Enhancing Fire Disaster Search with Multi-Robotic System: Optimizing Rescue Operations Effectively.

R24 – 098

Project Proposal Report

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DECLARATION

I declare that this is my own work and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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Signature of the Supervisor
(**Ms. Lokesha Weerasinghe**)

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28/02/2024

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ABSTRACT

This study explores the domain of "Supply Geo-location to the Robots and Identify the Rescue Path" within the larger project "Enhancing Fire Disaster Search with Multi-Robotic System: Optimizing Rescue Operations Effectively." to improve search and rescue operations in fire-related emergencies. The main goal is to create and put into use a sophisticated hybrid geolocation system that seamlessly integrates sensors, GPS, and visual odometry to provide robotic units deployed in fire disaster scenarios with precise real-time positioning. The study approaches the research issue of the increasing demand for accurate and flexible technology in the face of demanding and dynamic conditions during fire emergencies. The hybrid geolocation system will be thoroughly developed, tested, and validated in both simulated and real-world fire disaster scenarios, according to the study's basic design. The system employs dynamic path planning algorithms to effectively identify and improve rescue paths while adjusting to changing conditions. The analysis's key conclusions and patterns will have a substantial impact on the Multi-Robotic System's overall efficacy in boosting search and rescue efforts during fire disasters. The system's functionality and adaptability will be evaluated under a variety of conditions through extensive testing.

To summarize, this research focuses into the necessity of utilizing modern technology to overcome the obstacles presented by fire incidents, stressing the need to minimize reaction times and improve the effectiveness of rescue efforts. The conclusions gained from the research will guide future developments in robotic systems and disaster response, resulting in more potent approaches to dealing with complex and dynamic settings.

Keywords: Fire Disaster, Multi-Robotic System, Geo-location, Dynamic Path Planning, Operational Efficiency.

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LIST OF ABBREVIATIONS

API	Application Program Interface
GPS	Global Positioning System
IOT	Internet of Things

1. INTRODUCTION

1.1 Background Literature

When it comes to disaster response research, the focus on search and rescue operations optimization in fire-related disasters captures a detailed investigation of 'Supply Geo-location to the Robots and Identify the Rescue Path.' The effort "Enhancing Fire Disaster Search with Multi-Robotic System: Optimizing Rescue Operations Effectively" includes this essential element. To fully understand the suggested methodology, it is necessary to examine the complex history of research in this field.

Research on disaster response has had a dynamic history, with obstacles solved with creative solutions. Several research projects have attempted to improve techniques and expand technology to increase the effectiveness of search and rescue efforts. [1]In this scenario, the accuracy of the geolocation provided to robotic units and the determination of the best rescue routes take on significant importance in negotiating the complex and continually shifting geography of fire disasters. It is necessary to untie the complex web created by developments in path planning algorithms, geolocation systems, and the smooth integration of these technologies in the context of fire disaster response to fully understand the state of the art at this time.

Various approaches have been used in the past to handle different aspects of the complex problem of responding to a fire disaster. Developing adaptive navigation systems, improving real-time positioning accuracy, and improving dynamic path planning algorithms have all been the focus of research efforts. The dynamic nature of fire disaster scenarios demands a deviation from conventional methods, beyond the bounds of what is practical.

The suggested method both significantly advances and departs from earlier research. As we acknowledge the progress made in technology and approach, the work aims to provide a fresh viewpoint by creating a complete and flexible hybrid geolocation system.

By combining GPS, optical odometry, and sensors, this technology goes beyond the norm by giving robotic units the ability to plan their own paths dynamically in addition to delivering precise geolocation. The approach's unique benefit is its flexibility in the face of fire disasters, which are sometimes unexpected.

The goal as we pursue innovation is to rethink the traditional ideas of multi-robotic systems in fire catastrophe response, in addition to adding to the corpus of current knowledge. The strategy is ready to create an approach that minimizes response time and increases operational efficiency by embracing the lessons learned from past attempts. The goal is to not only push the boundaries but also alter the search and rescue scene in the demanding and dynamic circumstances created by fire disasters as we travel into new areas of technical innovation.

In conclusion, the study offers evidence of the group's continued efforts to improve disaster response. To provide a novel viewpoint on search and rescue operations optimization in fire-related catastrophes, the strategy strives to build upon and diverge from prior work. This includes mastering pertinent research and approaches as well as comprehending the state of the art now. The research aims to contribute to the developing field of multi-robotic systems and disaster response by providing a thorough grasp of the difficulties caused by fire disasters and a creative solution to them.

1.2 Research Gap

In the realm of disaster response research, specifically concerning the provision of geo-location to robots and the identification of optimal rescue paths in fire disasters, a thorough examination reveals significant research gaps. [1]These gaps signify the areas where existing literature falls short, creating an opportunity for our proposed approach to make substantial contributions to advancements in this critical field.

