**Project Proposal**

| **Student Name** | Gunarakulan Gunaretnam | |
| --- | --- | --- |
| **Student Number** | 2208408 | |
| **Course** | B.SC (Hons) Computer Science and Software Engineering | |
| **Supervisor Name** | Ms. Nideshika Ellepola | |
| **Course Coordinator Name** |  | |
| **Title of Project** | An Artificial Intelligence based Human Elephant Conflict Mitigation System | |
| **Abstract of the project** | * 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/night time 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. | |
| **Project deliverables** | * **Software**   + Daytime AI Model   + Nighttime AI Model   + Monitoring Software (AI)   + Web Panel (To see the records of elephants discovery) * **Documentation**   + Project Proposal   + Thesis Report   + Reflective report   + Final Report   + Test Report | |
| **Description of your artifact** | * **Existing Similar Projects**   + In Sri Lanka, there is no completed product for this problem, even, there is no AI-based solution for this problem, but, there are some similar prototype level projects (Rucksikaa Rajkumar 2020) that they are detecting elephants using IoT / electronic devices using sensors to detect the large size of object and then predict that the large-sized object may be an elephant but, that does not give accurate results than AI approach and these projects are under the research & development level. But, our approach is to use a camera and AI to process video with computer vision technology, this approach can provide better accuracy than the sensor-based method.   + There are some projects internationally for this problem, and Africa is also facing the same problem, human-elephant conflicts, therefore, On World Elephant Day 2020, two organizations decided to build a solution for this problem, NGO RESOLVE and CVEDIA organizations came up with an idea to provide a solution called “WildEyes AI”, the idea is to place hidden cameras in trees to monitor elephant and give warnings using artificial intelligence technology, they launched a testing prototype in Africa, this project is still in further development, our project is somewhat related to that project, but, we are using some external artificial sounds effects to try to block elephants instead of only informing the village and also we are using GPS technology, but in Sri Lanka, no more startups or completed projects 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. * **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.     - Implement GPS and write a logic to get the current location (coordinates) programmatically.     - 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 and GPS location.     - Write logic to automatically swap AI models depending on the day/night time, 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). * **Values Added**    + Able to change different models (change AI brains) to identify different objects (Lion/human/animals or any objects) in the future, in the future this system could be used to do the same for lions, tigers, or any types of objects.   + Able to stop the main system from the web panel, the full control of the main system will depend on the web panel. * **Intellectual Challenges**   + The implementation cost can be high.   + real-time testing is a bit risky since it is very dangerous to set up the camera and work in the wild/forest with elephants.   + Dataset collection bit tricky, we need to go to some zoos to take images of elephants, it is very difficult to take wild elephant's images in a forest.   + Nighttime data collection is also a bit tricky, we need to collect night vision images of elephants to train the nighttime AI model. * **References**    + *Rucksikaa Raajkumar: Prevent conflicts and protect Elephants with the help of AI article (October 18, 2020)*   + *WildEyes: helping to save wild elephants and prevent human-elephant conflict (2020 by NGO RESOLVE CVEDIA)* | |
| **What methodology (structured process) will you be following to realize your artifact?** | * **Methodology**   + This project is going to use the Agile methodology for development purposes since It involves artificial intelligence technology, normally, AI models are needed to be tested and evaluated frequently, therefore, we can’t go with a single shot / oneway methodology, we need to change the parameters such as weights, biases sometimes increase images to achieve good detection rates, so, at each stage there has to be a testing phase, if the testing goes wrong, then we need to add extra features or try in another way to fix the training process to finetune the AI model, the development, planning, researches, these three cycles are needed to be repeated many times during the development period. At beginning of this project, we will engage in the dataset preparation stage, we need to create a better dataset for a better AI model, for the training purpose, we need to train the AI model with the collected dataset, if the detection rate is low, this cycle will be repeated. Therefore, Agile is well-suitable for the project and it helps the project achieve faster. | |
| **How does your project relate to your degree course and build upon the units/knowledge you have studied/acquired** | * This project correlates with a lot of programming skills and software development methodologies those skillsets are acquired from our course of study, it also involves artificial intelligence, computer vision, AI model training, TensorFlow, OpenCV, and much more technical based frameworks & programming tools that are essential for the industrial opportunities, this project also involves much management and researching methodologies, this project has to be aligned with the researching methods that are acquired from our degree program, it makes the project delivery and outcome much easier, this project also involves into web panel development where MERN stack is needed to be used, therefore, nodeJS, Express.js, MongoDB, React.js these kinds of web development technologies are needed to be utilized in order to deliver the final product in a complete manner, this project correlates with skills from degree as well as it helps to gain some industrial experience, whoever engages in this project will be trained on development skills and also project management skills that are acquired from the degree program. | |
| **Resources** | * **Hardware**   + Laptop   + Camera   + GPS   + Mobile Phone * **Software**   + Documentation Tools     - Google Workspace     - MS-Office     - Emails   + Programming Languages & Frameworks     - Python     - TensorFlow     - OpenCV     - Keras     - Smtplib Module     - Urllib Module     - NodeJS     - ExperssJS     - MongoDB / MySQL     - React.JS     - Websocket     - HTML     - CSS     - Bootstrap   + Text Editors     - Visual Studio     - Visual Studio Code     - Sublime Text 3   + Other tools     - Other supporting tools / debugging tools | |
| **Have you completed & submitted your ethics form?** | YES | NO |
| **Acknowledgement**  I have been working on the human-elephant project for almost 2 years, I have the motivation naturally to provide a solution to this problem, at first I built a sensor-based prototype for this problem 2 years ago as a fun project, the reason why I am really eager about this problem that there is an emotional story behind it, I lost my friend in a human-elephant accident during the school time, my friend is from a rural area of Sri Lanka called “Koduvamadu”, where a lot of elephants are there, still, we use many properties and lives because of this problem, Earlier, I read more research papers about this problem, I did some basic works on this using traditional methodologies such as sensor-based, size-based detection and etc, But, this time, I am going to use deep learning technology, I brainstormed this idea and added some extra method that is mentioned in the proposal above. This complete idea came one day when I was traveling to Colombo from Batticaloa at night on the bus, our bus was broken down in a jungle-based place, I was sitting inside the bus, and I noticed that there are some humans near the paddy field area and watching for elephants, they make shouting when they see elephants, then I got to realize that we can convert this manual task as digital, why don’t we build an AI camera that watches for elephants and gives alerts, that would be super-efficient, this is how this idea was born. | | |

