SHAHEED ZULFIKAR ALI BHUTTO
INSTITUTE OF SCIENCE AND TECHNOLOGY

Final Year Project Report

Earthquake Intensity Minimizer

Project Team

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Project Supervisor

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Date: 7th May 2024

Bachelor of Science in Computer Science

Shaheed Zulfikar Ali Bhutto Institute of Science and Technology (SZABIST)
Karachi Campus

PLAGIARISM FREE CERTIFICATE

This is to certify that we**, Qirat Sohail** and **Prerna Rohra**, are the members of FYP group **Earthquake Intensity Minimizer** under registration numbers **2012312** and **2012221** respectively, at the Department of Computer Science at SZABIST, Karachi. We certify that our FYP documentation has been reviewed by our advisor and the work presented is our own.

Name of Advisor: **Dr. Khalid Rasheed**

Signature: _____

Declaration of Authorship

We, Qirat Sohail Registration No # 2012312 and Prerna Rohra No # 2012221, declare that this report titled, “Earthquake Intensity Minimizer” and the work presented in it are our own. We confirm that: This work was done wholly or mainly while in candidature for a bachelor’s degree at this University. Where any part of this report has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated. Where we have consulted the published work of others, this is always clearly attributed. Where we have quoted from the work of others, the source is always given. With the exception of such quotations, this report is entirely our own work. We have acknowledged all main sources of help. Where the report is based on work done by ourselves.

Signed: Qirat Sohail (2012312) and Prerna Rohra (2012221)

Date: 7th-May-2024

Project Description

Earthquakes have been the cause of damage and loss of lives from millions of years. With time multiple factors, natural and human induced are causing it's increase day by day. To address the concern of damage and loss of lives, we plan to develop a web app raising awareness and using AI technology to mitigate intensity (impact) of earthquake using certain solutions to help minimize the impact.

Our application goal is to let the users easily navigate through our web app to analyze intensity prediction compared to with and without implementing solutions. With necessary educational tools, insurance policies and earthquake precautionary measures available.

Our project is an Opens source project. It is a web application. We have used HTML CSS and Java script for frontend development and python (Flask) for backend development with MySQL database. Our IDE to Code is Visual Studio Code and Anaconda (Jupyter Notebook).

For this project we have used agile methodology. We have designed our project in five steps: Requirement gathering, Designing, Development, Testing, Deployment/Maintenance.

This application will assist users more related to education and geology.

Acknowledgement

In the name of ALLAH, the most beneficent and merciful who gave us the knowledge and courage to work on this area.

We would first like to thank our supervisor Dr. Khalid Rasheed of the Computer Science faculty at Shaheed Zulfiqar Ali Bhutto Institute of Science and Technology.

The door to Dr. Khalid Rasheed's office was always open whenever we ran into a trouble spot or had a question about our work. He consistently helped, cooperated and motivated us throughout the work.

We would also like to thanks our teachers who guided us in the light of their knowledge and experience. We would also like to express our gratitude to our loving parents and family members and friends who helped us and gave us encouragement.

At the end, we would like to thank Shaheed Zulfiqar Ali Bhutto Institute of Science and Technology for providing us such an inspiring environment. The quality education, the cooperative faculty members and the challenging environment have always motivated and boosted the confidence level of each and every student who has been a part of Shaheed Zulfiqar Ali Bhutto Institute of Science and Technology. Gratitude to all those who let us share their knowledge and resources.

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Project Proposal

1. Introduction

This Final Year Project (FYP) aims to create a web application that uses machine learning/deep learning algorithms to help minimize the intensity of an earthquake by implementation of certain solutions to lessen the impact of intensity.

2. Objective

"To Create a web application that minimizes the intensity of an earthquake Using machine learning/deep learning algorithms, paving a way to protect a high loss of life and damage."

3. Problem Description

Earthquakes are caused when underground tectonic plates suddenly collide or slide past each other. This releases energy that causes seismic waves to travel in all directions and results in the shaking of the earth's surface. Earthquakes have the potential to harm both people and property. Therefore, we aim is to lessen the intensity of an earthquake affecting the lives and property of millions of people. By using machine learning/deep learning algorithms on standard earthquake's dataset to predict the normal intensity rate by comparing with the rate of intensity achieved after implementation of solutions.

4. Methodology

- **Research:** Proper research on the topic since the project is research based.
- **Data Collection:** Gather a comprehensive dataset of historical earthquake records, including information such as location, magnitude, depth, and time of occurrence.
- **Algorithm Selection:** Utilize machine learning and deep learning algorithms, such as any Neural Networks, to develop a predictive model based on the standard earthquake data.
- **Predictive Model Development:** Train the selected algorithm on the standard earthquake dataset to create a predictive model. This model will estimate the likelihood of an earthquake occurring in a given area and its potential intensity.
- **Data Integration:** Incorporate data related to earthquake intensity solutions into the model.

- **Model Evaluation:** Assess the performance of the model by comparing its predictions of earthquake likelihood and intensity before and after incorporating solutions.
- **Outcome Comparison:** Measure the effectiveness of earthquakes intensity minimizing solutions by contrasting the model's predictions with actual earthquake intensity occurrence. This will help determine if the solutions have reduced the predicted earthquakes intensity.

5. Project Scope

This project's scope is restricted to using machine learning techniques to lessen earthquake intensity and contrasting the outcomes before and after implementing intensity minimizing solutions.

The project's scope does not involve real-time warning system development, hardware implementation, geological study, or regulatory issues. With a major focus on technical considerations, we assume the availability of appropriate seismic data and rely on existing datasets for analysis.

6. Feasibility Study

Given the project's clearly defined scope, it's critical to determine whether or not it can be completed on time. Important factors include:

i. Risks Involved:

- **Availability of Data:** The prediction model development and accuracy may be impacted by insufficient or unreliable historical earthquake data. Through validation procedures, efforts will be made to collect data from reputable sources and guarantee its quality.

ii. Resource Requirement:

- **Computing Facilities:** Data preprocessing, model training, and evaluation will all require sufficient computing power like cloud computation. This includes having access to computers with enough memory and processing power.
- **Storage of data:** To store historical earthquake data and any intermediate results, adequate storage capacity will be required. Local storage or cloud-based solutions may be used for this.

- **Tools for development:** The earthquake prediction model and web application will be implemented with essential tools like Anaconda, Colaboratory, PyCharm and XAMPP.

The project can be completed on time if the risks associated with model performance and data availability are addressed, and computing resources and development tools are made available.

7. Solution Application Areas

The domains of disaster management and risk assessment are the focus of the project. Below its applications are:

- **Infrastructure and planning for cities:** promoting construction and design that are resilient to earthquake-prone areas.
- **Earthquake Research Center:** An earthquake research center can benefit from our solution by gaining insights into the effectiveness of earthquakes intensity minimizer.
- **Educating the Public:** fostering preparedness of upcoming dangerous earthquake through education.

8. Tools/Technology

Following is the list of hardware and software technologies required for this project:

Hardware:

1. Cloud computation like GP, GPU or FGPA for data processing and model training.
2. Sufficient storage capacity to store the dataset and trained models.
3. High-performance processors for efficient computations.
4. Software:

- Anaconda (Jupyter, Python 3.0) for Python programming.
- PyCharm is an Integrated Development Environment (IDE) created especially for Python development. Django and Flask are two of the Python web frameworks that PyCharm is compatible with. It includes features and tools which support web development, such as HTML, CSS, JavaScript.

- For web developers, XAMPP is an open-source software package that offers a local development environment. The most renowned of its many components are the Apache web server and MySQL database server.
- Microsoft created the popular spreadsheet program called Excel. It offers a variety of tools and capabilities for organizing, calculating, visualizing and data analysis.
- Microsoft Word comes with the Microsoft Office package and offers a variety of tools for documentation.
- Power Bi offers multiple tools for data analysis and visualization.

9. Expertise of the Team Members

The successful completion of this project would require a solid understanding of machine learning and deep learning algorithms, data preprocessing, web development, and programming languages such as Python, HTML, CSS, and JavaScript. The relevant courses we have studied includes Artificial Intelligence and looking forward to study more about this and web development courses in depth.

Additionally, both of us are equally interested in this project. We have a common interest in using artificial intelligence to solve real-world problems. Our shared enthusiasm and commitment foster a cohesive and motivated team dynamic, ensuring successful project outcomes and effective collaboration.

10. Milestones

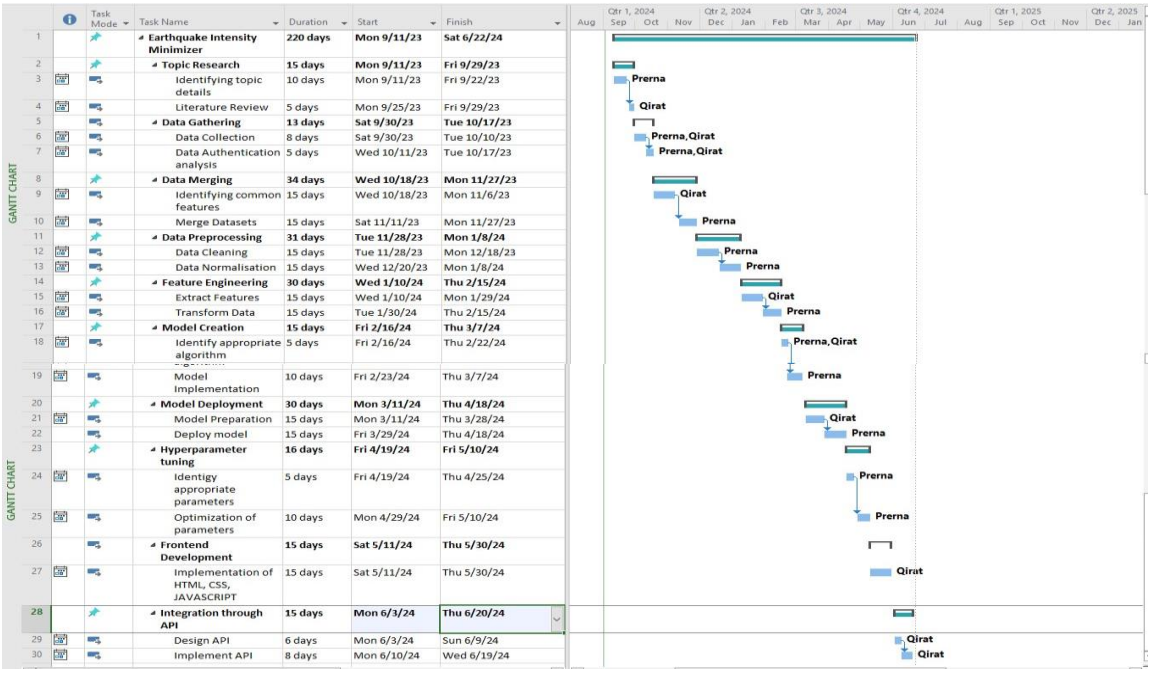
- Topic Research
- Data Gathering
- Data Merging
- Data Preprocessing
- Feature Engineering
- Model Creation
- Model deployment
- Hyperparameter Tuning
- Integration Through API
- Frontend – HTML, CSS, JavaScript

Actors:

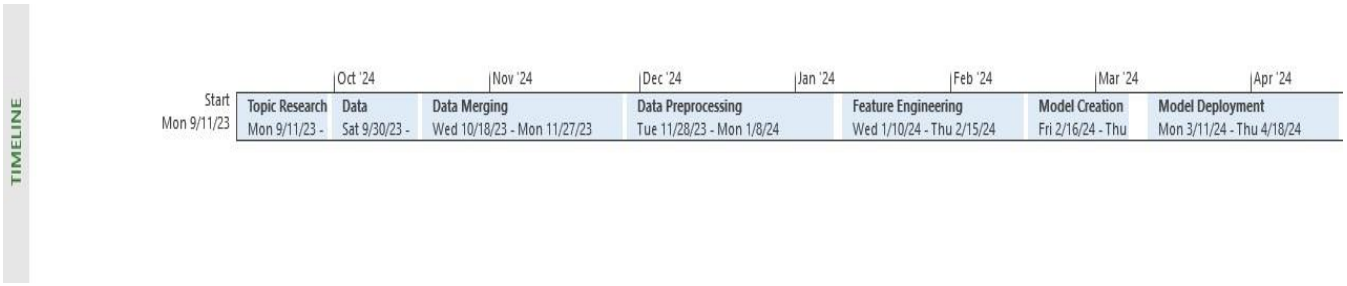
	Resource Name	Type	Material	Initials	Group	Max.	Std. Rate	Ovt.	Cost/Use	Accrue	Base	Code	Add New Column
1													
2	Qirat	Work		Q		100%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard		
3	Prerna	Work		P		100%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard		

11. Project Schedule

Gantt Chart:



Timeline:



12. Work Breakdown Structure

Fall WBS:

	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1		**Earthquake Intensity Minimizer**	**220 days**	**Mon 9/11/23**	**Sat 6/22/24**		
2		**Topic Research**	**15 days**	**Mon 9/11/23**	**Fri 9/29/23**		
3		Identifying topic details	10 days	Mon 9/11/23	Fri 9/22/23		Prerna
4		Literature Review	5 days	Mon 9/25/23	Fri 9/29/23	3	Qirat
5		**Data Gathering**	**13 days**	**Sat 9/30/23**	**Tue 10/17/23**		
6		Data Collection	8 days	Sat 9/30/23	Tue 10/10/23		Prerna,Qirat
7		Data Authentication analysis	5 days	Wed 10/11/23	Tue 10/17/23	6	Prerna,Qirat
8		**Data Merging**	**34 days**	**Wed 10/18/23**	**Mon 11/27/23**		
9		Identifying common features	15 days	Wed 10/18/23	Mon 11/6/23		Qirat
10		Merge Datasets	15 days	Sat 11/11/23	Mon 11/27/23	9	Prerna
11		**Data Preprocessing**	**31 days**	**Tue 11/28/23**	**Mon 1/8/24**		
12		Data Cleaning	15 days	Tue 11/28/23	Mon 12/18/23		Prerna
13		Data Normalisation	15 days	Wed 12/20/23	Mon 1/8/24	12	Prerna
14		**Feature Engineering**	**30 days**	**Wed 1/10/24**	**Thu 2/15/24**		
15		Extract Features	15 days	Wed 1/10/24	Mon 1/29/24		Qirat
16		Transform Data	15 days	Tue 1/30/24	Thu 2/15/24	15	Prerna

Spring WBS:

17		**Model Creation**	**15 days**	**Fri 2/16/24**	**Thu 3/7/24**		
18		Identify appropriate algorithm	5 days	Fri 2/16/24	Thu 2/22/24		Prerna,Qirat
19		Model Implementation	10 days	Fri 2/23/24	Thu 3/7/24	18	Prerna
20		**Model Deployment**	**30 days**	**Mon 3/11/24**	**Thu 4/18/24**		
21		Model Preparation	15 days	Mon 3/11/24	Thu 3/28/24		Qirat
22		Deploy model	15 days	Fri 3/29/24	Thu 4/18/24	21	Prerna
23		**Hyperparameter tuning**	**16 days**	**Fri 4/19/24**	**Fri 5/10/24**		
24		Identigy appropriate parameters	5 days	Fri 4/19/24	Thu 4/25/24		Prerna
25		Optimization of parameters	10 days	Mon 4/29/24	Fri 5/10/24	24	Prerna
26		**Frontend Development**	**15 days**	**Sat 5/11/24**	**Thu 5/30/24**		
27		Implementation of HTML, CSS, JAVASCRIPT	15 days	Sat 5/11/24	Thu 5/30/24		Qirat
28		**Integration through API**	**15 days**	**Mon 6/3/24**	**Thu 6/20/24**		
29		Design API	6 days	Mon 6/3/24	Sun 6/9/24		Qirat
30		Implement API	8 days	Mon 6/10/24	Wed 6/19/24	29	Qirat

13. References

- Douilly R., Haase J. S., Ellsworth W. L., Bouin M. P., Calais E., Symithe S. J., Armbruster J. G., De Lépinay B. M., Deschamps A. and Mildor S. L., Crustal Structure and Fault Geometry of the 2010 Haiti Earthquake from Temporary Seismometer Deployments, Bulletin of the Seismological Society of America, 103(4),2305-2325 (2013)
- Bowen H., Jacka M., Van Ballegooy S., Sinclair T. and Cowan H., Lateral spreading in the Canterbury earthquakes–Observations and empirical prediction methods, Proceedings, 15th World Conference on Earthquake Engineering (2012)
- https://www.usgs.gov/programs/earthquake-hazards/earthquakes

Software Requirements Specifications

1. Introduction

1.1 Purpose

Introducing the Earthquake Intensity Minimizer Software Requirements Specification (SRS) document, a project focused at reducing the impact of seismic events on infrastructure and lives of people. We describe the scope, functions, and technical specifications of the Earthquake Intensity Minimizer system's software in this extensive document. This SRS acts as a road map for the development team, directing the development of a strong and efficient solution to reduce seismic intensity and improve the resilience of impacted areas.

1.2 Document Conventions

For body:

- Text Style: Times **New Roman**
- **Size:** 12

For Section Heading:

- Text Style: Times **New Roman**
- Size: 18

For sub-headings in each Section:

- Text Style: Times **New Roman**
- **Size:** 14

1.3 Intended Audience and Reading Suggestions

- Laymen
- Educational institutions
- Geologist

1.4 Product Scope

The Earthquake Intensity Minimizer project is an advanced software option made to successfully lessen the impact of seismic events. The main role of the software is to predict earthquake intensity based on user input, taking into account variables like region and other data. Once the intensity is known, the system uses advanced reducing techniques to lessen the impact and guarantee the safety of people and infrastructure. The software also assesses the

remaining intensity and determines the probable devastation, offering insightful data. Beyond its capacity for prediction, the system goes above and beyond to deal with the fallout, providing helpful insurance plans and preventative measures to lessen future harm. The entire approach supports our business objective of improving community resilience, making our software a vital resource for areas vulnerable to seismic activity.

