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Approaches for saving human life and their properties from wildlife

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Abstract**:** Forest is a major environmental resource and is also considered as a rural industry around many parts of the world. In India, 24% of the geographical area is covered by forests which contribute raw materials to various industries. But unfortunately due to the effect of deforestation, wild animals living in the forest have started to invade the living places of the human beings. Thus wild animals such as lion, Tiger, elephant etc., enters into villages or towns for the sake of food and shelter. Therefore it is very much important to save the people and farmland located near the forests without hurting the animals as well. In the current scenario, various mechanisms has been proposed for preventing the entry of wild animals such as Electric Fences, Passive Infrared sensors(PIR) , Wireless Sensor Networks(WSN), SIFT algorithms , GSM/GPRS modules. This paper surveys various detecting and alerting mechanisms for the entry of wild animals to reduce the loss of human life and the farmlands.

Keywords: **forests, wild animals, human beings, farmland, deforestation, electric fences, Passive Infrared sensors(PIR) , Wireless Sensor Networks(WSN), SIFT algorithms, GSM/GPRS.**

I. INTRODUCTION

For the past 20 years, there had been at least one article in the newspaper stating the entry of wild animals into the human habitat or the farmlands in search of food and shelter. There cannot be any choice of putting the blame on animals since the major reason behind its entry is deforestation. Deforestation, pollution, anthropogenic climate change and human settlements have all been driving forces in altering or destroying habitats[31].Therefore the main objective of previous papers dealing with this kind of problem focuses on balancing the ecosystem of both the animals and the human life. More pronounced damage gets caused by wild animals in lands adjacent to forest areas during summer, due to food and water shortage in the forests."Farmers and officials plead helplessness in solving this perennial problem, and say they only try to drive the wild animals away manually," says Dr. Narahari, former Professor and Head, Poultry Science, Tamil Nadu Veterinary and Animal Sciences University, Chennai[32].Human–wildlife conflicts have occurred throughout man's prehistory and recorded history. Amongst the early forms of human-wildlife conflict is the predation of the ancestors of prehistoric man by a number of predators of the Miocene such as saber-toothed cats, leopards, spotted hyenas amongst others[33].Natural climate change, events have previously been the cause of many widespread and large scale losses in habitat. For example, some of the mass extinction events generally referred to as the "Big Five" have coincided with large scale such as the Earth entering an ice age, or alternate warming events[34].Other events in the big five also have their roots in natural causes, such as volcanic explosions and meteor collisions[35][36].The destruction of ecosystems such as rainforests has resulted in countless habitats being destroyed. These biodiversity hotspots are home to millions of habitat specialists, which do not exist beyond a tiny area[37].Once their habitat is destroyed, they cease to exist. This destruction has a follow-on effect, as species which coexist or depend upon the existence of other species also become extinct, eventually resulting in the collapse of an entire ecosystem[38.].Humans have been the cause of many species' extinction. Due to humans' changing and modifying their environment, the habitat of other species often become altered or destroyed as a result of human actions. Even before the modern industrial era, humans were having

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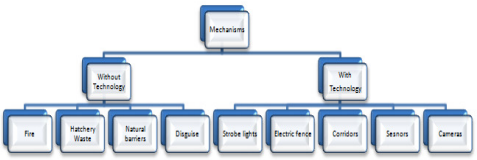
widespread, and major effects on the environment. A good example of this is found in Aboriginal Australians and Australian megafauna[39]. Panther and wild bears strays into the vicinity of fringe villages when they find sheep and goat camping in open fields. Villagers seek forest personnel to post a rescue team in the mandal to push straying animals into interior hilly areas**.**The villagers nexpect the Forest department to arrange multiple water tubs for the animals and also fill the tubs with tanker water if need be to prevent animals from disturbing human habitations. Rama Naik and Krishna Naik of Gullapalem village appealed to the forest personnel to post a Rescue Team in the mandal so that they could push straying animals into interior hilly areas[40].Senseless mining in hills and forests has resulted in wild animals entering human habitations in search of food and water. The drying up of water sources in the summer is also to be blamed for it. And animals are paying with their lives for it.[41]

II. HIERARCHIAL DIAGRAM OF MECHANISMS USED

The following diagram depicts the hierarchy of mechanisms that were used from the ancient times to till date.



