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An AI Based Disaster Detection Application Using Animals Alerts

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ABSTRACT: The AI-based disaster detection system utilizes animal alerts to continuously monitor vital signs, including heart rate, blood oxygen levels, temperature, and overall activity animal status.
By analyzing these parameters, the system can detect anomalies or distress signals among animals, serving as an early warning mechanism for potential disasters.
This innovative approach harnesses the keen senses of animals to detect environmental changes or impending dangers, offering a proactive and efficient method for disaster prevention and mitigation.

KEYWORDS: AI-based disaster detection system, Animal alerts, Vital signs monitoring, Heart rate, Blood oxygen levels, Temperature, Overall activity, Anomalies detection, Distress signals, Early warning mechanism, Environmental changes, Impending dangers, Proactive approach, Efficient method, Disaster prevention, Disaster mitigation, Keen senses, Innovative approach

I. INTRODUCTION

The introduction of an AI-based disaster detection system utilizing animal alerts represents a groundbreaking approach to enhancing early warning systems for natural calamities. Traditional methods often rely on technological sensors or human observation, which can be limited in scope or effectiveness. Leveraging animals' heightened senses and instincts, this innovative system promises to provide a more comprehensive and proactive approach to disaster detection. By continuously monitoring vital signs and activity levels, it offers the potential to detect subtle environmental changes or anomalies that may precede disasters, thereby enabling timely intervention and mitigation efforts. This stage for exploring the development and potential impact of this cutting-edge technology in safeguarding both human and animal populations from the devastating effects of disasters.

II. PROBLEM STATEMENT

Natural disasters pose a significant threat to communities worldwide, causing immense destruction and loss of life. The lack of early warning systems in many vulnerable regions exacerbates the impact of these disasters. Conventional detection methods often rely on sophisticated technology, which might not be readily available in remote or underprivileged areas. Furthermore, these methods are not always foolproof, and false alarms can lead to complacency or unnecessary panic among the population. Animal behaviour, on the other hand, has long been observed to change significantly before the occurrence of natural disasters. Animals often display acute sensitivity toenvironmental shifts, making their behaviour a potential early warning sign. However, there is a lack of an integrated, reliable, and scalable system that effectively translates these behavioural changes into actionable alerts using advanced AI technologies.

III. RELATED WORK

Since this proposal suggests the use of animals as MBS, both the use of sensors with animals and the existing forest fire detection systems have to be investigated. This section, therefore, gives some information about existing fire and animal behaviour detection systems. Animal behaviour research using sensors has been carried out for some time. A

great deal of scientific research has been conducted with regard to the existence and habitat of the marine and land animals. One such study has collected data about oceans. "UC Santa Cruz researchers are using marine animals outfitted with sensors to collect oceanographic data. For example, sensors on California sea lions collect the animals' location, speed, and dive data along with ocean temperature and salinity information. The data is then transmitted to the researchers via satellite" [2,3,4]. In another study, the first effective method was based on a pyro-detector which sensed the temperature contrast between the animal's body and the surrounding pasture [5]. There are similar studies related to animal tracking using sensors. The main idea is therefore to show the existence of many investigations into animal tracking using sensors. There are many existing techniques used for detection of forest fires. One of the most important is described by Harden et al [6]. Their paper outlines a model which can be readily adapted for analysis of any forest, and has actually been used to examine various fire detection strategies for the Footner Forest in Northern Alberta. Some research is based on image processing techniques, capturing camera segments and processing and classifying these images for fire detection. Using image processing methods, Roy and UNEP have used a satellite for capturing images from forests and, have detected whether there is a fire possibility or not [7,8]. Another satellite application in forest fires detection is by Lafarge et al. They present a fully automated method of forest fire detection from TIR satellite images based on the random field theory where preprocessing is used to model the image as a realization of a Gaussian field. This study shows some interesting properties because the fire areas considered to be in the minority are considered as anomalies of that field [9]. Nakau et al. developed a fire detection information system from receiving AVHRR satellite to output fire detection map and validated the early detection algorithm using AVHRR satellite imagery. Forest fires were detected using an Sensors 2007, 7 3086 algorithm; two-dimensional histogram method by Prof. Kudo [10]. A further study presents a system called Integral Forest Fire Monitoring System (in Croatian IPNAS) [11]. Another study is computervision based forest fire detection and monitoring system where fixed cameras are used [12]. Furthermore, there is a great many forest fire detection studies and systems [13-16]. Research involving the use of thermal and radiation sensors for fire detection and early warning systems can also be found. In his study, Hefeeda addresses the Fire Weather Index (FWI) System, which notes that different components can be used in designing efficient fire detection systems FWI [17]. Ollero et al. have studied a scheme using multi-sensorial integrated systems for early detection of forest fires. Several information and data sources in Olleros's study were used, including infrared images, visual images, data from sensors, maps and models [18]. Casanova et al. present the MSGSEVIRI sensor's ability to detect forest fires and subsequent fire monitoring [14]. There are a number of similar studies on fire detection using sensors. Using animals for disaster detection is not a new idea but it has been limited to a few of disaster types such as earthquake. Yeung describes an example of observing animals' behavior for early earthquake alert, but the author gives no guaranty that his study works correctly for every earthquake [19]. Kahn suggested an idea that the best and the cheapest biosensors are already distributed globally but generally ignored: They're called animals [20]. Kahn's idea leads the scientists to start new investigations to be made on animals. An important research, which is similar to the study proposed in this paper, has been conducted by Lee et al. [21]. In their study, they offered a Bio-adhoc sensors network for early forest fire warning system for mountain areas, and they used animals as wireless adhoc nodes. However, the proposal presented in this paper is based on the usage of many access points explicitly constructed in the forests instead of an adhoc network structure. Although it may not seem to be feasible to install sufficient number of access points to cover whole forests, some critical points which are highly under the risk of fire, can be selected for the access point locations. Moreover, the usage of the access points would remove the risk of interruption of communication (network failure) that usually occurs in adhoc networks, if animals are used as wireless nodes. Furthermore, Lee et al. in their study focused on the usage of animals' behaviour only for detection of fire possibilities this paper, however, focuses on using both animal behaviour classification and thermal detection methods. In this paper, a proposal for a fire detection system combining methods from both animal tracking and current fire detection systems is presented. The system proposed does not claim to detect every possible fire, and can readily be used to augment others.

