CERTAIN INVESTIGATIONS ON SIGNAL AND IMAGE PROCESSING BASED ANIMAL RECOGNITION SYSTEM TO RESOLVE WILDLIFE CONFLICT

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ABSTRACT

The rescue elephants are utilized by forest officials to guide problematic animals back into the jungle or to capture them using a cage. Conflicts between humans and wildlife are most prevalent near the hilly forest border areas. These conflicts can lead to human injuries and fatalities, property damage, and loss of livestock. In attempts to protect themselves, people sometimes resort to attacking wildlife, resulting in injuries or death for the animals.

This project proposes an automated, unsupervised module for detecting and distinguishing animals based on images captured by cameras. The animal images are stored in JPEG format and transmitted to a base station via a Radio Frequency (RF) network. We have implemented a Deep Convolutional Neural Network (DCNN) for feature extraction and classification tasks. Once an animal is identified, the system sends an alert message through the Global System for Mobile Communication (GSM) to the mobile numbers of rangers, local residents, and FM/radio stations stored in the system.

In this context, the Internet of Things (IoT) plays a crucial role by allowing the results to be displayed on a web page, which forest officials can access whenever needed. This system aims to enhance safety for both people and wildlife.

Keywords: Human-Wildlife Conflict (HWC), Deep Convolutional Neural Network (DCNN), Global System for Mobile Communication (GSM), Internet of Things (IoT).

IINTRODUCTION

Humans have played a role in natural reclamation for millennia. However, in recent years, human intervention has increased significantly. The fragmentation of natural habitats has created a complex interface between humans and wildlife. Large carnivores often confront livestock, cause crop devastation, or pose threats to people in their quest for food, leading to conflicts between humans and wildlife. Consequently, conserving these animal populations while protecting human interests has become increasingly challenging.

With the rise of agriculture, the cultivation of crops and the rearing of domestic animals have intensified interactions between humans and wild animals. The resulting increase in human-wildlife conflicts has left people frightened of wild animals, prompting some to relocate from hill stations to lower terrains. This migration has reduced the human population in certain areas while simultaneously increasing the number of hunted animals in border regions.

To mitigate human-wildlife conflicts, local communities have traditionally employed various methods, including shouting, using firecrackers, shining bright lights, and throwing stones. However, these methods have shown little improvement in ensuring safety. There is a need to reconsider these traditional approaches because agitating wild animals could lead to significant crop damage, severe injuries to humans, and harm to domestic animals, potentially resulting in fatalities.

Human-wildlife conflict is an emerging area of research. Studies have highlighted the significant role that agricultural activities play in the livelihoods of communities, particularly in areas such as tea plantations. Cattle rearing serves as a secondary source of income for people residing in the Valparai Plateau. Some residents in this region move their cows, sheep, goats, and other livestock from one location to another in search of water sources and grasslands. Unfortunately, during these migrations, their cattle are frequently attacked by wild animals like leopards and tigers.

IILITERATUREREVIEW

Hayward et al. discussed that conflicts occur globally; however, some common conflicts, such as attacks on birds, geese, small animals, and rare species, happen in the hills and mountains surrounding areas where humans have driven wolves out of Asia, North America, and Europe. Similarly, jaguars (Panthera onca) in the Americas, lions (Panthera leo) and wild dogs (Lycaon pictus) in Africa, and tigers (Panthera tigris) in Asia have seen their ranges severely reduced.

Bakhit et al. focused on conflicts involving proboscides (elephants) and Artiodactyla (including swine, deer, and hippopotamus) as these animals frequently come into conflict with humans. Nearly 60% of the 74 largest ground herbivorous species with a body mass of 100 kilograms or more are in danger due to factors such as hunting, competition with other species, and ecological changes.

Tripathy et al. described forced raiding, which occurs when animals lose their regular habitats due to severe degradation. Elephants, in search of food, may raid crops to meet their needs. Consequently, effective guarding of crops becomes essential. A robust framework is statistically evaluated through cross-validation.