1.5 References

- https://app.diagrams.net/
- https://slcc.pressbooks.pub/technicalwritingatslcc/chapter/software requirements- specification-srs/
- https://www.usgs.gov/programs/earthquake-hazards
- https://creately.com/blog/diagrams/uml-diagram-types-examples/

Dataset links

- https://public.opendatasoft.com/explore/dataset/significant-earthquake-database/export/?refine.country=PAKISTAN
- https://data.humdata.org/dataset/catalog-of-earthquakes1970-2014
- https://www.un-spider.org/links-and-resources/gis-rs-software?field_sw_filetype_value_i18n=XLS
- https://www.gns.cri.nz/data-and-resources/?q=earthquakes&sort=relevance&start=0&science=&type=&location=
- https://ohiodnr.gov/discover-and-learn/land-water/earthquakes/ohio-earthquake-database
- https://www.sciencedirect.com/science/article/pii/S2666544120300010#sec3
- https://open.canada.ca/data/en/dataset/4cedd37e-0023-41fe-8eff-bea45385e469
- https://data.ibb.gov.tr/en/dataset?tags=deprem
- https://www.emdat.be/explanatory-notes
- https://figshare.com/articles/dataset/Earthquake_Early_Warning_Dataset/9758555

- https://www.mathworks.com/help/matlab/matlab_prog/loma-prieta-earthquake.html
- https://www.geeksforgeeks.org/analyze-and-visualize-earthquake-data-in-python-with-matplotlib/
- https://ourworldindata.org/natural-disasters
- https://data.usgs.gov/datacatalog/data/USGS:5c1be499e4b0708288c7a999
- https://www.disasterpartners.org/datasets/esri2::shake-intensity/about
- https://www.kaggle.com/datasets/warcoder/earthquake-dataset
- https://seismic.pmd.gov.pk/?page=131
- http://structurespro.info/pegmd/
- https://earthquake.usgs.gov/earthquakes/search/
- https://earthquake.usgs.gov/earthquakes/feed/v1.0/csv.php

2. Overall Description

Product Perspective (Context Diagram):

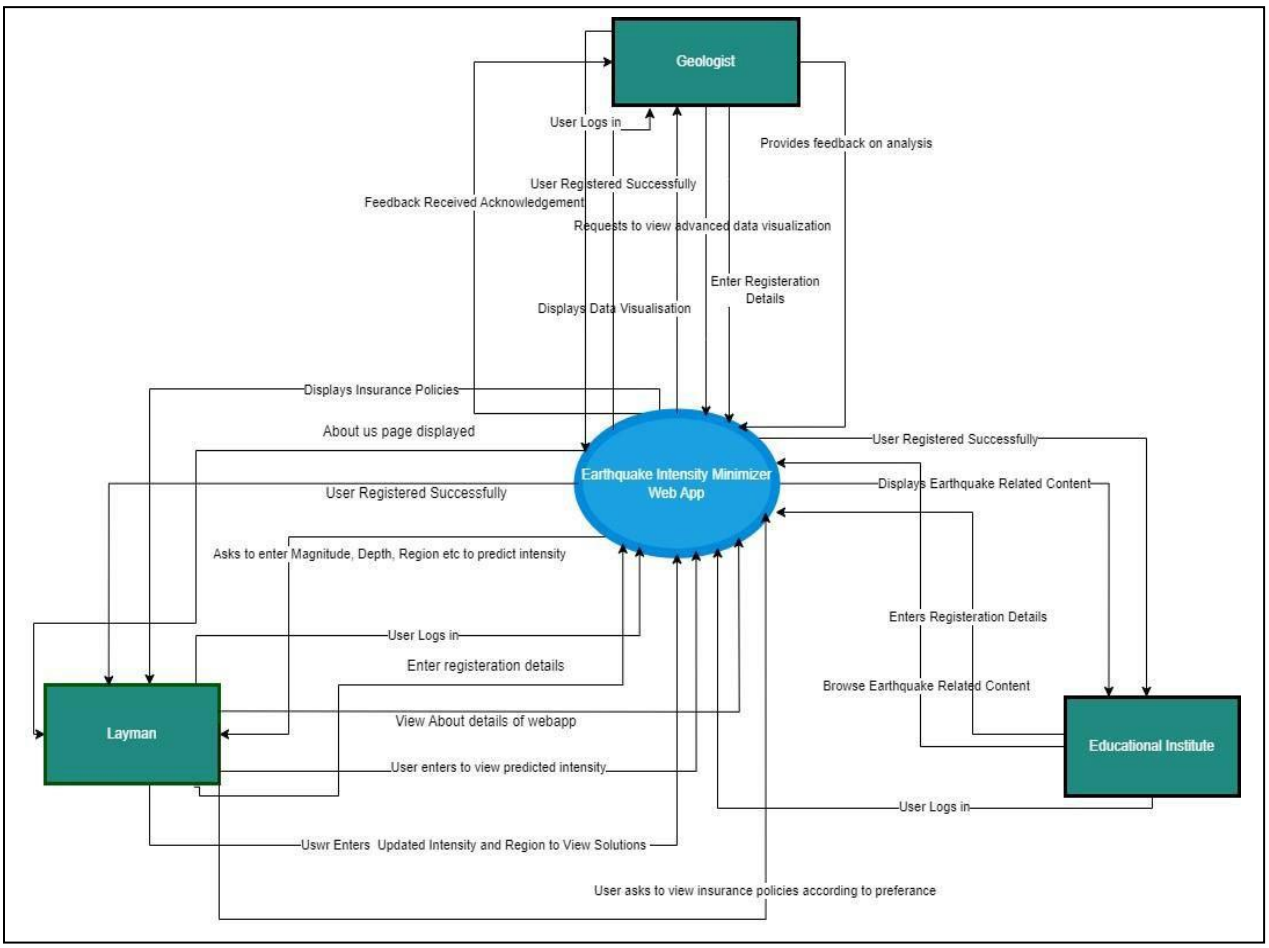


Figure 1 Context Diagram

2.1 Product Functions

- **Earthquake Intensity Prediction:** Based on the geography and relevant criteria, user input analysis predicts earthquake intensity.
- **Earthquake Intensity Minimization:** Use modern methods to successfully reduce expected earthquake intensity.
- **Earthquake Magnitude Reduction:** Use underground science to successfully reduce magnitude of earthquake.
- **Destruction Assessment:** Determine the potential degrees of destruction and assess the intensity that remains after minimizing.
- **Insurance recommendations:** Make available via the web app cooperative

insurance plans and preventative measures for disaster management and recovery.

2.2 User Classes and Characteristics

- **Users (Laymen):** Residents in seismic zones and varied levels of technical proficiency.
  -Usage: Data entry, support access, and safety information.
- **Authorities in Disaster Management:** Expertise in disaster response and technical expertise.
  -Usage: Examine forecasts and prepare efficient emergency responses.
- **Insurance agents and organizations:** Expertise in risk assessment and insurance specialists.
  -Usage: Adjust policies in accordance with the system's risk evaluations.
- **Scientists and researchers:** Seismology, geology, and technical expertise specialists.
  -Usage: Validate predictions and advance scientific knowledge.

Importance:

- **Users:** Providers of input data.
- **Authorities in charge of disaster management:** Ensure alignment with the real world.
- **Insurance agents:** Financial safety nets.
- **Researchers:** Increase scientific knowledge and system credibility.

2.3 Operating Environment

Our database will be running on a windows server and software applications will run on multiple screen or devices on the windows operating system as it is the most familiar and popular operating system for both consumers and developers.

2.4 Design and Implementation Constraints

- **Regulatory Compliance:** It is essential to follow national and international disaster management laws.
- **Hardware Restrictions:** In order to guarantee real-time predictions and responses, the system must function well within predetermined timing and memory restrictions.
- **Interface Compatibility:** Easy data interchange and analysis integration with current databases and disaster management systems.
- **Security measures:** To protect sensitive data, user authentication and strong data

encryption should be used.

- **Compliance with Standards:** Following design guidelines and programming standards to make it easier for the customer's organization to maintain and update its software in the future.
- **Scalability:** The system must be scalable in order to accommodate changing data loads and seismic characteristics of various places.

2.5 User Documentation

Three types of documents will be provided, System Requirements Specification (SRS), Test Cases and System design specification (SDS).

2.6 Assumptions and Dependencies

- **Third-Party Components:** Predicted on the accessibility and portability of necessary third-party libraries and tools for the study and prediction of seismic data.
- **Development Environment:** Assumes the availability of the required hardware and software in a stable and secure environment.
- **Data Sources:** Relies on consistent external data providers and presumes dependable access to current seismic data sources for precise forecasts.
- **Regulatory Compliance:** Requires that, during the duration of the project, all legal and regulatory standards pertaining to disaster prediction and management stay the same. Any modifications could affect the needs and scope of the project.

3. External Interface Requirements

3.1 User Interfaces

The Earthquake Intensity Minimizer will have a straightforward user interface with a dashboard that is easy to use for entering local data and viewing estimates. It will follow standardized GUI guidelines to guarantee uniform screen layout and navigational components. To ensure a smooth user experience, the interface will have standard buttons, error message displays, and help buttons.

3.2 Hardware Interfaces

The Earthquake Intensity Minimizer communicates with hardware components to support a range of devices, including servers and data storage systems. Real-time seismic data input

and output are handled using sophisticated algorithms in data exchanges. Industry standards are followed in the communication protocol, which guarantees smooth data and control signal interchange between the hardware and software components. The system's physical interfaces guarantee compatibility with a variety of hardware components essential for earthquake prediction and mitigation, while its logical interfaces provide effective data processing.

3.3 Software Interfaces

Through the use of SQL protocols, the Earthquake Intensity Minimizer communicates with a centralized database system to provide smooth data storage and retrieval. Utilizing Python modules for sophisticated data analytics, the system runs on a Windows Server (version 2022) environment. Real-time simulations are made easier with integrated commercial components, including disaster modeling software (version 2.0). The system uses common CSV formats to import seismic data, applies bespoke algorithms to process it, and produces reports on risk assessment and minimized intensity data.

3.4 Communications Interfaces

Because it uses secure HTTP protocols for communication, the Earthquake Intensity Minimizer guarantees data integrity and confidentiality. Through an online browser interface, users can interact with the system and access reports on risk assessments and earthquake predictions. The system allows users to enter data electronically in forms that are formatted in CSV, facilitating easy data interchange. The system runs at low latency and high data transmission rates to preserve synchronization and accuracy in real time. Industry-standard encryption techniques are used to safeguard private user information and improve system security as a whole.

4. System Features

The Earthquake Intensity Minimizer's functional needs are arranged according to system features. These capabilities include using user input to forecast the strength of earthquakes, applying solutions to minimize intensity, estimating the amount of intensity left and the possible damage, and offering consumers collaborative insurance coverage and preventative actions. Every feature is made to be useful to particular user groups and improve readiness for emergencies, guaranteeing effective and focused reactions to seismic incidents. This structure makes it possible to comprehend the main services that the product provides, which facilitates

efficient development and smooth user experiences.

4.1 System Feature 1: Login/Signup

Description and Priority: This essential function gives users the ability to register, establish accounts, and log in to the system, giving them individualized access and data storage. Establishing user identity and enabling customized services makes it of utmost importance.

Actors: Layman, Geologist, Educational Institute.

Stimulus/Response Sequences:

- When registering, new users must enter the required information and choose a password.
- Users who have registered log in with their login details.
- The system authorizes user data and provides access to customized features.

Functional Requirements:

- **REQ-1:** To safeguard sensitive data, the system must use encryption methods to safely store user credentials.
- **REQ-2:** To improve security, users should receive an email verifying their account activation after signing up.
- **REQ-3:** Personalized features, like the ability to save preferences and view previous earthquake data, should be available to registered users.

4.2 System Feature 2: Access of Real-Time Datasets of Earthquake

Description and Priority: With the use of this feature, users can view seismic data for active earthquakes in real time. It has a high priority since it gives people the most recent information, they need to make decisions right away.

Actors: Layman, Geologist.

Stimulus/Response Sequences:

- Users can request global or regional real-time seismic data.

- The system obtains up-to-date seismic data from dependable sources.
- The system presents the seismic data in real time in an easily navigable way.

Functional Requirements:

- **REQ-1:** To ensure data correctness and dependability, the system must retrieve seismic data in real-time from reliable sources.
- **REQ-2:** The location, magnitude, and depth of earthquake data should be given in an easily comprehensible format in real-time.
- **REQ-3:** Real-time data should be able to be filtered and sorted by users according to particular parameters, like location or magnitude.

4.3 System Feature 3: Access Educational Content about Earthquake

Description and Priority: To improve user's awareness and readiness, this feature provides educational resources about earthquakes, such as articles, films, and tutorials. Encouraging user's awareness and education is a high priority.

Actors: Layman, Educational Institute.

Stimulus/Response Sequences:

- The area with instructional content is accessed by users.
- The system presents a range of learning materials.
- The instructional materials can be viewed, read, or interacted with by users.

Functional Requirements:

- **REQ-1:** The educational information must be categorized by the system according to subjects such safety precautions, seismic preparedness, and past seismic incidents.
- **REQ-2:** To give consumers access to the most up-to-date and pertinent information, educational content should be updated often.

4.4 System Feature 4: Earthquake Intensity Prediction

Description and Priority: This feature involves using user input to anticipate earthquake intensity, with a high priority. It is essential for delivering alerts on time and making preparations possible.

Actors: Layman, Geologist.

Stimulus/Response Sequences:

- The user submits regional data, such as magnitude, depth etc.
- The system uses predictive algorithms to process input.
- The system reacts with the anticipated magnitude of the earthquake and other risk indicators.

Functional Requirements:

- **REQ-1:** The system needs to properly analyze data entered by users, including geographic and geological factors.
- **REQ-2:** A real-time prediction of intensity is required.
- **REQ-3:** Incorrect inputs should be handled by the system politely, with users receiving clear error notifications that they can correct.

4.5 System Feature 5: Earthquake Intensity Minimization

Description and Priority: This feature reduces the expected intensity of earthquakes by using sophisticated methods. Ensuring the efficacy of catastrophe mitigation initiatives is a top responsibility.

Actors: Layman, Geologist.

Stimulus/Response Sequences:

- Data about expected earthquake intensity is received by the system.
- Using minimization procedures, the intensity is decreased.

- The system reacts by implementing remedies and reducing intensity levels.

Functional Requirements:

- **REQ-1:** In order to decrease anticipated intensity while preserving data accuracy, the system must use the proper algorithms.
- **REQ-2:** Users should be provided with minimized intensity results and implemented solutions in an easily comprehensible style.
- **REQ-3:** During intensity minimization, the system must manage unforeseen faults and notify administrators and provide fallback options.

4.6 System Feature 6: Destruction Assessment

Description and Priority: With this feature, possible destruction is assessed using the intensity that remains after minimization. It has a medium priority and gives users crucial information about the anticipated impact.

Actors: Layman, Geologist.

Stimulus/Response Sequences:

- Data parameters such as magnitude, depth and intensity are sent to the system.
- Destruction level is predicted in the progress bar.

Functional Requirements:

- **REQ-1:** The system must determine whether potential destruction is low, moderate, or high by looking at the progress bar.

4.7 System Feature 7: Insurance and Precautionary Measures

Description and Priority: Offering cooperative insurance plans and preventative measures is part of this function. Giving people access to vital resources for disaster recovery and preparedness makes it a high priority.

Actors: Layman.

Stimulus/Response Sequences:

- Users ask for details on insurance plans and safety precautions.
- The system shows suggested safety precautions and insurance plans that are available.
- Users are able to choose and sign up for insurance plans.

Functional Requirements:

- **REQ-1:** Detailed listings of cooperative insurance plans, including information on coverage, premiums, and insurance agents' contact details, must be displayed by the system.
- **REQ-2:** Based on the user's location and anticipated intensity levels, precautionary measures, like evacuation plans and emergency supplies, must be given.
- **REQ-3:** Prior to enrollment, users ought to have the ability to choose insurance plans and obtain comprehensive policy documentation for examination.

4.8 System Feature 8: Feedback on Analysis

Description and Priority: Users can comment on the predictability and utility of earthquake intensity and mitigation suggestions using this tool. It has a medium priority since it allows for ongoing enhancements depending on user experiences.

Actors: Layman, Geologist.

Stimulus/Response Sequences:

- Users provide input on estimated seismic intensity and how to mitigate it.
- The system keeps track of user comments and user information (registered or anonymous).
- The system might notify users when their feedback has been submitted.

Functional Requirements:

- **REQ-1:** The system should enable users to provide input with an easy-to-use interface, indicating the context in which they would like it to be used (e.g., prediction accuracy, usability, etc.).
- **REQ-2:** To find patterns and opportunities for improvement, user feedback has to

be recorded and reviewed on a regular basis.

- **REQ-3:** Users must receive acknowledgement messages after successfully submitting feedback.

4.9 System Feature 9: Magnitude Reduction

Description and Priority: Users can reduce magnitude with the help of our research by entering earthquakes magnitude and we will be explaining how magnitude can be reduced.

Actors: Researchers, Geologist.

Stimulus/Response Sequences:

- Users provide input on earthquake magnitude.
- The system keeps track of user input and provide output on the basis of conditions.

Functional Requirements:

- **REQ-1:** The system should enable users to provide input with an easy-to-use interface, indicating the context in which they would like it to be used.

5. Other Nonfunctional Requirements

5.1 Performance Requirements

The goal of the Earthquake Intensity Minimizer is to reduce the response time for earthquake intensity assessments to less than two seconds by offering real-time predictions and response suggestions. During seismic events, this quick reaction guarantees timely alerts and facilitates quick decision- making. The system should also be able to handle up to 1000 concurrent users and facilitate concurrent user interactions, all while keeping responsiveness even during periods of high demand. In order to ensure that the system is effective in disaster management, allowing for prompt, data- driven responses and minimizing possible harm, certain performance requirements are essential.

5.2 Safety Requirements

In order to guarantee user safety, the Earthquake Intensity Minimizer needs to offer precise forecasts and suggestions. Real-time notifications of seismic events are one type of safeguard that enables users to swiftly take the necessary actions. False alerts must be avoided by the system to spare consumers from unneeded anxiety or interruption. It is required to abide by national

and international disaster management laws, and the system design follows the safety recommendations made by the appropriate authorities. Furthermore, the software needs to acquire safety certificates attesting to its precision and dependability in reducing seismic intensity and giving users reliable, timely information.

5.3 Security Requirements

Security and privacy are given top priority by the Earthquake Intensity Minimizer, which makes sure that all user data—input and output included—is secured during transmission and storage using industry-standard protocols. To improve system integrity, user identity authentication is required in order to access sensitive functionalities. The system is compliant with data protection laws, protecting user privacy and guaranteeing safe processing of personal data. To demonstrate its reliability in safeguarding user data and privacy, the program needs to receive security and privacy certifications.

5.4 Software Quality Attributes

- **Reliability:** To guarantee dependable access to earthquake forecasts and response suggestions, the system should run constantly with a goal uptime of 99.9%.
- **Usability:** Make user-friendliness your first priority. Aim for a System Usability Scale (SUS) score of 80 or above, and make sure your interface is simple enough for users to interact with.
- **Maintainability:** To obtain a Mean Time to Repair (MTTR) of less than 4 hours, which facilitates effective maintenance and upgrades, implement code modularity and good documentation.
- **Robustness:** To achieve zero critical failures during times of heavy demand, the system must be able to gracefully manage faults and unexpected inputs.
- **Interoperability:** To guarantee a smooth user experience and encourage widespread accessibility, make sure that the program is compatible with popular web browsers (Chrome, Firefox, Safari) and operating systems (Windows, macOS, Linux).
- **Adaptability:** The system must be able to adjust to changing data environments without sacrificing accuracy or efficiency. It should support new seismic data formats and sources.

5.5 Business Rules

- **User Roles:** Predictions and regional data input are available to general users. Authorities in charge of disaster management have complete analytical access to all

system functionalities. While researchers employ gathered data for scientific study, insurance brokers evaluate risk data and provide policies.

- **Sensitive Data:** User identity and data entered are private. Authentication is required in order to access sensitive features. Reports on risk assessment and predicted intensity are given publicly, but personal user information is kept private.
- **Updates and maintenance:** Scheduling routine maintenance doesn't interfere with operations in real time. Updates are rolled out during times of low user activity to reduce user impact.

6. Other Requirements

- **Database Requirements:** A reliable database management system that can securely and effectively handle massive volumes of seismic data should be used by the system.
- **Legal Compliance:** To ensure that user information is handled and utilized in an ethical and lawful manner, the software must abide by all applicable international laws and regulations pertaining to data privacy.
- **Internationalization:** To accommodate users from a variety of linguistic backgrounds, the user interface and system responses must be sensitive to cultural differences and neutral in language.
- **Error Handling:** Put in place thorough error handling procedures to give users understandable, easy-to-use error messages that help them identify problems and find solutions.
- **Reuse Objectives:** By allowing developers to utilize components in later projects, code modularization and documentation should facilitate future reuse and foster efficiency and uniformity among applications.