To begin with, there exists a notable research gap concerning the limited focus on simulated fire disaster environments. Current studies often lack a concentrated exploration of scenarios simulating fire disasters. While real-world experiences are invaluable, simulations provide a controlled yet realistic platform for testing the robustness of geo-location systems under specific conditions. The scarcity of literature addressing the supply of geo-location to robots and the identification of optimal rescue paths within simulated fire disasters motivates our research to fill this void.

Additionally, integration challenges in simulation studies represent another significant gap. Many studies lack a comprehensive approach to integrating geo-location technologies within the simulation framework, particularly for precise robot positioning in fire disasters. [2]The seamless integration of GPS, visual odometry, and sensors requires attention in simulated environments. Current literature often overlooks the complexities associated with incorporating these technologies into simulations, hindering the development of accurate and adaptive systems. Our research aims to bridge this gap by addressing the intricacies of integration, ensuring that simulated environments accurately reflect the challenges posed by real-world fire disasters.

Furthermore, a crucial research gap exists in the domain of dynamic path planning within simulated environments. [3] While dynamic path planning algorithms are acknowledged as vital components for effective search and rescue operations, their development and validation, specifically tailored for simulated fire disaster scenarios, remain understudied. Existing studies lack a nuanced exploration of how these algorithms adapt to dynamic environmental conditions in simulated settings. Our research endeavors to contribute to this gap by developing and validating dynamic path planning algorithms, ensuring their efficacy in both simulated and real-world fire disaster scenarios.

Another identified gap is the absence of a unified approach for realistic simulations in the current research landscape. [4] The lack of a comprehensive methodology that considers the unique challenges posed by fire disasters in simulations, including dynamic environmental conditions and the necessity for real-time decision-making, leaves a considerable void. Our research aims to fill this gap by proposing a unified approach that addresses the intricacies of simulating fire disasters realistically. This approach encompasses dynamic environmental factors, real-time decision-making processes, and adaptive technologies to enhance the authenticity of simulations.

Lastly, the adaptability and fault tolerance of geo-location systems in simulated scenarios require dedicated attention. Existing literature lacks a thorough investigation into how these systems respond to unforeseen challenges and errors in a simulated environment. Our research aims to explore the adaptability and fault tolerance of geo-location systems, ensuring robust performance even in the face of unexpected scenarios during simulated fire disasters.

In conclusion, the identified research gaps underscore the need for a comprehensive and dedicated approach to supplying geo-location to robots and identifying optimal rescue paths in fire disasters, particularly within simulated environments. Our proposed research aims to address these gaps, contributing valuable insights and advancements to the broader field of disaster response and multi-robotic systems. Through meticulous investigation and innovative solutions, our approach seeks to enhance the effectiveness of search and rescue operations in the dynamic and challenging context of fire disasters.

Aspect	**Existing Research A**	**Existing Research B**	**Existing Research C**	**Proposed System**

Focus on Simulated Fire Disasters	Limited	Limited	Limited	Comprehensive
Integration Challenges in Simulations	Inadequate	Inadequate	Inadequate	Addressed
Dynamic Path Planning in Simulations	Understudied	Understudied	Understudied	Developed & validated
Unified Approach for Realistic Simulations	Absent	Absent	Absent	Proposed
Adaptability and Fault Tolerance	Lack of Attention	Lack of Attention	Lack of Attention	Explored

Table 1: Comparison with existing applications

1.3 Research Problem

The research is positioned to address major weaknesses in the existing state of disaster response systems with the goal of maximizing search and rescue operations within the demanding environment of fire-related emergencies. The shortcomings of current technology regarding precision and real-time accuracy in geo-location provisioning for robotic units constitute a key research challenge that the study aims to address. The complexity of integration in multi-robotic systems, including the combination of GPS, ocular odometry, and sensors, presents difficulties for smooth communication, interoperability, and effective data transfer.

[2]Additionally, the research explores the critical component of flexibility, acknowledging the dynamic and unpredictable character of fire disaster contexts and the requirement for real-time modifications in rescue route identification and geolocation providing. Another problem is the

identification of shortcomings in effective path planning algorithms, highlighting the need for sophisticated approaches that guarantee both efficiency and flexibility in the face of unforeseen roadblocks. Given the significance of system reliability in real-world fire disaster scenarios, closing the possible gap between simulation scenarios and real-world efficacy is a critical concern. Minimizing delays for timely geo-location supply and optimal rescue path selection highlights the importance of communication latency concerns between robotic units and the central command system. Finally, a gap in the current research is the absence of extensive benchmarking and comparison assessments against current systems, underscoring the necessity of a complete review of suggested methodologies. The study intends to make a significant contribution to novel solutions by methodically tackling these research difficulties. This will ultimately improve the overall capabilities of multi-robotic systems in providing accurate geo-location data and determining the best rescue routes during fire emergencies.

2. OBJECTIVES

2.1 Main Objective:

The primary aim of the "Supply Geo-location to the Robots and Identify the Rescue Path" segment is to elevate the capabilities of multi-robotic systems within the realm of fire disaster response. This encompasses the seamless furnishing of geo-location data to robotic units and the determination of optimal rescue paths, ultimately enhancing the overall efficiency of search and rescue operations.

