A Mini Project Synopsis on

"SAFER: System for Assessment and Forecasting of Emergency Risks"

T.E. – Computer Science and Engineering-Data Science

Submitted By

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CERTIFICATE

This to certify that the Mini Project report on **"SAFER: System for Assessment and Forecasting of Emergency Risks "** has been submitted by Sonal Sonarghare (21107033), Janhavi Kasar (21107030), Sanskruti Chavan (21107047) and Harsh Shelke (21107022) who are a Bonafede students of A. P. Shah Institute of Technology, Thane, Mumbai, as a partial fulfillment of the requirement for the degree in **Computer Science and Engineering(Data Science)**, during the academic year **2023-2024** in the satisfactory manner as per the curriculum laid down by University of Mumbai.

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Chapter 1

Introduction

In an increasingly interconnected and vulnerable world, the frequency and intensity of natural disasters are on the rise. These catastrophic events, ranging from hurricanes and earthquakes to wildfires and floods, have devastating consequences on human lives, infrastructure, and the environment. Addressing the challenges posed by disasters has become a pressing concern for governments, organizations, and communities worldwide.

To confront this crisis, innovative technologies and strategies are essential, and one such solution is "SAFER" - a comprehensive disaster analysis and prediction system. The acronym "SAFER" stands for "System for Assessment and Forecasting of Emergency Risks". The fundamental goal of this mini-project is to develop a multifaceted approach to enhance disaster preparedness, analysis and prediction. The SAFER system leverages the power of advanced technologies and data analytics to create a holistic framework for mitigating the impact of disasters.

In this report, we delve into the core aspects of the SAFER Project, with a focus on our detailed analysis of flood and drought prone areas in majorly affected states and the predictive capabilities we have harnessed through algorithms. In a world increasingly impacted by climate change, the need for better understanding and preparedness against natural disasters has never been more urgent. Floods and droughts pose significant threats to human lives and infrastructure. The SAFER Project endeavors to address these challenges by integrating advanced technology, data analysis, and predictive models.

In conclusion, the SAFER project represents a crucial step forward in the quest to address the escalating global challenge of disasters. By combining advanced technology with community-driven initiatives, it offers a comprehensive approach that aims to protect lives, preserve infrastructure, and build resilient communities in the face of adversity. This report provides a comprehensive overview of our efforts to enhance preparedness, prediction, and disaster response in the face of floods and Droughts.

1.1 Purpose:

The primary purpose of "SAFER: System for Assessment and Forecasting of Emergency Risks" is to revolutionize the way societies prepare for and respond to, from natural disasters. This comprehensive initiative seeks to address the growing global challenges posed by increasingly frequent and severe disasters. At its core, SAFER aims to save lives, protect infrastructure, and minimize the socio-economic and environmental impacts of catastrophes by integrating cutting-edge technology, data analytics, and community engagement.

One of the fundamental purposes of SAFER is to enhance disaster preparedness. The goal of the project is to enhance the resilience of communities and regions vulnerable to floods. Thus it seeks to reduce the risks associated with it by providing accurate analysis and prediction. By fostering community engagement and awareness, SAFER equips individuals and local communities with the knowledge and tools needed to proactively plan for disasters.

In essence, the purpose of the SAFER Project is to make communities safer and better prepared for floods and droughts, ultimately reducing the devastating consequences of these natural disasters.

1.2 Objectives:

The objectives of the "SAFER: System for Assessment and Forecasting of Emergency Risks " project are designed to address the pressing challenges and vulnerabilities posed by natural disasters. These carefully outlined objectives serve as a roadmap, guiding the project's mission to enhance disaster management across multiple dimensions.

1. Analyze disaster affected areas

To analyze previous occurred floods and droughts with the help of maps which show the affected areas.

2. To improve disaster prediction accuracy:

To develop and deploy advanced predictive modeling techniques to enhance the accuracy of disaster forecasting. Utilize technology like data analytics to improve prediction using real-time parameters.

