new land uses, such as dwelling or the more economical land use. Furthermore, growing population on the land during this time period has the tendency to diminish agricultural production. The Internet of Things (IoT) will be the cornerstone of Smart Computing in the future. The transition of existing technology from the home to the office into "next-generation computing" is a critical aspect. Along with increasing the crop production in limited resources, it is also very necessary to decrease the crop-loss because of various factors(Siddhant Kumar et al., 2019).The factors of crop losses or crop damages can be flood, fire, drought, wildlife attacks or pests and diseases in crop. Flood is a natural calamity. And it is impossible for us to solve out this problem alone. But next cause i.e. Animal Attacks can be prevented by using the given proposed IoT model. A novel LASER is being used in this model to fence the surrounding of the cropland. Multiple LASERs are used at a specific distance along with nRF24L01 trans-receiver so that we create a connected LASER fence surrounding the field. This LASER can effectively work in night also. In this paper section1 is introductory part of this research, section2 depicts about the problem statement and objective of this research, section3 is describing about existing system, section4 is the objective of this research, section5 is describing about the proposed model and system architecture of the proposed model, section6 is the future enhancements of this model and finally section7 is the conclusion part.

2. PROBLEM STATEMENTS

Most wildlife species numbers in India have expanded significantly since the implementation of the Wildlife Protection Act (1972) and the general management approach, and a few have clearly become regionally overabundant. These species have become ecological dislocates as a result of varied and frequently incompatible land use strategies(Farooq et al., 2019). Those that have been successful in adapting to man-made environments have prospered, and in many locations, these species have become severe pests of agricultural crops, competing for resources with domestic livestock(Putri et al., n.d.). Wild animals are also increasingly using agricultural regions on reserve outskirts. One of the better instances is the elephant conundrum. Nilgai, blackbuck, wild boar, and porcupine damage to crops has been documented practically from every part of India(Md Alimul Haque et al., 2021). Rural communities that rely on subsistence agriculture cannot afford to have their crops raided by these creatures.

Recognizing the gravity of the situation, poor farmers and others are becoming more and more intolerant of crop raiding. Some people have developed hateful attitudes toward animals and want to eradicate them.

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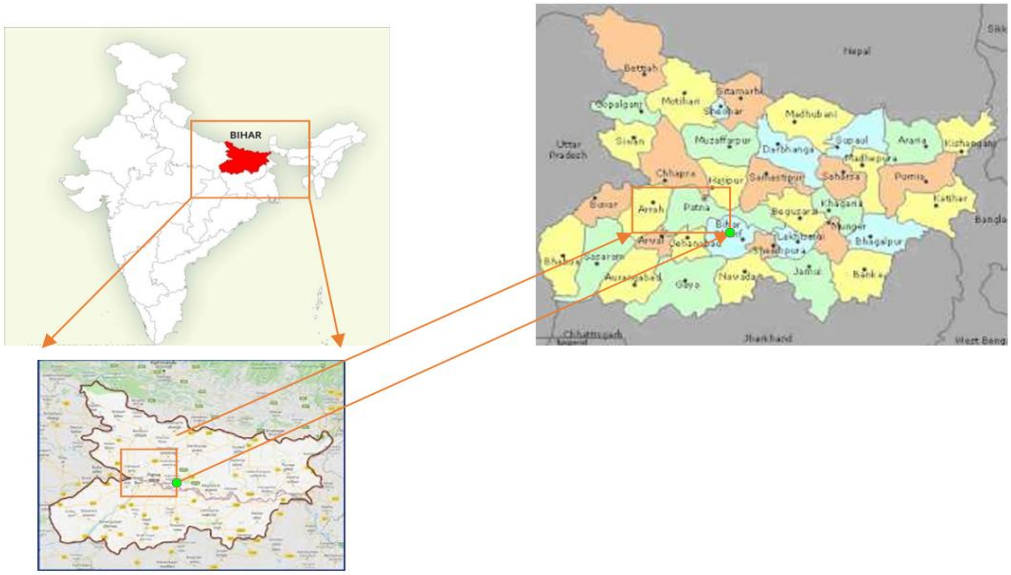
2.1 Problem Area Locations

This research and observation is being conducted at Rural Areas near Patna, Bihta and Ara (Bhojpur), Bihar shown in Figure1. Paddy (Oryza sativa), wheat (Triticum aestivum), maize (Zea Mays), and pulses (Phaseolus Mungo) are some of the most common food crops in this area. Sugarcane, potato, tobacco, oilseeds, onion, chilies, and jute are the main cash crops.