III. APPROACHES

In ancient times, people used fire to eradicate the wild animals that approaches the villages. Kumki is the Tamil name for captive, trained Indian elephants[42].These are used mostly for taming and training of newly captured wild elephants and also to lead away wild elephants that stray into human settlements. Though farmers tried several methods, the problem continued. Interestingly, some workers in chick hatcheries noticed that the deer herds do not come near the places where they dispose their hatchery waste; which contains a lot of unhatched eggs," says Dr. Narahari. By observing this, some hatchery workers started spraying the egg

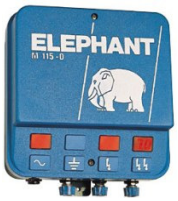


Fig: Electric Meter

contents mixed with water, on their home gardens and noticed that the deer do not come near the plants (sprayed with egg contents), probably due to the pungent odour emitted by the raw egg contents when exposed to the air[43].On the other hand, people also make unwanted sounds with the help of vessels, kitchen utensils, drums etc.,Secondly, gunshots were used to threatenthe animals.

To keep elephants at a safe distance from their farms and homes, some African villagers have turned to two unlikely, all-natural solutions: bees and hot peppers. Elephants dislike the chemical capsaicin found in chili peppers, prompting farmers in Tanzania to smother their fences with a mixture of oil and chili peppers. In addition to a spice aversion, elephants are also terrified of bees. This realization has led to the construction of marauding pachyderms out. Villagers in India have had recent success preventing tiger attacks

Fig:Natural barriers

by exploiting their knowledge of big cat behavior.Tigers stalk their prey and attack from behind, so forest workers began wearing masks on the back of their heads to prevent sneak attacks.

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zFig: Strobe Lights

Over a 3-year period, no attacks were reported among those wearing masks, while 29 unmasked people in the same region were attacked over 18 months. Unfortunately, the effectiveness of masks decreases over time as tigers become habituated to thedisguise. To scare off destructive nocturnal wildlife, farmers increasingly rely on automatic light machines. Half strobe light and half motion sensor, the machines flash beams of light randomly in all directions to mimic a farmer with a flashlight. Wary nocturnal animals have been shown to avoid such light signals, although the effect wears off over time as wildlife becomes habituated to the lights. Animals don't like getting shocked any more than you do. To deter wildlife from human dominated areas, conservationists commonly use electricity to create a lasting negative impression. Solar powered electric fences keep crop-raiding elephants out of fields in Africa, while wildlife managers in Alaska use tasers to deter moose and bears that have become habituated to humans. Conservationists in India have even tried to discourage tiger attacks by rigging human shaped dummies with electricity

Fig:Disguised Man

While a sharp electric zap may sound like an extreme way to deter animals, such methods are highly preferable over lethal control measures.While the elephants themselves don't send text, their radio collars containing SMS chips do. Imagine getting a text message from a

Fig:Collared animal

elephant. In the Western Ghats of India, a new conservation initiative has utilized texting as an early warning system to prevent human-elephant encounters. Elephant tracking collars embedded with SMS chips automatically text nearby residents, warning them of recent elephant movements. Before the project was implemented, a lack of awareness of elephant whereabouts played a roll in 75% of elephant-attributed human deaths in the region. Since the implementation of the early warning system, human deaths have dropped by 50%, with none being reported in 2010 and 2013. This wildlife overpass in Canada helps animals cross roads safely. Photo credit: K Gunso One way to reduce conflicts with wild animals is by guiding theirmovements in developed areas. Wildlife corridors, areas of preserved native habitat in human dominated regions, provide wildlife with a safe pathway as they travel between larger areas of intact habitat. By placing corridors away from potential conflict hotspots, such as farms or ranches, animals can be steered out of harms way and instances of human-wildlife conflict can be proactively avoided. All these were done with by risking life and technology plays no role in the above methods. After the evolution of technology, there were various mechanisms that were used to avoid this problem with a minimum loss of both human and animal life. The first method to threaten animals after technology evolved was Electric fences. But this method lead to loss of large percentage of animal life[6]. The next technology used was Wireless sensor networks(WSN)[5] that would detect the presence of animals with the help of variety of different kind of sensors like PIR[1],Microwave motion detector, Tomomgraphic motion detector,night vision cameras[22][19] etc., The network was also combined with communication module,GPS/GPRS were generally used[2]. This paper[15] does two tasks. One is to identify whether the electric fence is broken. The second task is to find the location of the breakage. Fence controller and pulse generator is used in this

