ECOLOGY MONITORING

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***ABSTRACT*:** Balance of the ecology has been a big concern and it has been the most important duty of every person. Ecology monitoring is the system of regular long observations in space and time, informing about environmental conditions with the purpose to estimate the past, the present and the future forecast of environmental parameters which are important for the human being. There is no chance that the condition of the earth will increase unless wildlife and trees are protected. 8000 years ago, half of the earth's land was covered by forests. Today, these areas represent less than one third. This not only disturbs the atmosphere of the earth, but also the animals. If one species in the food web ceases to exist, one or more members in the rest of the food chain could cease to exist too. The proposed system consists of wireless sensor network for detection of forest fires and also to monitor the health of animals. Even the location of the animals will be detected. It is very important to protect the endangered species and to make sure that the forest fires do not spread too far and cause more damage in order to maintain the balance of the ecology. When the fire starts or even if there is any sign of forest fires, immediately the forest officers are informed about the same. The health of the animals is monitored frequently. The location of the animal is traced so that there can be assurance that animals do not enter human living areas.

***IndexTerms* - Forest fires, animal monitoring, shock generator and sensors.**

1. INTRODUCTION

The system of ecological monitoring accumulates, systematizes and analyzes information about observations, estimation and the forecast of the environmental conditions in the forest. Forests are part of the important and indispensable resources for human survival and social development that protect the balance of the earth ecology. Forest mainly consists of trees and animals and protecting them is a very difficult task.

Due to some uncontrolled activities and abnormal natural conditions forest fires occur which ends up damaging most of forest areas. Forest Fires occur frequently. In recent years, the frequency of forest fires has increased considerably due to climate changes, human activities and other factors. The prevention and monitoring of Forest Fires has become a global concern in Forest Fire prevention organizations. Currently, Forest Fire prevention methods largely consist of Patrols, Observation from watch towers, Satellite Monitoring and lately Wireless Sensor Networks. Although observation from watch towers is easy and feasible, it has several defects. In the first place, this method requires many financial and material resources and a trained labour force. Second, many problems with fire protection personnel abound, such as carelessness, absence from the post, inability for real-time monitoring and the limited area coverage.

Many algorithms and methods have been developed in order to have a better understanding on the animal behaviour. Besides, these applications also can acts as a warning system to human beings from intrusion of of dangerous wild animal for early precaution measures. These applications are being monitoring and tracking. The animal tracking is the main topic in monitoring animal locomotive behaviour and its interaction with the environment. With the technology of sensor, radio frequency identification (RFID), and global positioning system (GPS), we can develop new zoological systems for animal tracing ability, identification. By tracking the animal movements, it helps human to have a better understanding on living creatures on earth, especially on how the animal interacts with its environment.

LITERATURE SURVEY

The paper [1] proposes a UAV based forest fire monitoring and detection method using visual sensors. The purpose of this paper is to improve fire detection performance, while reducing false alarm rates. The proposed system deploys a group of fire detecting sensors equipped UAVs in an assigned area to search while communicating with the ground station, if fire is confirmed related authorities are notified with fire images data. Here the fire is detected by the following design procedure: 1) based on motion feature of fire, optical flow technique is adopted for extracting moving regions as candidate fire pixels; 2) colour features of fire are extracted employing colour-based decision rules to segment fire coloured pixels from candidate fire pixels; 3) finally, fire is confirmed if the suspicious fire region can be extracted based on both colour and motion features. The UAV is controlled by slide mode control and linear quadratic control regulator (LQR), and the quad rotor control is divided into two loops, inner and outer loop. (LQR) is used to control the quad rotor positions, while the sliding mode control is used for the inner-loop control which is responsible for the attitude stabilization In order to demonstrate the proposed model a indoor environment is created and a unmanned quad rotor Helicopter is used which is equipped with a QuaRC-powered (QuaRC is a real-time control software developed by Quanser Inc.) single-board Gumstix embedded computer, which is adopted to implement algorithms developed in MATLAB/Simulink environment for real-time applications. To monitor and detect fire a camera is mounted at the bottom of UAV for the purpose of collecting images from ground and this data I transmitted to ground station via a wireless communication system (consists of a 5.8GHz 200mW transmitter and a 5.8G AV receiver) Motion and colour features are extracted by employing optical flow method and colour-based decision rules, respectively. The drawback of this system is that it does not capture the 360 degree view of the area and if an adjacent UAV failed to communicate with other the system fails in intimating the department about the failure in most of locations.