III EXISTINGSYSTEM

This study introduces an analysis model that utilizes heat-sensitive infrared camera images. Thermography is an imaging technique that maps variations in the body's surface temperature, potentially revealing vascular, neurological, or inflammatory conditions. The proposed method facilitates the early detection of inflammatory processes, helping to reduce the unnecessary

stress often associated with veterinary examinations and promoting quicker recovery.
A recognition framework was developed using a dataset collected via a thermal camera in a natural setting. This system includes images of wild deer as a unique species of study. It employs a combination of Histogram of Oriented Gradients (HOG) and Convolutional Neural Network (CNN) models. The results demonstrate that this system surpasses other tested machine learning algorithms, achieving a detection accuracy of approximately 91% for wild deer located on roadsides.

IV BLOCKDIAGRAM

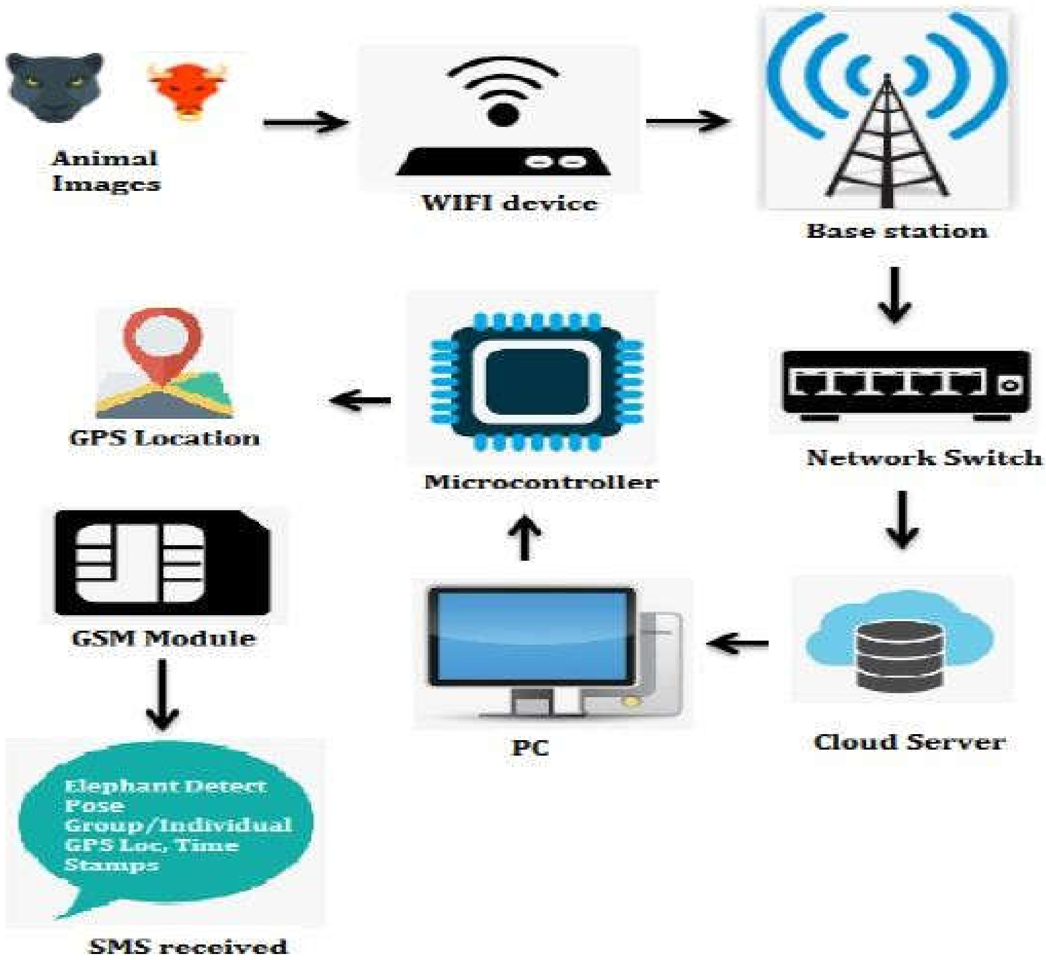


Figure: The system architecture of the proposed animal detection model

V PROPOSEDMETHODOLOGY

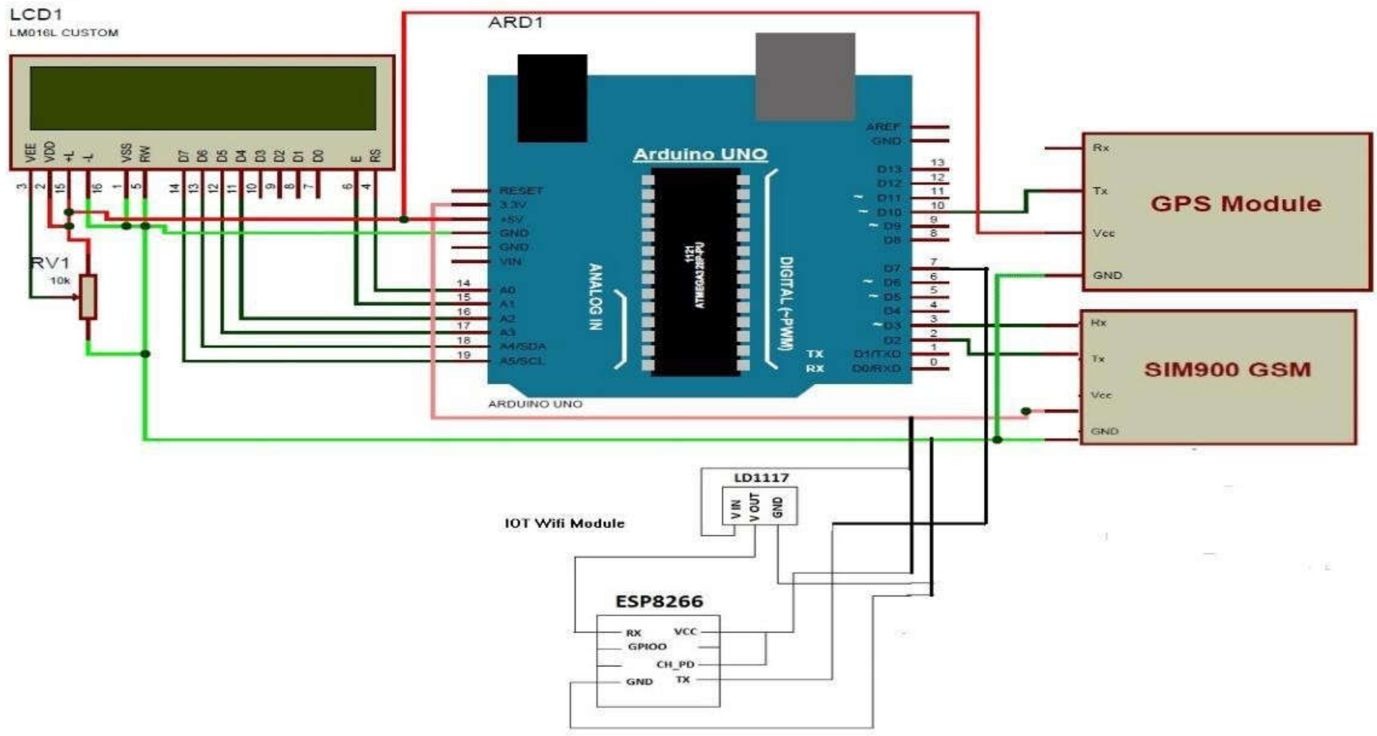
For our proposed scheme, we focus on the acoustic samples of elephants, leopards, and bears as target species for recognition and classification. Some of these samples were collected from forest officials, while others were downloaded from various websites in .mp3 format. These samples were then filtered and transformed into a uniform format. We used Audacity software, which operates at a sampling rate of 44.1 kHz, to convert the .mp3 files to .wav format at 16 bps (bits per second). The recorded acoustic samples of the target species are stored in read-only memory within the processor. They can also be permanently saved on an external hard drive or personal computer (PC) for future use.

1) From the environmental sound signals, we extract animal sounds and detect the presence of the target species (elephant, leopard, and bear). Once identified, we determine whether the animal is solitary or part of a group.

2) If a single animal is detected, we estimate its age (adult or calf).

3) For a single adult elephant, we assess its State of Mind (SOM) to determine whether it is stressed or relaxed. A stressed elephant has a higher likelihood of attacking humans and their belongings.