3. To Enhance Environmental Resilience:

To protect and preserve the environment in the wake of disasters using disaster analysis which will help to analyze the damage to environment.

4. For Enhancing Disaster Preparedness:

This can be used to facilitate the development of comprehensive disaster preparedness plans at local and regional levels.

Overall, these objectives collectively define the comprehensive approach of "SAFER: System for Assessment and Forecasting of Emergency Risks" aimed at creating more resilient communities and minimizing the devastating impact of natural disasters.

1.3 Scope:

The scope of "SAFER: System for Assessment and Forecasting of Emergency Risks " is as expansive as the challenges posed by natural disasters in our modern world. In a time when climate change is fueling an increase in the frequency and intensity of these catastrophic events, SAFER emerges as a comprehensive initiative with a remarkable breadth of applications.

1. Natural Disasters:

This can be used to analyze and predict the natural disasters like floods and droughts. It can be used to identify disaster prone areas and ensuring accurate risk assessment.

2. Urban and Rural Settings:

It can benefit both urban and rural communities, tailoring solutions to the unique challenges each setting presents.

3. Research and Innovation:

It can serve as a hub for research and innovation in disaster management, continually advancing predictive technologies.

4. Public Health and Healthcare Systems:

SAFER can be instrumental in protecting public health during and after disasters by aiding in the prediction of disease outbreaks and ensuring the continuity of healthcare services.

5. Education and Public Awareness:

SAFER can be used in educational programs to make people understand the extend of disaster damage and analysis.

The scope of "SAFER: System for Assessment and Forecasting of Emergency Risks" is truly comprehensive, reaching across geographical, sectoral, and societal boundaries. Within regions prone to floods and droughts, SAFER stands as a guardian, providing advanced prediction.

In the realms of government and disaster management agencies, SAFER serves as a catalyst for efficient response strategies, optimizing resource allocation and streamlining disaster recovery planning. For NGOs, it enables targeted humanitarian assistance, facilitating their mission to support affected communities. In essence, SAFER is not merely a project; it is a transformative force, offering hope and security in an era where disaster preparedness is of paramount importance.

Chapter 2

Problem Definition

The development of "SAFER: System for Assessment and Forecasting of Emergency Risks" unearthed critical problems plaguing disaster management. From inadequate disaster preparedness and limited predictive capabilities to fragmented data integration and insufficient community engagement, these challenges underscored the urgent need for innovative solutions in the face of escalating natural disasters. SAFER's mission is to confront and address these issues head-on, aiming to build resilience, save lives, and protect communities worldwide.

1. Inadequate Disaster Preparedness:

Numerous regions lacked sufficient awareness and resources for disaster planning and mitigation. This critical issue left these areas vulnerable when catastrophic events struck. The consequence was a heightened risk to human lives, damage to infrastructure, and the environment.

2. Limited Community Resilience:

Communities often lack the knowledge and resources needed to effectively prepare for and respond to flood disaster, resulting in higher levels of vulnerability.

3. Insufficient Response Coordination:

In many cases, response efforts suffered from inefficiencies, delays, and communication breakdowns, impacting the effectiveness of disaster relief. The lack of a cohesive, streamlined approach often resulted in inadequate aid distribution and recovery efforts.

4. Ineffective Early Warning Systems:

The effectiveness of existing early warning systems for various types of disasters, such as tsunamis, floods, varied significantly. In some cases, these systems lacked the necessary infrastructure and coverage to reach all at-risk communities, leading to delays in warnings reaching those in harm's way.

5. Lack of Comprehensive Data Integration:

Without a unified data integration approach, it was challenging to gather and analyze real-time information critical for decision-making during disasters.

In sum, the "SAFER: System for Assessment and Forecasting of Emergency Risks" project identified a range of problems in disaster management, from inadequate preparedness and limited predictive capabilities to coordination challenges and resource constraints. Addressing these issues is central to the project's mission of enhancing disaster resilience and minimizing the impact of disasters on communities and ecosystems.