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paper. Every 15 minutes the fence controller detaches from the pulse generator and connects to ground. The major task of control detector is to identify faults. The fence wires are used to send control signals to the nodes. Therefore, it is possible for the wires to be destroyed by the animals which in turn will cause loss of animal species.This paper[30] focuses on elephant monitoring. It proposes an automated elephant call detection algorithm that was tested on approximately 4000 hectares of field. The recordings from the field were collected from few forest in Central Africa, including both inside protected areas and in logging concessions. Recordings were obtained from different seasons and diverse weather conditions. The result from the detector was proven to be 83.2% positive and 5.5% negative. These results facilitate near-real-time monitoring and conservation of elephants in a wide range of conditions and parameters. The advantages of this paper is Real time elephant monitoring, acoustic monitoring to monitor the extracted sound streams. Recordings may produce negative rate as it does not segregate the sound of nature which is a major disadvantage.This paper [10]focuses on monitoring the behaviour and classifying the wild animals in the wildlife sanctuaries.. It uses a Wireless Sensor Networks to transmit and store the information received from the wildlife sanctuary. in a distributed system with a sensory fusion integration in order to study and classify animal behaviours in real time, which is a novelty for animal tracking networks. This uses a network topology that allows this kind of processing of the information obtained from the sensory fusion, and the communication between every element. A collar with sensor is placed on every animal to track its behaviour and health. This sensor is based on power consumption microcontroller. The usage of collar on the target animals may have a higher chance of causing choking to the animals and it may also break due to several reasons which is a major drawback to this paper.Sheela.S and etal[24]-This paper focuses on tracking the movement of wildlife near the human boundary. The sensor tower used here is made of raspberry Pi. PIR sensors are used for motion detection. A GPRS Module is used to transmit the collected information from the Raspberry Pi. The PIR Sensor used here focuses only upto 10 degree,but animals may enter from any direction in the forest. There is no specific algorithm to classify animals as dangerous or non dangerous. Using GPRS module information may sometime not reach the authorized person properly due to lack of connectivity issues. This paper[14] focuses on monkeys trespassing into agricultural fields. A wireless sensor network(WSN) using tone based application specific protocol for the prevention of monkey trespassing in agricultural field is proposed. The system uses ultrasonic sound to irritate monkeys and make them get away from the field. Using the flooding technique of alarm tone without any data has improved the efficiency of the wireless sensor network as there is no load to transmit. Also it consumes less energy which leads to extended lifetime of the sensors used in the network. This system is proposed only to the areas where monkeys are usually found. This paper[4] uses an automatic unsupervised elephant image detection system. The elephant's image is captured in the forest border and it is sent to the base station using an RF networks. The received image is decomposed and then similarity between the detected image and the image that is already stored in the database is compared using image vision algorithms. An alert system is sent to the authorized user that an elephant's image is found. Species are not distinguished, concentrates only on elephant conservation. Joshi V. V and etal[1].This paper focuses on tracking the health of wild animals inside the national sanctuaries/parks. A light weight designed system is attached to the neck of the target animal such that temperature sensor will be very close to the body of that animal. Thus body temperature is sensed and the information is sent to microcontroller. GPS modem will receive string from satellites. Then microcontroller will extract latitude and longitude information from string and sends it to the GSM modem.In this[13] paper, we propose a method for detection of wild animals in images using dictionary learning. DFDL is used to learn discriminative features of positive images, that have animals present in positive class, as well as of negative images that do not have animals present in that class. This paper presents sparse representation based wild animal detection system using Discriminative Feature-oriented Dictionary Learning (DFDL). We acquired class-specific dictionaries allowed to represent a new image to identity of the class of the image. Our system creates dictionaries which are class-specific and is capable of automatic feature extraction using example training image samples. Our DFDL algorithm learns these dictionaries by using positive (animal class) and negative background class) sparse representation of image samples. This result to an optimization problem, where similarities in intra-class are promoted and the inter-class dissimilarities are stressed. The system has been evaluated with the different set of parameters.