4) Information regarding animal detection, along with the log date, time, and location (latitude and longitude), is sent as a Short Message Service (SMS) to forest officials, local residents living near high-conflict areas, and FM/radio service stations. This information is also updated on a dedicated webpage using the Internet of Things (IoT).



VI ADVANTAGES

The objective of the presented system is to develop a robust model for detecting wild animals that enter residential areas and create conflicts, especially in hilly regions. These conflicts can occur for various reasons, leading to human injuries and fatalities, significant property damage, and livestock loss. To mitigate human-wildlife conflicts, we have developed an early warning and monitoring module. This module assists in the following ways to prevent these issues:

First, we apply signal processing techniques and machine learning algorithms to analyze the acoustic signals of different animal species, enabling us to detect their presence.

Second, we utilize image processing combined with deep learning techniques for animal detection, emphasizing intra-class classification.

Finally, we implement thermal image processing integrated with deep learning techniques for effective detection of animals at night.

Based on the results obtained from these methods, an early warning message is sent via SMS to local residents, nearby forest authorities, and radio/FM stations. Additionally, this information is stored on a dedicated website for future reference, allowing forest officials to monitor it using a user ID and password on an IoT platform.

VII APPLICATION

1. Medical Imaging Techniques:
   - MRI and CT Scans: Enhancing the clarity of MRI and CT scans for improved diagnosis and treatment planning.
   - X-Ray Imaging: Improving the quality and detail of X-ray images to detect fractures, tumors, and other anomalies.
   - Ultrasound Imaging: Enhancing ultrasound images for more accurate visualization of internal organs and fetal development.

2. Remote Sensing:
   - Satellite Imaging: Analyzing satellite images for applications such as land use mapping and resource monitoring.
   - Aerial Photography: Using drones and aircraft to capture high-resolution images for mapping and surveying.
   - Environmental Monitoring: Tracking environmental changes and natural disasters through image analysis.

VIII RESULTSANDCONCLUSION

Animals are an integral part of nature, and protecting them is a fundamental responsibility for every individual. However, avoiding conflict with animals is a sensitive issue. Human-animal conflict avoidance is the primary focus of this research. The objective of the presented study is to develop a robust detection system that takes into account various critical factors related to animal detection and is implemented as an accurate platform.

The proposed research incorporates key technologies such as audio processing, digital image processing, thermal image processing, deep learning, and embedded systems for the novel implementation of early warning and monitoring modules. This framework acts as an early warning system that identifies an animal and provides information, including its intra-class classification and GPS coordinates. This data is sent via SMS to local communities, forest officials, and local radio channels.

Using the Internet of Things (IoT), the collected data will be updated on a web server and saved in the cloud. A dedicated web page will be designed with a User ID and secure password, ensuring that access is granted only to authorized personnel. On this page, GPS coordinates (latitude and longitude), animal type, gender (in the case of elephants), age assessment (calf or adult), grouping (group or individual), pose recognition, log time, and date will be recorded.

