An Intelligent Hybrid Intrusion Detection System with Virtual Fencing

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ABSTRACT: Crop damage caused by the animal attack is one of the major threats in reducing the crop yield. The farm areas near the forest edges are prominently affected by the wild animal attacks. This paper presents the development of a Wireless Sensor Network application for Crop Protection to divert animal intrusions in the crop field. The nodes in the crop field are equipped with PIR sensors, sound generating devices, light flashers and RF module. For early detection of the animal at the perimeter of the farm intrusion detection system is installed. Animal entry at the farm boundary is detected by the nodes fixed at the boundary and is communicated to the central base station. The sequence of the node activation is location based, time based and proximity based. On receiving this information the nodes in the vicinity of the animal activates the deterring gadgets and diverts the animal away from the field.

KEYWORDS: Wireless Sensor Network (PIR sensors, IR sensor, Ultrasonic sensor)

I. INTRODUCTION

The result of rising global population has led to higher food production demand. Farms are always under threat of attacks from various animals, insects and birds. Due to the expansion of cultivated land into previous wildlife habitat, crop raiding is becoming one of the most common conflicts antagonizing human-wildlife relationships. On the other hand, one of the main challenges facing wildlife conservation in the twenty first century is the increasing interaction between people and wildlife and the resulting conflicts that emerge. Crop fields specifically in the proximity of forest area, the issue of wildlife animals entering and destroying crop field has taken a major crisis situation. The total yield in the farm is reliant on how the crop is secured from the external attacks from insects, birds, animals and other intruders causing damage to the crop. Crop-raiding animals may cause substantial damage to agricultural crops, and this has always been a major issue of contention throughout the world. Automated systems are part of the agricultural processes leading to high yield and maintaining good quality of the crop. These systems are easily available and adaptable by the farmers. Wireless Sensor Networks (WSN) has been emerging in the last decade as a powerful tool for connecting the physical and digital world. They can be used in challenging locations where it is inconvenient for human to be present. Wireless Sensor Network based designs have been largely exploited in the last decades for the solution of several real world problems, ranging from environmental monitoring to advanced wireless localization services. Many Wireless Sensor Networks are used to monitor and understand the wild animal behavior. WSNs have been used for various applications including habitat monitoring, agriculture, nuclear reactor control, security and tactical surveillance. Researchers have reported a well developed and tested Wireless Sensor Network for the detection of wildlife crossing the roads and giving alert signals to the vehicles in order to avoid mishaps on the roads. Doppler radar technology has been used along with a WSN platform to achieve a low cost and scalable solution of the problem. Virtual fencing, radio tracing, various sensor architectures and low cost wireless sensor technology and along with UAV mobile node is used in the application of animal monitoring and related environmental control. Zigbee based Wireless Sensor Network are used for monitoring animals. In most of the protection techniques diversion of animals from the crop area is not given more thought and the existing techniques many a times can be harmful for the animals leading to disturbance in

ecological balance. The focus of the proposed system is to create closed loop animal intrusion detection and deterring system, which is capable of sensing, reporting and taking preliminary prevention actions in an automated manner. To make the system more cost effective, a set of sensors and related gadgets are identified and used in the Wireless Sensor Network development process. The challenges for this system take account of use of appropriate Sensor Nodes, distance estimation and sleep strategies of nodes for maintaining their efficiency, as well as keeping it scalable for any size of the farm field. The foremost concern of this research contribution is the application of the WSN and use of technology assisted upgrades to achieve crop protection without hurting the animals and diverting them in appropriate way towards the cover crops to avoid their starvation.

