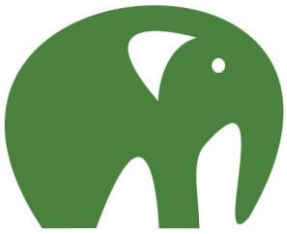

ETH PAURA

Human Elephant Conflict Mitigation System and Elephant information sharing hub with behavior analyzer

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1. PROJECT PROPOSAL SECTION

1.1 INTRODUCTION

Human-Elephant conflict (HEC) is not only a key conservation concern but also a major socio economic concern with no stand-alone universal solution.

Influx of humans and conversion of natural habitat to human dominated land-use causes fragmentation and loss of elephant habitat. Because of this reason elephants raid crop fields and villages searching for food and water. Harmful methods employed by people in the process result in death and injury of both humans and elephants thereby escalating human-elephant conflict.

Prevailing solutions include construction of elephant barriers such as rubble walls, ditches and canals, biological and electric fences, deployment of alarms, development of communication systems, capture, translocation and culling of problem animals etc. But none of them provide a successful control over the problem.

1.2 PROBLEM

This proposal, prepared for the Rajarata University of Sri Lanka, will describe Human Elephant Conflict Mitigation System and Elephant Information Hub (ETH PAURA) which is targeted on mitigating elephant and death incidents attached. Recent literature, researches and interviews will be analyzed to determine the best possible solution. Final target deliverables will be a solution to mitigate elephant invasions and a web application with an analytical component to work as a hub for elephant information and researches.

1.3 OBJECTIVES

As mentioned in the above section 2, it is convinced that the need of a cost effective, accurate elephant invasion detection system. Therefore apart from other objectives our main objective is to develop a solution to mitigate Human-Elephant-Conflict by using SMS, Wi-Fi technologies, laser modules etc.

Specific objectives:-

- To identify the best non-invasive elephant detection mechanism while studying different techniques available such as light and camera, ultra-sound, seismic waves, wireless sensors etc.
- To develop an effective solution that has the capability of deploying at village boarders considering the infrastructure barriers.
- To develop algorithms to maximize the accuracy rate of detection and to eliminate any false-triggers.
- To analyze elephant behavior patterns and their vital patterns to identify any critical situations.
- To improve awareness and information distribution via the information hub.

General objectives:-

- Reduce time wastage
- Preparation of final documentation
- Reliability & availability
- Reducing the cost of total solution

1.4 RELATED PROJECTS / LITERATURE

Background

The association between man and elephant in Sri Lanka is ancient. Elephants being the largest terrestrial herbivores require relatively large areas and diversity of environments to forage. With the increase in human population density and changes in the land-use patterns, elephant habitat is being continuously reduced. As a result, much of the present day elephant range extends into and overlaps with agricultural lands resulting in conflict with man. (Santiapillai et al., 2010)

The surveillance and tracking of these herds are difficult due to their size and nature of movement. Therefore, there is a need for intelligent elephant surveillance and tracking system. The magnitude of impact of human– elephant conflict can be viewed from the fact that globally around 5 lakh families are affected by human– elephant conflict per year. (Sugumar and Jayaparvathy, 2014)

Related Projects / Literature

1. An Improved Real Time Image Detection System for Elephant Intrusion along the Forest Border Areas, S. J. Sugumar and R. Jayaparvathy, January 2014
2. Wi-alert : a wireless sensor network based intrusion alert prototype for HEC, Ruwini Edirisinghe, Dileeka Dias, Rakhitha Chandrasekara, Lanka Wijesinghe, Prasanga Siriwardena and Prasad Kumara Sampath July,2013
3. An early warning system for elephant intrusion along the forest border areas by S. J. Sugumar and R. Jayaparvathy June,2013

Human–elephant conflict is a rapidly expanding area of research, with conservationists working hard to under- stand the circumstances under which tensions are highest between humans and elephants. A number of factors con- tribute to such conflicts, including population density of humans, elephant habitat structure, weather, time of year and animal life.(“2011 R.Sukumar J.Lenin Action Plan for the mitigation of Elephant - Human Conflict in India .pdf,” n.d.)