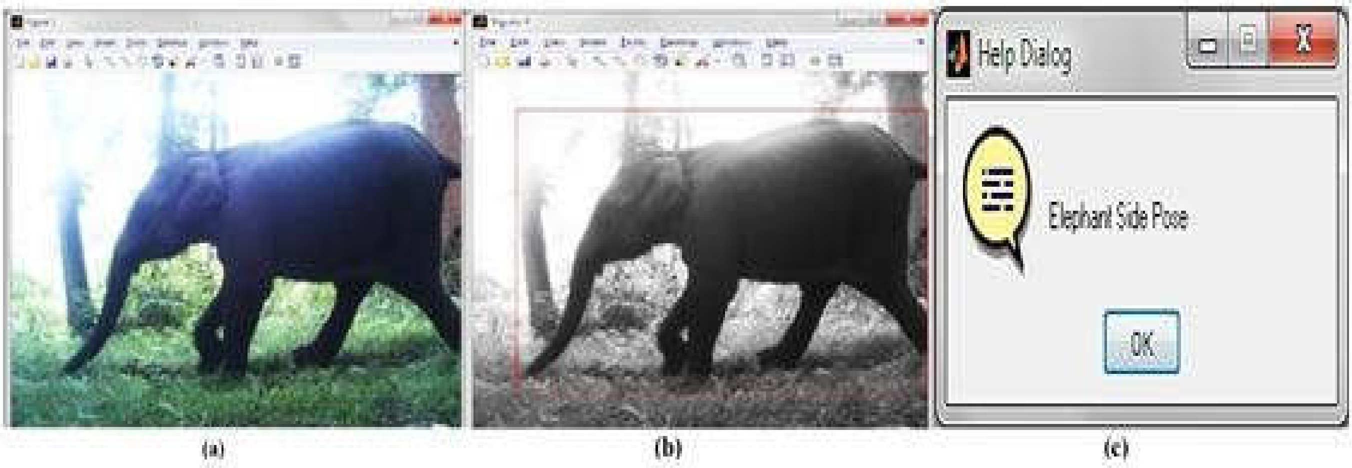


Figure:Result for Elephant Detection (a) Input (b) Pre-processed input (c) Output

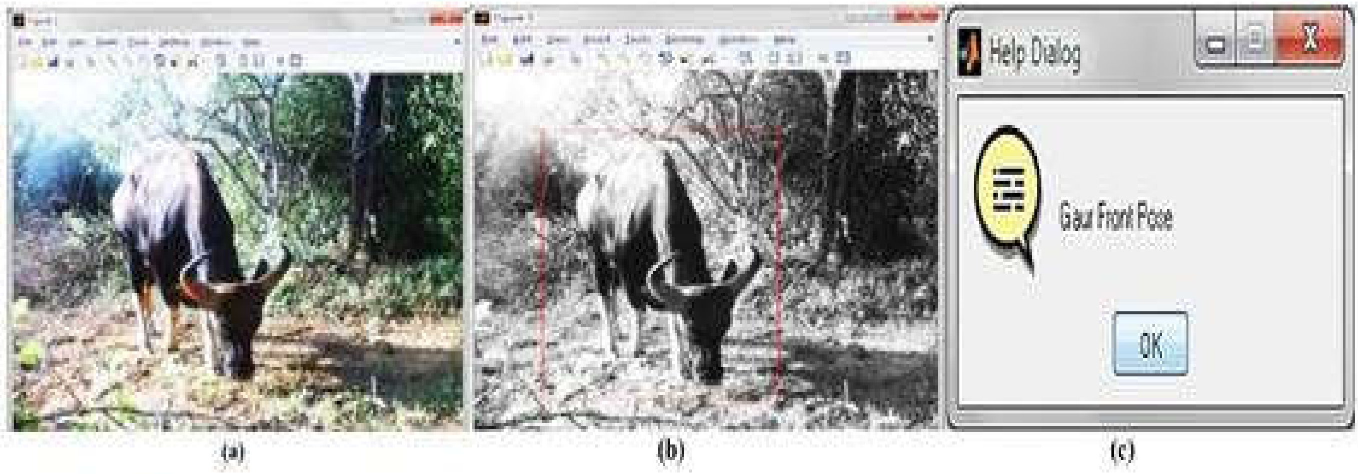


Figure:Result for Indian Gaur Detection (a) Input; (b) Pre-processed input (c) Output

