**Abstract**

This project is aimed to propose a computerized system to provide a solution to the following topic "Human Elephant Conflicts". As a sustainable solution for this problem, this research proposes the following early-warning system to be developed "An Artificial Intelligence-based Human Elephant Conflict Mitigation System." Sri Lanka is famous for wild animals and their natural beauty. Elephants are one of the critical components of Sri Lankan tourism. However, human-wild elephant conflicts are the most frequently reported issue in rural areas of our country. Several lives and properties have been lost due to past conflicts between humans and elephants. The idea of the proposed system is a bit complex. But, it is very straightforward to understand that this system is going to perform the following methodology to prevent human-elephant conflicts: At first, this system will process the video(frame by frame) from CCTV / wildlife camera traps devices and try to discover elephants in video frames, and if it is found, then it sends an early warning message to the corresponding village with the current GPS location (Where the elephant is identified) to alert the village people to take actions to prevent damage. This system uses external methods to block (scare) elephants, such as the artificial sounds of buzzing bees and monkeys; a study shows that elephants are a bit afraid of buzzing bees and monkeys' sounds. Therefore, this system will play those sounds artificially to take action to prevent elephants from entering the village while sending an early warning message to the corresponding village people's mobile phones with the GPS location. Currently, the government is using the electric fence methodology to block elephants from entering villages. However, elephants are capable of breaking the fence and entering villages. Now, there is no intelligence camera to take over the process of alerting people and scaring elephants; in some places, there are no electric fences, and they cannot be installed in paddy field areas. In some rural parts of Sri Lanka, this task is assigned to real humans; their job is to monitor/watch for elephants in the middle of paddy fields or sitting in jungles during the nighttime like a watchman; if they find elephants, they will alert the village people and let them take actions, this is one of the problems that this project is aimed to sort out. This research is trying to build an Artificial Intelligence-based system that is capable of sending early warning messages and blocking elephants from entering villages using some external methodologies as mentioned above. As technological tools, this project will use computer vision, the subset of artificial intelligence technology, and other programming languages and frameworks like Python and TensorFlow, OpenCV, Databases, web technologies, mobile technologies, etc. This system should have the ability to monitor elephants during the day/nighttime to provide efficient results. This research is aimed at building a software product for sorting out the problems that the outcome of this research will come in the form of software; there are no hardware devices to be built. Implementing these kinds of smart systems will prevent many kinds of problems in the country, which will lead us to build powerful and productive societies that stick with technology to have beautiful lives for everyone.

**Introduction**

This chapter provides the basic information about the proposed project, it is explaining the project background and the problem that this research is trying to solve, the reasons behind this project’s implementation, and explains clearly how this process is manually done with manpower and how this proposed project is implementing that method with artificial intelligence to look for elephants instead of humans sitting and waiting for elephants.

This chapter also went through the project's aim, objective, and sub-objective, clearly defined the aim and ultimate scope of the proposed project, and explained the artifact's description and the prototype.

**Project Background**

The conflict between humans and elephants is one of the most reported issues and severe conservation concerns in elephant-range countries. Several management strategies have been developed and employed at different scales to reduce conflicts between people and elephants worldwide.

Human-elephant conflict is one the most popular and much-debated topics in Sri Lanka. There were 14,516 total numbers of human-elephant conflict cases reported during 2010–2019. Approximately three hundred elephants were intentionally killed by humans each year; there were 807 total human deaths and 10,532 property damages caused by human-elephant conflicts in Sri Lanka, according to a 2020’s research paper.

Moreover, Sri Lanka has endangered subspecies of elephants (Elephas, Maximus); therefore, protecting these species of elephants is one of the huge responsibilities of the Sri Lankan communities to maintain the natural beauty and tourism sector.

Still, there is no solid solution to this problem. Currently, many innovators and social workers are motivated to build solutions that are all on prototype levels, such as IoT sensor-based systems for detecting elephants. The only implemented system for this problem by the government is an electric fence, which does not even work properly. In contrast, elephants can break the fence; sometimes, the electric fence methodology does not work efficiently as expected.

However, This AI approach uses a camera and computer vision technology to process video, identify elephants, and block them by providing the buzzing bee sounds and sending an early warning message to the nearest village regarding the elephant intrusion; this will give a glimpse to the village people to be alert, and at the same time, the system plays buzzing bee sounds artificially to block elephants entering the village, normally, this method is done by manpower in some villages there are some humans sit and watch for elephants during night time. If the elephant is found, they forward the message to the nearest village; this research aims to automate this manual to machines with artificial intelligence technology.