Appendix A: Glossary

- **SRS:** (Software Requirement Specification) A detailed document that outlines the needs and specifications of the software system.
- **APIs:** Application programming interfaces, are a collection of guidelines and conventions that let various software programs talk to one another.
- **CSV:** "Comma-Separated Values", A simple file format called is used to store tabular data in plain text format. Each line in the file represents a data record, and each record is made up of one or more fields that are separated by commas. CSV is frequently used

in a variety of applications for data import and export functions.

- **SQL:** Relational database management and manipulation are accomplished with the help of SQL, or structured query language, a domain-specific language.
- **HTTPS:** Hypertext Transfer Protocol Secure, is a commonly used extension of HTTP that allows for safe online communication over a computer network.

Appendix B: Analysis Models

Class Diagram:

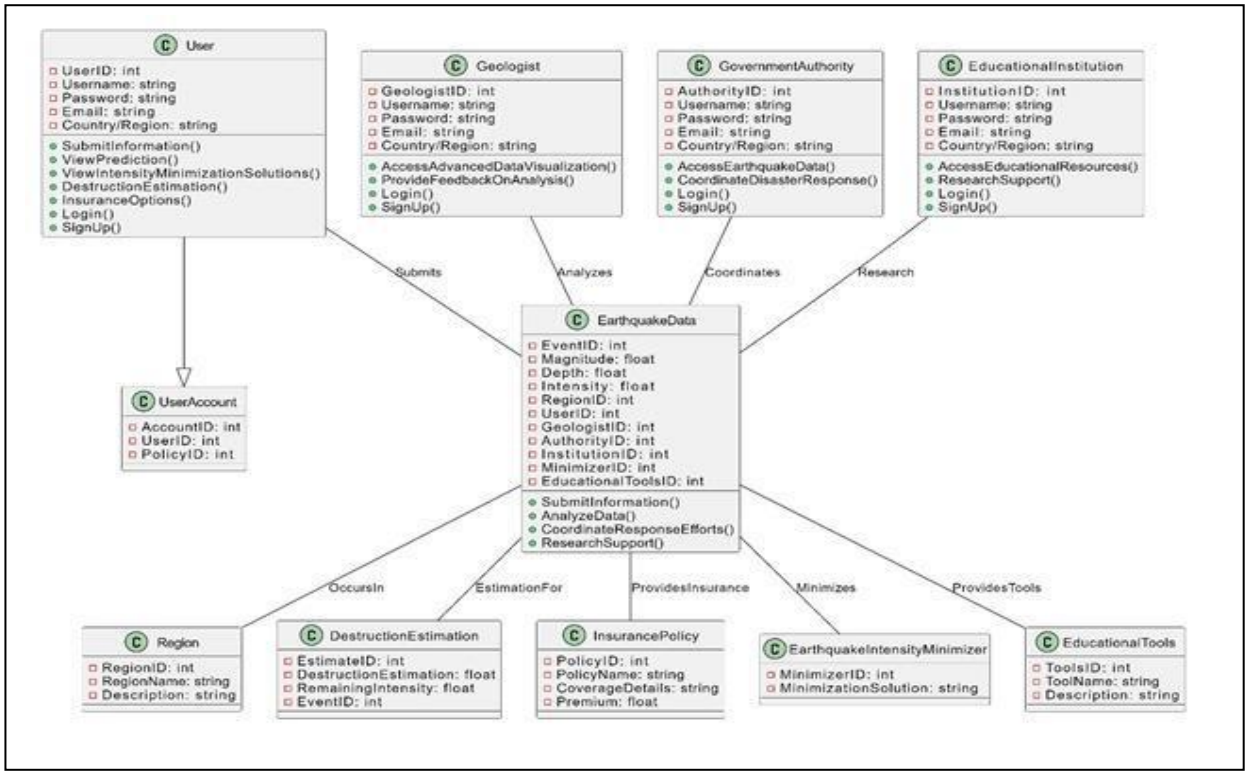


Figure 2 Class Diagram

ERD (Entity Relation Diagram)

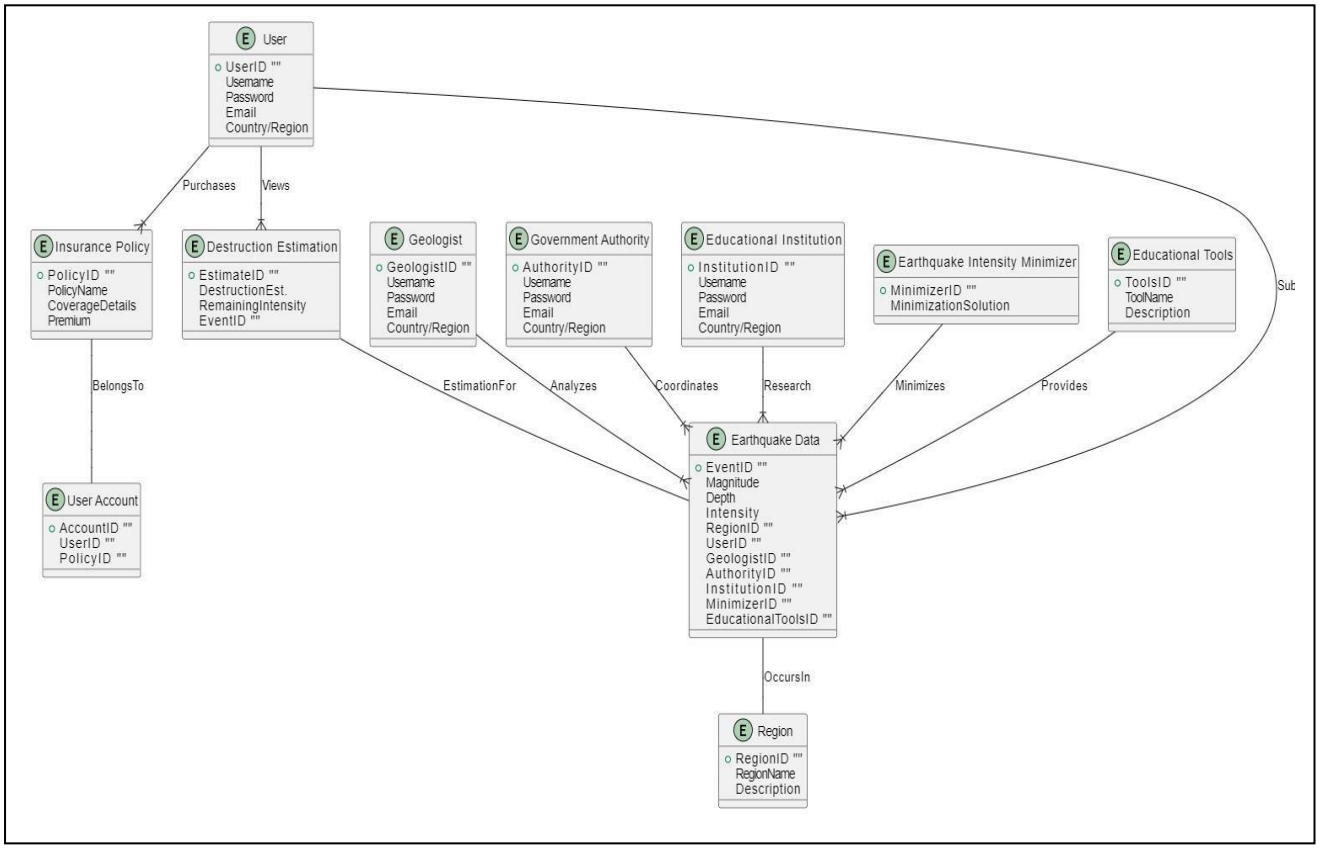


Figure 2.1 Entity Relationship Diagram

Software Design Specification

1. Introduction

1.1 Purpose of this document

The Software Design Specification (SDS) document's main goal is to provide a comprehensive and in-depth discussion of the design elements and architectural concerns for the Earthquake Intensity Minimizer Web App. Considering a breakdown of the software's functionalities, system architecture, and essential design ideas, it is an invaluable resource for the development stage of the application.

1.2 Scope of the development project

The Earthquake Intensity Minimizer project is an advanced software option made to successfully lessen the impact of seismic events. The main role of the software is to forecast earthquake strength based on user input, taking into account variables like region and other data. Once the intensity is known, the system uses advanced reducing techniques to lessen the impact and guarantee the safety of people and infrastructure. The software also assesses the remaining intensity and determines the probable devastation, offering insightful data. Beyond its capacity for prediction, the system goes above and beyond to deal with the fallout, providing helpful insurance plans and preventative measures to lessen future harm. The entire approach supports our business objective of improving community resilience and disaster preparedness, making our software a vital resource for areas vulnerable to seismic activity. Our software greatly supports disaster management techniques, guaranteeing a safer environment for all, by integrating predictive analysis, preventative measures, and post-event support.

1.3 Definitions, acronyms, and abbreviations

- **SRS:** (Software Requirement Specification) A detailed document that outlines the needs and specifications of the software system.
- **APIs:** Application programming interfaces, are a collection of guidelines and conventions that let various software programs talk to one another.
- **CSV:** "Comma-Separated Values", A simple file format called is used to store tabular data in plain text format. Each line in the file represents a data record, and each record is made up of

one or more fields that are separated by commas. CSV is frequently used in a variety of applications for data import and export functions.

- **SQL:** Relational database management and manipulation are accomplished with the help of SQL, or structured query language, a domain-specific language.
- **HTTPS:** Hypertext Transfer Protocol Secure, is a commonly used extension of HTTP that allows for safe online communication over a computer network.

1.4 References

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- https://www.usgs.gov/programs/earthquake-hazards
- https://creately.com/blog/diagrams/uml-diagram-types-examples/

Dataset links

- https://public.opendatasoft.com/explore/dataset/significant-earthquake-database/export/?refine.country=PAKISTAN
- https://data.humdata.org/dataset/catalog-of-earthquakes1970-2014
- https://www.un-spider.org/links-and-resources/gis-rs-software?field_sw_filetype_value_i18n=XLS
- https://www.gns.cri.nz/data-and-resources/?q=earthquakes&sort=relevance&start=0&science=&type=&location=
- https://ohiodnr.gov/discover-and-learn/land-water/earthquakes/ohio-earthquake-database
- https://www.sciencedirect.com/science/article/pii/S2666544120300010#sec3
- https://open.canada.ca/data/en/dataset/4cedd37e-0023-41fe-8eff-bea45385e469
- https://data.ibb.gov.tr/en/dataset?tags=deprem

- https://www.emdat.be/explanatory-notes
- https://figshare.com/articles/dataset/Earthquake_Early_Warning_Dataset/9758555
- https://www.mathworks.com/help/matlab/matlab_prog/loma-prieta-earthquake.html
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- https://ourworldindata.org/natural-disasters
- https://data.usgs.gov/datacatalog/data/USGS:5c1be499e4b0708288c7a999
- https://www.disasterpartners.org/datasets/esri2::shake-intensity/about
- https://www.kaggle.com/datasets/warcoder/earthquake-dataset
- https://seismic.pmd.gov.pk/?page=131
- http://structurespro.info/pegmd/
- https://earthquake.usgs.gov/earthquakes/search/
- https://earthquake.usgs.gov/earthquakes/feed/v1.0/csv.php

1.5 Overview of document

This section offers a summary of the SDS document's main sections and a roadmap for it.

Section 2: System Architecture Description

Rationale about data and architectural design choices.

Section 3: Detailed Description of Components

Comprehensive review of every design element, encompassing type, purpose, function, and identification.

Section 4: User Interface Design

Principles, conventions, and comprehensive descriptions for an interface that is easy to use.

Section 5: Reuse and Relationships to Other Products

Utilizing already-existing tools and modules, providing justifications for their divergence or reuse.

Section 6: Design Decisions and Tradeoffs

Key design decisions and trade-offs, including discarded ideas, are explained.

Section 7: Pseudocode for Components

Logical and algorithmic insights for crucial components using pseudocode.

Section 8: Appendices

Visual representations, such as object diagrams, class diagrams, and more.

2. System architecture description

This section provides an overview and rationale for the program's data and architectural design decisions.

2.1. Section Overview

An overview of the Earthquake Intensity Minimizer system architecture is provided in this subsection, along with a brief description of its main elements. The System Architecture Description describes the data and architectural design choices of the Earthquake Intensity Minimizer, going into depth on its fundamentals.

2.2. General Constraints

There are several significant constraints that shape the design for the Earthquake Intensity Minimizer:

- **Software and Hardware Environment:**

  For best results, compatibility with specific hardware and software environments is essential.

- **Interface specifications:**

  Compliance with established interface standards, encompassing external system integration and user interactions.

- **External Data Visualizations:**

  For efficient data sharing, compatibility with industry-standard data formats is required.

- **Benchmarks for Performance:**

  Achieving predetermined performance standards to guarantee data processing in real time.

- **Network-Related Considerations:**

Effective data transfer and communication to support different network conditions.

2.3. Data Design

The system relies on **My SQL** database to store and manage seismic data, user information, and predictive models.

2.4. Program Structure

The Earthquake Intensity Minimizer follows a Three-Tier Architecture, featuring key components:

1. **Module for Predicting Earthquakes Intensity:**

   Predicts the strength of earthquakes using local data and user input.

2. **Engine for Intensity Minimization:**

   Uses modern techniques that minimize the expected intensity of earthquakes.

3. **Module for Assessing Destruction:**

   Assesses possible damage following minimization.

4. **Assistance Following the Event:**

   Offers preventive measures and insurance policies via the web.

2.5. Alternatives Considered

A number of different architectural models were considered throughout the Earthquake Intensity Minimizer's design process. The following were the main factors to be taken into account:

- **Client-Server Architecture:**

  Justification: Despite its widespread use, it was found to be less appropriate for the real-time processing and quick response needs that come with earthquake prediction and mitigation.

- **Three-Tier Architecture:**

  Justification: Its capacity to divide user interface, application logic, and data storage, promoting scalability and maintainability, was taken into consideration and finally selected.

- **Microservices Architecture:**

  Justification: Though considered modular and flexible, it was thought to be too complicated for the Earthquake Intensity Minimizer.

Based on its compatibility with the project's needs for scalability and easier maintenance, the **Three-Tier Architecture** was ultimately chosen. The accurate prediction and efficient functioning of the Earthquake Intensity Minimizer are ideally suited to this architecture.

3. Detailed description of components

3.1. Section Overview

A comprehensive review of the Earthquake Intensity Minimizer's components is provided in this section. Identification, type, function, dependencies, interfaces, subordinates, processing specifics, internal data representation, and processing details are all addressed.

3.2. Component 1 Detail (User Authentication Module):

3.2.1. Description

Identification	**User Authentication Module**
Type	Module
Purpose	Implements user registration, account establishment, and login functionality.
Function	Manages user registration and login processes. Transforms user inputs. Processes encryption methods. Stores and retrieves user account information. Modifies user data based on account activity.
Subordinates	Internal structure includes subcomponents for registration and login. Satisfies functional requirements related to user account management.
Dependencies	Depends on encryption algorithms for data security. Used by other components for user authentication. Interaction details include user input timing and data sharing.

Interfaces	External interfaces for user registration and login. Internal interfaces with encryption modules. Error messages and codes for authentication failures.
Resources	Uses memory for storing user account data. Utilizes I/O channels for user input and output.
Processing	Implements registration and login functions using pseudocode.
Data	Data stored includes user credentials and account information.

Table 1 Authentication module

3.2.2. Data Members (include type, visibility, and description)

- **Type:** String
- **Visibility:** Private
- **Description:** User username
- **Type:** String
- **Visibility:** Private
- **Description:** User password (encrypted)

3.2.3. Methods (include English or psuedocode descriptions for each one)

1. RegisterUser (username, password):

- Registers a new user with the provided username and encrypted password.
- Sets the account creation date.
- Activates the user account.

2. LoginUser (username, password):

- Validates user credentials during the login process.
- Grants access upon successful validation.
- Triggers error messages for failed login attempts.

3.3. Component 2 Detail (Historical Earthquake Data Processor):

3.3.1. Description

Identification	Historical Earthquake Data Processor
Type	Subprogram
Purpose	To process and present historical earthquake datasets to users.
Function	Loads historical earthquake data from provided datasets and presents the seismic data in an easily navigable format.
Subordinates	N/A (This is a standalone component).
Dependencies	Relies on historical earthquake datasets provided by the user. May be used by the user interface component to display historical data.
Interfaces	Interfaces with the user interface for data presentation.
Resources	Utilizes CPU and memory resources for data processing.
Processing	Utilizes CPU and memory resources for data processing. May involve algorithms for sorting and filtering data.
Data	Internal data structures for storing and managing historical earthquake data. Data format includes location, magnitude, and depth.

Table 1.1 Dataset Access Provider Module

3.3.2. Data Members (include type, visibility, and description)

No specific data members for this component as it primarily processes and presents existing datasets.

3.3.3. Methods (include English or pseudocode descriptions for each one)

1. Load Data from File:

- **Description:** Loads historical earthquake data from the provided dataset file.
- **Parameters:** File path or dataset identifier.
- **Return Type:** Boolean (success/failure).

2. Present Data:

- **Description:** Presents the historical earthquake data in an easily navigable format.
- **Parameters:** Processed earthquake data.
- **Return Type:** User-friendly presentation format.

3.4. Component 3 Detail (Educational Content Management):

3.4.1. Description

Identification	**Educational Content Manager** Manages educational content related to earthquakes.
Type	Subprogram
Purpose	Organizes, updates, and provides access to educational materials on earthquakes.
Function	Categorizes and presents learning materials on earthquake-related topics.
Subordinates	Manages content categorization.
Dependencies	Relies on updated and relevant educational materials on earthquakes.
Interfaces	Presents educational content to users.
Resources	Utilizes CPU and memory for content management.
Processing	Describes functions involved in organizing and presenting educational content.
Data	The data associated with this component includes information on various educational content items, such as text articles, videos, and tutorials.

Table 1.2 Educational Content Manager Module

3.4.2. Data Members (include type, visibility, and description)

1. **ContentID (Private, Integer):** Unique identifier for each educational content item.
2. **ContentTitle (Private, String):** Title or topic of the educational content.

3.4.3. Methods (include English or pseudocode descriptions for each one)

1. Retrieve Content (content ID):

- Retrieves specific educational content based on content ID.
- Returns content details and media.

3.5. Component 4 Detail (Earthquake Intensity Prediction):

3.5.1. Description

Identification	**Earthquake Intensity Prediction**
Type	Class
Purpose	Anticipates earthquake intensity based on user input.
Function	Processes user-provided regional data, predicts earthquake magnitude, and outputs risk indicators. Utilizes the **OpenStreetMap API** for accurate location information.
Subordinates	Utilizes algorithms for data analysis and prediction.
Dependencies	Depends on accurate user input; used by the Destruction Assessment component.
Interfaces	Communicates with the user interface.
Resources	CPU time, memory for calculations.
Processing	Analyzes user input using predictive algorithms.
Data	Internal data includes user input and calculation results.

Table 1.3 Intensity Predictor Module

3.5.2. Data Members (include type, visibility, and description)

- **Type:** Input parameters

- **Visibility:** Private
- **Description:** Contains user-provided data such as geographic coordinates and geological details.