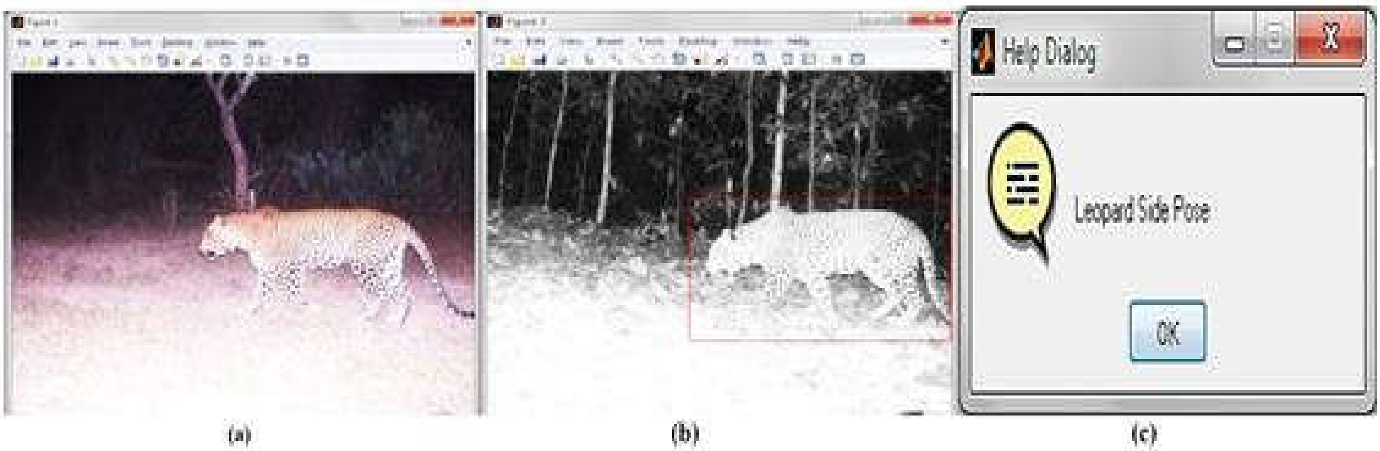


Figure:Result for Leopard Detection (a) Input (b) Pre-processed input (c) Output

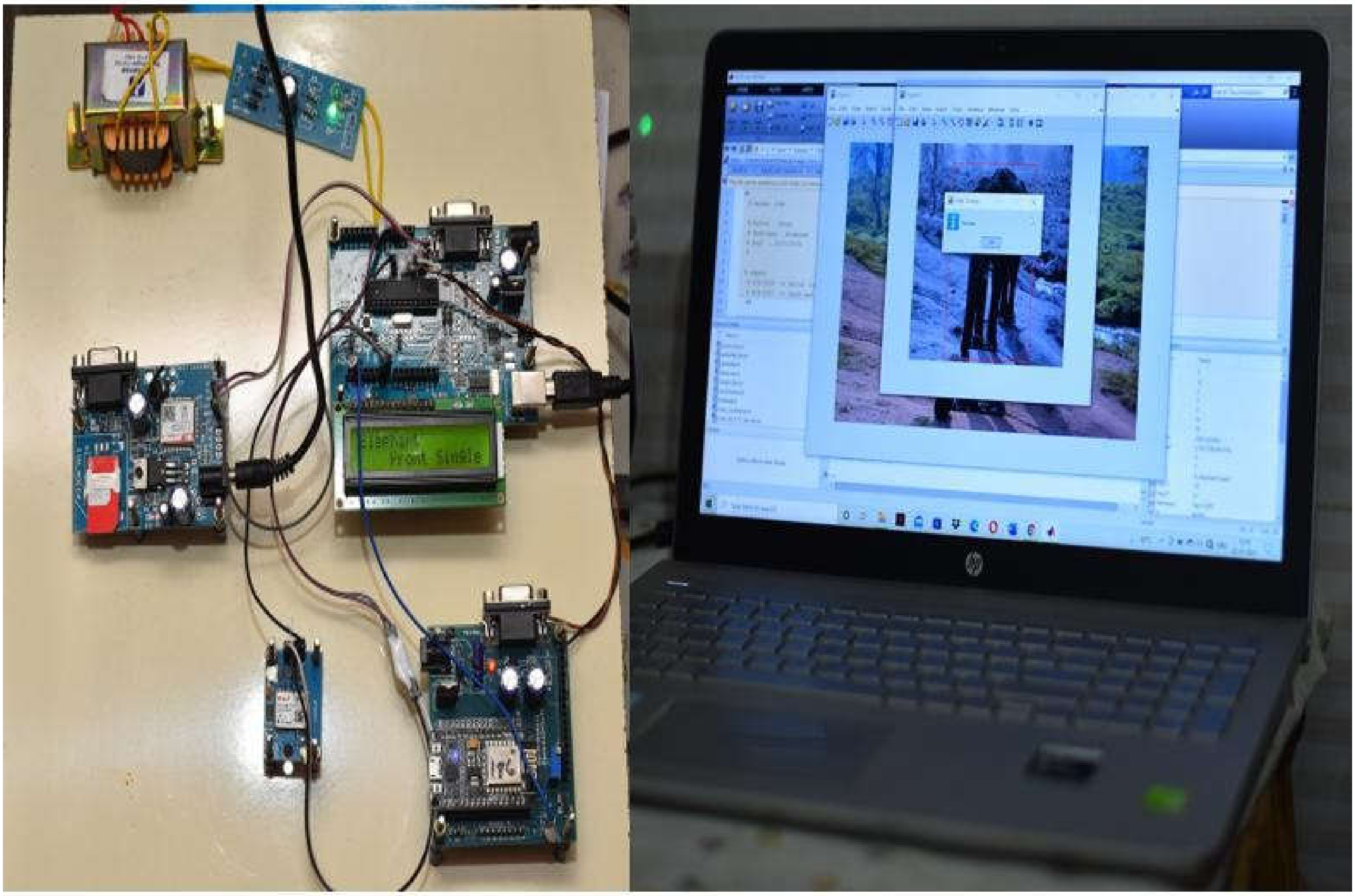


Figure: Experimental Hardware setup for Animal Detection and Discrimination system

IX FUTURESCOPE

acoustic signals, we can significantly boost accuracy if we train on a more extensive collection of animal acoustic datasets. Additionally, refining the training and testing of audio samples for the target animal species can lead to substantial improvements in accuracy.

In the realm of digital image processing, we focus on the classification of various animal species, including Gaur, Elephant, Bear, and Leopard. A major challenge in the detection process arises from dealing with images of animals that are occluded, overexposed, or captured in unexpected postures..

X REFERENCES

1. Angela S. Stoeger, Matthias Zeppelzauer, and Anton Baotic (2014). "Age Group Estimation in Free-Ranging African Elephants Based on Acoustic Cues of Low-Frequency Rumbles." Bioacoustics, vol. 23, no. 3, pp. 231-246..
2. Catherine Jampel (2016). "Cattle-Based Livelihoods, Changes in the Taskscape, and Human–Bear Conflict in the Ecuadorian Andes." Geoforum, vol. 69, pp. 84-93.
3. Chen, Ruilong Little, Ruth Mihaylova, Lyudmila Delahay, Richard Cox & Ruth 2019, ‘Wildlife surveillance using deep learning methods. Ecology and Evolution’, vol. 9, no. 17, pp. 9453-9466.
4. Cilulko, Justyna; Janiszewski, Pawel; Bogdaszewski, Marek; and Szczygielska, Eliza (2012). "Infrared Thermal Imaging in Studies of Wild Animals." European Journal of Wildlife Research, vol. 59.