In Sri Lanka, many youngsters and innovators are naturally motivated by this problem, especially people from the rural areas of the country; this problem provides many reasons for innovators to be invented a solution for this problem.

**Aim**

The primary aim of this project is to build an automatic elephant intrusion detection system to send an early-warning message to the nearest villages and try to block elephants using some external artificial sound effects.

**Main Objective**

* + To compare existing elephant detection models.
  + To build an AI model for elephant detection in the daytime using deep learning algorithms.
  + To build an AI model for detecting elephants at nighttime using deep learning algorithms.
  + To develop a web panel to facilitate monitoring.
  + To test and evaluate the accuracy

**Sub Objectives**

* + Build an AI model for daytime detection
    - Collect daytime elephant images
    - Label images
    - Cleanup image data
    - Prepare dataset
    - Write a Python script to build the model with TensorFlow
    - Train the model (AI Brain)
  + Build an AI model for nighttime detection
    - Collect nighttime elephant images
    - Label images
    - Cleanup image data
    - Prepare dataset
    - Write a Python script to build the model with TensorFlow
    - Train the model (AI Brain)
  + Build a monitoring system in Python (Main System)
    - Write a Python script to inference the trained models
    - Implement OpenCV to process the videos (Input)
    - Write logic to break videos into frames
    - Process frames with the trained models to look for elephants from the video input.
    - Write logic to send SMS/Emails as early warning messages to the nearest villages based on the GPS location.
    - Write logic to play artificial sounds of buzzing bees and monkeys to block (scare) the elephants
    - Write a logic to update the database if elephants are found with time/date.
    - Write logic to automatically swap AI models depending on the day/nighttime; during the nighttime, the nighttime AI model (AI Brain) will be working, like that during the daytime, the daytime AI model (AI brain) will be working.
    - Write logic to run all processes in a looping manner.
  + Build a web panel (Management System)
    - Design the web panel (UI/UX)
    - Create the web panel with MERN Stack.
    - Connect the monitoring system’s (Main System) database with this web panel to view information on elephant discovery.
* Testing the functionalities
  + Test daytime AI model accuracy.
  + Test nighttime AI model accuracy.
  + Test the main system functionalities.
  + Test the web panel functionalities.
* **Features**
  + Able to identify elephants in video frames.
  + Able to send early warning messages to nearest villages.
  + Able to send emails/SMS as warning messages.
  + Able to block elephants via playing artificial sounds of  buzzing bees and monkeys.
  + Able to send GPS location with warning messages.
  + Able to view elephant discovery history in the web panel.
  + Able to switch AI models (AI brains) automatically depending on the time (daytime/nighttime).

**Description of the artifact**

In Sri Lanka, there is no solid solution for this problem; this project tries to implement artificial intelligence technology-based solutions for human-elephant conflicts. There are many similar technological solutions, but none of them are in operation except the electric fence method; in Sri Lanka, many innovators are building IoT-based technologies for this problem; however, this research introduces artificial intelligence technology and tries to automate a manual process by machines.

This artifact tries to automate the following problem statement in some rural parts of Sri Lanka during the nighttime daytime; a man will be assigned to a task to watch for elephants, especially in the nighttime, that watchman (usually a farmer) needs to watch for elephants if the elephant comes, that watchman needs to report to the nearest villages as an early warning alert.

This research is willing to replace this process with artificial intelligence technology, that this research implements an AI technology that could do the same process with machines without manpower.

The artifact will be a computer-based artificial intelligence software program that can see the elephant with computer vision technology and has the ability to send an early warning message to the nearest villages to be alert. This system will block the elephants from entering the villages by playing the artificial sounds of a buzzing bee since the elephants are afraid of bees’ sounds.

Technically, this system has two parts: a **monitoring system** and a **management panel**. The primary tasks of the monitoring system are **looking for elephants** by processing the vision from a camera source and **sending early warning messages** to the corresponding villages.

The primary tasks of the management panel are storing information on elephant detection and having the ability to set settings for the monitoring system example, the password can be changed from the management panel, and the detection parameters can be changed from the management panel; likewise, the detection method could be changed from the management panel.

There are two detection methods used in the monitoring system is using those are with motion detection method and with full processing method; full processing method is computationally expensive since it processes all the frames from the video source, and the second method is motion detection based, which can only process vision that has movement, if any big changes happen in the screen, then it will send the frames for model processing, these settings and parameters can be set from the management panel.

Therefore, the ultimate scope of this system is to send early warning messages to corresponding villages when an elephant detects and tries to block the elephant by playing artificial bee sounds, basically, this project tries to automate the manel works without manpower but with machine power.

**Project Plan**