II. EXISTING SYSTEM

As a result of the socio-economic activities in certain areas, forest cover has been reduced leaving the animals with smaller habitats and less food. So the wild animals have resorted to feeding on crops in farm fields, resulting into a conflict. Human beings want survival while wild animals need the same. This has brought about confusion and resentment from both sides rendering conservation and preservation a challenge, hence need for interventions that reduce crop raiding to enhance ecological, economical and social sustainability so as to foster co-existence. Starting from seed selection, soil preparation, irrigation, cultivation to harvesting process different technologies have been used by the farmers. Animals and birds attack the crop field and inadvertently damage the crop at different stages right from seed level to the ready crop. It is reported that these wild animals attack the farms located at the forest edges. Due to the scarcity of food in the forest area they enter the crop field boundary and damage the crop. Researchers have reported that White-tailed deer (Odocoileus virginianus) may cause more damage than any other species of wildlife. These damages include crop losses, automobile and aviation collisions, disease transmission, environmental degradation, and destruction of ornamental plantings. Crop damage is the most prevalent form of human-wildlife conflict across the African continent. The occurrence and frequency of crop-raiding is dependent upon a multitude of conditions such as the availability, variability and type of food sources in the area, the level of human activity on a farm, and the type and maturation time of crops as compared to natural food sources.

The problems associated with wildlife include:
_ Destruction of crops,
_ Destruction of farm infrastructure,
_ Creation of an environment of fear,
_ Loss of human life,
_Injure to human beings

The issue of wild animal attacks on crop fields is becoming a very common phenomenon all over the globe. There are several traditional methods applied by the farmers which include use of Scare-Crow, Hellikites, Balloons, Flyers, Shot/Gas guns, String & stone, etc. Nylon nets are used by some farmers to cove the whole farm area but it is a not economical solution, though it is full proof. Also, its lifetime is short and has high maintenance cost. Some farmers use traditional techniques such as wire fencing, bush fencing, Dog guarding or manual guards to protect their crops from animal attack. In their quest to protect their crops against wildlife raiding, farmers utilize strategies that are often cruel and ineffective. While arbitrary killing or trapping of suspect crop-raiders may provide a short-term solution to the perceived problem, it fails to address the long-term needs of either farmers or wildlife. For example captured animals are frequently taken at random and their removal often has little effect on the level of crop damage. Technology assistance at various stages of agricultural processes can significantly enhance the crop yield. There are traditional and Non-traditional techniques used by the farmers to protect their ready crop from the animal attacks. Habitat and environment monitoring represent a class of sensor network applications with enormous potential benefits for scientific communities and society as a whole. Sensor networks represent a significant advance over traditional invasive methods of monitoring.

III. PROPOSED SYSTEM

One of the key advantages of Wireless Sensor Networks (WSN) is their ability to bridge the gap between the physical and logical worlds, by gathering certain useful information from physical world and communicating that information to more powerful logical devices that can process it. WSN can in due course minimize the intervention of human in variety of applications. Thus, there is need of a technology assisted crop protection system which will be cost effective robust, reliable and easily adaptable by the farmers. In the proposed crop protection system, the first issue to be addressed is the detection of entry of the animal in the crop field. At the boundaries of the crop field Wireless Sensor Nodes will be placed at the corners of the field which will detect the animal entry using a laser assisted perimeter guarding sensor. At the center of the field the Base station node is located which will note the entry of the intruder and accordingly activate the nodes in the vicinity of the animal. According to the area of the farm, several wireless sensor nodes will be deployed at strategically chosen locations in the rest of the crop field. The range covered by the individual node and the total area of the crop field will decide the number of nodes to be deployed in the field. The sensors placed on the nodes will locate the animal presence and divert it by activating flashers and sound devices based on the location, time and proximity. Even when the animal bypasses the boundary level alert and somehow enters into the crop field, the PIR sensors on the system nodes will identify their presence and activate the deterring gadgets and force them to come out of the crop area and divert them to a buffer zone, where there would be sufficient food for them. This would save the precious crop and prevent starvation of the animals, thus help maintaining ecological balance. The nodes in the neighborhood of the attack zone at the boundary will be activated by the central node and all other nodes in safe area are set in sleep mode in order to save power.