Along the forest boarders, for many centuries, the villagers used many traditional approaches such as lighting fire crackers, making loud sounds and digging trenches to scare the elephants.

A reasonably technical approach commonly introduced to control the movement of elephants worldwide is electric fences. Over 1000km has been erected with electric fences in Sri Lanka with over 300km being erected in 2009.(Wijesinghe et al., 2011). In electric fences elephants are deterred from forcing through the fence by an electric shock. The elephants tend to respect the fence and it acts as a psychological barrier. (“Wi-alert : a wireless sensor network based intrusion alert prototype for HEC, Ruwini Edirisinghe, Dileeka Dias, Rakhitha Chandrasekara, Lanka Wijesinghe, Prasanga Siriwardena and Prasad Kumara Sampath,” n.d.).

Electric fence yet not regarded as the best possible solution since it produce many counter problems such as the high cost. It is approximately 0.5Million per Km. Apart from that the difficulty in maintenance, and the reaction from the elephants (They short circuit it with tree

branches and logs) has made the electric fence redundant. Also 90% of the fence is not functioning now.

(Sugumar and Jayaparvathy, 2014) used an automatic unsupervised elephant image detection system called EIDS. The EIDS was implemented for the well-known elephant corridors in Tamil Nadu, and the wireless cameras powered by a 12v batteries were mounted on the top of the trees and mountains. The pictures were taken every 5seconds and sent to a central facility to analyze using 'Haar Wavelet' algorithms and the pictures were cross-checked with 114 pictures in the Database. If more than 5 matches occurred an SMS will be sent to notify forest officials. The biggest problem we identified was the image retrieval time and the maintenance problem. (Sugumar and Jayaparvathy, 2014) mentions that they tried to overcome the retrieval time problem using a large distance. And the other problem which is the difficulty in maintaining (the tree branches blocking the cameras etc.) still prevails. Also the light conditions in nights will require switching into night vision modes. And we understand that the system costs high.

As in the article, ("An early warning system for elephant intrusion along the forest border areas by S. J. Sugumar and R. Jayaparvathy," n.d.) the intrusion detection system using geophones makes an event of interrupt when an elephant enters its radius of 24 meters. The footfall of the elephant produces a vibration in the ground which is sensed by the geophones(Sugumar and Jayaparvathy, 2013). But this system is considered not effective due to two major problems. In a situation where the soil moisture is very high due to rain fall it may not produce sufficient vibrations to be sensed. This problem is discussed in their next research article.(Sugumar and Jayaparvathy, 2014). Apart from that the system requires a high initial cost, approximately 75,000 Indian rupees.

As we have studied, there prevails few different mechanisms as alternatives we can go along. Like (Edirisinghe et al., 2013) says the requirements of a such system are,

- Should be non-invasive
- Tagging elephants with any kind of a device is not an option.
- Minimal installation complexity
- Energy efficiency
- Easy maintenance
- Scalability
- Minimal or no false alarms

Usage of light and camera as a detection mechanism will create problems of reliability and complexity. Given that the light conditions are varying over time during the day the reliability will be questioned.

Ultra sonic waves for detection may be asked the question of distance limitation and the need of a complex rotating mechanisms.

Infra-sound and seismic waves may have the added advantage of chasing elephants back, but creating problems in complexity, high power requirement problem and need of high domain expertise.

From the discussion we had on existing mechanisms raise the need of a robust, reliable and a simple cost-effective detection system. What will be addressed in our research will be the practicality, scalability and the cost effectiveness which had not addressed in the previous studies. The current and future studies are more towards the usage of wireless sensors and our research will cope with those technologies.

1.5 METHODOLOGY

Proposed Solution

This System consists of three main parts.