2.2 Specific Objectives:

1. Develop and Implement Hybrid Geolocation System:

Create and deploy a hybrid geolocation system integrating GPS, visual odometry, and sensor technologies seamlessly.

Ensure real-time precision in geo-location provisioning for robotic units deployed in fire disaster scenarios.

2. **Test and Validate in Simulated Disaster Scenarios:**

Conduct rigorous testing of the developed hybrid geolocation system in controlled simulated disaster scenarios.

Validate the system's performance and adaptability in simulated environments mirroring real-world fire disasters.

3**. Test and Validate in Real-world Fire Disaster Environments**:

Evaluate the hybrid geolocation system's performance in actual fire disaster environments.

Adjust and optimize based on real-world testing to enhance the system's reliability and effectiveness.

4. **Develop Dynamic Path Planning Algorithms:**

Research, design, and implement dynamic path planning algorithms tailored for multi-robotic systems in fire disaster scenarios.

Ensure adaptability of path planning algorithms to evolving conditions and dynamic environments.

5. **Integrate Geo-location Information into Multi-Robotic System:**

Implement mechanisms to seamlessly integrate geo-location information into the broader multi-robotic system.

Ensure compatibility and efficiency in communication between robotic units and the central command system.

6. **Optimize Rescue Paths Efficiently:**

Develop algorithms and protocols to identify and optimize rescue paths based on real-time geo-location information.

Prioritize efficiency and adaptability in identifying optimal paths for robotic units during rescue missions.

7. **Conduct Comparative Analysis:**

Undertake a comparative analysis of the proposed approach against existing methods for geo-location provisioning and path planning.

Identify strengths, weaknesses, and areas for improvement in the developed system.

8**. Contribute to Disaster Response Knowledge Base:**

Contribute findings and insights to the broader knowledge base of disaster response and multi-robotic systems.

Publish research outcomes and lessons learned to benefit the scientific and practitioner communities.

These specific objectives collectively contribute to the overarching goal of optimizing search and rescue operations in fire-related emergencies through the effective supply of geo-location information to robotic units and the identification of efficient rescue paths.