Chapter 3

Proposed System

The Proposed System within the SAFER project represents the core innovation that aims to revolutionize disaster management, particularly in the assessment and prediction of floods. The Proposed System holds the promise of reducing the devastating impact of these natural disasters, supporting emergency responders, and aiding decision-makers in critical choices.

1. System Objectives:

The primary objective of the Proposed System is to significantly enhance flood and drought assessment, prediction and advanced forecasting capabilities. It is driven by the aim to minimize the devastating consequences of these natural disasters and empower communities and decision-makers.

2. Data Sources and Integration:

The system will consolidate a multitude of data sources, including satellite imagery, weather data, historical records, and additional relevant datasets. This integration of diverse data is a cornerstone for generating comprehensive and precise predictions.

3. Machine Learning Models:

State-of-the-art machine learning models, tailored to the specific characteristics of flood and drought predictions, will be at the heart of the Proposed System. Careful model selection will be made to ensure their suitability for each disaster type.

4. User Interface Design:

The system will incorporate a user-friendly interface for easy accessibility by various stakeholders, such as emergency responders, local authorities, and community members. The design will prioritize clarity and usability.

We chart a visionary path towards revolutionizing disaster management, with a specific focus on flood and drought assessment and prediction. This dynamic system, rooted in advanced data analytics and machine learning techniques, strives to redefine the precision in predictions. With an emphasis on accuracy and timeliness, the Proposed System holds the potential to significantly reduce the impact of natural disasters.

3.1 Features and Functionality: -

The SAFER (System for Assessment and Forecasting of Emergency Risks) project introduces a constellation of key features that represent the cornerstone of its innovation in disaster management. These features form the bedrock of a versatile, responsive, and environmentally-conscious system designed to predict, mitigate, and recover from a broad spectrum of natural disasters like floods and droughts.

1. Real-Time Monitoring:

Real-time monitoring involves the tracking of environmental data, such as weather conditions and water levels, enabling the system to detect and respond to changes as they happen, enhancing its ability to provide up-to-the-minute assessments.

2. Maps and Visualization of Disaster-Prone Areas:

The system employs advanced mapping and visualization tools to display areas vulnerable to disasters, aiding stakeholders in identifying high-risk zones. Visual representations provide valuable insights for planning and resource allocation.

3. Analysis of Past Calamities and Major Events:

The system conducts an in-depth analysis of historical disaster data and major events, identifying patterns and trends that help stakeholders make informed decisions, improve preparedness, and assess the long-term impact of disasters.

4. Providing Predictions of Floods:

Leveraging advanced data analytics and machine learning models, the system offers predictive capabilities, forecasting the likelihood and severity of floods and droughts. These predictions are instrumental in disaster preparedness and risk reduction.

5. User-Friendly Interface:

The system's interface is designed with a user-centric approach, prioritizing ease of use and accessibility. It enables users of varying technical expertise, from community members to emergency responders, to access and interpret critical data and insights efficiently.

Incorporating a suite of essential features, the SAFER project sets out to revolutionize disaster management. It categorizes the extent of damage, offering a clearer perspective on disaster impact, and conducts thorough analyses of historical data to enhance preparedness. As these features come together, SAFER embodies the commitment to creating a safer, more resilient world where technology and information empower us to mitigate the devastating consequences of natural disasters effectively.

Chapter 4

Project Outcomes

Project outcomes are the changes that occur as a result of your actions. These typically involve improvements for a product or service. When designing a project, it's important to know what your project outcomes are so you have a way of measuring your success and understand what your overall goal is. They are also valuable for businesses because they help create deliverables to meet their purpose and goal.

1. Search for Major Historical Events:

Users can explore the extensive database of historical disaster events, gaining valuable insights into past calamities. This feature aids researchers, policymakers, and communities in understanding disaster trends and planning for the future.