3.5.3. Methods (include English or pseudocode descriptions for each one)

1. Method 1: Predict Intensity

- **Description:** Predicts earthquake intensity based on input data.
- **Parameters:** User-provided data.
- **Algorithm:** Utilizes predictive algorithms for intensity calculation.

3.6. Component 5 Detail (Intensity Minimization & Solutions):

3.6.1. Description

Identification	**Intensity Minimization & Solutions**
Type	Module
Purpose	Implementing solutions to reduce earthquakes' predicted intensity using advanced techniques and informing users of the outcomes.
Function	Utilizes algorithms to reduce intensity, implements remedies, and shows results with location-specific solutions.
Subordinates	Internal structures handle algorithms and UI.
Dependencies	Requires accurate intensity data and interfaces with Destruction Assessment.
Interfaces	Communicates with the External API Interface for data input and has interfaces for displaying results to users.
Resources	Needs computational and UI resources.
Processing	Analyzes data, reduces intensity, implements solutions, and displays results.
Data	Stores intensity values and mitigation details.

Table 1.4 Reduced Intensity with solutions

3.6.2. Data Members (include type, visibility, and description)

1. Type: Integer, Visibility: Private
2. Type: List of Strings, Visibility: Private

3.6.3. Methods (include English or pseudocode descriptions for each one)

- Minimize Intensity (data: Earthquake Data) -> Intensity Result
- Display Minimized Intensity () -> Display Result
- The OpenStreetMap API integrates for location-based data.

3.7. Component 6 Detail (Destruction Assessment):

3.7.1. Description

Identification	Destruction Assessment
Type	Module
Purpose	Evaluate potential destruction based on minimized earthquake intensity.
Function	Receives reduced intensity data, compares against destruction thresholds, and provides evaluation reports.
Subordinates	Internal structures for intensity evaluation and reporting.
Dependencies	Relies on accurate intensity data from Intensity Minimization.
Interfaces	Communicates with Intensity Minimization for data.
Resources	Requires computational resources.
Processing	Analyzes data, compares against thresholds, and generates reports.
Data	Stores intensity evaluation results.

Table 1.5 Destruction Assessment

3.7.2. Data Members (include type, visibility, and description)

1. Type: Integer, Visibility: Private

2. Type: String, Visibility: Private

3.7.3. Methods (include English or pseudocode descriptions for each one)

- valuateDestruction() -> DestructionEvaluation
- generateEvaluationReport() -> EvaluationReport

3.8. Component 7 Detail (Insurance and Precautionary Measures):

3.8.1. Description

Identification	**Insurance and Precautionary Measures**
Type	Module
Purpose	Provide information on cooperative insurance plans and safety precautions.
Function	Displays details on insurance plans, safety measures, and allows users to view plans.
Subordinates	Internal components managing insurance plan data and safety measures.
Dependencies	Relies on Real-Time Datasets of Earthquake for location and intensity information.
Interfaces	Accesses Real-Time Datasets of Earthquake for location and intensity information.
Resources	Utilizes databases to store and retrieve insurance plans and precautionary measures.
Processing	Implements algorithms to match location and intensity with relevant insurance plans and safety measures.
Data	-

Table 1.6 Insurance and precautions module

3.8.2. Data Members (include type, visibility, and description)

1. Type: String

Visibility: Public

Description: Stores insurance plan details.

3.8.3. Methods (include English or pseudocode descriptions for each one)

- displayInsurancePlans()

3.9. Component 8 Detail (Feedback on Analysis):

3.9.1. Description

Identification	Feedback On Analysis
Type	Module
Purpose	Allow users to provide feedback on earthquake intensity predictions and mitigation suggestions.
Function	Collects user input on prediction accuracy and usability, records feedback for analysis.
Subordinates	Internal components managing user feedback data.
Dependencies	Utilizes Earthquake Intensity Prediction for user feedback on predictions.
Interfaces	Interfaces with Earthquake Intensity Prediction for prediction accuracy feedback or any other user's concern.
Resources	Database for storing and retrieving user feedback.
Processing	Analyzes and records user feedback for system improvement.
Data	Stores user feedback and acknowledgment messages.

Table 1.7 Feedback Module

3.9.2. Data Members (include type, visibility, and description)

1. Type: String

Visibility: Public

Description: Stores user feedback on earthquake predictions and mitigation suggestions.

3.9.3. Methods (include English or pseudocode descriptions for each one)

- submitFeedback(feedback: String)

- recordFeedbackAnalysis()

4. User Interface Design

4.1. Section Overview

An overview of the web application's user interface (UI) design is provided in this section. It gives a brief overview of the main elements influencing the user experience and offers a look at the layout and capabilities of the interface.

4.2. Interface Design Rules

By following accepted web design guidelines, the interface design offers a visually appealing, responsive, and user-friendly experience. It is influenced by accepted guidelines and standards for web design.

4.3. GUI Components

The user interface (UI) uses particular elements and APIs, like OpenStreetMap for location services, to create an engaging and user-friendly experience for location-based concerns.

4.4. Detailed Description

Sign-up form

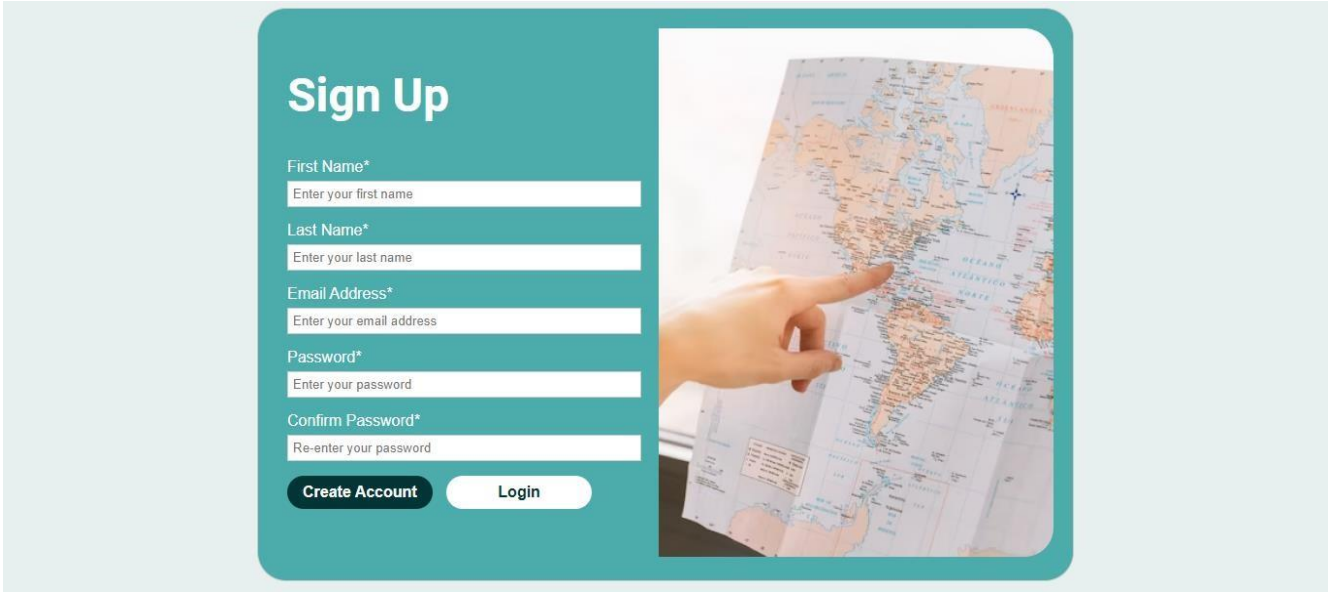


Figure 3 Sign-up form

Login form

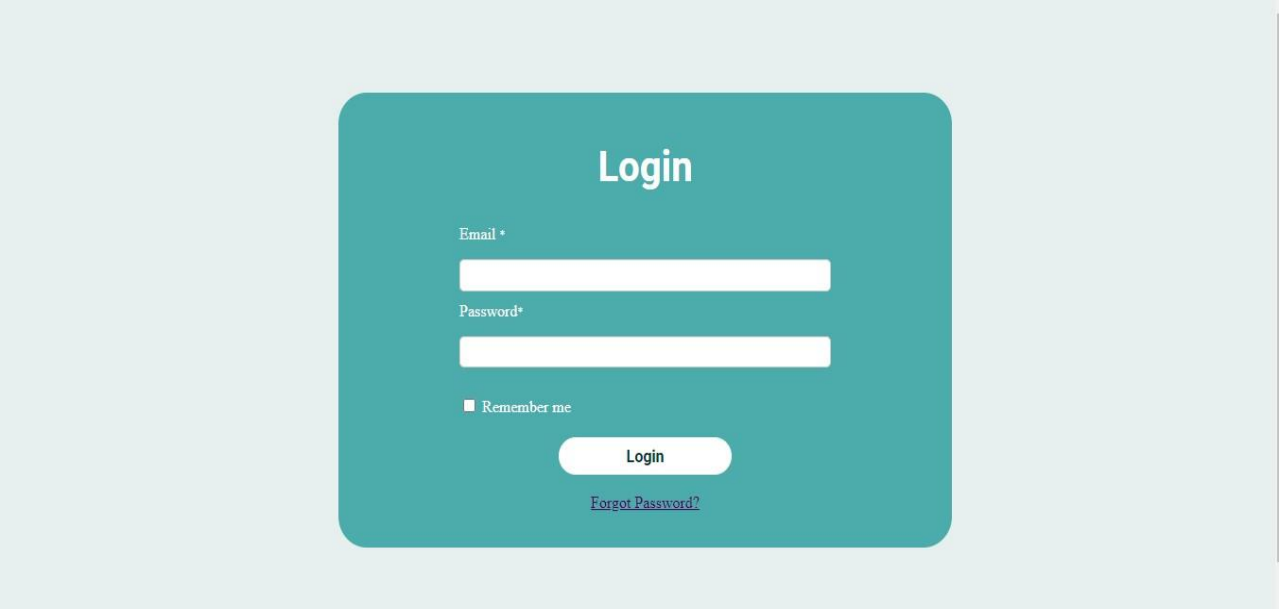


Figure 3.1 Login form

Home Page

Figure 3.2 Home Page

About Page

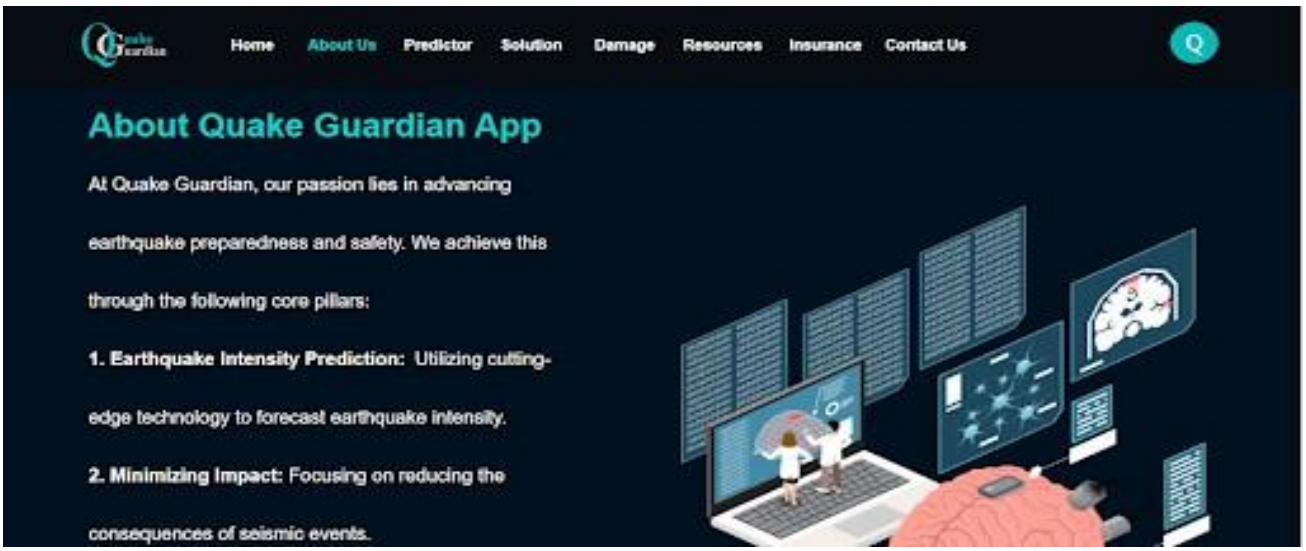


Figure 3.3 About Page

Intensity Prediction Page

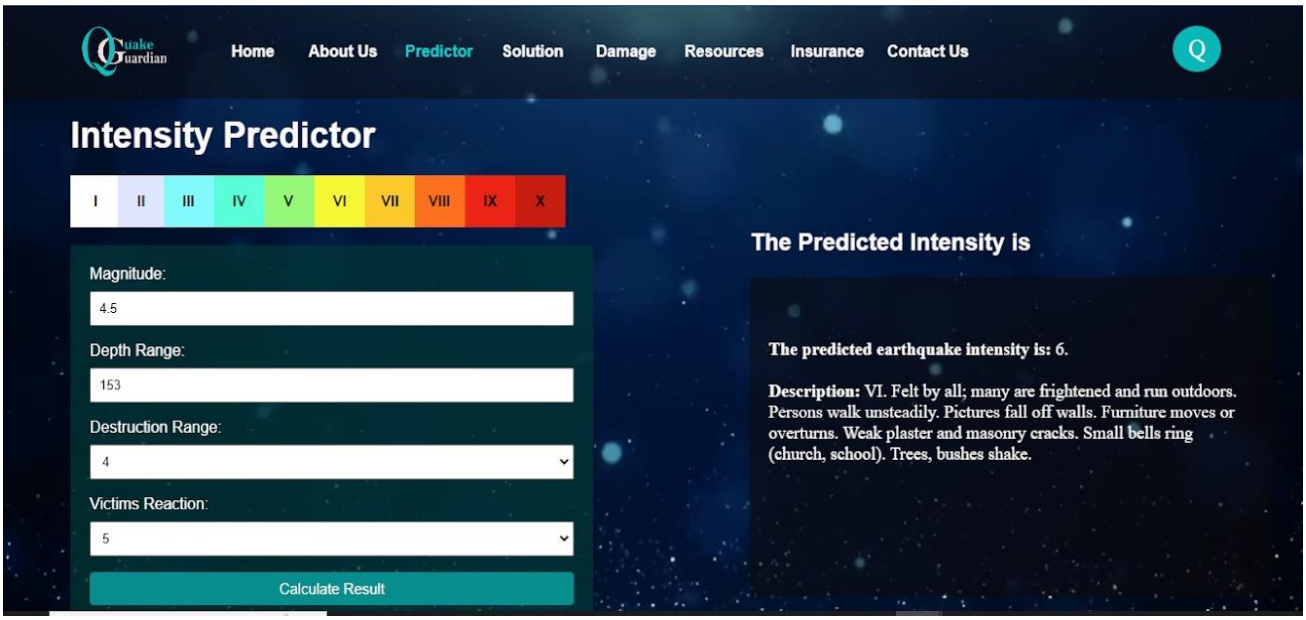
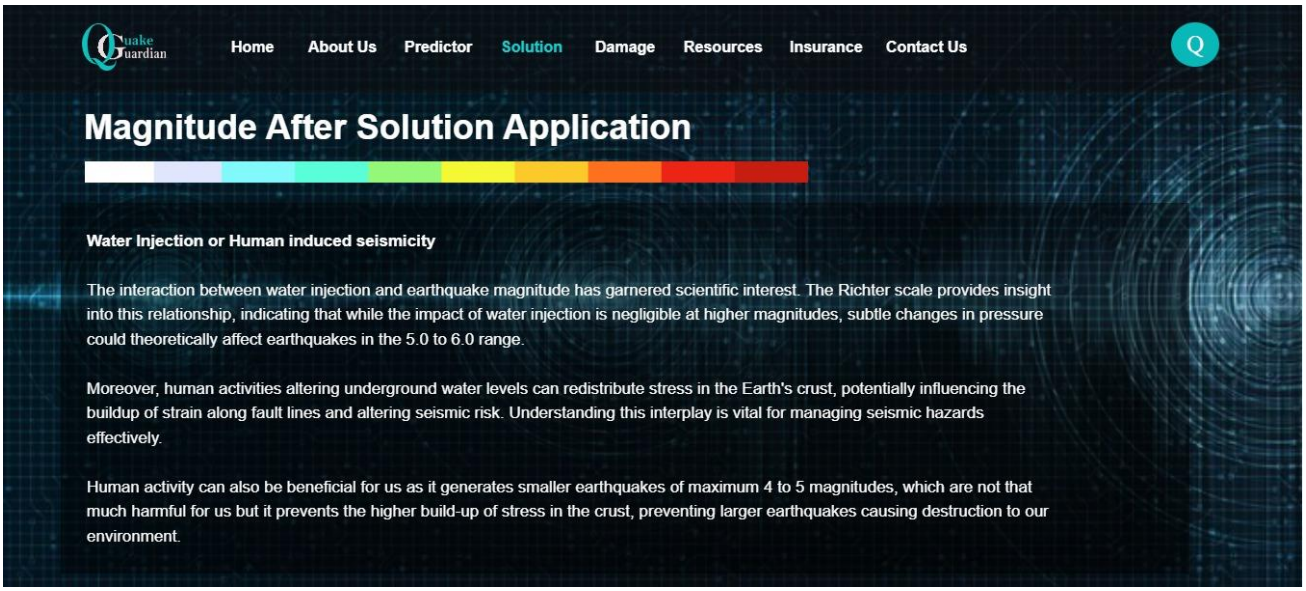