1. HEC (Human Elephant Conflict) mitigation system
2. Elephant behavior analyzing System
3. Elephant information hub

HEC mitigation system

The intrusion detection system will identify an elephant entering and leaving the village and will send immediate SMS messages and at the same time will notify the forest officials via SMS or push notifications. And a village centered alarming mechanism is also added.

Elephant behavior analyzing System

Collared elephants will be tracked and monitored continuously for the research and conservation purposes. Their behaviors will be identified and analyzed in order to provide meaningful information to the relevant parties such as informing about badly injured, sick or trapped elephants who needs attention.

Elephant Information Hub

This is a web application acting as an elephant information hub This will operate around the elephant research center. Research articles, updates, elephant track details will be submitted to the website where students and other interested parties can ask questions and get expert answers.

Resource Requirements

The data and necessary information gathering will be done using formal and informal meetings with field experts such as professors. And the data sets will be gathered for testing and training algorithms form previous researches done with the elephant tracking collar. Other technical expertise and the domain knowledge is expected to gather from resource personnel and by researching.

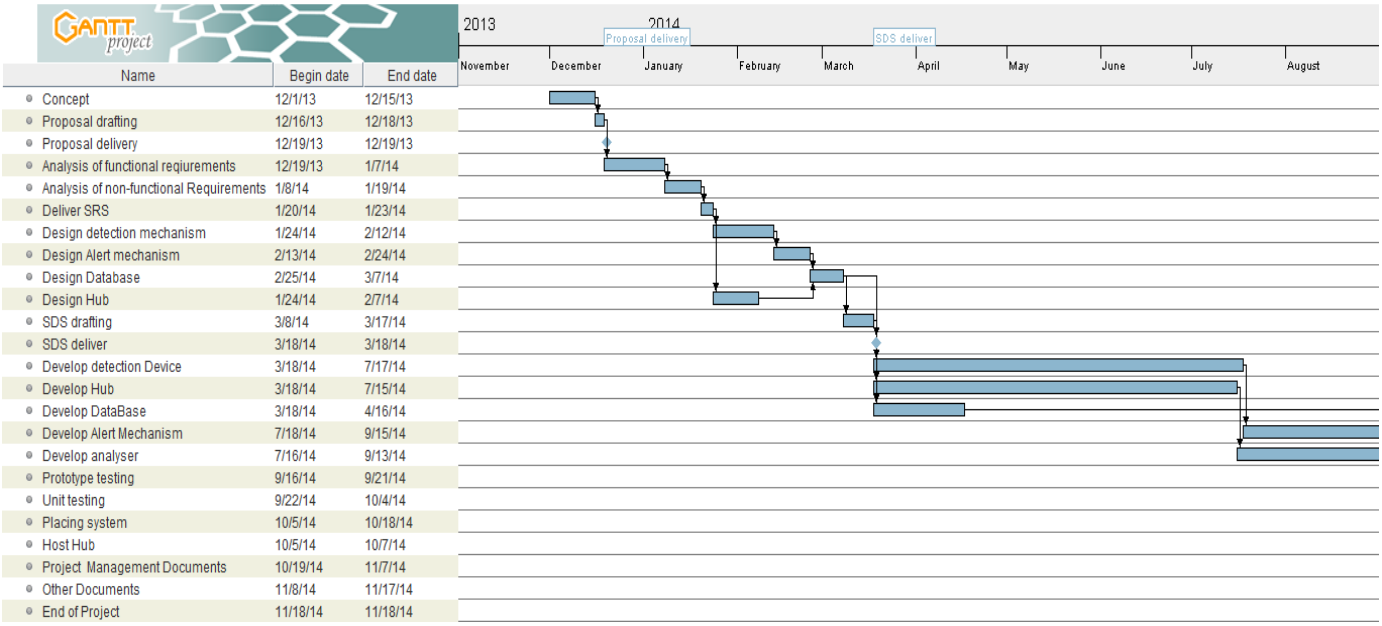
Other requirements

- Pentium IV computer with RAM 256 or up
- Arduino Uno board
- Wi-Fi shield for Arduino
- Batteries and solar panel charger
- Tomcat and a testing server like red-hat
- Eclipse, MySQL, android SDK
- Android phone
- Phone with GSM connection
- Wi-Fi router
- Sirens
- Other components which will be needed in the implementation of the detection device.