2. Analysis of Real-Time Damage Maps:

Users can access real-time damage maps and use them to assess the extent of damage in disaster-affected areas. This information empowers decision-makers to allocate resources effectively and prioritize response efforts.

3. Access to Predictive Models:

The project provides users with the access to predictive models for disasters like floods and droughts. These models offer insights into future disaster scenarios, enabling better preparedness and proactive risk reduction.

4. Future disaster possibilities:

Predict the occurrence of flood and drought using river level, rainfall and temperature, precipitation, soil moisture, soil temperature respectively of that particular area, then it will predict the disaster.

Chapter 5

Software Requirements

Software Requirement Specification (SRS) Format as name suggests, is complete specification and description of requirements of software that needs to be fulfilled for successful development of software system. These requirements can be functional as well as non-functional depending upon type of requirement. This is description of features and functionalities of the target system. Requirements convey the expectations of users from the software product. It is the responsibility of system analyst to document the requirements in technical language so that they can be comprehended and useful by the software development team.

The software and technology stacked used in development of the SAFER are:-

Frontend:

HTML & CSS

Python 3.8

JavaScript

Backend:

Django 4.2.5

Datasets:

Analysis

i. Maps: Google Earth Engine – Sentinel-1A

ii. Graphs: Data from Open-Meteo API

Chapter 6

Project Design

Design is the first step in the development phase for any engineering product (or) system. It may be defined as “the process of applying various techniques and principles for the purpose of defining a device, a process, or a system insufficient detail to permit its physical realization”. Software design is an iterative process through which requirements are translated into a ‘Blue print’ for constructing the software.

The design is represented at a high level of abstraction, a level that can be directly translated to specific data, functional and behavioral requirements. The interface design describes how the software communicates within itself, to systems that interoperate with it, and with humans who use it.