Figure 1: Area considered for Research



Approximately 100 farmers from these areas were being surveyed and asked about the major cause of their crop destruction. Most of them affirmed about major cause of crop destruction are due to Nilgai raiding into the field. Figure2 shows the locations in Indian region where Nilgai can be seen.

Figure 2: Locations of Nilgai in India

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2.2 Crop Damage Pattern

The antelope Nilgai (Boselaphus tragocamelus), also called Blue buck is extremely adaptable. It raids crops in the evenings and at night, as it is naturally diurnal. It has been discovered that it causes significant damage to most agricultural crops. Estimates are in the works. It does, however, prefer grams, wheat seedlings, and Pulses. Maize has been severely damaged in Bihta. Jute is not easily damaged and is commonly used as a cover. Crop damage varies in severity, possibly based on the quantity of animals present and the crop protection approach used in the area. According to villagers near Ara, damage can amount to up to 58 percent of total yield and is rarely less than 10%. In the case of Blackbuck (Antilope Cervicapra), the animal feeds the most in the mornings and spends the rest of the day either grazing in open areas or sleeping. Nilgai causes far more damage than blackbuck. Crop damage is also exacerbated by the presence of blackbuck in some regions.

3. EXISTING DAMAGE PROTECTION TECHNIQUE

3.1 Crop Protection

Efficient crop protection techniques are required for rural communities living in Nilgai and blackbuck-affected areas. Barricades of any kind are sometimes used. Brushwood fencing is effective against cattle only in select areas, but it is rarely successful against Nilgai and blackbuck. Farmers' most usual protection approach is to keep an eye on their fields throughout the crop growing season.

3.2 Constraints in Damage Control

Animal Hunting is a punishable offence in almost all countries of the world. In India, we strictly follow this rule. So, to protect crops from being destructed, we cannot kill or physically harm those wild animals. We need to find a solution either to deviate them or to scare them away from the crop field.

4. OBJECTIVE

The main objective of this research is to find out the way in which we can protect farmer’s crop more efficiently than their existing traditional technique and without physically harming the wild animals(Siddhant Kumar et al., 2019). For this we are using IoT techniques and equipment to guard the cropland day and night. As manual guarding is not efficient all the time, so we are proposing a model that can assist the farmers and help them out in crop field guarding as well as protection of crops(David et al., 2020). The main objective of this proposed model is to:-

- Fence the crop land using LASER sensor
- Detect the entry of the animals and alarm the buzzer

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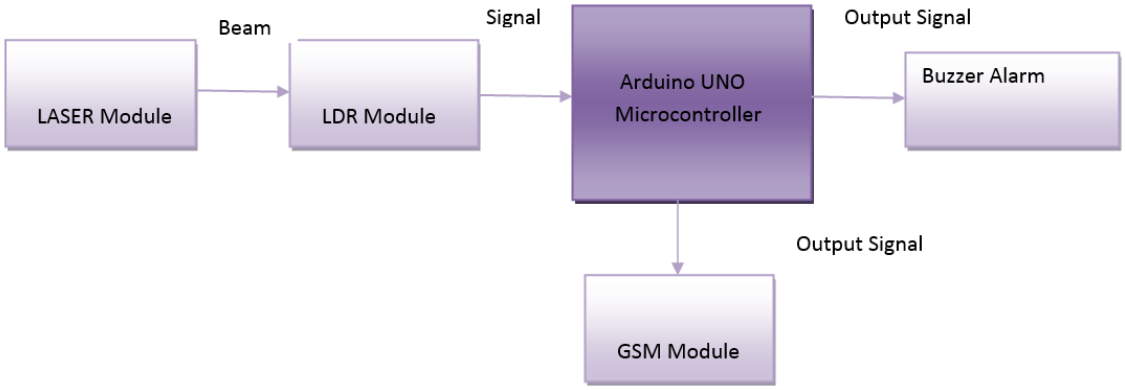
- Inform the farmers immediately through message using GSM module

5. PROPOSED MODEL

We are proposing a Fencing System to protect the crops from wild animals. In this system we are going to use LASER 560nm sensor, LDR module, buzzers, GSM Module and microcontroller to control the equipment's (Sandeep Kumar et al., 2018). As soon as the animals will enter the boundary of the cropland, LASER sensor will detect the entered object and start producing buzzer sound as well as a message will immediately be sent to farmer's mobile phone(Md Alimul Haque et al., 2021). The alarm sound will try to scare and deviate the animals trying to enter into the farm(Sinwar et al., 2020). Here, Figure3 shows the Block diagram of the proposed model.