The paper [2] focuses on protecting vineyards from grazing animals especially sheep's as they are used to remove the wild species in the vineyards but end up grazing the vines and fruits hence causing harm to the culture of vineyards. Sheep's are used to remove the wild species so that the vines get more nutrients and necessary sunlight more than the wild species. This paper, therefore proposes a system called Sheepit with overall system architecture which keeps track of posture and location of sheep's while grazing in the vineyards. This architecture mentioned consists of collars and mobile nodes which is put around the neck of the sheep, makes use of cloud platform as it deals with huge amount of data to analyse, process and store the data. This is done to keep track of the various postures of the sheep. For example, if the sheep is grazing very close to the ground it is not harming to the culture, but is harmful only when it lifts its head and starts grazing at a certain desired height. Hence to analyse process and store data various machine learning algorithms were tested to make this system highly efficient. Out of which, decision tree proved to have more accuracy and better area under the curve properties than others which is why is used in the Sheepit system to protect vineyards from the sheep. Sheepit then defined the posture of the sheep's accurately placed around the neck.The advantage of this system is that it can easily detect and locate the sheep and automatically sends signals if the sheep tries to graze the vines with the help of decision tree algorithm using machine learning. As large amount of data can be fed and more options can be implemented on the collar such as health monitoring this system proves to be highly effective. As the machine is fed with only sheep's data it cannot protect the vineyards if another herbivore comes to graze the vineyard. The system is not tested at high temperature levels as during summers the temperature increases and it may damage the system.

The detecting of forest fire and the tracking of it was done using multiple UAVs' [3]. These UAVs are meant to be in a formation all the time. The formation is made such that, it covers almost all the space with minimal number of UAVs. An algorithm is written as to control and manage all the UAVs from the ground. If anyone of the UAVs detects fire, a message is sent to the manager or the ground station and action will be taken by them. The whole space coverage formation of the UAVs is also done by the same algorithm. If anyone of the UAV's charge is down and the battery has to be recharged or if there is any fault in any one of them, then the formation will be broken down and the whole area coverage will not be achieved as the communication links are broken. The manager has to reconfigure the formation with the remaining UAVs.

The paper [4] proposes a system for automatic animal detection using HOG and Cascade classifier algorithm. This system was basically implemented to reduce the number of road and highway accidents occurring due to animal vehicle collision. This can cause death to both human as well as animal. This system is implemented with the main subject animal as cows and the algorithm used works efficiently in all conditions on the highways and roads. This proposed system shows an accuracy of 82.5% in detecting animal from a certain distance. More than 2200 images are fed to the system to make the system learn. The animal detection system with the mounted camera on the vehicle captures the image of an animal approaching the vehicle or stationary on the road or highway and compares it with system fed input images with the help of HOG and cascade classifier, depending on the match found it sends an alert signal to the driver so as to brake and avoid collision.The advantages of the proposed system are that it can be upgraded to do detect animals other than cows with proper testing and training. It helps to wake up the driver by sending an alert signal on detection of animal.The disadvantages are that the animal located at a distance more than 20 meters cannot be detected by this system. Collision can only be avoided only if the vehicle travels within 35 kmph speed limit mark. It can only detect animal when it is in the path of the vehicle. Animal approaching the vehicle from sideways cannot be detected and accidents cannot be avoided.

An early stage forest warning system was developed after certain areas were thoroughly examined with L-band SAR. The experiments in paper [5] were conducted in Brazil and also in Peru. Few active spots were taken in these two countries and four PALSAR-2/ScanSAR sets of data were obtained and were further used for analysis. If any deforestation region was obtained, then that particular region was presented in purple colour in the map. Also when there are many trees, it is presented by dark colour and the same region becomes light green when the trees are cut down. The landset data which says trees are fallen down and left on the ground, is also taken. The landset time series data is taken for around 16days and the PALSAR-2/ScanSAR time series data is taken for every one and a half month. These values are used to calculate the detection of deforestation timings.