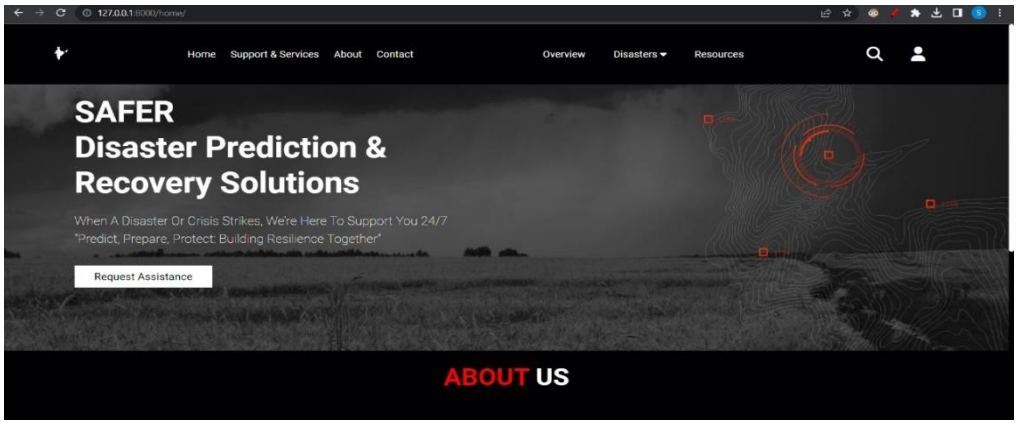


Figure 6.1: Home page

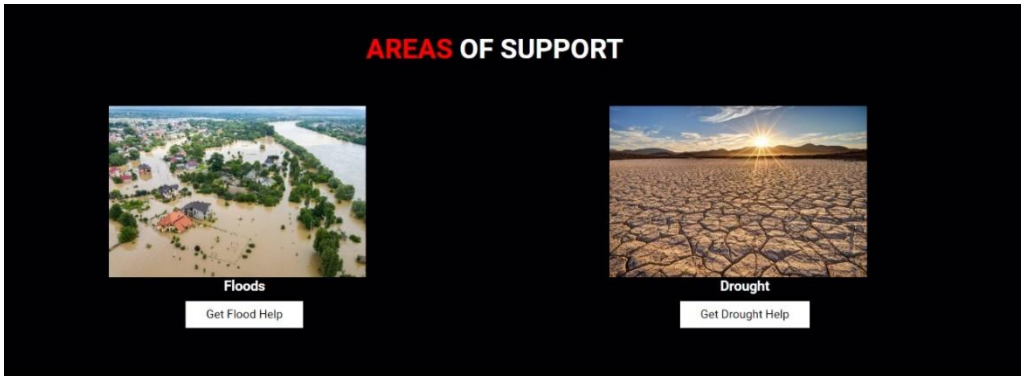


Figure 6.2: Home page – Areas of Support

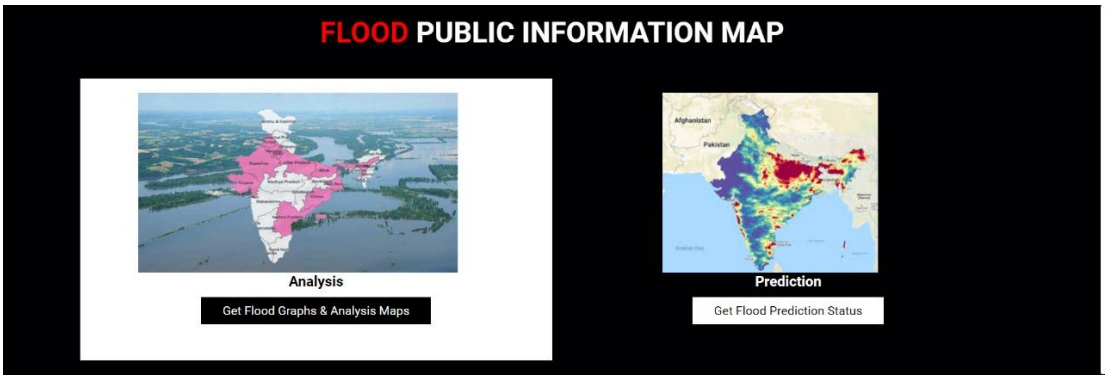


Figure 6.3: Analysis and Prediction of Flood