3. METHODOLOGY

3.1 System Architecture

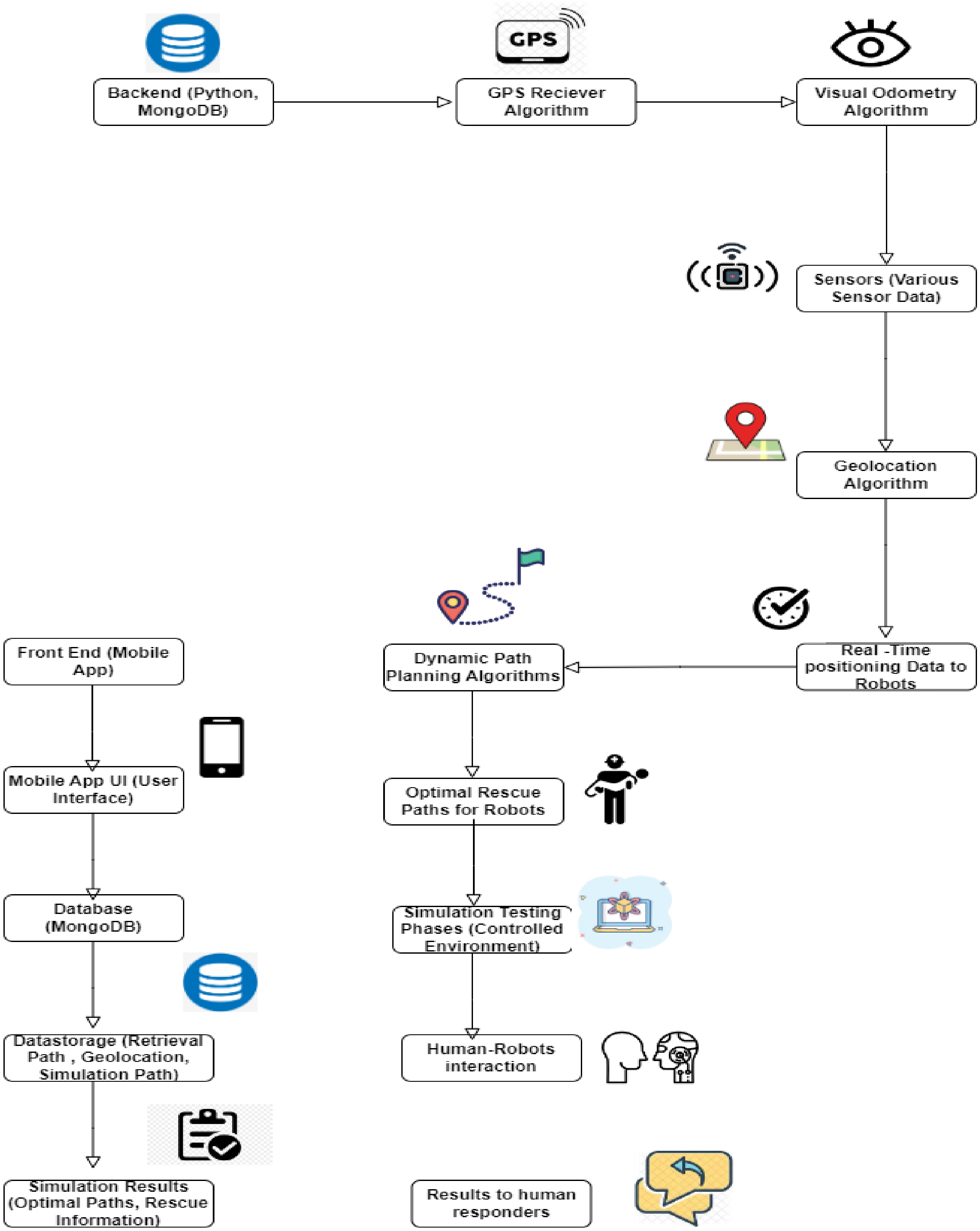

Figure 1: System Diagram

[3]Backend (Python, MongoDB): Represents the server-side processes, including algorithms and the database (MongoDB or other). The backend handles data processing, storage, and retrieval.

Frontend (Mobile App): The Mobile App's user interface (UI) allows human operators to interact with the system. The app sends user inputs and requests to the backend for processing.

Database: Represents a data storage solution (e.g., MongoDB) to store and manage geo-location, path, and simulation results. The backend interacts with the database for data storage and retrieval.

Data Flow: The data flow includes real-time positioning data from robots, sensor data, and algorithm outputs. This data is stored in the database and used for dynamic path planning and generating optimal rescue paths.

Simulation Results: The backend sends simulation results (optimal paths, rescue information) to the database. The Mobile App can retrieve these results for visualization and analysis.

Human-Robot Interaction: The UI of the Mobile App facilitates human interaction with the system, allowing users to input commands, view results, and monitor the simulation.

Connecting Frontend to Backend:

The Mobile App communicates with the backend using APIs (Application Programming Interfaces).
APIs define the methods and data formats that applications can use to request and exchange information. For example, the Mobile App can send requests to the backend API to retrieve simulation results or send commands for the robots.

Simulation Environment:

The blueprints of the building can be supplied to the robots through the backend, and the simulation environment (e.g., WeBot Simulation) interacts with the backend to simulate real-world scenarios.

This high-level overview provides a basis for integrating a database and connecting the frontend (Mobile App) to the backend for your "Supply Geo-location to the Robots and Identify the Rescue Path" project. Specific implementation details will depend on the technologies you choose for the backend, frontend, and database.

3.2 Project requirements

3.2.1 Functional Requirements and Non-Functional Requirements

Functional Requirements	Non-Functional Requirements
1. The system should adapt the provision of geo-location information dynamically to the changing conditions of fire disasters.	1. Ensure a high level of accuracy in geo-location provisioning to meet the precision demands of search and rescue operations.
2. Efficiently optimize rescue paths for robotic units based on real-time geo-location data.	2. Prioritize real-time responsiveness to minimize delays in geo-location supply and path optimization.

3. Seamlessly integrate geo-location information into the broader multi-robotic system.	3. Exhibit robustness and reliability, particularly in real-world fire disaster scenarios, to enhance overall operational effectiveness.
4. Facilitate effective communication between robotic units and the central command system for streamlined operations..	4. Be designed with scalability to accommodate varying numbers of robotic units and different scales of fire disasters.
5. Undergo rigorous testing in simulated and real-world fire disaster environments to validate performance and adaptability.	5. Adhere to data security and privacy protocols to safeguard sensitive information related to disaster response operations.

Table 2: Functional and Non-Functional Requirements

3.2.2 Software Requirements

The software requirements encompass the necessary tools, frameworks, and programming languages for developing simulation software for the multi-robotic system. This involves software for sensor data processing, path planning algorithms, creating a simulation environment, and visualization tools to analyze simulation outcomes.

1. Navigation Algorithms

Sophisticated algorithms are under development to ensure efficient path planning and obstacle avoidance in complex and dynamic fire disaster environments.

2. Sensor Fusion Software

This software integrates data from diverse sensors, providing comprehensive situational awareness for the robotic system.

3. Communication Protocols

Specific communication protocols are designed to facilitate real-time data exchange and coordination between robotic units and the central control system.

4. Machine Learning Algorithms

Development is underway for machine learning and artificial intelligence algorithms to enhance the system's adaptability and decision-making capabilities in unpredictable and dynamic situations.

5. Human-Robot Interface

The system includes user-friendly interfaces for human operators to monitor and control robotic units, interpret data, and make informed decisions.

6. Simulation Software (WeRobots)

Simulation tools are utilized to test and validate the Multi-Robotic System in virtual fire disaster scenarios before actual deployment. The WeRobots Simulation Software is a comprehensive platform designed to facilitate simulation and optimization of disaster identification processes within the context of multi-robotic systems.