The paper [6] discusses about levels of damages due to recent forest fires in October 2008 in Canakkale Province of Turkey, here the images of the satellites LANDSAT and ASTER are used to determine the damage level. The study includes the data about two forest fires happened in Turkey, one fire has started on 18.06.2008, on the European side of the canakkale Strait and was extinguished only after 3 days of burning on 21.06.2008. According to CFMO, a total of 324 hectares of forest area were burned and the total economical loss was estimated to be1.8Million TL (MTL) or about 1.2 M $ and the other fire had started on 30 July 2008, and was fully extinguished out on 02 August 2008. Total of area about1464 hectares were lost to the fire. Total economical losses estimated by ÇFMO were about 5.3 MTL (or ~3.6M$). Once the areal data is obtained various analysis techniques were applied and a procedure frequency distribution of vegetation index values from the fire area before and after the event. Was used to find out the agricultural land burnt and forest area burnt

By this kind of technique is easy to find out the boundaries of fire areas and estimate the extent of fire areas in a quick and economic way.

The proposed system in the paper [7] implement a Support vector machine based segmentation method for forest fire metrology. The obtained results from SVM method is compared with four other techniques using three evaluation protocols.

SVM technique is used because of its wide range of usage in image segmentation. This method involves dividing the RGB color space into two subspaces which are fire colored pixels and the remainder of image. Each fire pixel is characterized by its three normalized coordinates in the RGB plane. Then add label to each training RGB triplet, a label plus 1 for fire pixels and minus 1 for non-fire pixels. They chose Lib-SVM as SVM implementation and selected a radial basis function for the SVM kernel. After getting SVM output, a set of post treatment operations are implemented to remove scattered false positives and bright false positive pixels. Thus this eliminates bright regions including bright fire cores. Hence this paper implement the RGB characteristics of fire pixels which have high red, medium green and low blue value to retain bright fire cores which suits for this purpose.

The three evaluation metrics are F score metric, martins' criteria and Hafianes criteria. The proposed system shows good performance in F Score and Martins criteria but the same performance as other techniques in Hafianes criterion. The drawback of this paper is that precise segmentation of fire was not achieved which also lead to inaccurate fire front positions.

The paper [8] presents the outline of a new and accurate phantom model for skin tissue properties of animals that helps with progress of UHF RFID tags for animals. These phantom layers can be filled with three different artificial tissue substances in order to provide a precise body model for animal tag development and optimization. These three artificial layers epidermis, the fat, and the muscle layer of an animal body are exactly reproduced. This represents an animal body phantom for a subcutaneous placement of RFID transponder. Registration and identification of livestock, pets and lab animals is widely done by RFID with respect to Animal surface layer model, Tissue properties, Spherical phantom, Measurements with spherical phantom, Reader power needed for tag activation. The model has been designed and verified with simulations and subsequent measurements.

The paper [9] evolved instrumentation can be easily exercised 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 reliable means of measuring rotational head angle in birds and potentially in other animals, using a similar marker.
To obtain high perfection, the camera's available resolution must be fully utilized 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 and the camera exposure time must be set appropriately to minimize blurring when the object is in motion.
The techniques of tracking and subsequent control over the search area, as well as adjusting the minimum score and search angle range depending on search outcome in the prior frame can easily be adapted in other detection applications. The instrumentation records timestamp data that is essential for the accurate synchronization of stimuli with behavioural data obtained from cameras operating at a variable fps rate.

The limitations of the developed instrumentation were:

1. Speed of movement of the object of interest, which may lead to blurring and as a result of inability to extract data in a particular frame.
2. The loss of data and fiducial mark being lost due to the view being two-dimensional, out of plane movement of the object of interest has a detrimental effect on the accuracy of the data extracted.
3. The instrumentation depicted here was outlined as an offline analysis of pre-recorded data.

Few basic points were taken into consideration like minimization of errors in extracted data, fine-tuning and trouble shooting of the analysis software. So examination of the repeatability of video data extraction leads to the following:

1. Processing a video with same template produces identical data
2. Using different templates produces errors of which the s.d is less than 0.3 in a good quality video.
3. In the case of an overexposed video s.d. increased to 1.4.

Although techniques have been developed for specific applications to automate the analysis of behaviours, including some commercial solutions, many are not always adequate for that situation or sufficiently flexible .Recording visual observations of animals followed by manual post analysis was most common approach and had the advantage of being non-invasive. The only disadvantage of manual approach was of time consumption and a risk of bias in identifying salient responses. Implementation of a relatively low cost system for video recording and reliable for animal's kinetic responses and this was successfully utilized in our investigation of pigeon head movements by enabling us to record and compare behavioural responses to various types of stimuli.