**Supervisor Signature:**

**Student-supervisor meeting schedule:**

| **Supervisor’s name** | **Student’s name** | **Meeting on the day of the week** | **Meeting at the time of the day** |
| --- | --- | --- | --- |
|  |  |  |  |
|  |  |  |  |

**Course Coordinator Signature**

**After the proposal has been signed off by both the supervisor and course coordinator scan the proposal and upload on BREO with signatures. Projects that follow proposals that have not been approved may be canceled and there will be no compensation for any time lost.**

**Part 2 – List of relevant resources**

*Fill in this section after your project proposal has been approved by your supervisor. Use Harvard referencing (see* [*https://lrweb.beds.ac.uk/a-guide-to-referencing*](https://lrweb.beds.ac.uk/a-guide-to-referencing) *). Modify the list below as appropriate. This list is part of Assignment 1 and will be submitted with the Project Proposal.*

1. *Books*
   * *…*
   * *…*
2. *Journal Papers*
3. *Web Sites with relevant information*
   * [*https://www.sjp.ac.lk/news/wireless-sensor-network-to-solve-human-elephant-conflict-replacement-for-existing-electric-fences/*](https://www.sjp.ac.lk/news/wireless-sensor-network-to-solve-human-elephant-conflict-replacement-for-existing-electric-fences/)
   * [*http://dl.lib.uom.lk/bitstream/handle/123/15793/TH3856-2.pdf?sequence=3&isAllowed=y*](http://dl.lib.uom.lk/bitstream/handle/123/15793/TH3856-2.pdf?sequence=3&isAllowed=y)
   * [*https://www.researchgate.net/publication/352675524\_Modern\_Solution\_for\_Human\_Elephant\_Conflict*](https://www.researchgate.net/publication/352675524_Modern_Solution_for_Human_Elephant_Conflict)
   * [*https://github.com/datitran/raccoon\_dataset*](https://github.com/datitran/raccoon_dataset)
   * [*https://towardsdatascience.com/how-to-train-your-own-object-detector-with-tensorflows-object-detector-api-bec72ecfe1d9*](https://towardsdatascience.com/how-to-train-your-own-object-detector-with-tensorflows-object-detector-api-bec72ecfe1d9)
4. *Relevant software*
   * Python
     1. <https://www.python.org/>
   * TensorFlow
     1. <https://www.tensorflow.org/>
   * OpenCV
     1. <https://opencv.org/>
   * Keras
     1. [*https://keras.io/*](https://keras.io/)
   * NodeJS
     1. <https://nodejs.org/en/>
   * ExperssJS
     1. <https://expressjs.com>/
   * MongoDB
     1. <https://www.mongodb.com/>
   * MySQL
     1. <https://www.mysql.com/>
   * React.JS
     1. <https://reactjs.org/>
   * Bootstrap
     1. <https://getbootstrap.com/>
   * Visual Studio
     1. <https://visualstudio.microsoft.com/vs/community/>
   * Visual Studio Code
     1. <https://code.visualstudio.com/>
   * Sublime Text 3
     1. <https://www.sublimetext.com/3>
5. *Relevant hardware*
   * USB GPS Receiver:
     1. <https://www.amazon.com/Receiver-Antenna-Gmouse-Laptop-Navigation/dp/B073P3Y48Q/ref=sr_1_1_sspa?keywords=usb+gps+receiver&qid=166671103sr=8-1-spons&psc=1>
   * HD Webcam:
     1. <https://www.daraz.lk/products/logitech-c270-hd-webcam-720p-video-with-noise-reducing-2-years-warranty-i116120142-s1028778941.html?spm=a2a0e.searchlistcategory.list.3.f2d9283f5kHfGT&search=1>
6. *Other*
   * *…*
   * *…*