The software operates by creating virtual environments that mimic real-world scenarios impacted by fire incidents. Within these simulated environments, WeRobots enables the deployment of multi-robotic systems equipped with various sensors.

The functioning of WeRobots Simulation Software involves key components:

1. Scenario Setup: Users configure the simulation environment by defining parameters such as terrain, building layouts, fire dynamics, and the presence of survivors.
2. Robot Deployment: Multi-robotic systems are deployed within the simulated environment, each equipped with specialized sensors for disaster identification.
3. Sensor Data Fusion: WeRobots integrates data from multiple sensors, enhancing the accuracy and reliability of disaster identification.
4. Disaster Identification: The software analyzes the fused sensor data to identify potential fire incidents, locate survivors, and assess the severity of the disaster in real-time.
5. Simulation Analysis: Users can analyze simulation results to evaluate the system's performance in various scenarios.
6. Iterative Optimization: Based on the analysis of simulation results, users can iteratively optimize the behavior of the multi-robotic system and fine-tune parameters to improve overall performance.

By leveraging WeRobots Simulation Software, researchers and practitioners can conduct virtual experiments, test different strategies, and validate algorithms for disaster identification without the risks associated with real-world deployments. This simulation-driven approach accelerates innovation and enhances the preparedness of emergency response teams in mitigating the impact of fire disasters.

7. Data Analytics

The robotic system utilizes analytics tools to process and analyze vast data, providing valuable insights for rescue operations.

3.2.3 Personnel Requirements

Individuals with diverse skills and expertise are essential for the development and implementation of the multi-robotic disaster identification system. Typically, the team consists of professionals specializing in various areas, including robotics, software development, data analysis, and project management. Each team member is committed to collaborative efforts in completing the project and delivering the required outcomes. As the external supervisor, we are seeking someone with experience in both robotics and the Internet of Things (IoT).

3.3 Software Solution

The proposed approach for the software development life cycle is based on the Agile Scrum methodology, which is an iterative framework aligned with the agile concepts of the Agile Manifesto. Scrum, characterized as a lightweight development method, emphasizes full transparency and rapid adaptability. Agile inherently supports frequent modifications to components during the implementation phase to accommodate evolving requirements. The efficient handling of these modifications will be facilitated through the application of the Agile

Scrum methodology. Consequently, the proposed solution will be implemented within this framework, ensuring support for constant changes, and enabling rapid adaptability.

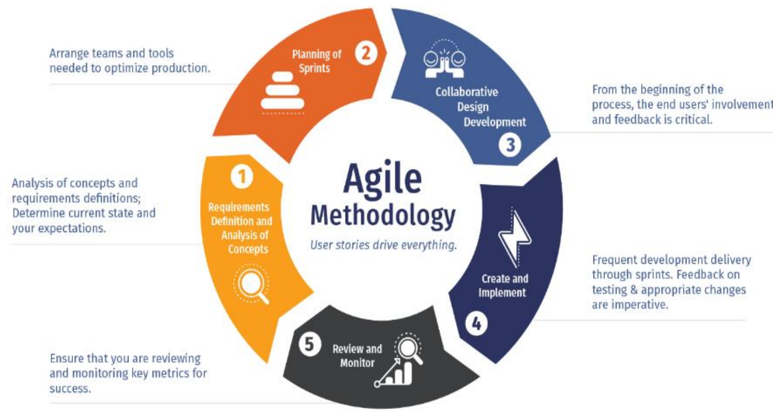

Figure 2: Agile Methodology

3.3.1 Requirement Gathering and Analysis

Throughout the phase of gathering and analyzing requirements, our team extensively engaged in consultations with stakeholders, conducted literature reviews, and performed domain analysis to gain a profound understanding of the specific needs and challenges associated with identifying disasters in fire scenarios. The primary goal during this phase was to define clear objectives, scope, and constraints for developing simulation software customized to meet these requirements.

In close collaboration with Mr. Solomon Jayasena, Chairman of Arya Labs (Pvt) Ltd., we conducted in-depth discussions to clarify their distinct requirements and gain valuable insights into their expectations. These consultations allowed us to identify crucial parameters necessary for the effective identification of disasters within their facilities. Understanding the intricacies of their operational environment and the critical elements of disaster response was pivotal.

[1]A significant facet of our partnership with Arya Labs (Pvt) Ltd. involved receiving blueprints and architectural schematics of their physical locations. The integration of these blueprints into our system is intended to replicate the actual layout and characteristics of their facilities within the simulation environment. This meticulous step ensures that our simulation software faithfully mirrors the real-world conditions and challenges encountered during disaster scenarios.

By incorporating stakeholder input and utilizing architectural data, we are well-positioned to develop a simulation solution that closely aligns with Arya Labs' requirements, fostering effective disaster identification and response. This collaborative approach underscores our dedication to providing tailored solutions that address the unique needs of our clients and enhance their preparedness for emergency situations.