Animals often wander off into the human living areas or roam along the road side. While they enter the human living areas either the animal can kill human beings or human beings can kill the animal, also while animals wander-off the roadside, the cause of accidents increases. In order to decrease these accidents one of the main technologies used is Image Processing [10]. By detecting the animal's face using a feature called Haar, the presence of animal will be known. The presence of the animal is calculated by calculating the likelihood. The detection of the region in which the animal is present is also done with the help of AdaBoost classifier. More than 680 positive images and 1000 negative images, the system is trained. Since the animals behaviour is non linear and unpredictable it will be very difficult to train any system by just using a motion object therefore an algorithm was developed to check the locomotion of animals, 22 samples turned out to be true positive out of 25 input samples. But there were still few problems like very slow locomotion of the animal of being masked. This algorithm first identifies the face of an animal and makes a model with central area interest. If that particular point leaves or if it is even lost in the interest rectangle, then it is discarded and new image is taken. The system also includes a special feature where in it can combine two independent mechanisms such as detector and tracking modules. This is done to obtain more efficient result.

This paper [11] describes the development and the software-in-the-loop validation of a flight control system for a small fixed wing UAV Currently there is a large interest in low cost unmanned aerial vehicles (UAV) development aimed to civilian applications. The proposed approach follows standard techniques for modelling, linearizing and decoupling the highly nonlinear six degrees-of-freedom dynamics of the vehicle. As a novelty in the UAV field, the participation factors analysis is applied in order to validate the decomposition into longitudinal and lateral-directional dynamics. Thus a linear quadratic regulator is developed for controlling the airspeed and the altitude, while a cascaded proportional-integral-derivative control is adopted for the heading tracking of the lateral dynamics, so to obtain the full waypoint navigation. In this work the lack of ailerons can be considered a peculiar feature of the considered platform since it determines a greater difficulty in controlling the flight of the UAV with respect to other airframe platforms.

The state of the art of different drive train qualification and parameter sets on the topic of Unmanned Aerial Vehicles (UAVs) [12]. Focus is set on a Quadrocopter UAV model; the involved electrical and mechanical systems are analysed. Principal components of the system such as the BLDC motor, the propeller as well as the control systems are studied in depth. Complementing with the analysis of different possible test benches and evaluating the influence on their drive train qualification and parameters. Also, a practical case study of a motor-propeller configuration is provided, analysing its mechanical and electrical performance.

II. GAPS FOUND IN LITERATURE

The UAVs used for the detection of forest fires and tracking of the same is a pretty expensive system and also if there is any fault in the system or if there is any battery back-up need, at that point of the point the area covered by that particular UAV is not under surveillance and that is a big disadvantage [1, 3, 11-12].

The areal data used, sometimes might not give a right analysis. The boundaries are correctly estimated but there is no proper device or sensor used to detect the fire immediately [6].

The belt monitors each and every animal [2] but the belt doesn't have any equipment which stops the sheep from grazing. It is difficult to observe each and every sheep and then go and take required action on it.

The animals are detected (using image processing) in less time using HAAR [4], but if the animals detected when the vehicle is moving with more speed then there are chances that the accident might happen.

Evaluation metrics are used to detect the forest fire [7], but the results are not satisfactory. Most of the time the results are inaccurate

As discussed in paper [4] even the paper [10] tries to identify the animal using digital image processing. But here it first detects only face which requires a lot time. Also very small moments of animals will not be considered i.e., will be masked.

The detection of deforestation land [5], sometimes it is not the deforestation but might be a natural calamity, which will just be detected as deforestation (even if the trees are fallen down). In that case the branches of the trees get dried up and might lead to a fire.

IV. PROPOSED SYSTEM

The animal detection near the boundaries is very vital and to keep them from harming human beings or even themselves is a difficult task. And it is critical to monitor the health of animals constantly and treat them. Wild animals often fight with each other and almost kill one another and humans cannot stop it by intrusion.
We should monitor the health of endangered species and if there is any abrupt change in the temperature of the animal it should immediately be informed to the officers. Should maintain the animal within the boundaries and avoid them to enter into the human living areas so as to protect both animals and human beings and also to avoid fighting between the animals of same and/or different species.