5. Corcoran, E.; Winsen, M.; Sudholz, A.; and Hamilton, G. (2021). "Automated Detection of Wildlife Using Drones: Synthesis, Opportunities, and Constraints." Methods in Ecology and Evolution, vol. 12, no. 6, pp. 1103-1114..
6. Devi, K.J. and Thongam, K. (2019). "Automatic Speaker Recognition with Enhanced Swallow Swarm Optimization and Ensemble Classification Model from Speech Signals." Journal of Ambient Intelligence and Humanized Computing.
7. Darras, Evin; Pütz, Peter; Fahrurrozi; Rembold, Katja; and Tscharntke, Teja (2016). "Measuring Sound Detection Spaces for Acoustic Animal Sampling and Monitoring." Biological Conservation, vol. 201, pp. 29-37.
8. Favorskaya, M. and Pakhirka, A. (2019). "Animal Species Recognition in Wildlife Based on Muzzle and Shape Features Using Joint CNN." Procedia Computer Science, vol. 159, pp. 933-942.
9. Feng, Wenzhao Zhang, Junguo Hu, Chunhe Wang, Yuan Xiang & Qiumin Yan Hao 2018, 'A σovel Saliency Detection Method for Wild Animal Monitoring Images with WMSσ', Journal of Sensors, pp. 1-11.
10. Figueroa, K, Camarena-Ibarrola, A, García, J & Villela, HT 2014, 'Fast Automatic Detection of Wildlife in Images from Trap Cameras.Lecture σotes in Computer Science', pp. 940-947.
11. Francisco-Javier Ferrández-Pastor, Jerónimo Mora-Pascual & Daniel Díaz-Lajara 2022, Agricultural traceability model based on IoT andBlockchain: Application in industrial hemp production, Journal of Industrial Information Integration, vol. 29, pp. 100381.