Work-Breakdown- Structure

- Concept
- Proposal deliver
- Analysis of requirements
    - Functional requirements
    - Non-functional requirements
- Design
    - Detection mechanism
    - Alerting mechanism
    - Database
    - Hub
- Deliver SRS
- Implementation
    - Detection device
    - Alert function
    - Hub
    - Database
    - Analyzer
- Prototype testing
- Unit testing
- Placing system
- Host Web Hub
- Project management documents
- Other Documents

Gantt chart



Name	Begin date	End date
Concept	12/1/13	12/15/13
Proposal drafting	12/16/13	12/18/13
Proposal delivery	12/19/13	12/19/13
Analysis of functional reqiurements	12/19/13	1/7/14
Analysis of non-functional Requirements	1/8/14	1/19/14
Deliver SRS	1/20/14	1/23/14
Design detection mechanism	1/24/14	2/12/14
Design Alert mechanism	2/13/14	2/24/14
Design Database	2/25/14	3/7/14
Design Hub	1/24/14	2/7/14
SDS drafting	3/8/14	3/17/14
SDS deliver	3/18/14	3/18/14
Develop detection Device	3/18/14	7/17/14
Develop Hub	3/18/14	7/15/14
Develop DataBase	3/18/14	4/16/14
Develop Alert Mechanism	7/18/14	9/15/14
Develop analyser	7/16/14	9/13/14
Prototype testing	9/16/14	9/21/14
Unit testing	9/22/14	10/4/14
Placing system	10/5/14	10/18/14
Host Hub	10/5/14	10/7/14
Project Management Documents	10/19/14	11/7/14
Other Documents	11/8/14	11/17/14
End of Project	11/18/14	11/18/14

Roles and Responsibilities

1. D.R.T.Thilanka — Team Leader, working with detection device and Hub
2. M.R.R.Y.W.Ranathunga — Project Manager, working with detection device, Analyzer Hub.
3. D.M.M.A.D.Sumanarathna — Android Application
4. M.G.L.L.Jayasekara — Hub
5. D.M.A.Kotikawatta — Android application.
6. M.G.S.S.Gunarathna — Hub

1.6 REFERENCES

Wi-alert : a wireless sensor network based intrusion alert prototype for HEC, Ruwini Edirisinghe, Dileeka Dias, Rakhitha Chandrasekara, Lanka Wijesinghe, Prasanga Siriwardena and Prasad Kumara Sampath, n.d.

2011 R.Sukumar J.Lenin Action Plan for the mitigation of Elephant - Human Conflict in India .pdf, n.d.

An early warning system for elephant intrusion along the forest border areas by S. J. Sugumar and R. Jayaparvathy, n.d.

Santiapillai, C., Wijeyamohan, S., Bandara, G., Athurupana, R., Dissanayake, N., Read, B., 2010. An assessment of the human-elephant conflict in Sri Lanka. Ceylon J. Sci. Biol. Sci. 39. doi:10.4038/cjsbs.v39i1.2350

Sugumar, S.J., Jayaparvathy, R., 2014. An Improved Real Time Image Detection System for Elephant Intrusion along the Forest Border Areas. Sci. World J. 2014, e393958. doi:10.1155/2014/393958