Forest fires either starts by dry leaves or by the friction between the branches of trees, it is very difficult to stop the fires from starting therefore should take measures to stop them from spreading. When the fire starts it is very hard to stop because it spreads in all direction taking many living organisms lives.

Should detect any sign of forest fire and inform the forest officers immediately and should make sure to reduce the fire from spreading and destroying more area including animals. Protecting both animals and trees restores the balance of the ecology. The proposed system deals with a health monitoring and tracking system for animals. This device tracks the animal space and also measures the animal's physiological signal by using ZigBee transceiver and GPS module and GSM module. It also deals with wireless sensor network paradigm for real-time forest fire. The wireless sensor network can detect the forest fires and immediately inform the forest officers about the fire with the location and direction in which the fire is spreading.

There is a RFID tag attached to animals. The temperature sensor (LM35) which is in the tag measures the temperature of the animal and transfers it through ZigBee. The location of the animal is obtained by GPS module and the data delivery is done with the help of GSM module. If there is any abrupt change in the temperature or if the animal is likely to move into human territory then required measures will be taken. There is a shock generator which is attached to the animal where it is triggered at appropriate situation as in if an animal is passing in to human living areas the shock generator can be used to stop the animal before it kills or gets killed.

Temperature sensor or smoke sensors are placed in the bamboo trees and pine trees (since these are the trees which start the fire most of the time). When there are positive values from the sensors indicating that there is a rise in the temperature or if there is lot of smoke then an immediate message to the forest department to help reduce the damage caused by fires and control so that it doesn't harm many animals or even humans.

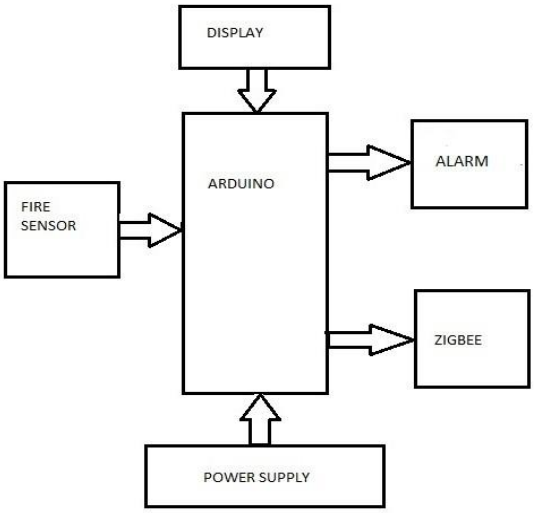

Fig. No: 1 block diagram of animal section.

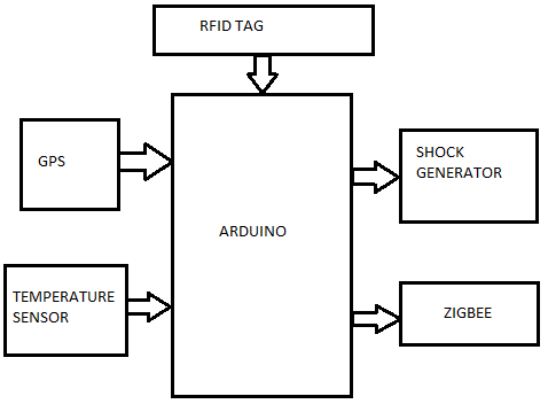

Fig. No: 2 block diagram of tree section.

4. CONCLUSION

Ecology monitoring influences the conditions of the well-being of animals and protection of trees. The proposed system includes safety measures for both animals and forest fires. When an animal's temperature is not normal the forest officials will receive information about the animal's condition. Also if the animal enters into a different land, using the GPS and GSM module the forest official will know its location and can alert the people and can take care of the animal. If in case the animal is about to make contact with a human being or even if the animal is in fight, the shock generator can be used to provide a mild shock and paralyze the animal for few minutes.

In the tree section, the sensors will be placed on the trees. This placement of the sensors will be decided by seeing the previous activities. Whenever there is a lot smoke or if it detects a fire it sends an alert message to the forest official. Then the forest department will know the direction in which the fire is spreading and can take action on it.

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