a) System architecture and programming

The focus of this system is to create a closed loop animal intrusion prevention system, which is capable of sensing, communicating and taking preliminary deterrence actions in an automated mode. Here, a detector system is used which actually alarms if any intrusion occurs. During the initialization, the central node of the system localizes all the nodes. The information that a particular node resides near with fixed or anchor node is sufficient. Then the system shifts to a wait state. Any intrusion at the boundary of crop field is detected by an array of Opto interrupter and is reported to central node. Once such intrusion is detected, the central node uses distance estimation data to identify which mobile nodes lie near the intrusion area. The central node then selects several of these nodes at random. This selection also includes a parameter that a node with low battery level would be selected for a short time or never selected. After the node selection, the central controller sends them an action command. At the same time, it also informs the caretaker node present on a farm field about the intrusion. During this, if any outward intrusion is detected, the central node should send stop command to all other mobile nodes. The foremost focus of all the commands of central controller is on power saving. Thus, a central node is also responsible for defining a sleep strategy tailored to our needs. Mobile nodes equipped with a sound source and flashers are activated based on the intrusion location. Besides this, a node is also responsible for forwarding any other nodes data to and from the source. The mobile node is also responsible to monitor its battery level. If the level falls below a prescribed value, then the node should inform it to the central controller. This process is continued until a stop command is received from central controller. Finally, a system also has a caretaker node that is held by the owner or caretaker of the farm field. The caretaker node is also equipped with a sound buzzer and a LED indication and is responsible for notifying the caretaker about the intrusion. The caretaker node informs the central controller about its location once it is present near crop field. So that a stop command can be initiated. This can be implemented by the caretaker through a switch on the node, thereby acknowledging the intrusion. Throughout the development process, the implementation of this system is based on two key principles: Low cost and easy adaption by the user.
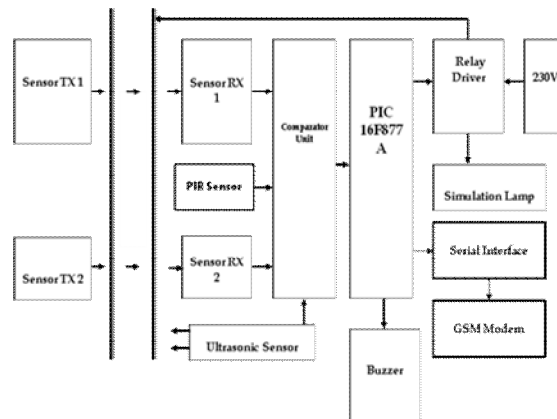
b) Block Diagram

Fig 1: Intrusion Detection System

c) System Hardware

System operation basically includes the activation and deactivation of nodes depending upon the status of intrusion at a particular location. The process of detecting an intruder can be at Boundary level node (due to intrusion from crop field edge), or at Mobile node level (due to motion detection).The electronics is developed to form a boundary level Intrusion detection system. Here the sound signal generated will be in audio frequency range. Here the components used are Ultrasonic Sensor, IR Sensor, PIR Sensor, PIC16F877A, Buzzer, Voice Board, Relay, ULN2003, GSM (Global System for Mobile) Modem. These above components are needed to build the Intrusion Detection System.

IV. OUTPUT

V. CONCLUSION AND FUTURE ENHANCEMENT

The project "**VIRTUAL FENCING**" has been completed successfully and the output results are verified. The results are in line with the expected output. The project has been checked with both software and hardware testing tools. In this work "LCD, PIC Microcontroller are chosen which are proved to be more appropriate for the intended application. The project is having enough avenues for future enhancement. The project is a prototype model that fulfills all the logical requirements. The project with minimal improvements can be directly applicable for real time

applications. Thus the project contributes a significant step forward in the field of **"ADVANCED AUTOMATION",** and further paves a road path towards faster developments in the same field. The project is further adaptive towards continuous performance. This work can be applied to variety of industrial and commercial applications.

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