3.3.2 Feasibility Study

Technical Feasibility:

1. System Architecture: Evaluate the necessary technical architecture for the hybrid geolocation system, incorporating the integration of GPS, visual odometry, and sensors.
2. Robotic Technology: Examine the current state of robotic technology and its alignment with the proposed system.
3. Software Development: Investigate the feasibility of developing essential software components for real-time geo-location provisioning and dynamic path planning.

Operational Feasibility:

4. Integration with Existing Systems: Assess the viability of seamlessly integrating the proposed system with current multi-robotic systems and disaster response infrastructure.

5. Operational Impact: Consider the effects of system implementation on existing operational procedures and workflows.

6. Training Requirements: Evaluate the feasibility of providing necessary training to operators and emergency response personnel for proficient system utilization.

Economic Feasibility:

7. Cost-Benefit Analysis: Conduct an in-depth analysis to determine the economic viability of developing and implementing the proposed system.

8. Return on Investment (ROI): Estimate the expected ROI, taking into account potential benefits in terms of improved search and rescue operations.

Legal and Ethical Feasibility:

9. Regulatory Compliance: Examine legal aspects and ensure adherence to regulations related to disaster response technologies.

10. Ethical Considerations: Evaluate potential ethical implications, particularly regarding privacy concerns related to geo-location information.

Schedule Feasibility:

11. Project Timeline: Assess the feasibility of meeting project milestones within the designated timeline.

12. Dependencies: Identify potential dependencies and risks that may impact the project schedule.

Resource Feasibility:

13. Human Resources: Evaluate the availability and expertise of personnel required for system development and implementation.

14. Technological Resources: Assess the availability and suitability of technological resources, encompassing hardware and software.

Environmental Feasibility:

15. Impact Assessment: Evaluate the environmental consequences of implementing the proposed system, considering factors such as energy consumption and waste generation.

3.3.3 Design

3.3.3.4 Dataset

[2]The dataset is crucial for constructing a predictive model aimed at identifying optimal rescue paths in fire disaster scenarios. To ascertain the key factors influencing rescue path selection, relevant data is indispensable. This dataset will be sourced by extracting information from various geospatial databases, including topographical maps and satellite imagery. Historical data, capturing the terrain characteristics, climate conditions, and past fire incident patterns, will be collected to establish a comprehensive understanding. Additionally, real-time data feeds from weather APIs will be integrated to provide up-to-date information on current weather conditions and forecasts. The dataset's richness, encompassing both historical and real-time data, is vital for training the system to make informed decisions regarding rescue path optimization based on geo-location factors.