IV. PROPOSED ALGORITHM

Modern molecular biology is constantly evolving, and it is necessary and feasible to explain abnormal animal behaviour before earthquakes from modern molecular biology. According to modern molecular biology theory, during the course of biological evolution, animals acquired certain specific sensory systems through natural selection. Some species may develop a sensitive auditory system with good infra-sound or ultrasonic hearing; some animal sensory systems can feel the weak vibrations of the outside world; some animals have electrocute-sensing functions that are extremely sensitive to changes in peripheral electric fields. The behavioural abnormal activity of animals before the

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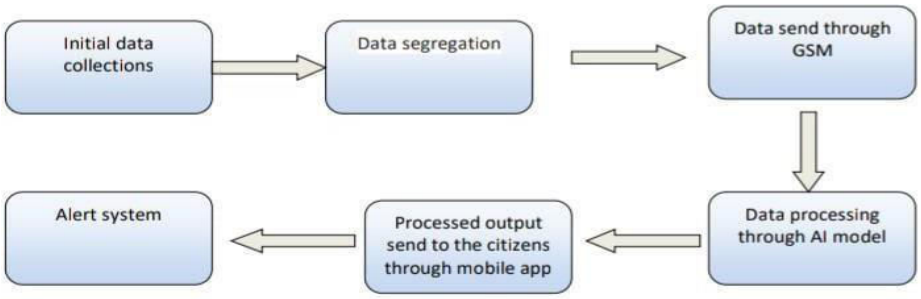
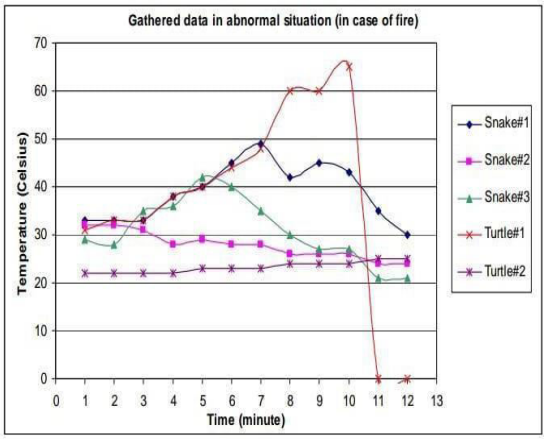
earthquake is mostly through sensory organs, and the sensory conduction response to some geophysical and geochemical signals in the surrounding environment related to the occurrence of the earthquake, and in some form Behavioural activities are shown. Existing preliminary studies on animal habit anomalies before the earthquake show that the animal's ability to perceive the earthquake is also related to the animal's body shape, living habits and special living environment. Domesticated animals are less alert to environmental changes than wild animals. Burrowing animals feel more sensitive than animals on the ground. The reaction time is the earliest. Small animals feel more sensitive than large animals. At different places and at different times, the performance of abnormal animal habits is different. In the earthquake that happened by the sea, the response of marine fish is more sensitive.