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The accuracy of the system is not so good and can still be enhanced with the use of standard training set. This paper[14] uses an algorithm for automatically detecting the movement of wild animals in the snow in the airborne remote sensing images. This algorithm is applied to all the images to detect moving animals. The aerial image of 2000x2000 pixels is extracted from the 2 dummy masses and is further used for obtaining the biological information such as habitats, population size etc., This algorithm targets only for bear, sika,deer,fox and human. This is applicable only to the snowy areas. This paper[23] automatically detects the presence of animals using matched filter and difference in their time of arrival. This method is similar to the GPS is presented. This system enables simultaneous tracking of thousands of animals with transmitters Tags are attached to tags using a backpack style harness .The tags were configured to transmit once per second, in order to ensure sufficient data for post-processing analysis. The data for the arrival times of each tag are stored in a database and then processed with our position evaluation software. The locations computed were overlaid on Google maps-based images. The principle drawback of GPS is that it does not directly provide a means of reporting position information back to the researcher. The position information is either stored and retrieved later, or downloaded via a radio frequency link. This [25] paper focuses on bird monitoring system, a bird-tag, equipped with GPS which is attached on the bird's body. Base stations are geographically distributed to receive the GPS from bird-tags using low power wireless transmission system. A data centre collects the GPS data from the base stations to track the position of each bird. Simple analysis shows that the real-time bird tracking performance is greatly improved by the proposed position estimation method using the concept of the monitoring coverage of each base station. The proposed monitoring system coverage of each base station is as far as 7 km. José-Vicente and etal[20].This paper presents a WSN-based system for moving target monitoring in areas of special interest. In particular, it has been applied for tracking animals approaching wildlife passages under roads. The surveillance systems are compared with other systems installed on passages, which only allow for target detection. The information obtained can be used for analyzing in details the effect of ecological conditions. The system uses a combination of tracking capabilities, provided by infrared motion sensors, together with target identification through the use of camera sensors and it also uses two different hardware prototypes. But analyzing the ecological system is a very complex process. This paper[28] deals with a health monitoring and tracking system for animals. The proposed work of this paper combines the embedded system with the Zigbee wireless communication technology. This technology uses very high low power consumption, low Complexity. In the heart rate sensing module they have used the Rs232 transmitter and the developed module is transmitting data only up to 2 meters. They will need the modification of the heart rate sensor module and could be increased the transmission range. This device tracks the space for every animal and also measures the animal's physiological signal by using Zigbee transceiver and GPS. But using the GPS module, the signals cannot be received efficiently and it cannot be transmitted properly to the transmitter. [6]This paper focuses on an algorithm that categorises animal locomotive behaviour by combining detection and tracking of animal faces in wildlife. As This algorithm is algorithm is applied to animal faces.

The paper[18] uses wireless sensor networks (WSN). In WSN, our proposed model uses mobile agents (MAs) for handling huge area communication and injecting them for different guarding issues of different species of wildlife. Virtual Sensor Cloud (VSC) is being discussed to trace different group of endangered wild animals such as Tigers, Lions, Elephant The paper has introduced a technical intervention in the form of an innovation named Forest Guard model that can indirectly guard the wildlife by providing real-time information to the institutional authorities, which can directly intervene to protect the wildlife from poaching and other life threatening disturbances. We assumed that the hardware of sensor motes is capable to detect different species. The proposed model uses AGILLA middleware, which has features to inject different Mobile Agents according to need. With the help of MAs our model creates clouding, which is unique feature of the model to capture different species of wildlife. The simulation results show that the model would work perfectly in its stated objectives. The captured information from the model may be misused on species of wildlife in future; therefore the proposed model must be implemented under the guidance of institutionally authorized body.