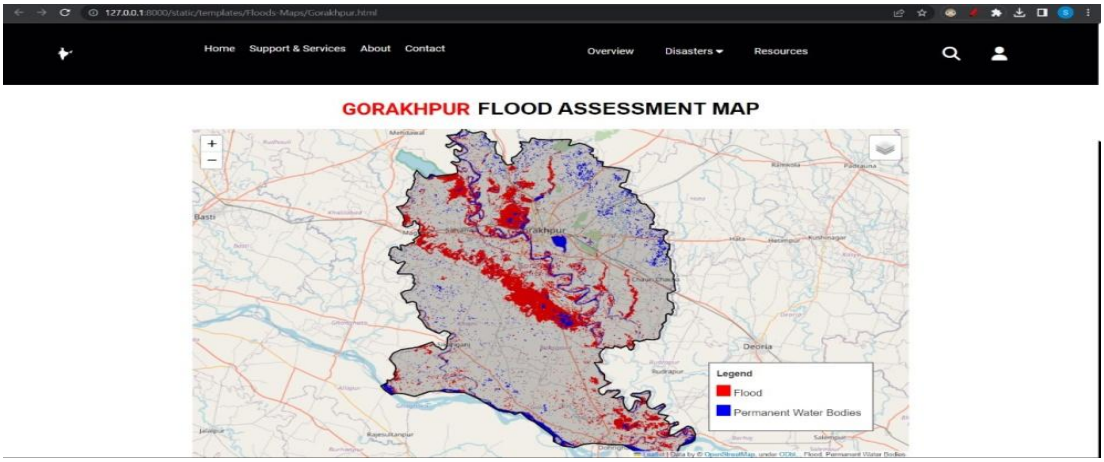


Figure 6.4: Map of Gorakhpur flood assessment

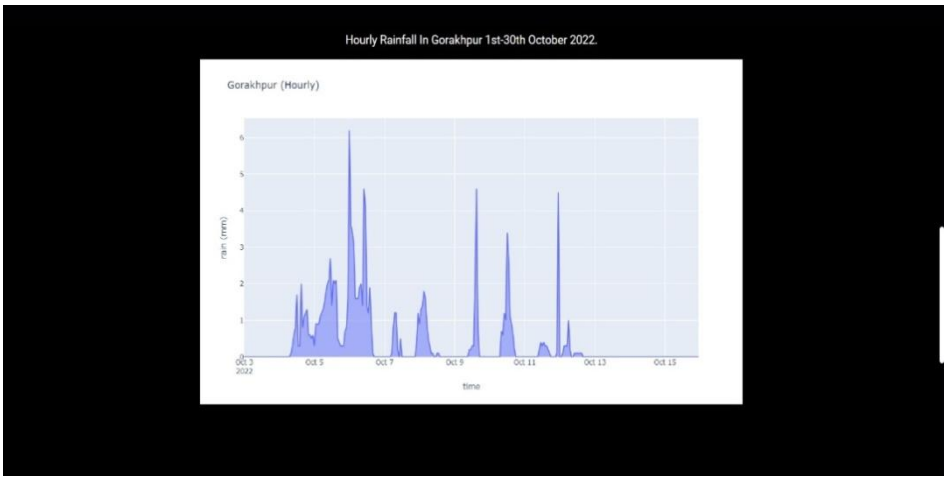


Figure 6.5: Hourly rainfall graph of Gorakhpur (October 2022)