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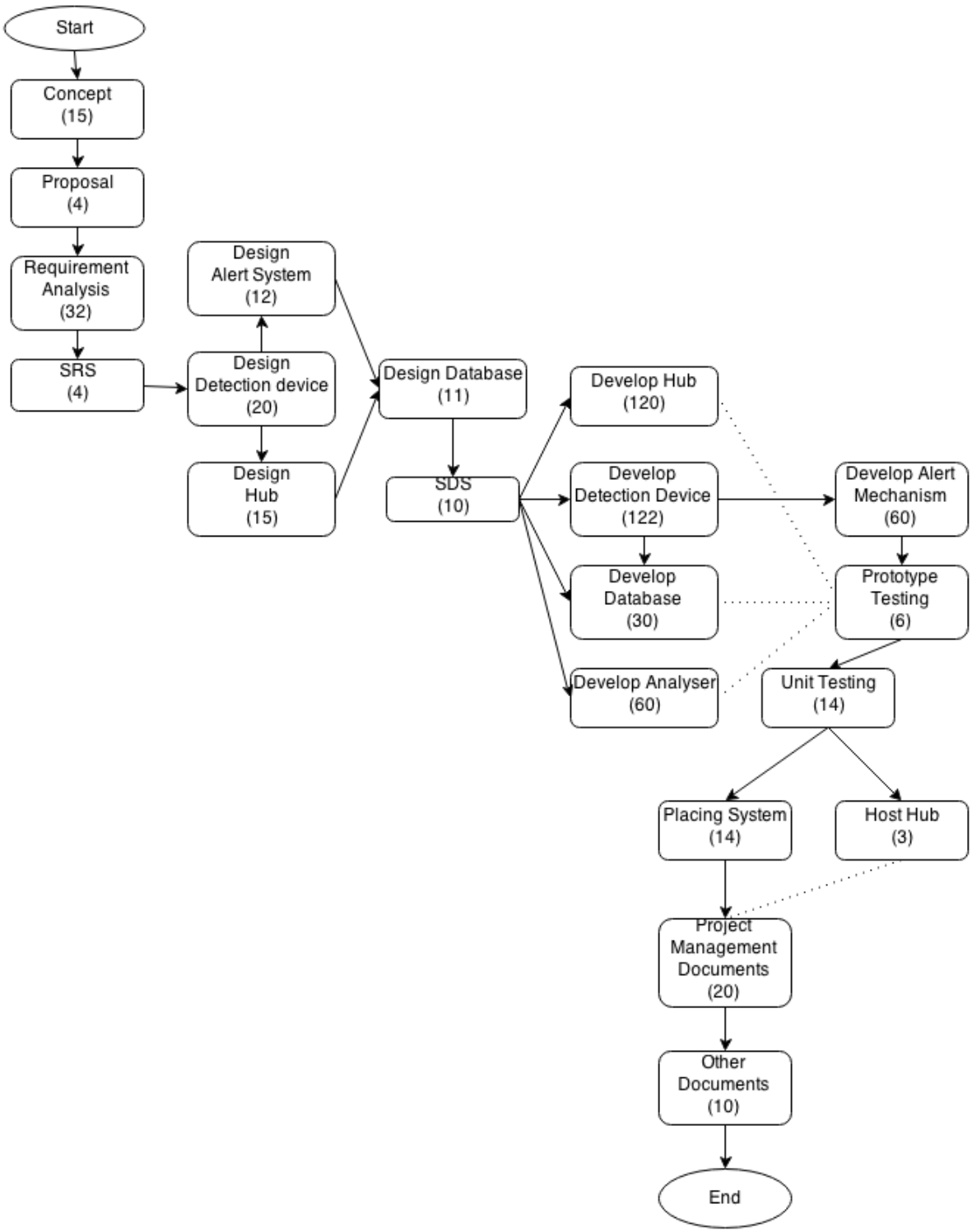
2. TIME MANAGEMENT ASPECTS

The Network diagram



Critical path

Critical path has higlighted in the following diagram. The float calculation is mainly used to identify the critical path.