This paper [21] proposes a method for non-invasive elephant identification system using computer vision algorithms, for management and conservation of elephants. The additional information of an elephant can be used with an evidence combining mechanism to recognize individual elephants. Web portal will also include secondary data such as socio-economic and Human Elephant Conflict (HEC) information,

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that is tagged to geographic locations. Proposed method has achieved an accuracy around 72%, only using the facial recognition images of elephants. The current system can be useful as a semi-automated mechanism for elephant tracking, and can be converted to a fully automated system by further increasing the accuracy. The accuracy can be affected by the low quality of the images, the strange poses of the head positions of the elephant and high illumination variances which is a major disadvantage.

GSM modem is used as a second communication device. But this project concentrates only in the crane species.

This paper [17] has hardware components equipped with Inertial Measure Unit(IMU) and Zigbee transmitter. The sensory fusion tells us how to combine the data from sensors to filter the noise and obtain useful information. The useful information are pitch, roll and yaw, angles of rotation in each axis of 3D dimension. This system is designed to measure the orientation of an animal but it could be used on other rigid body.

The [7] developed instrumentation can be easily employed in recording animals' activity in behavioural experiments, in light and darkness. Synchronization of the extracted data with stimuli has been verified. The video processing application provides a good means of measuring rotational head angle in animals especially using a similar marker. To obtain high accuracy rate, the camera's resolution must be fully exploited by using a lens for which the field of view is matched to the area within which the animal moves. At the same time, the lens must provide a focused image of the object of interest such as head,body etc., of the animal and the camera exposure time must be set appropriately to minimise blurring when the object of interest is in motion.

This paper[2] focuses on setting a plan to set up a grid of receiving stations carrying fixed anchor nodes. Currently we are assuming that these would be deployed in a 2-dimensional terrain. A mobile node (animal node) would be deployed on the body of the turtles to be tracked. The data packets would contain a sequence number to identify the packet and may contain sensor readings as well. These beacons would be received by one hop anchor nodes and they would record signal strength of the packet in form of RSSI value as well as link quality. Since the system would be deployed within the WII campus, we are assuming that anchor nodes would be ON all the time and listening to incoming packets. However animal node would be limited in its energy resource and would need lot of effort to keep the energy consumption to be as low as possible. The plan to do this by selecting low power consuming components as well as duty cycling the animal node. In absence of any direct location sensors, there is a need to utilize indirect way of estimating location of the animal node.

This [16] paper develops and evaluates the tracking platform for Cranes, which is a unique challenges in their mobility and extremely low population size. The developed cellular sensor network platform seeks to provide more detailed data on these birds' behaviour. Crane Tracker's design aims to provide multi-modal sensing and multi-modal communication capabilities that allow reliable and time-critical monitoring

A portable system in paper[11] has been designed to enable monitoring of autonomic nervous system output in primates for the purpose of studying neural function related to social behaviour over extended periods of time in an. In contrast to prior systems which measures heart activity and are restricted to a constrained laboratory setting, or require surgical attachment. Our system is comprised of a multi-sensor self-contained wearable vest that can easily be transferred from one subject to another. The vest contains a small detachable low-power electronic sensor module for measuring electro dermal activity (EDA), electrocardiography. An Android application was created on the mobile phone for recording live data .Data from up to seven animals can be recorded simultaneously using the mobile phone, with the option of real-time upload to a remote web server. This system enables new possibilities for studying underlying mechanisms between autonomic nervous function and social behaviour with connection to human research in areas such as autism, substance abuse, and mood disorders. But this may lead to loss of species.

J.Nirmal Prince[8]This paper deals with Elephant Intrusion on the forest border areas with herds of elephants straying into human habitation and creating a great loss to their properties. The surveillance and tracking of elephants are difficult due to their size and nature of movement. This paper uses a method for detecting and tracking elephants along the forest border areas using the vocal communications of elephants. Two approaches are used to find the spectral energy magnitude and the other to determine highest pitch frequency which is produced by elephants. A threshold is identified by two approaches; once the elephant vocal communication signal crosses the limit an alert is sent to the forest officials and tells them about the elephant intrusion to redirect the elephant again into the forest.

Non-imaging sensors in [22] paper offer low power and long lasting solutions for border crossing, and forward operating base protection. In this paper, the study of utility of acoustic, seismic, and ultrasonic transducers for detection and identification of people and animals. Various algorithms are used which are computationally less intensive on sensor network. The acoustic data are also used to estimate the of animals walking and discriminate between animals and

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people when a human voice is not present. Seismic data are analyzed for footstep detection and classification of humans and animals. Ultrasonic data estimates the number of targets. Each algorithm uses sensor's particular phenomenology for the detection and classification. The algorithms presented are computationally efficient, consume less power and hence amenable for implementing on sensor networks such as networked .