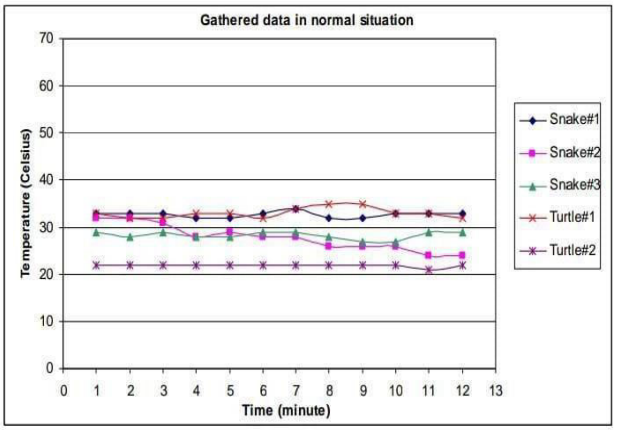
Before the earthquake, the ground stress would cause the cave where the animals live to deform and rupture, causing the intrusion of groundwater or underground toxic gases, etc., which directly affects the burrowing animals and causes their abnormal reactions. Snakes can feel the smell of sulfide and end hibernation; rats are rodents, and there may be four causes of abnormalities before the earthquake: there are ring bodies in the mesentery and interosseous membrane of mice, which are sensitive to mechanical vibration. Otoacoustic information when the rock was slightly ruptured before the earthquake was detected; the sensitivity of the mouse's hearing, coupled with the reverberation and resonance effect of the cave on the sound, increased its reception sensitivity and may be stimulated by external infrasound or ultrasound; the rat's sense of smell is also very Sensitive, may smell some of the gas spilled underground before the strong earthquake; the sensitive sixth sense of the mouse can make it escape the disaster early.

V. BLOCK DIAGRAM



VI. SIMULATION RESULTS





The diagram to the left of shows the temperature values received under normal conditions from MBSs, and the one to the right shows the temperature values received on the abnormal (fire) situation. In the alter, there is a 60°C value

received from Turtle1 in the eighth minute, which is a signal for a problem related to excessive heat. Moreover, the figure shows significant deviations on temperature that can easily be seen between fifth and tenth minutes, and the temperature values are fluctuating for Turtle2 and Snake1-2-3 MBSs, hence, these deviations in the temperatures are possible an indication of a fire. The communication with Turtle1 has been interrupted after the tenth minute, hence, the sensor attached to Turtle1 may have been broken down or it may have run out of battery or it has been burned at the tenth minute. Thus, the location of Turtle1 must immediately be monitored against either a fire possibility or a sensor failure. Actually, a fire initiated at the fifth minute according to the scenario, and fire can possibly be detected beginning from the eighth minute, so this means there is a little delay in detection like three minutes. This scenario is based on the usage of five MBSs for one acre. The amount of such sensors may be increased or decreased according to the type of forest and the risk of fire.

VII. CONCLUSION AND FUTURE WORK

In this paper, a method which uses animals as mobile biological sensors, has been presented. The proposed methodis based on existing animals tracking systems used for zoological studies. Hence, combining these fields may contributeto developments in both animal tracking and forest fire detection simultaneously. Furthermore, combination of two different braches of research into a single system means low cost and more efficiency. The system presented in this paper can be implemented for all kinds of forest fires and can be executed in every natural environment using many different animal species. This system could detect potentially serious forest fires early, reducing their effect, thus helping to reduce the speed of global warming. Since the system presented in this paper has not actually been implemented in any forest, some additional unforeseen disadvantages may occur, however the advantages suggest it could have implemented with considerable environmental benefits. To improve the system, the following could be carried out based on the proposed methods;

1. A number of investigations can be made regarding animal behaviour in case of fire to improve system reliability.
2. A reorganization of classification algorithms to be used for animals' panic detection, could be developed forclassification of MBSs.
3. New sensors can be produced or existing sensors can be improved to increase robustness of the proposed system.
4. New wireless technologies and new satellite tracking systems can be adapted to increase the efficiency of the system.
5. Some studies on fire extinguishing such as using CO2 bombs at the access points for fire spread prevention, can be made. In summary, forests on the Earth are vanishing rapidly due to fire, and global warming and oxygen levels are also becoming more critical for all living things. This paper aims to present an alternative way to detect fire in its early stages, which seems both effective and economic to use.

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