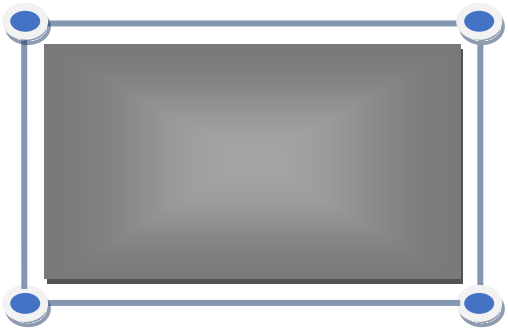
Figure3: Block Diagram of Proposed Model



5.1 System Architecture

In this proposed model we are going to arrange the LASER sensor module properly aligned with LDR module consecutively to fence the surrounding of the cropland. It will act as a boundary wall of land(Sonal et al., n.d.). If any animal will try to intercept this LASER beam by trying to enter the cropland then it will easily be detected by the sensor and immediately a message will be sent to registered mobile number. The microcontroller will also direct the buzzer to produce an alarm sound that will try to frighten the animals away from the field(Muangprathub et al., 2019). Here Figure 4 is showing the LASER fencing of the crop-field to protect the crops from wild animals.

Figure4: LASER Fencing of Crop-field



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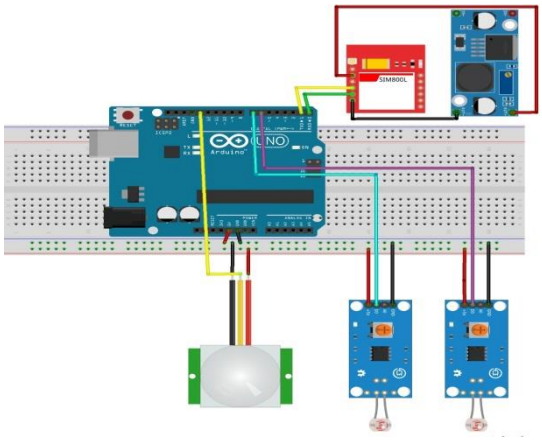
Circuit diagram of the proposed model is being shown in Figure 5. It is showing the connectivity of Arduino UNO microcontroller with GSM Modules and Buzzers. LASER sensor is attached at the INPUT pin of microcontroller. Buzzer and GSM Module are attached at OUTPUT pin of the board.

Figure5: Circuit diagram of the Proposed Model



5.2 Algorithm of the model

Start

- **LASER** sensor sends the single wavelength light in the aligned direction and LDR module receives the light at another end, this pattern fence the surrounding of the crop field.
- **IF**

Wild animal crosses this LASER fence

THEN

Repeller frequency will be generated & a message will be sent to registered mobile number.

End

6. FUTURE ENHANCEMENTS AND CHALLENGES

There is a large scope of enhancements in this proposed model. It is purely scalable in nature. We can add as many features we want in it. We can easily add various features such as fire detection, soil moisture sensing and android based application of this

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system. However, the adoption of this technology brings with it special difficulties in India, notably for the farmer who has a small piece of land and lives in a rural location without enough infrastructure, internet connectivity, or proper surveillance systems(M.A. Haque et al., 2021). Farmers from a low socioeconomic background may be disappointed by the high cost and sophistication of IoT equipment.

7. CONCLUSION

As the conclusion, we can conclude that this model is being designed for the protection of cropland and preventing the animals as well as any intruder in the field with wrong intensions. LASER sensor will detect any object at the boundary itself and will enhance the security of the farmland and crops(Gowri, 2019). This will enhance the safety of farmers also. The main goal of this research is to identify methods for protecting farmer's crops that are both more effective than their current traditional methods and do not cause direct harm to wild animals. We are doing this by employing IoT technology and strategies to watch over the crops day and night.

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