Ms. Bindu D, Mr. Dilip kumar M D,etal[29].The aim of this project is to detect elephants entering into the agricultural areas. This paper uses Raspberry Pi board and a GSM Module. The Raspberry Pi based elephant detection system identifies the presence of elephants that may enter into the agricultural fields. Once the elephant has been detected, the information is sent to the authorized person (i.e) the farmland's owner through the GSM Module. Low cost maintenance. The major disadvantage of this paper is that it requires continuous power supply to the detection system. Secondly, The GSM Module requires strong network connectivity for efficient operation. It is practically not possible that every forest will have signal connectivity. Hence, the information from the GSM Module cannot be transmitted properly to the Authorized user. This increases the fallacy rate.

This paper[13] mainly deals with animal detection.In the proposed work, images of animals are obtained in the form of videos using which they have classified animals. Background Subtraction techniques followed by thresholding has been used for processing the images. Using background subtraction technique, the moving objects have been subtracted from the background image. After all these process, object detection is done using SIFT Algorithm. The obtained output is sent to the microcontroller and an alarm is generated. Fast moving species cannot be detected easily using this SIFT Algorithm.

This paper[12] is an alternative to the existing elephant alert system. Sensor network based solution is chosen as the best alternative to many techniques. The results of the initial phases of an ongoing research project called Wi-Alert which is a wireless sensor network based elephant detecting and alerting system. The first phase experiments of the prototype verified the feasibility of reducing multi-path effect and the ability to filter the presence of obstacles. The second phase experiments conducted in the presence of elephants proves the ability of the prototype to detect elephants. Real time on site implementation has not yet been developed which is a major drawback.

This paper[9] focuses on Aerial system for radio collar tracking system consisting of ,a low cost television receiver dongle serving as an SDR unit which is attached to an omnidirectional antenna, a programmable control board for command and data storage and the relevant software for after-flight data processing. The flight path is intended to follow a lawnmower pattern, covering search area. During the flight, the control board interfaces with the radio, and records the down converted signals from the SDR as well as the GPS data. The use of an omni directional antenna simplifies the overall system operation, since it does not requires accounting precisely for the plane orientation during flight or deploying an accurate control system for directing the antenna. Ultimately, this prototype has demonstrated the method to be a promising low cost and fast to deploy solution, to be used with the conventional VHF method for wildlife tracking. But this a very traditional approach of tracking animals and it may lead to damage of the device.

This paper[19] deals with animal detection using Template matching algorithm. Intelligent farm surveillance system refers to the video level processing techniques for identification of target objects. In our work, we have assumed video to be a series of images and have illustrated the concept to identify birds from videos of the farm. Background sub-traction methods like frame differencing, mixture of Gaussian are used here. Different feature extraction methods were obtained as a result. After performing feature extraction, database is generated for target and template images. At last the template matching mechanism is used for detecting the animal like bird from the video. The template matching, algorithm uses normalized cross correlation technique is used. On detection of the bird an alarm is generated as a feedback. Feature extraction is a very complex process and this approach is expensive when compared to the other methods.

The paper[26] mainly concentrates to avoid the animal vehicle crashes along the roads crossing the wildlife sanctuaries or forest. First the process starts. It checks where the traffic light is red or not. Then changes the traffic light to red. Then it checks whether the PIR value is greater than the set value. If no, the traffic light changes to green. If yes, then the warning system is switched on and a message is sent to the person that an animal is crossing the road and this message is displayed. The major disadvantage is the transmitting range.

IV. CONCLUSION

The major purpose of this survey was to analyse the various trends in the past 3 years and examine how the technology has changed in the specific context. It is very much clear from the survey that most of the techniques that had been commonly used affect either the humans or the poor wild animals. As a result, there is a drastic increase in the number of animals that are endangered. Due to these fundamental problems, there is a high need for a system that

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balances the ecosystem of both the humans and wild animals.

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