Activity	Earliest Start	Latest start	Earliest Finish	Latest Finish	Float	Free Float	Activity Span	Interfering Float
Concept	1	1	**15**	15	0	0	15	**0**
Proposal	15	15	19	19	0	0	4	0
Requirement Analysis	19	19	51	51	0	0	32	0
SRS	51	51	55	55	0	0	4	0
Design Detection Mechanism	55	55	75	75	0	0	20	0
Design Alert Mechanism	75	78	87	90	3	12	15	9
Design Hub	75	75	90	90	0	0	15	0
Design Database	90	90	101	101	0	0	11	0
SDS	101	101	110	110	0	0	10	0
Develop Detection Mechanism	110	110	232	232	0	0	122	0
Develop Database	110	262	140	292	152	152	182	0
Develop Hub	110	172	230	292	62	32	182	30
Develop Alert Mechanism	232	232	292	292	0	0	60	0
Develop Analyzer	110	232	170	292	122	128	182	6
Prototype Testing	292	292	298	298	0	0	6	0
Unit testing	298	298	312	312	0	0	14	0
Placing System	312	312	326	326	0	0	14	0
Hosting hub	312	323	315	326	11	11	14	0
Project Management Documents	326	326	346	346	0	0	20	0
Other Documents	346	346	356	356	0	0	10	0

3. COMMUNICATION PLAN

A proper communication plan is very important for an undergraduate project. So we have constructed a communication plan as depicted below.

Objective of each communication activity	Stakeholders for each activity	Date	Venue	Channel
Meeting with mentor	Mentor & all the team members	Monthly	Mentor's Office room	Meeting
Meeting with group members to evaluate the project progress	Team leader & all the team members	Weekly (Saturday)	Faculty	Meeting / Video
Review risks related to project	All the team members	As required Usually monthly	Faculty	Meeting
Manage issues of the project	All the team members	After each Progress Demonstration	Faculty	Meeting
Reports to acknowledge the project progress	All the team members	Weekly (Tuesday)	Report to LMS	Report – online Document
Meetings to knowledge improvements	All the team members & experts of the field	Monthly (when required)	Faculty & Outside the faculty	Meeting / Telephone
Other Communication Means	Among team	As required		Facebook group page, SMS

4. HUMAN RESOURCE MANAGEMENT ASPECT

HRM aspect

- Analyzing the work load and the project scope.
- Analyzing the team members against their expertise and their other skills.
- Match them together to and assign tasks and adjust the workload if needed.
- Identify their supervision needs and provide the necessary guidance.
- Build small teams under the large team and appoint sub leaders.
- Clearly state their roles and responsibilities.
- Assigning the right person to the right task

When working with the critical path,

- Assign the tasks with the critical path in the mind
- Strict to the timeline we have assigned.
- Assign backup persons if we came across any difficulties such as a team member gets sick.
- Assign non-critical resources if there is any human resource shortfalls.