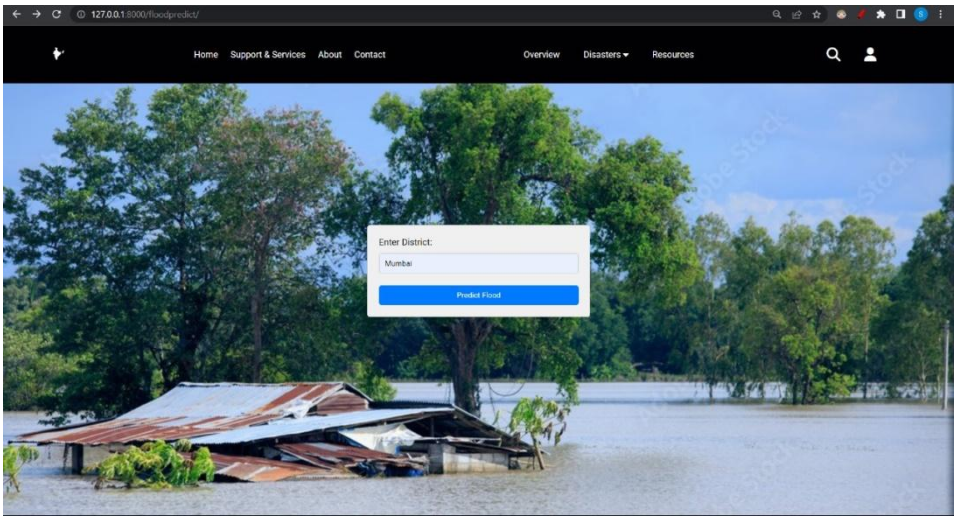


Figure 6.6: Flood Prediction

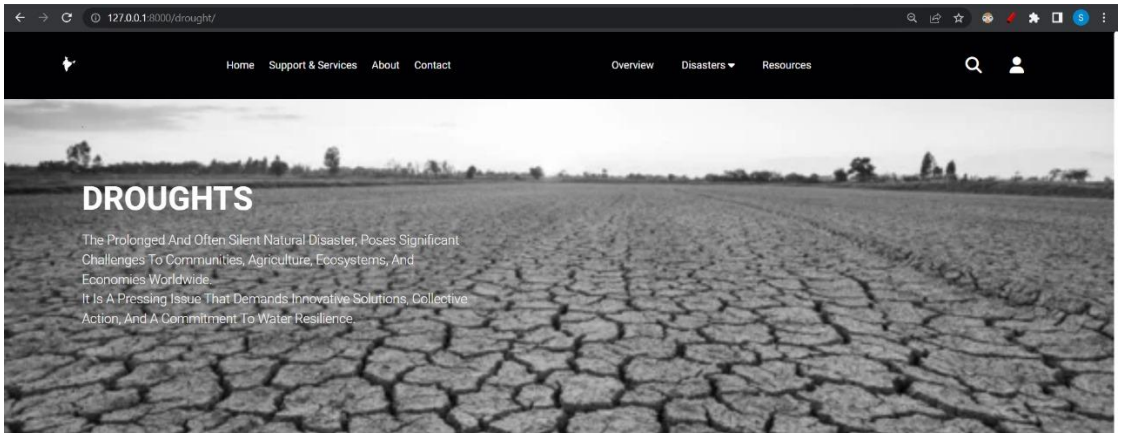
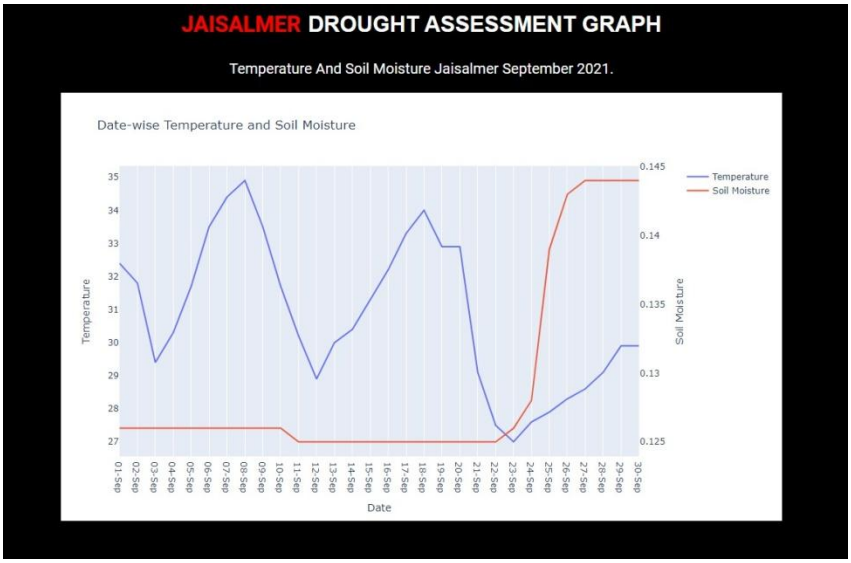


Figure 6.7: Drought



6.8: Drought assessment of Jaisalmer (September 2021)

Chapter 7

Project Scheduling

In project management, a schedule is a listing of a project's milestones, activities, and deliverables. Usually, dependencies and resources are defined for each task, then start and finish dates are estimated from the resource allocation, budget, task duration, and scheduled events. A schedule is commonly used in the project planning and project portfolio management parts of project management. The development and maintenance of the project schedule is the responsibility of a full-time scheduler or team of schedulers, depending on the size and the scope of the project. The project schedule is a calendar that links the tasks to be done with the resources that will do them. It is the core of the project plan used to show the organization how the work will be done, commit people to the project, determine resource needs, and used as a kind of checklist to make sure that every task necessary is performed.

A Gantt chart is a type of bar chart that illustrates a project schedule. Modern Gantt charts also show the dependency relationships between activities and the current schedule status. This chart lists the tasks to be performed on the vertical axis, and time intervals on the horizontal axis. The width of the horizontal bars in the graph shows the duration of each activity. Gantt charts illustrate the start and finish dates of the terminal elements and summary elements of a project. Terminal elements and summary elements constitute the work breakdown structure of the project. Modern Gantt charts also show the dependency (i.e., precedence network) relationships between activities. Gantt charts can be used to show current schedule status using percent-complete shadings.