3.3.3.5 Work Breakdown Structure

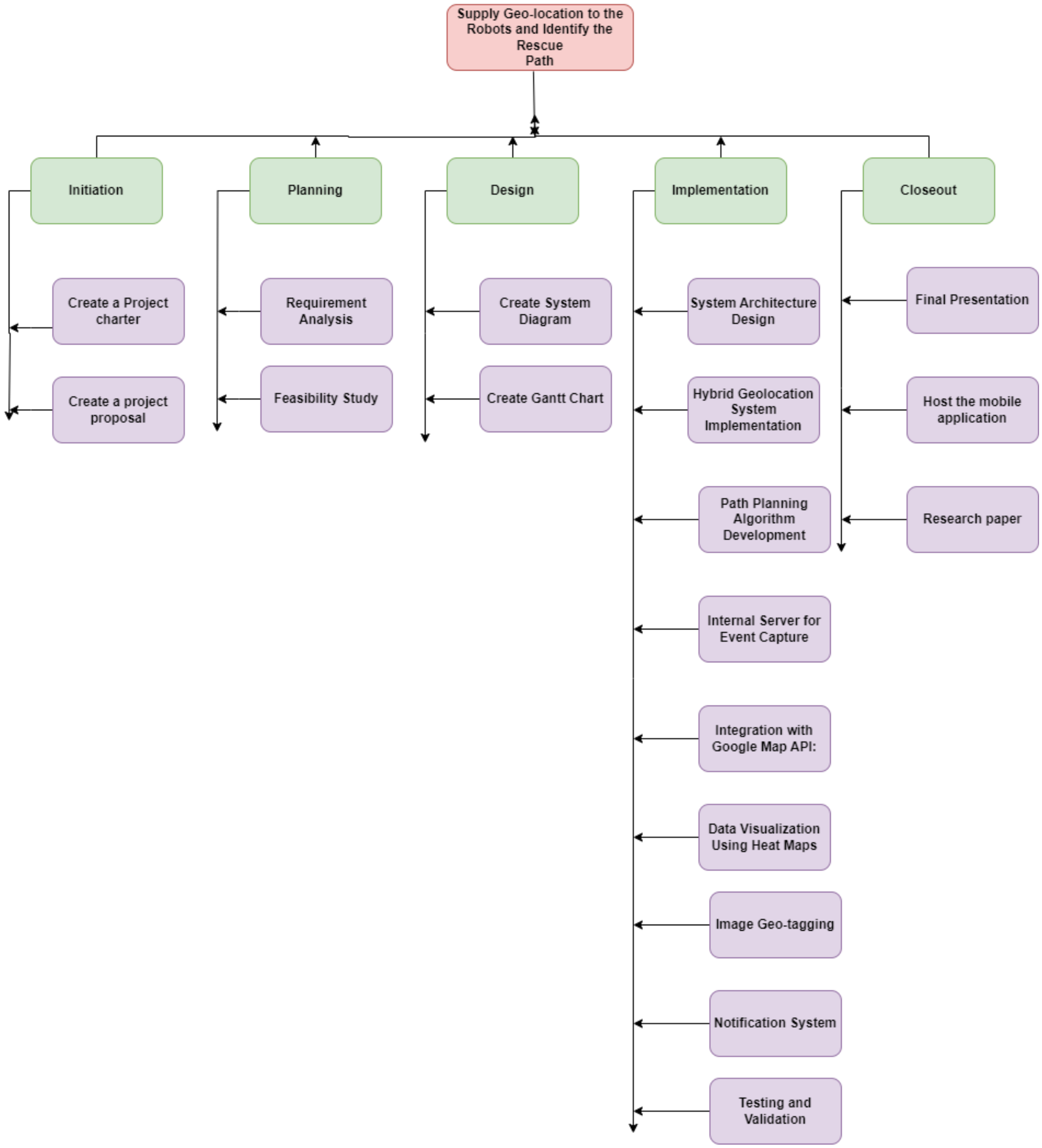

Figure 3: Work Breakdown Structure

3.3.4 Implementation

1. **System Architecture Design:**

[3]Develop a comprehensive system architecture that integrates GPS, visual odometry, and sensors to precisely provision geo-location to robotic units.

Ensure the architecture enables real-time communication between robotic units and the central command system.

2. **Hybrid Geolocation System Implementation:**

Implement the hybrid geolocation system, combining data from GPS, visual odometry, and sensors to deliver accurate geo-location information.

Choose suitable programming languages and frameworks, ensuring compatibility with robotic hardware.

3. **Path Planning Algorithm Development:**

Research, design, and implement dynamic path planning algorithms tailored for multi-robotic systems in fire disaster scenarios.

Ensure adaptability to dynamic conditions and changing environments, considering potential obstacles and hazards.

4. **Internal Server for Event Capture:**

Implement an internal server capturing events triggered when an infected coconut tree is identified using the application.

Utilize an Event-driven architecture for real-time event processing.

5. **Integration with Google Map API:**

Use Google Map API's Geometry Library to extract locations of farmers in specific Chief Disaster Officer (CDO) areas.

Implement distance and area functions to identify affected farmers for timely notifications.

6. **Data Visualization Using Heat Maps:**

Develop algorithms for data visualization, creating heat maps highlighting infected areas and their severity.

Ensure heat maps are accessible to authorized users, providing a clear overview of affected regions.

7. **Image Geo-tagging:**

Implement a mechanism to identify geo-tagged locations from uploaded images.

Extract GPS information from the metadata of captured/uploaded images, storing it in the database for further processing.

8. **Notification System**:

Develop a notification system informing nearby farmers and the respective Chief Disaster Officer (CDO) of detected infected coconut trees.

Ensure timely and efficient communication for quick response and preventive measures.

9. **Testing and Validation:**

Conduct rigorous testing of the entire system in simulated disaster scenarios and real-world fire disaster environments.

Validate performance, adaptability, and reliability through iterative testing and optimization.

3.3.5 Mobile Application

The mobile application plays a crucial role in the fire disaster simulation solution, acting as a central hub for seamless communication and monitoring during crises. When a disaster is detected, the application immediately notifies the administrator, prompting an investigation into the incident's cause and characteristics. The administrator gains real-time visibility into the robotic unit's activities through the app, closely monitoring its actions and responses throughout the disaster scenario. Throughout the unfolding crisis, the app facilitates the identification and evaluation of solutions proposed by the robotic unit, offering insights into the effectiveness of rescue efforts. Users can monitor the progress of the disaster response until its resolution, ensuring comprehensive oversight and well-informed decision-making. By consolidating communication, observation, and analysis functionalities, the mobile app enhances coordination and situational awareness, ultimately optimizing rescue operations in fire disaster scenarios.

3.3.6 Testing (Track and Monitor)

The software development lifecycle encompasses multiple testing phases to guarantee the application's quality and dependability. [4]Unit testing entails the independent examination of individual components to detect bugs early in the development phase. Integration testing assesses the interactions among different units, ensuring smooth functionality. System testing scrutinizes the integrated system, concentrating on end-to-end functionality,[9] performance, and reliability. Acceptance testing validates the software against acceptance criteria and user requirements. Regression testing ensures that recent modifications do not negatively impact existing functionality. Performance testing gauges the application's responsiveness, throughput, scalability, [5]and stability under diverse workload conditions. Security testing evaluates the application's resilience against potential threats. User acceptance testing (UAT) involves end-users testing the software to verify its alignment with their business needs and expectations. The application will undergo assessment at relevant stages when applicable.