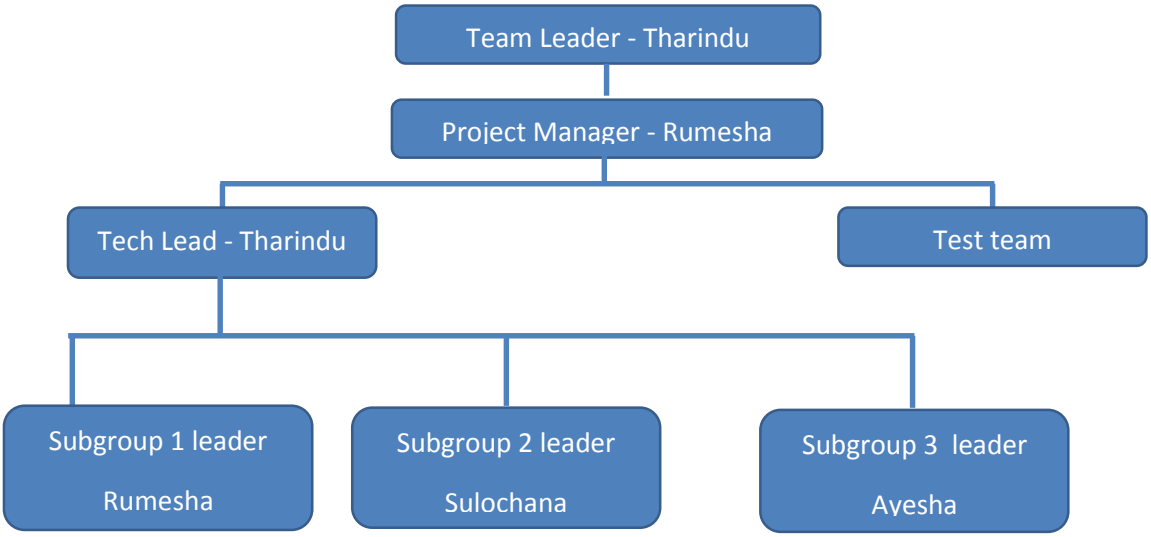
To motivate

- Identify their needs of motivation using Maslow's hierarchy of needs.
- Appreciate their work at the group discussions and via the social media group.
- Give challenges to everyone in the group.
- Recognition and putting trust on them is important

Team building activities

- Working together as a team whenever possible.
- Help each other.
- Field visits.
- Motivating and celebrating small parties.

Organizational charts



Measuring results

- The subgroup leaders are responsible for the allocated sub group activity completion and the timely completion.
- Sub group leaders will educate the team leader and the project manager about the issues and the compliance with the critical path.
- At every group meeting the progress and the compliance will be checked with the proposed quality and functions.
- If any deviation from the original plan is detected then the responsible persons will be advised to complete it doing overtime.
- In a case where a serious deviation of the time line is identified then the resources from the non-critical sections will be allocated to those critical activities.

5. RISK MANAGEMENT ASPECT

1. Unknown Domain

Our main domain is about elephants which is an unfamiliar domain. Due to this the project will be faced with the difficulty of continuity. Also the quality of the final product can be minimized. Product features may need to be reduced if we could not get the necessary expertise on time.

Actions to prevent

- Already met with some field experts like Professor Devaka and Dr.Pruthuviraj to get their advice and knowledge.
- Learning and reading about the elephants.
- Analyzing research articles and the literature.

2. Unknown Languages and framework

Spring framework and hibernate tools are foreign to the group members and the android language is known by one person only. Due to that the learning period became long and the project faced the problem of time overrun.

Actions to prevent

- We worked and learned together to help each other sorting the problems.
- We tried to learn those languages before the start of the project to save time.
- Those who had the expertise inside the group conducted small workshops.

3. Personnel shortfall

Typical personnel problems like getting sick, came across with an accidents or getting surgeries are expected in a project like this.

Actions to prevent

- Assign a backup person to each critical task
- Provide resources from non-critical activities to critical activities

4. Technical difficulties

Since we are developing a system with hardware and technical/ electronic components play a major role, it is expected to face many difficulties in technology.

Actions to prevent

- Studying alternative technologies
- Getting expert advice
- Contingency plans like prototypes

5. Cost overrun

Common to most of the projects. Since we had to use many electronic components, our budget also face this risk.

Actions to prevent

- Using cheaper alternatives in the initial prototype
- Getting funds from the university
- Multiple estimate plans with alternatives.
- Switching technologies.
- Thorough survey before choosing products.

6. Time overrun

Up to this point we did not faced the risk but expected in the future.

Actions to prevent

- Eliminating unwanted features
- Focusing on the critical path.
- Employ resources which are withdrawn from non-critical paths to the critical path
- Redesign the critical path if necessary.

7. Changes to the requirements

Since we are going along a research path, it is expected some late changes.

Actions to prevent

- Frequent discussions with supervisors.
- Get some approve before adding features
- Develop prototypes and get comments.

8. Environment factors

Since the project is in the public domain, we have to work with the villagers and other parties such as forest officials, professors who do not have the technical background.

Actions to prevent

- Using skilled member to deal with those situations.
- Consider psychological factors and get an understanding
- When dealing with the villagers not giving much hope since it can damage their psyche.
- Use authorized contacts to get into the field rather than working of our own.

9. Getting data to test and real time equipment.

Elephant collar and elephant records taken from the collar is crucial for our project. Getting a working collar is the difficulty now we are facing.

Actions to prevent

- Using a simulator