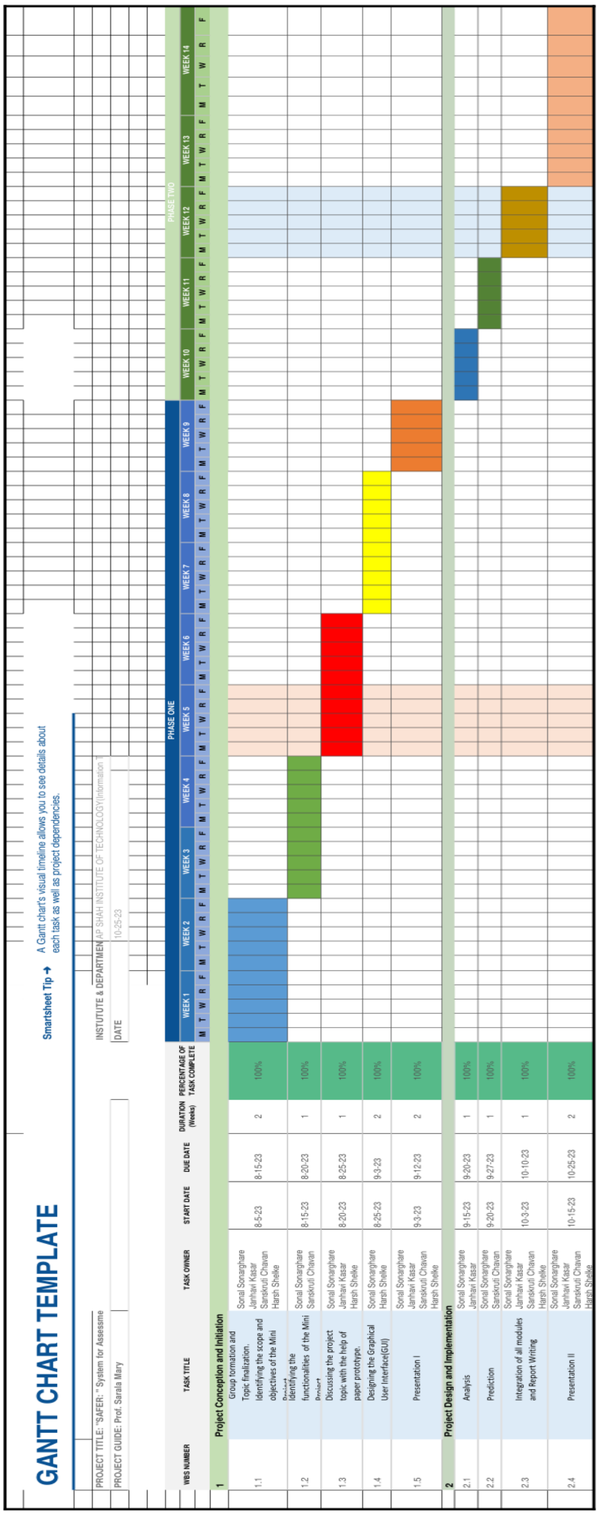


Figure 7.1: Gantt Chart

Chapter 8

Conclusion

In conclusion, the SAFER project represents a groundbreaking advancement in disaster management and mitigation. With a comprehensive approach that encompasses data integration, real-time monitoring, and predictive modeling, SAFER equips stakeholders with the capabilities to effectively address the challenges posed by floods.

As we navigate a world increasingly marked by climate-related challenges, SAFER's future scope promises further innovation and collaboration, aiming to ensure the system remains at the forefront of disaster management. The commitment to data security, user engagement, and continuous improvement underscores our dedication to creating a safer and more resilient world, where technology and knowledge come together to mitigate the consequences of natural disasters and build more secure environments for vulnerable populations worldwide.

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