4. GANTT CHART

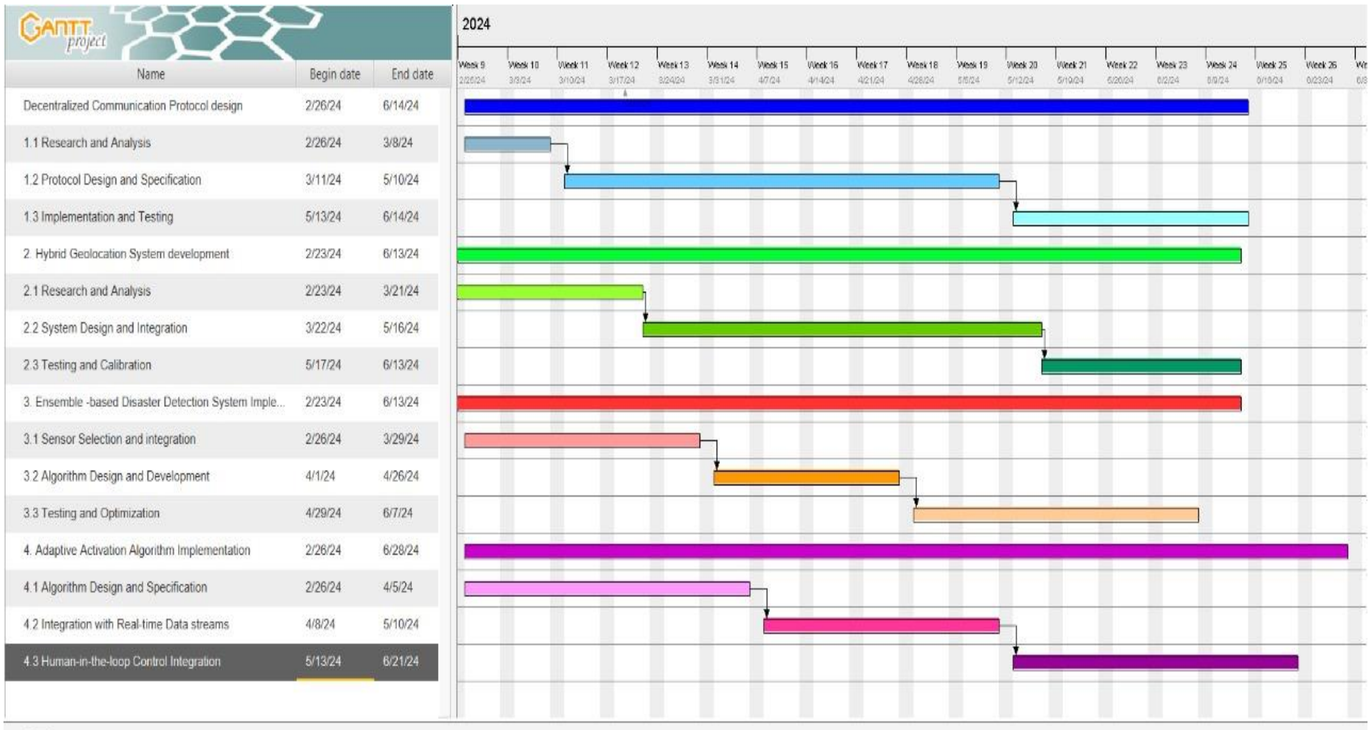

Figure 4: Gantt Chart

5. DESCRIPTION OF PERSONAL AND FACILITIES

Facilitators:

- Mrs. Lokesha Weerasinghe – Sri Lanka Institute of Information Technology (SLIIT)
- Miss.Rivoni De Zoysa - Sri Lanka Institute of Information Technology (SLIIT)
- Mr. Nelum Chathuranga - Sri Lanka Institute of Information Technology (SLIIT)
- Mr. Solomon Jayasena - Arya labs (Pvt) Ltd. (Arya Labs)

Facilities:

- Arya labs (Pvt) Ltd.

6. BUDGET AND BUDGET JUSTIFICATION

The estimated budget contains subscription costs, deployment costs, database costs, and hosting costs.

Feature	**Price**
Database Cost	Rs.14000
Cloud Infrastructure	Rs.7000
User Interface Design	-
Testing and Quality Assurance	Rs.4000
Marketing and Promotion	Rs.7000
Transportation	Rs.5000
Contingency	Rs.2000
Total	Rs.39000

7. COMERCIALIZATION

7.1 Target Audience and Market Space

7.1.1. Target Audience

- Researchers
- Arya Labs (pvt) limited Company.
- Fire Fighters

7.1.2. Market Space: -

- Need a instructions before use this.
- Need knowledge in Technology.
- There is age limitations.

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9.APPENDICES

Plagiarism Report:-