Figure 3.4 Predictor Page

Figure 3.5 Intensity Reduction

Solutions Page



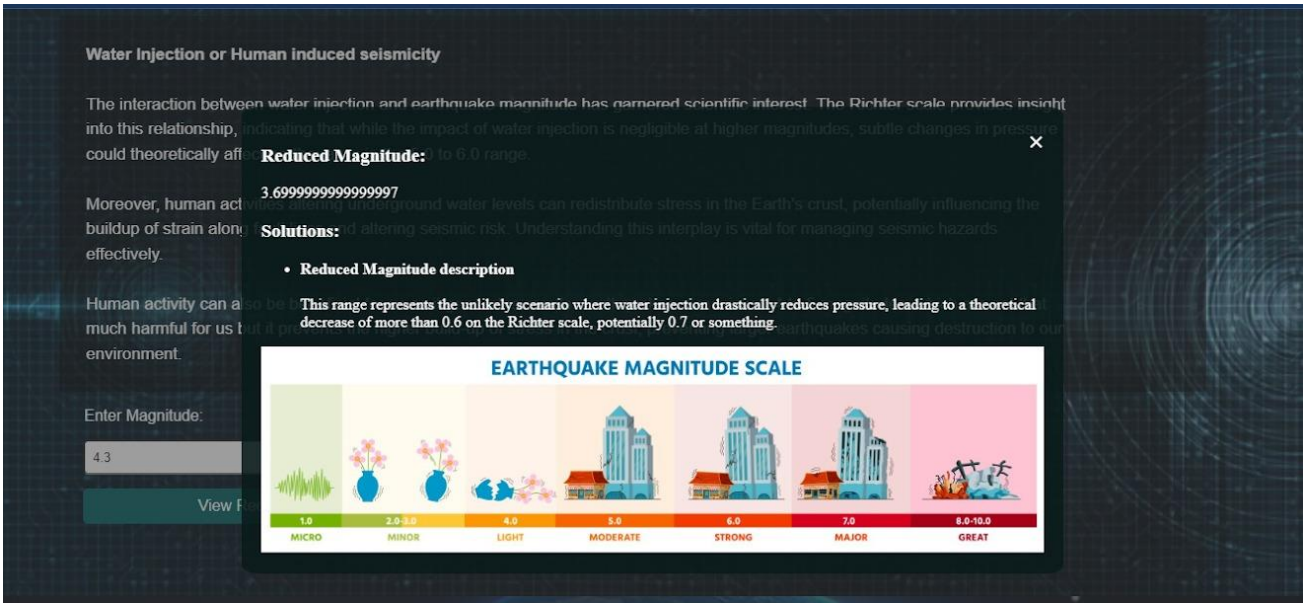
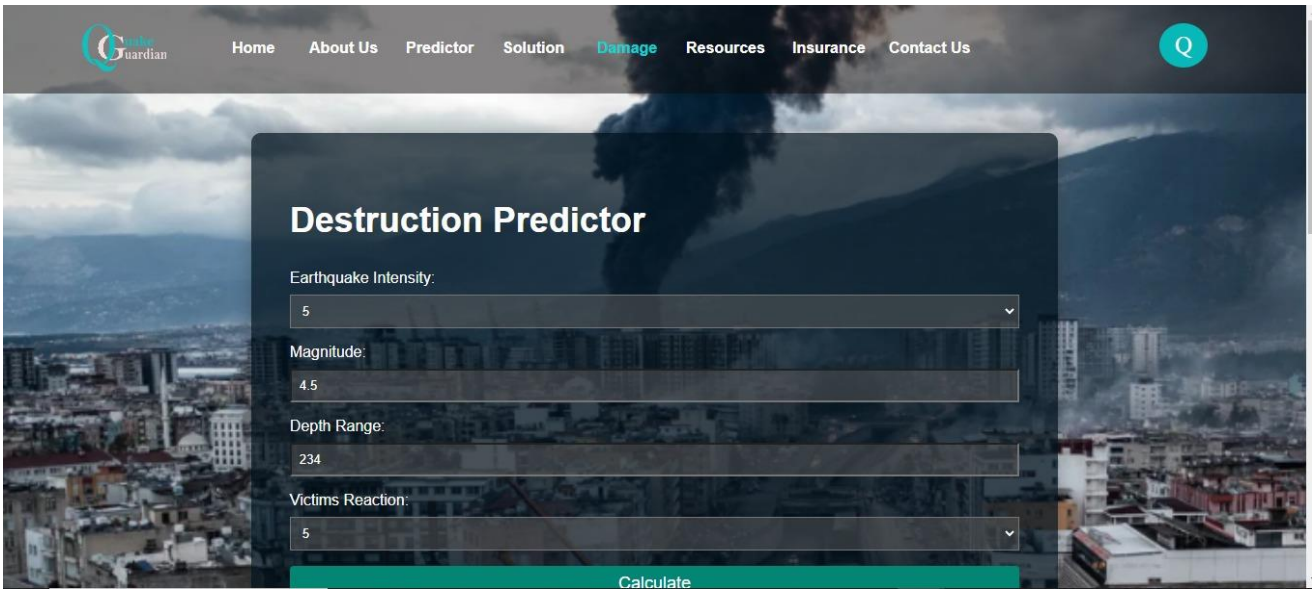


Figure 3.6 Solutions Page

Destruction page



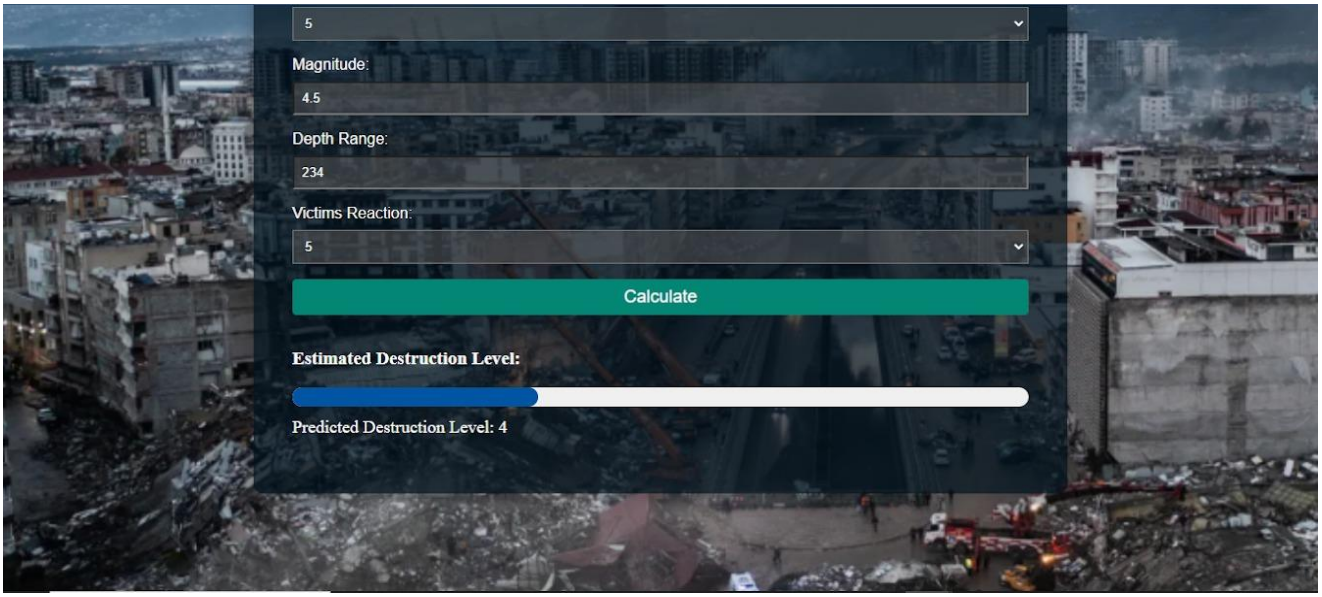


Figure 3.7 Destruction page

Insurance Page

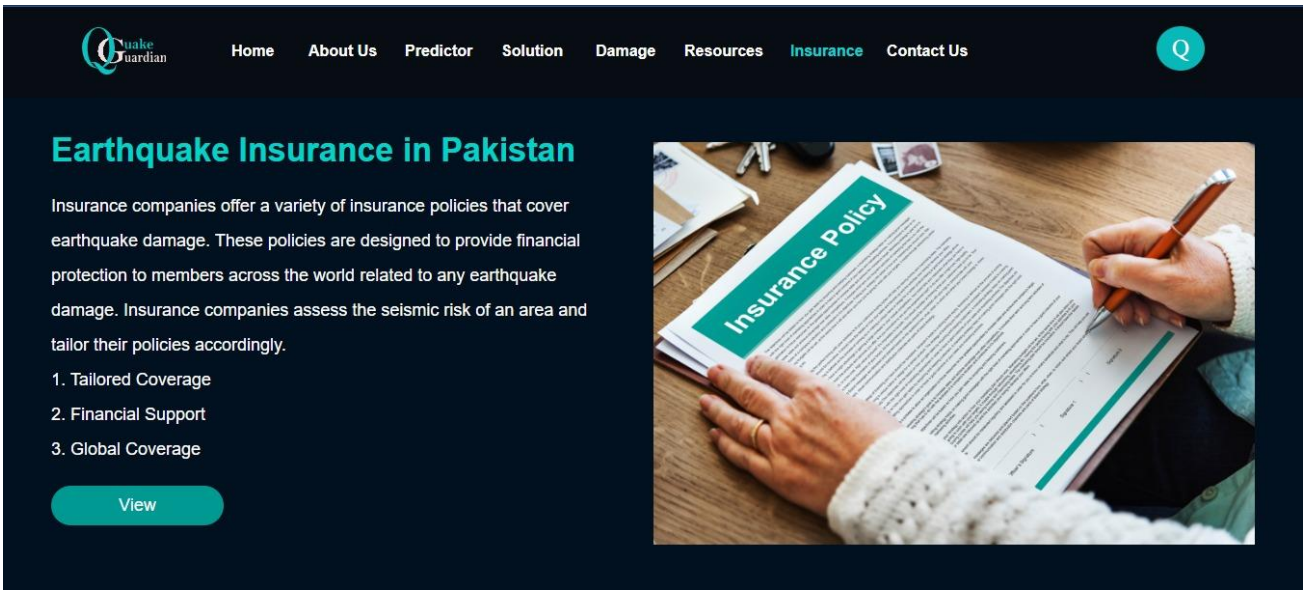


Figure 3.8 Insurance Page

Resources Page

Figure 3.9 Educational Content page

Contact / Feedback Page

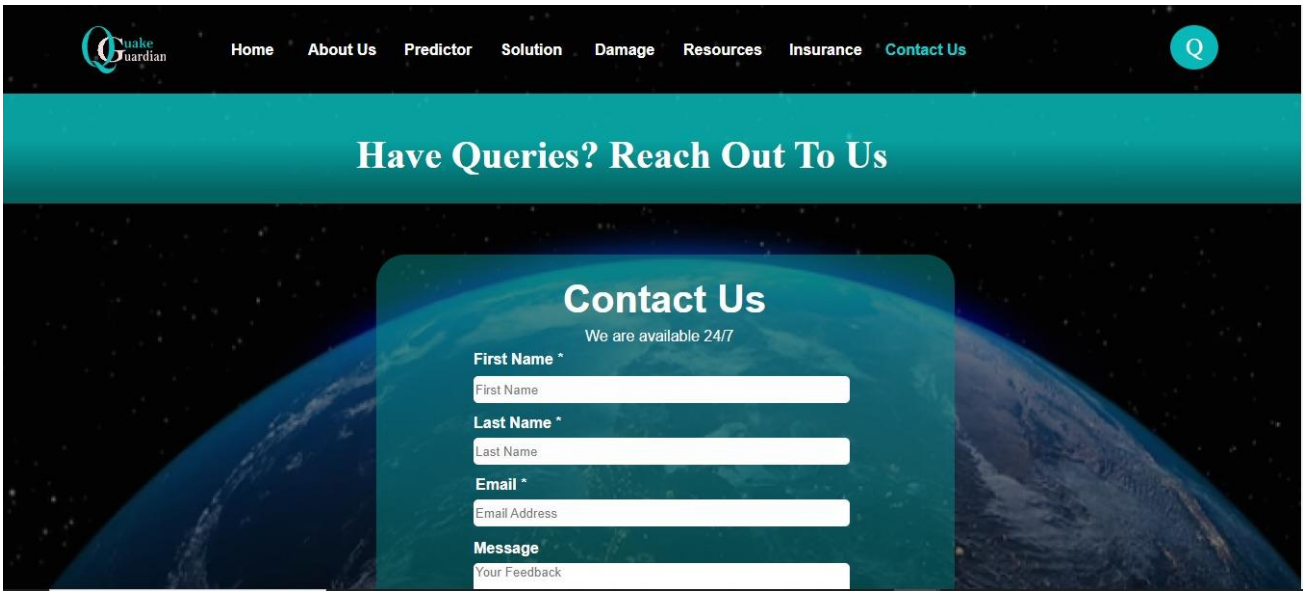


Figure 3.7 Contact Page

5. Reuse and relationships to other products

5.1 The Function of Reuse in Product Design: Reuse is an essential component of our product design that boosts productivity and expands on previously developed solutions. We're guaranteeing that well-tested functionality contributes to the design basis by reusing parts and

algorithms from earlier seismic data analysis systems. This method preserves the dependability of tested components while expediting the design process.

5.2 The Function of Reuse in Product Implementation: By expanding and modifying tried-and-true modules and algorithms, reuse is essential to the way our product can be implemented. Strategic reuse optimizes the effectiveness and dependability of current solutions to speed up the deployment process.

5.3 Reasons for Modifications to Reused Material: The necessity to adapt used material to new technology and project specifications drives modifications to it. For example, updates might be applied to guarantee compatibility with seismic data sources and the most recent geographical data formats. In order to satisfy modern requirements and smoothly incorporate reusable components into the new system, certain modifications are essential.

6. Design decisions and tradeoffs

Important choices and compromises were made in order to balance user accessibility and efficiency when designing our earthquake intensity minimizing system:

6.1 Platform via the Web:

Web application for global accessibility was chosen.
Tradeoff: Giving up native features to increase cross-platform accessibility.

6.2 API for OpenStreetMap:

Choice: User location input integration.
Tradeoff: Choosing community-driven and open-source data versus competing mapping APIs.

6.3 Integration of Datasets:

Historical datasets are preferred over real-time data.
Tradeoffs include ensuring system stability, reducing API dependency, and ensuring offline functioning.

6.4 Web-Based User Interface:

Choosing a web-based design was the decision.

Tradeoff: Selecting adaptability with minimal maintenance above a native user interface.

6.5 Limited Notifications:

Conclusion: Eliminating the notification system for solution.

Tradeoff: Maintaining a focused user experience while avoiding information overload.

7. Pseudocode for components

Not Applicable.

8. Appendices

Object Diagram:

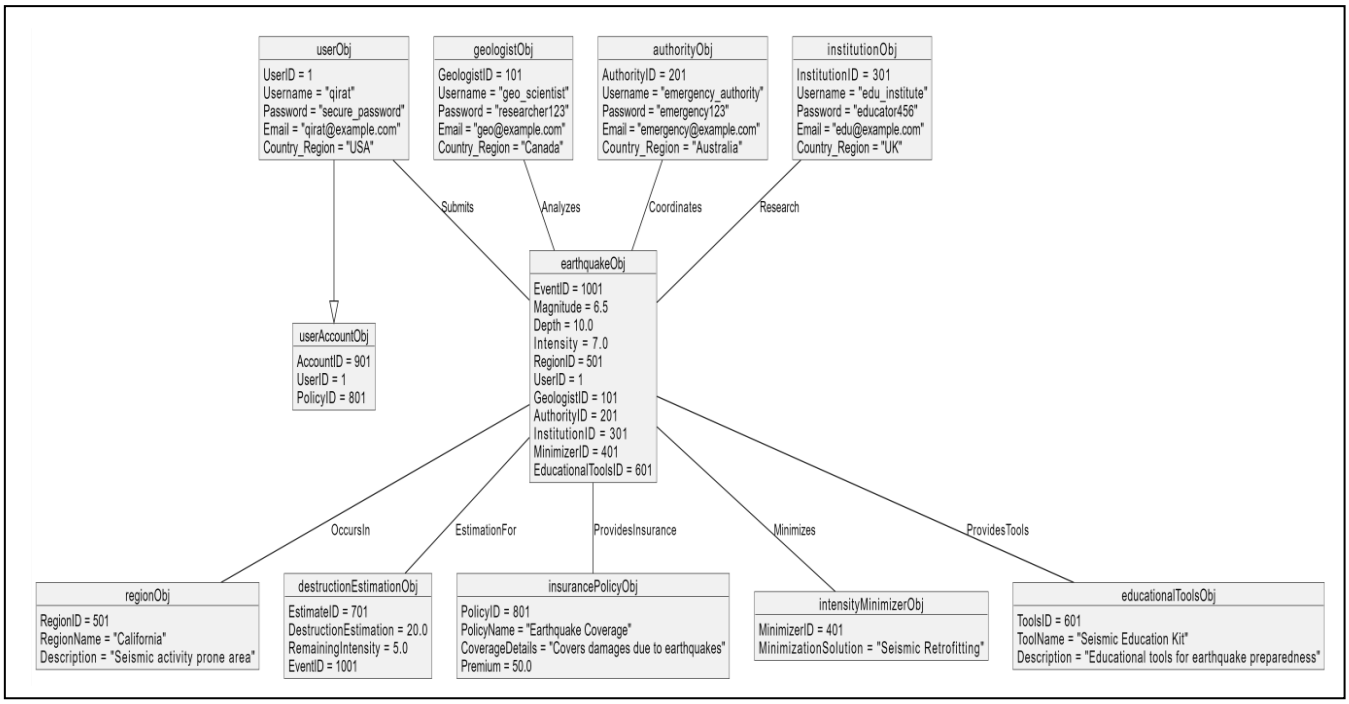


Figure 4 Object Diagram

State Chart Diagram:

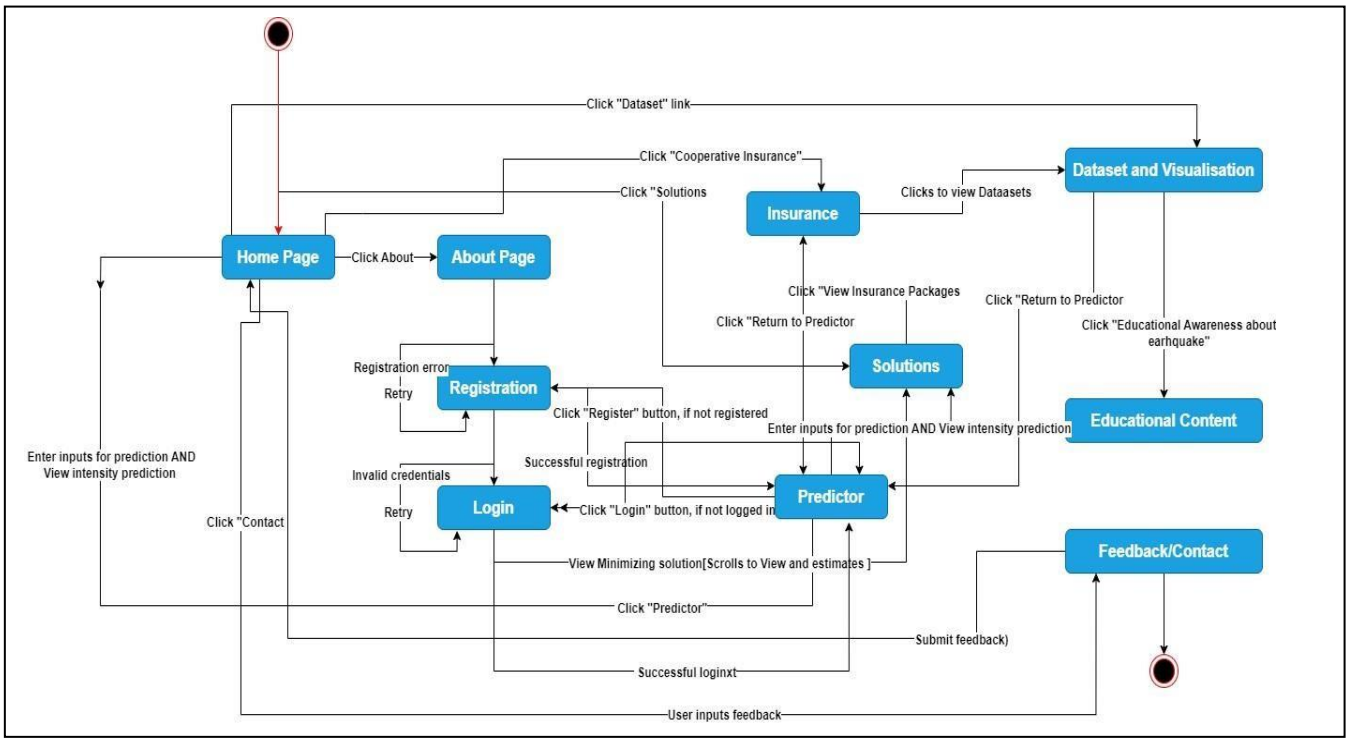


Figure 4.1 State Chart Diagram

Activity Diagram:

1. Login/Sign up

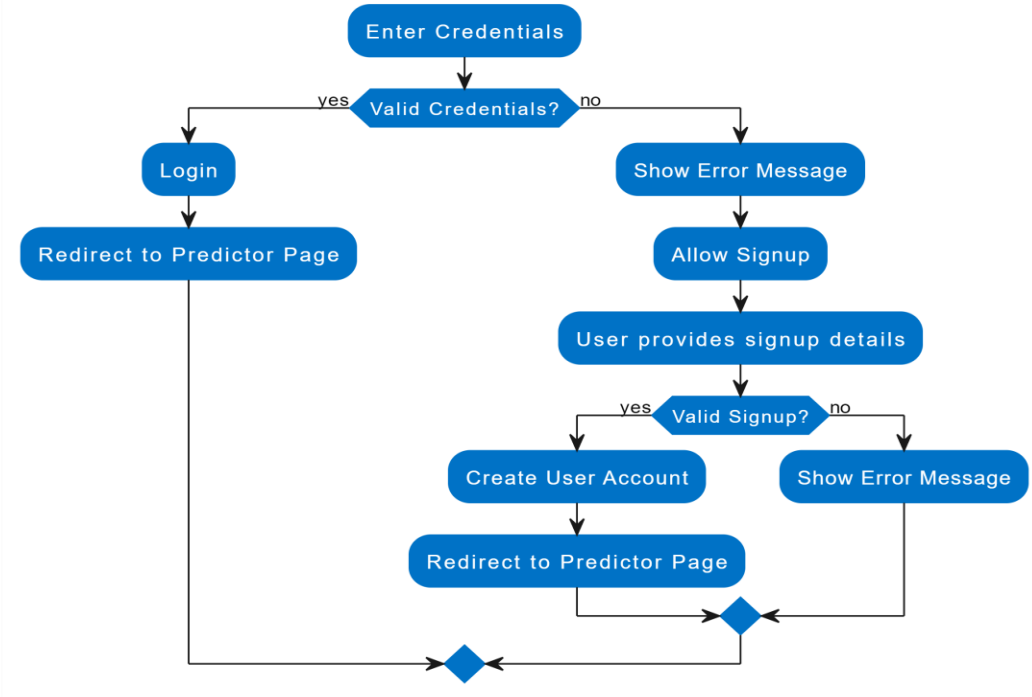


Figure 4.2 Login/Signup Activity Diagram

2. Access Earthquake Data

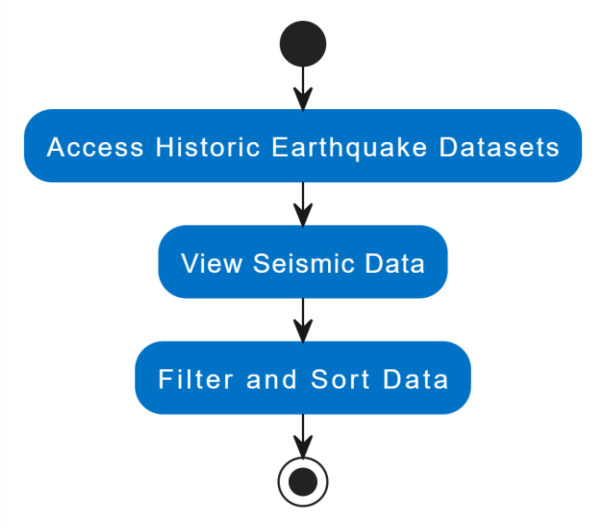


Figure 4.3 Access Earthquake Data Activity Diagram

3. Access Educational Content

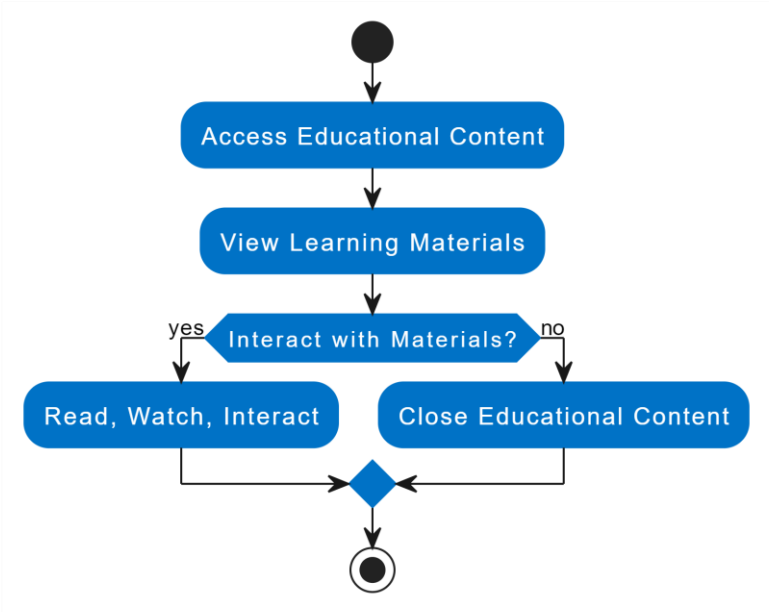


Figure 4.4 Access Educational Content Activity Diagram

4. Intensity Prediction

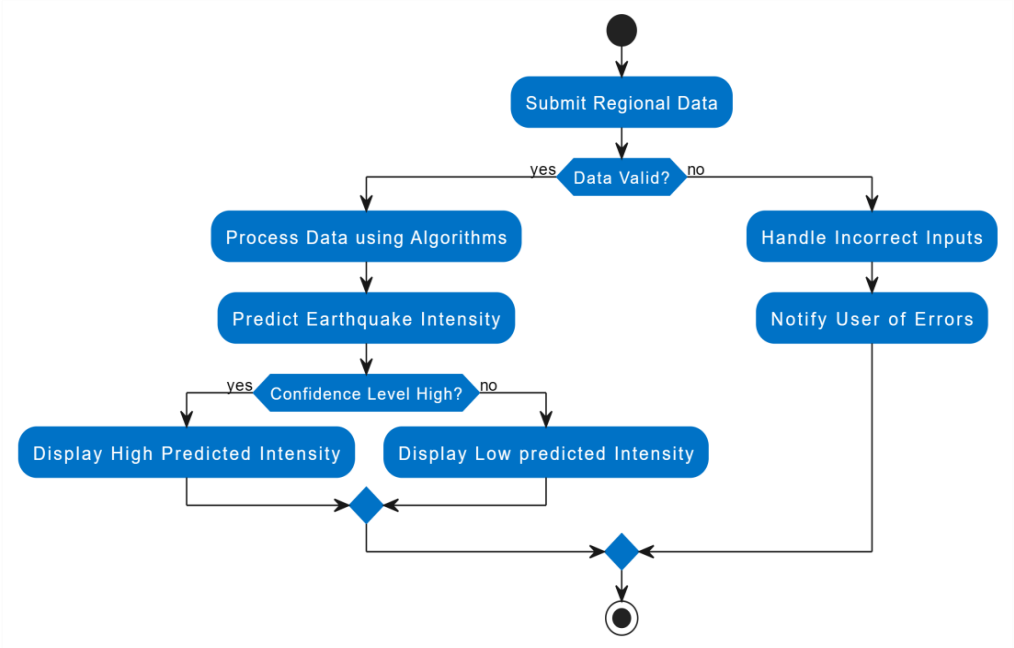


Figure 4.5 Intensity Prediction Activity Diagram

5. Intensity Prediction After Applying Solutions

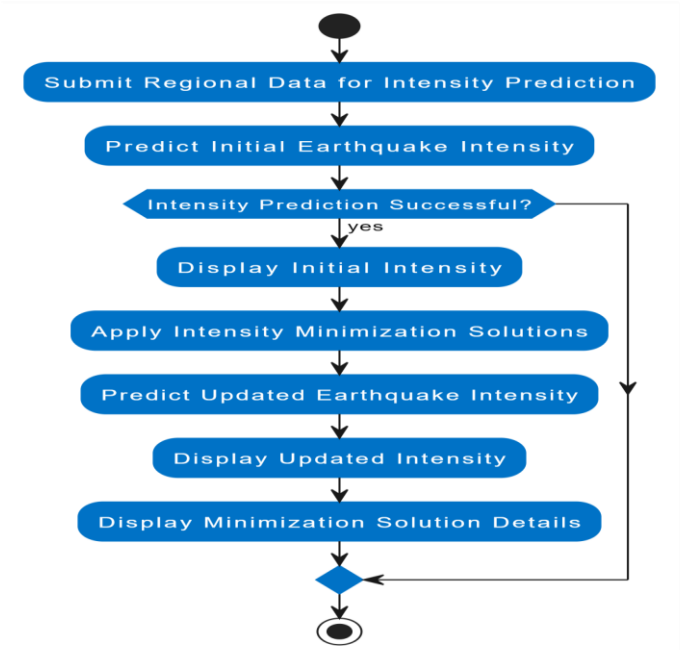


Figure 4.6 Reduced Intensity Activity Diagram

6. Destruction Assessment

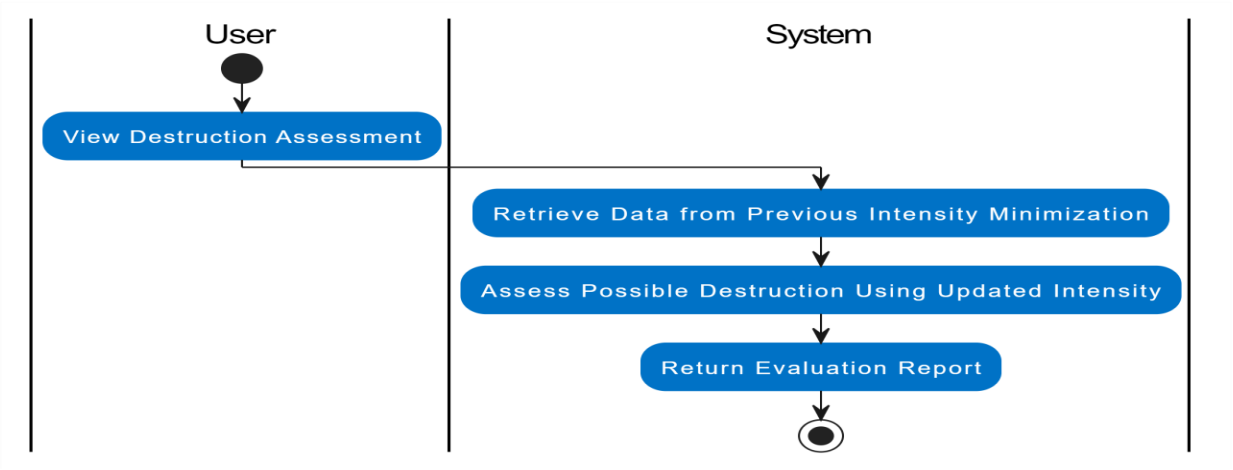


Figure 4.7 Destruction Assessment Activity Diagram

7. Displaying Insurance Policies

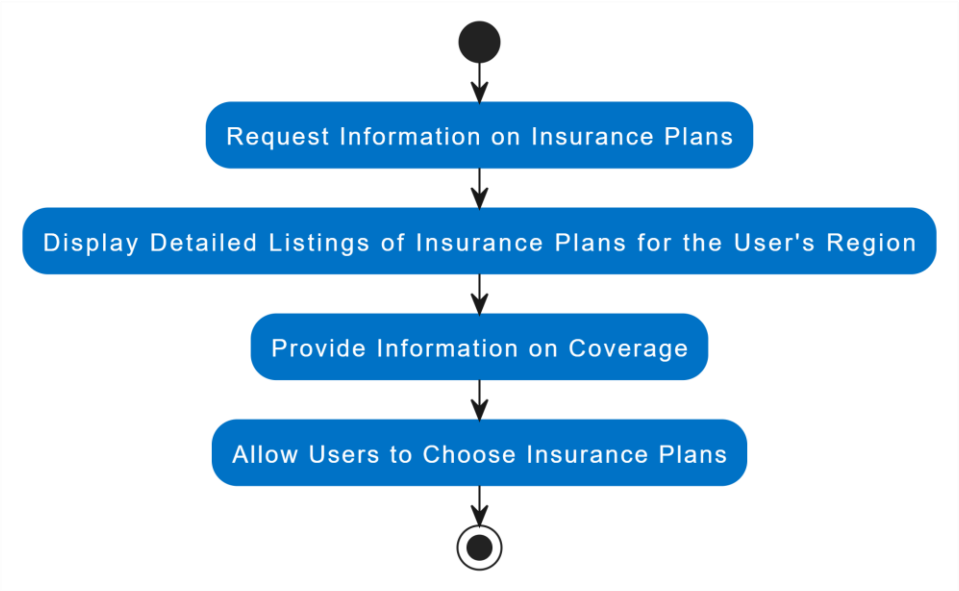


Figure 4.8 Insurance Policies Activity Diagram

8. Feedback

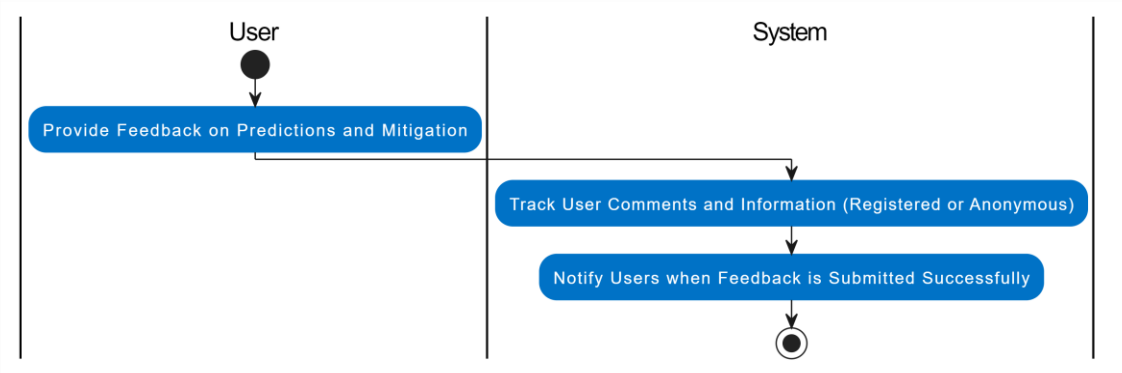


Figure 4.9 Feedback Activity Diagram

Sequence Diagram:

1. User Login:

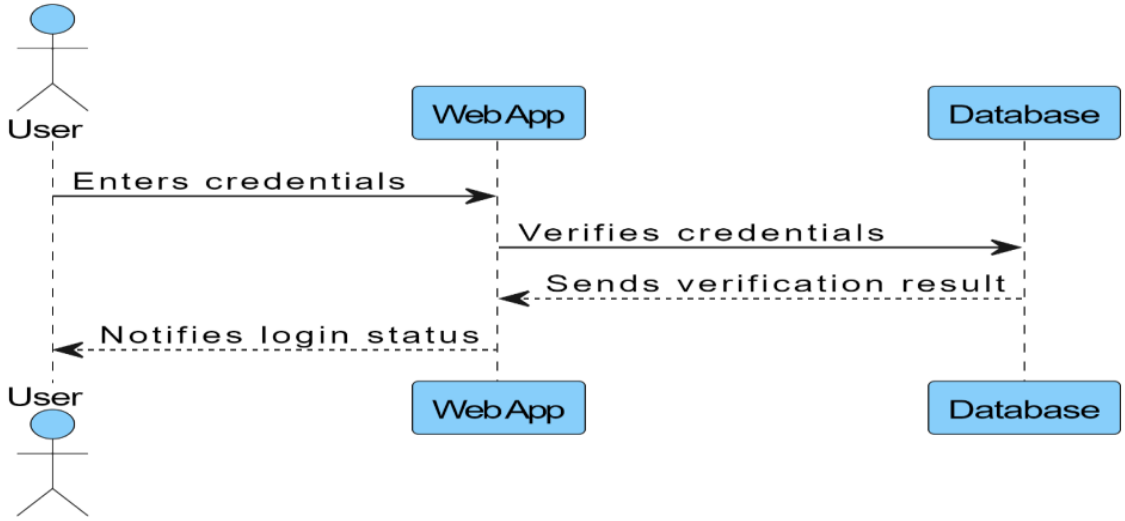


Figure 4.10 Login Sequence

2. User Sign Up:

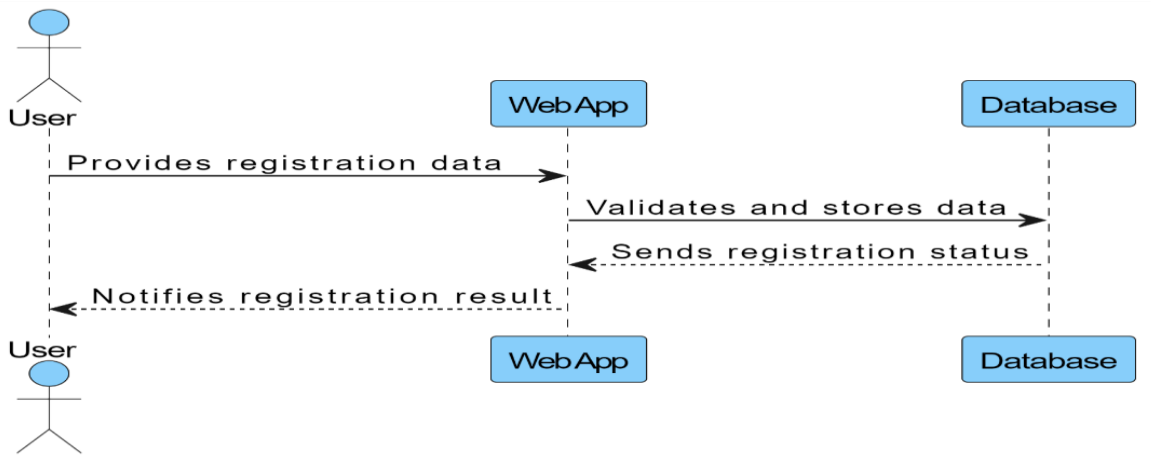


Figure 4.11 Signup Sequence

3. Predicting earthquake intensity feature:

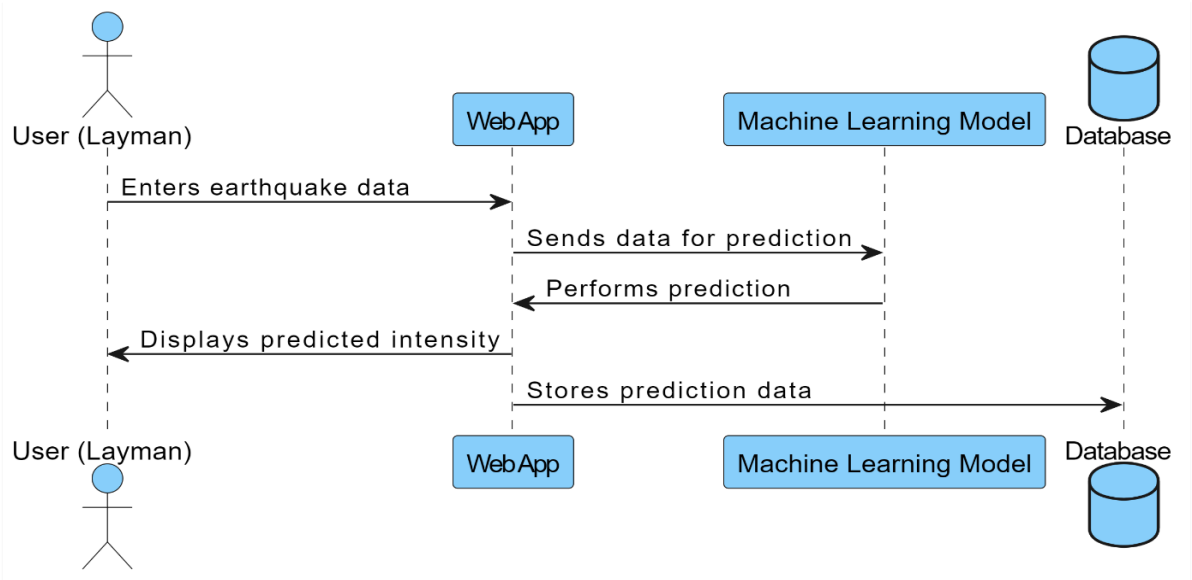


Figure 4.12 Intensity Prediction Sequence

4. Earthquake intensity minimizer feature:

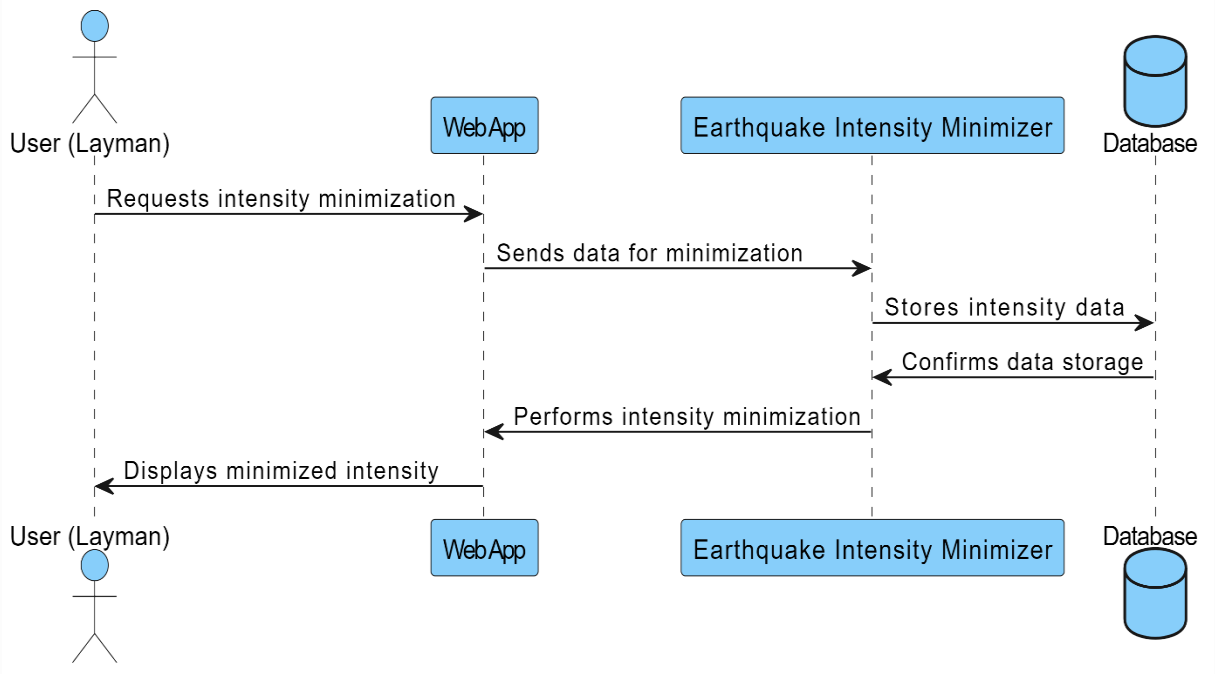


Figure 4.13 Intensity Minimization Sequence

5. View solutions feature:

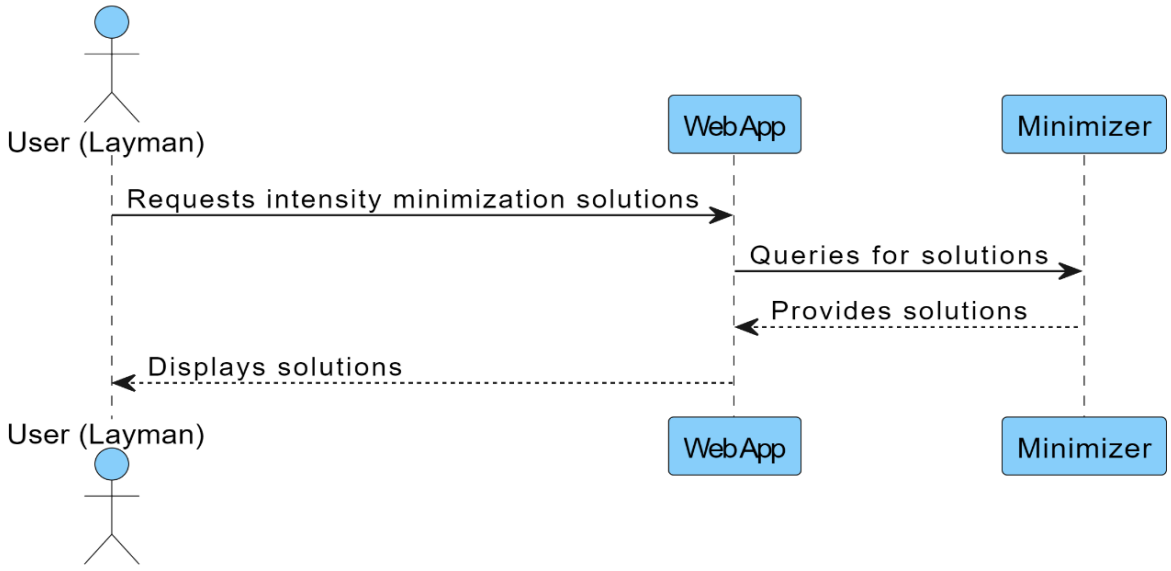


Figure 4.14 Viewing Solutions Sequence

6. Destruction estimation feature:

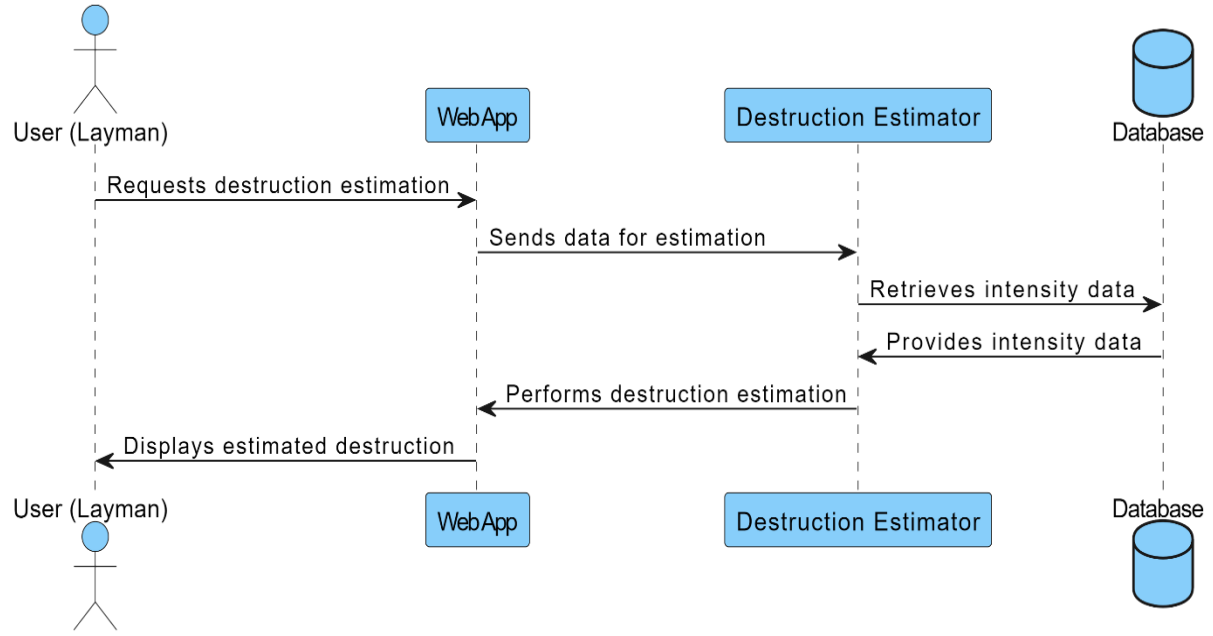


Figure 4.15 Destruction Estimation Sequence

7. Insurance policy provider feature:

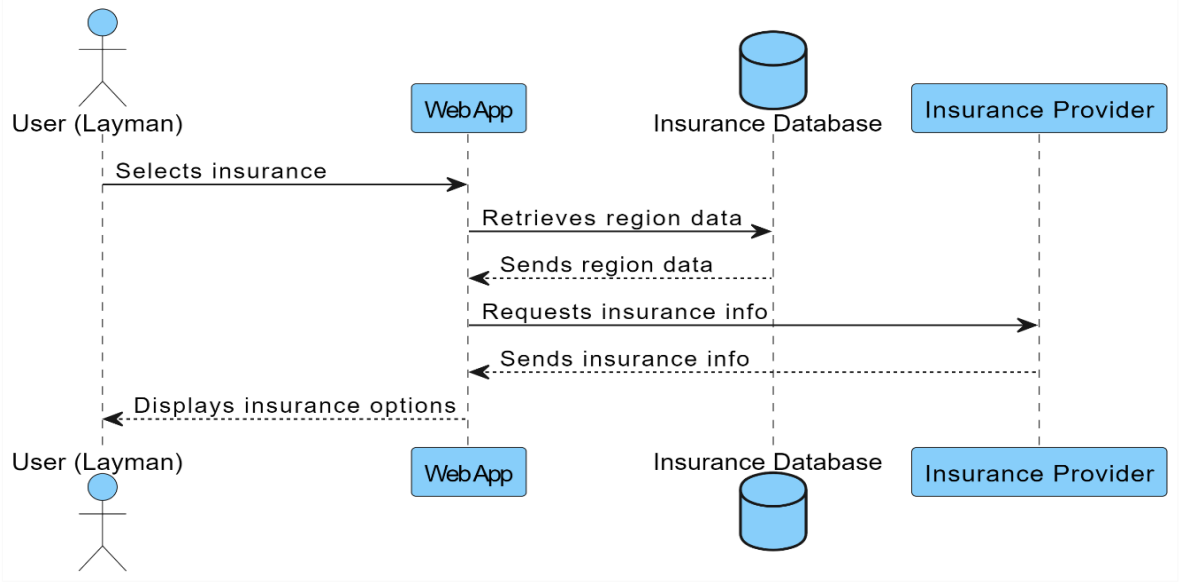


Figure 4.16 Insurance providing Sequence

8. Access educational content about earthquake feature:

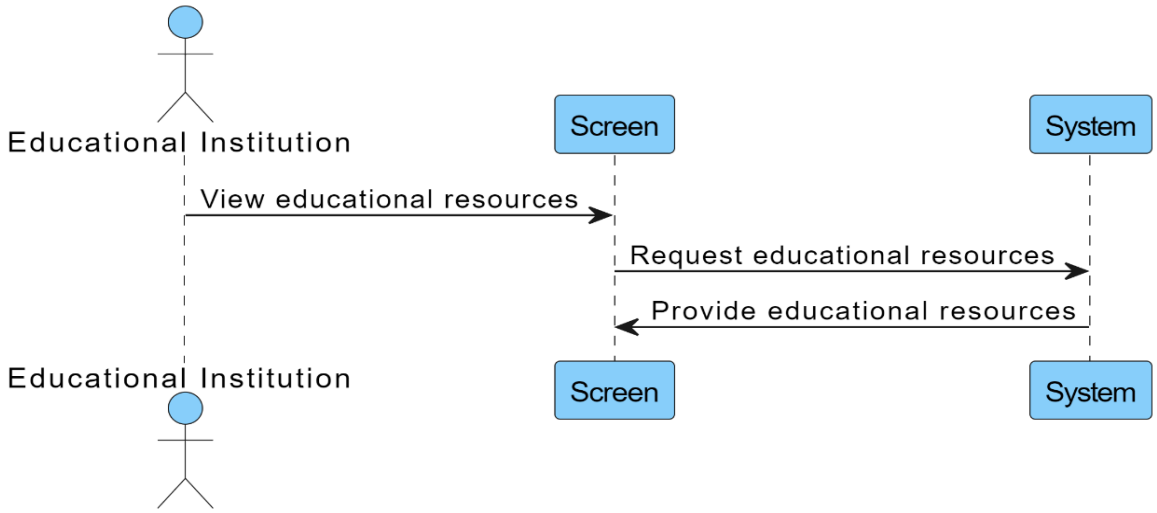


Figure 4.17 Accessing educational content Sequence

9. Access earthquake datasets feature:

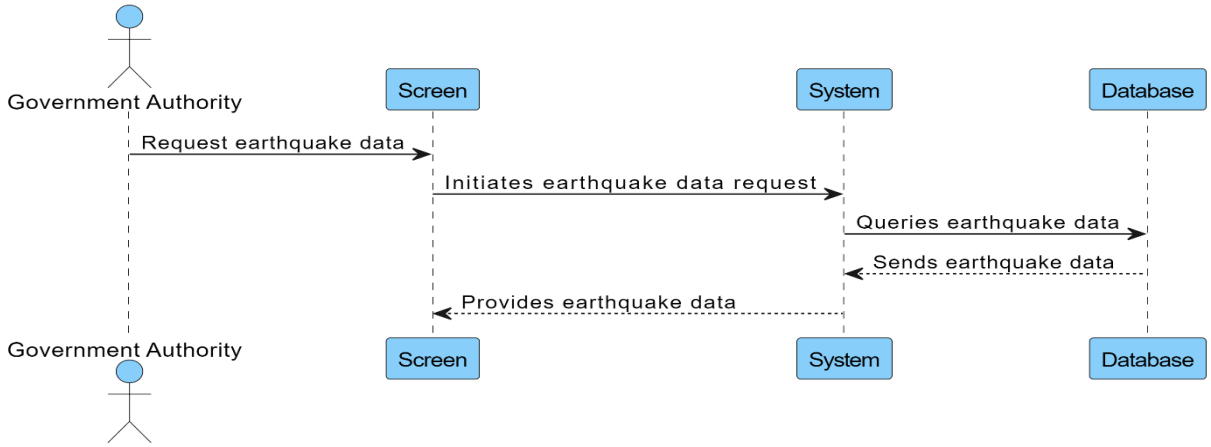


Figure 4.18 Accessing datasets Sequence

10. Access data visualization feature:

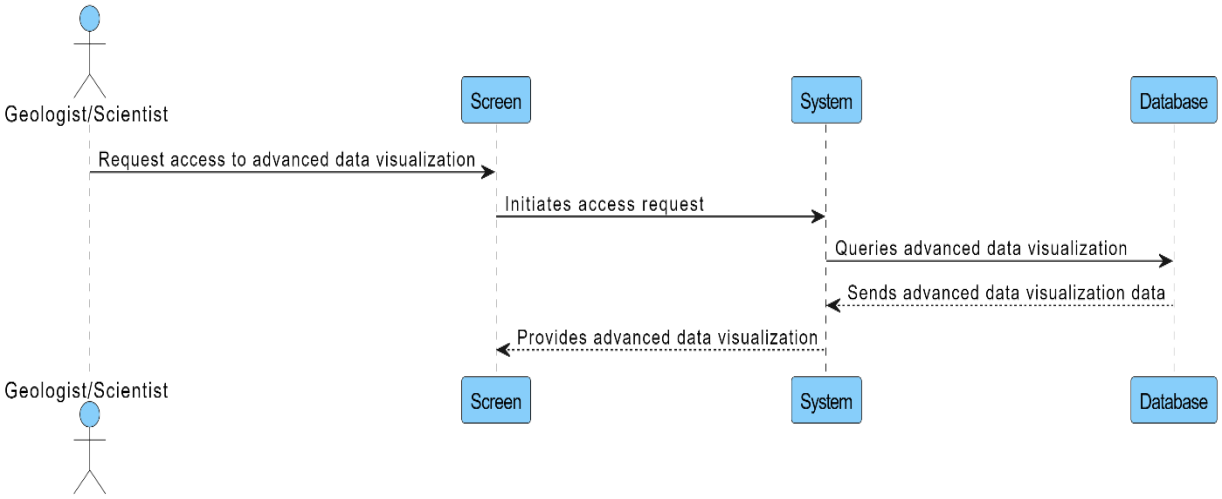


Figure 4.19 Accessing data visualization Sequence

11. Feedback analysis feature:

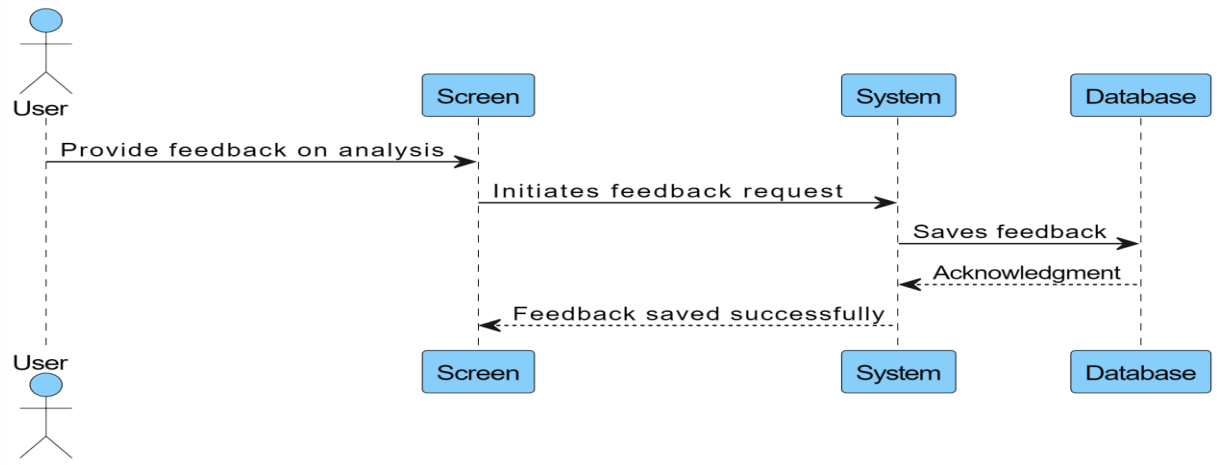


Figure 4.20 Feedback Sequence

Collaboration/Communication Diagram:

1. User Login:

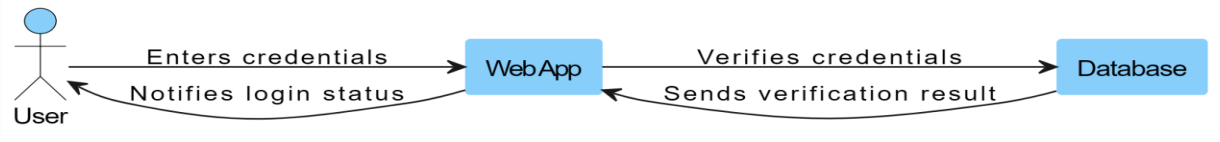


Figure 4.21 Login Collaboration Diagram

2. User Sign Up:

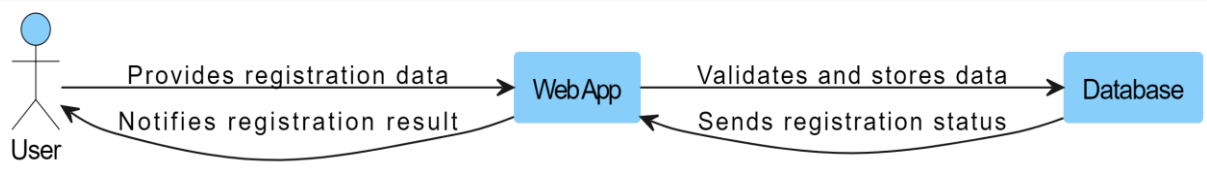


Figure 4.22 Sign Up Collaboration Diagram

3. Predicting earthquake intensity feature:

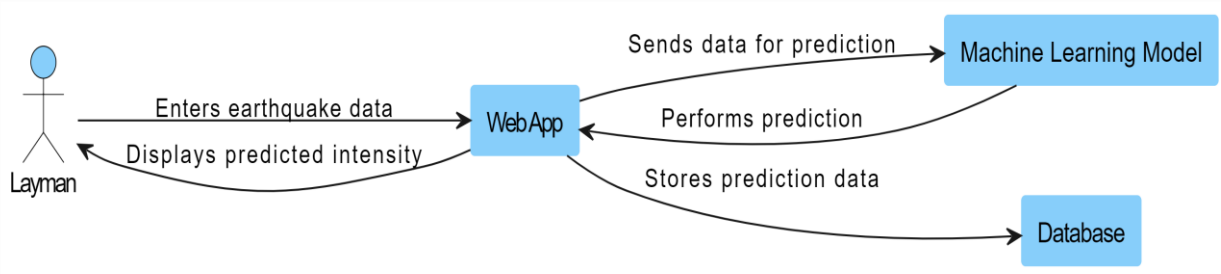


Figure 4.23 Intensity Prediction Collaboration Diagram

4. Earthquake intensity minimizer feature:

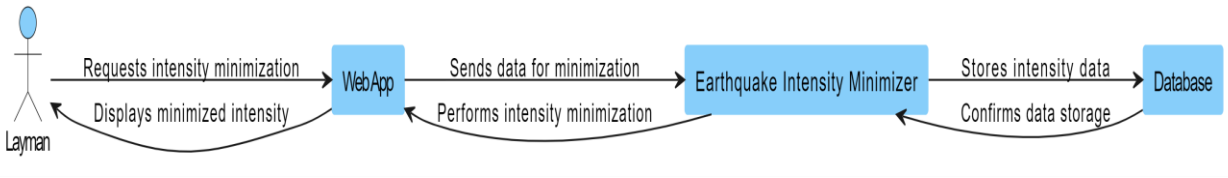


Figure 4.24 Intensity Reduction Collaboration Diagram

5. View solutions feature:

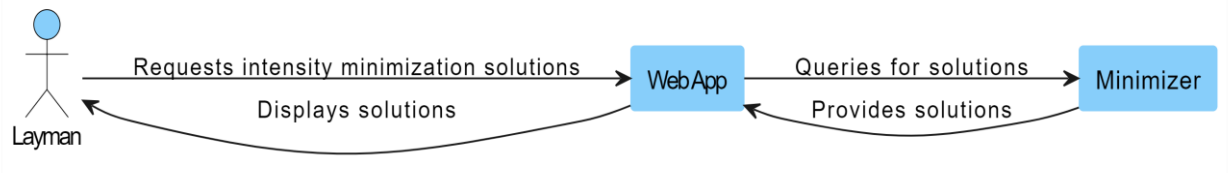


Figure 4.24 Solutions Viewing Collaboration Diagram

6. Destruction estimation feature:

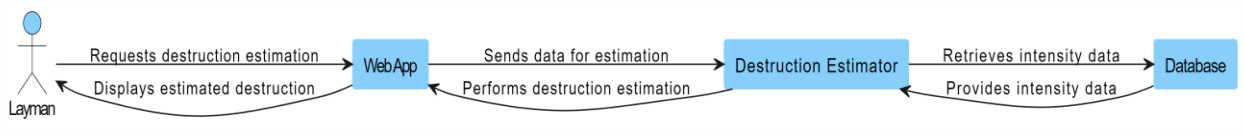


Figure 4.25 Destruction Estimation Collaboration Diagram

7. Insurance policy provider feature:

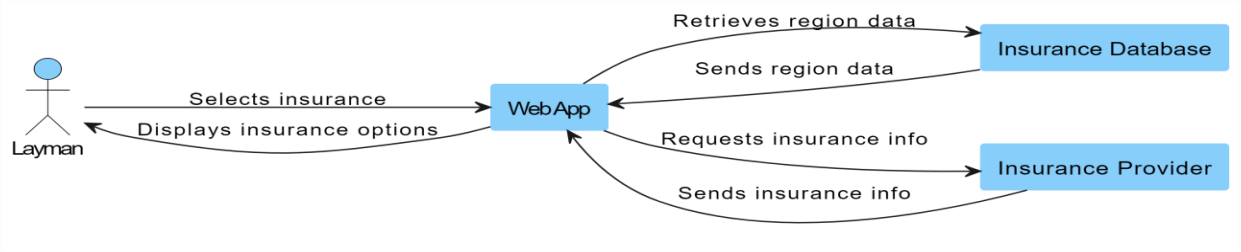


Figure 4.26 Insurance policy Collaboration Diagram

8. Access educational content about earthquake feature:

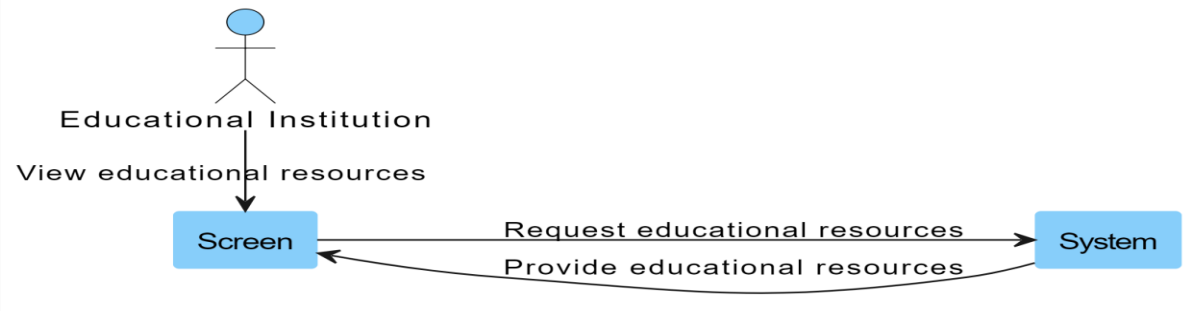


Figure 4.27 Access Educational Content Collaboration Diagram

9. Access earthquake datasets feature:

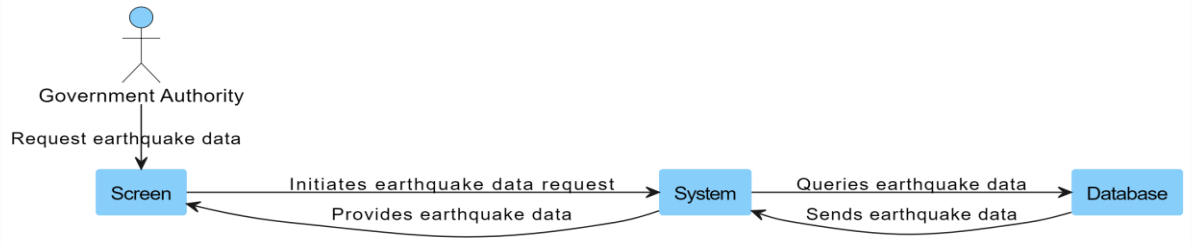


Figure 4.28 Accessing earthquake datasets Collaboration Diagram

10. Access data visualization feature:

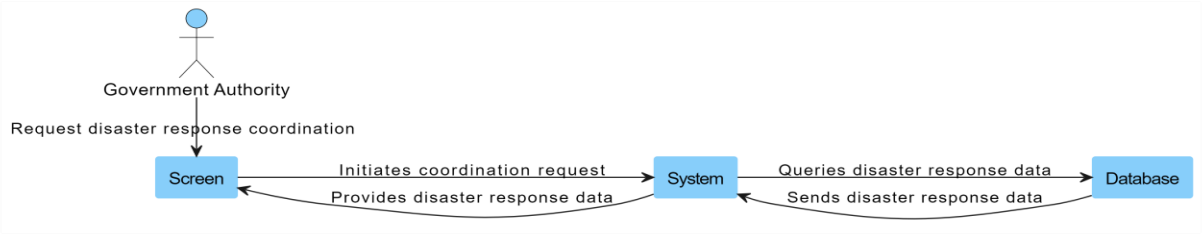


Figure 4.28 Accessing data visualization Collaboration Diagram

11. Feedback analysis feature:

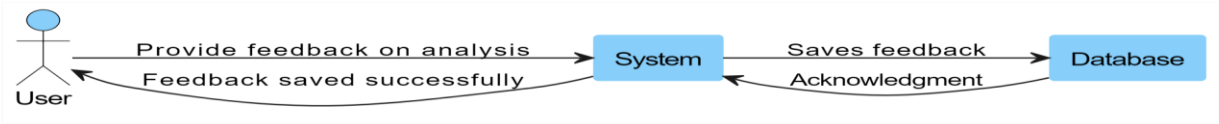


Figure 4.29 Feedback Analysis Collaboration Diagram

Use Case Diagram:

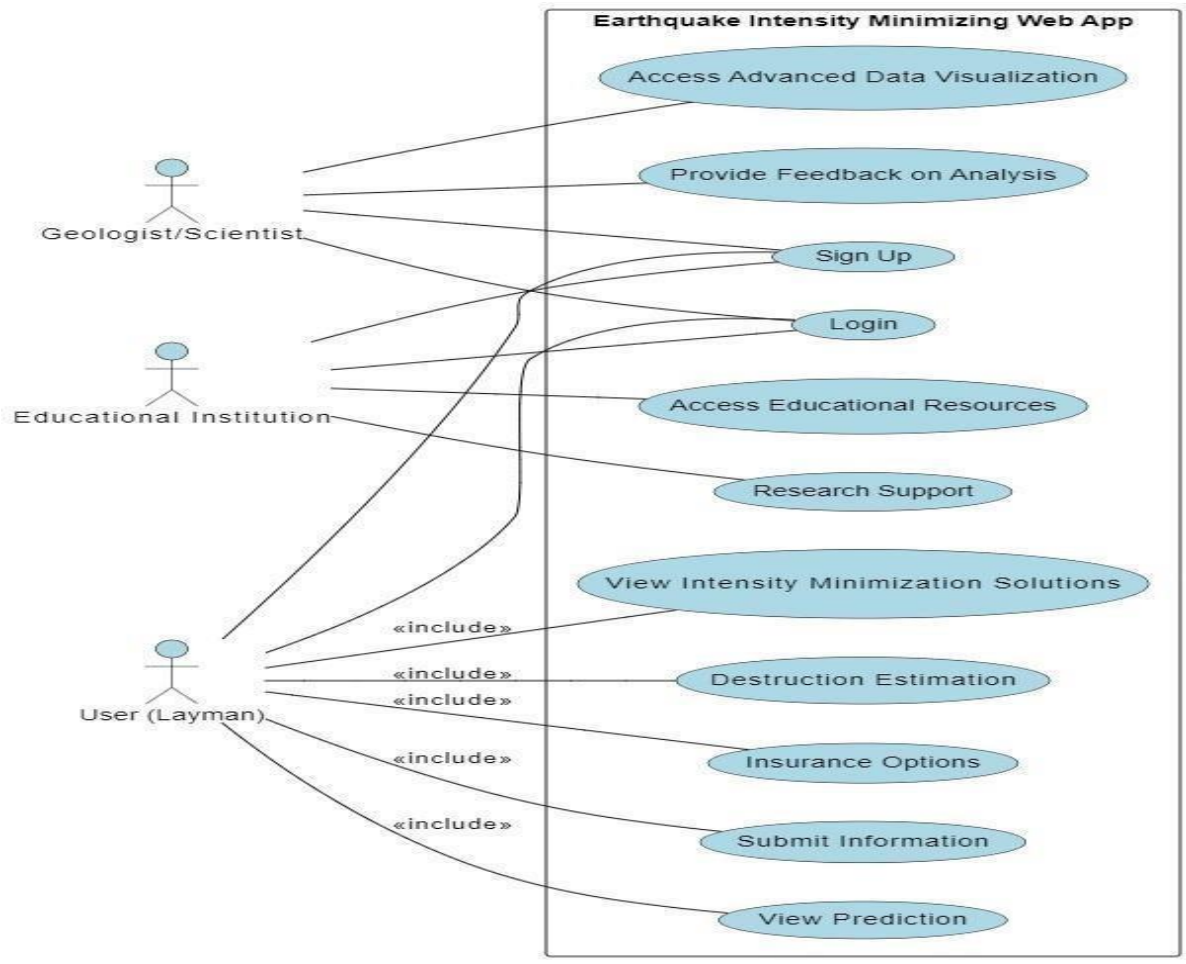


Figure 4.30 Use Case Diagram

Component Diagram:

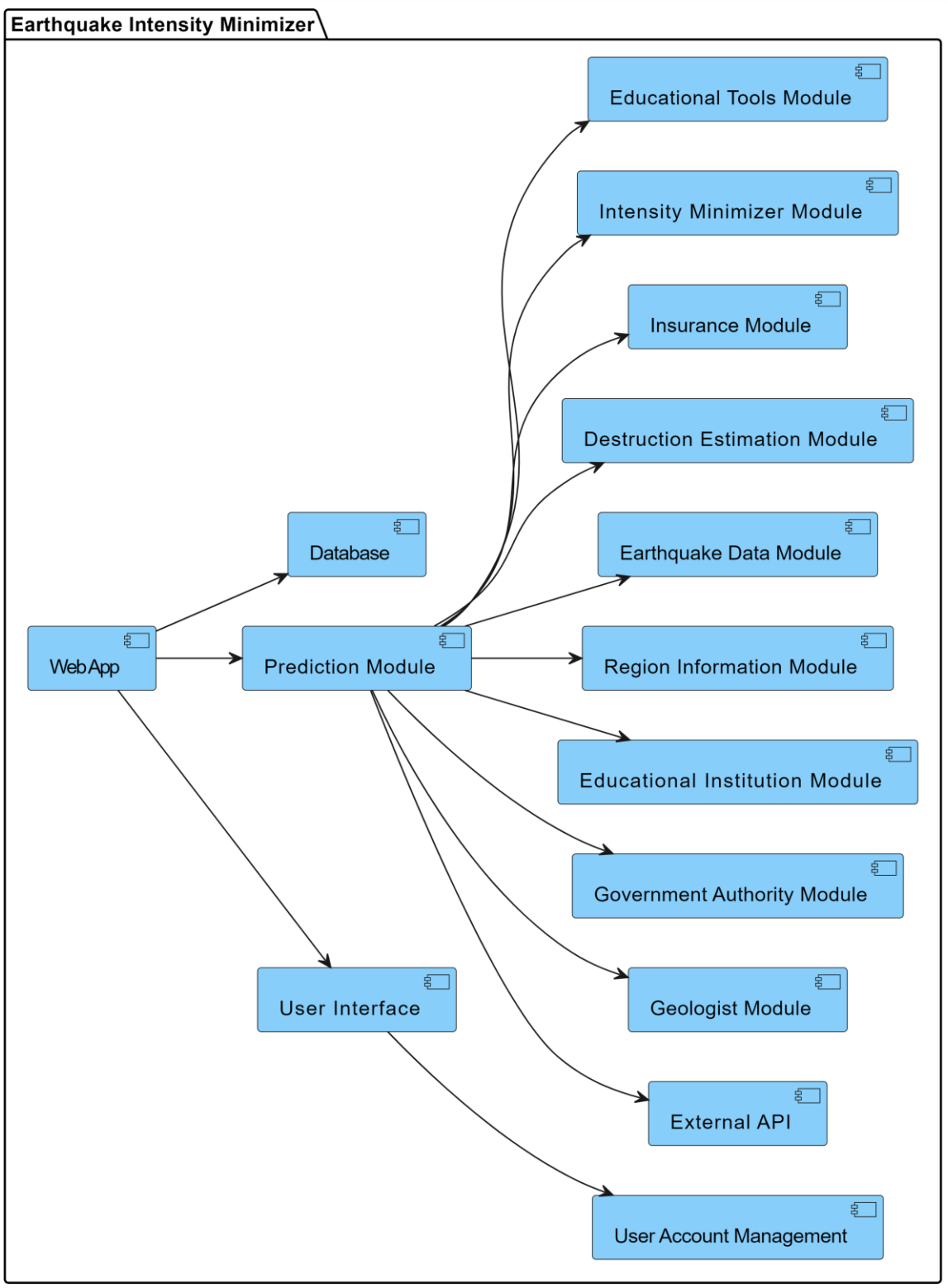


Figure 4.31 Component Diagram

Deployment Diagram:

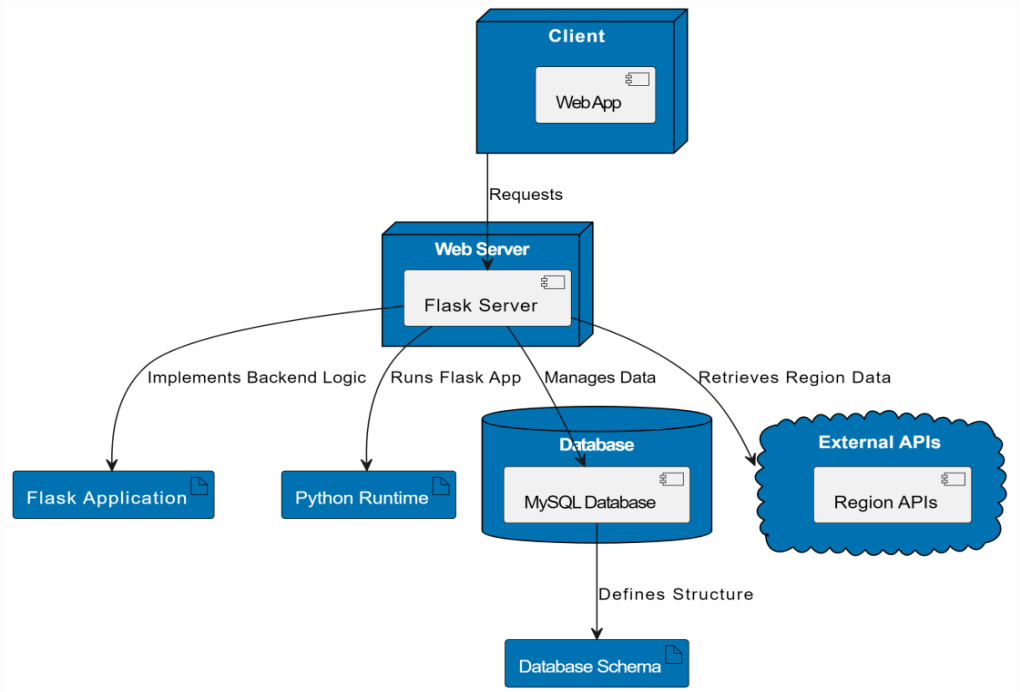


Figure 4.32 Deployment Diagram

System Block Diagram:

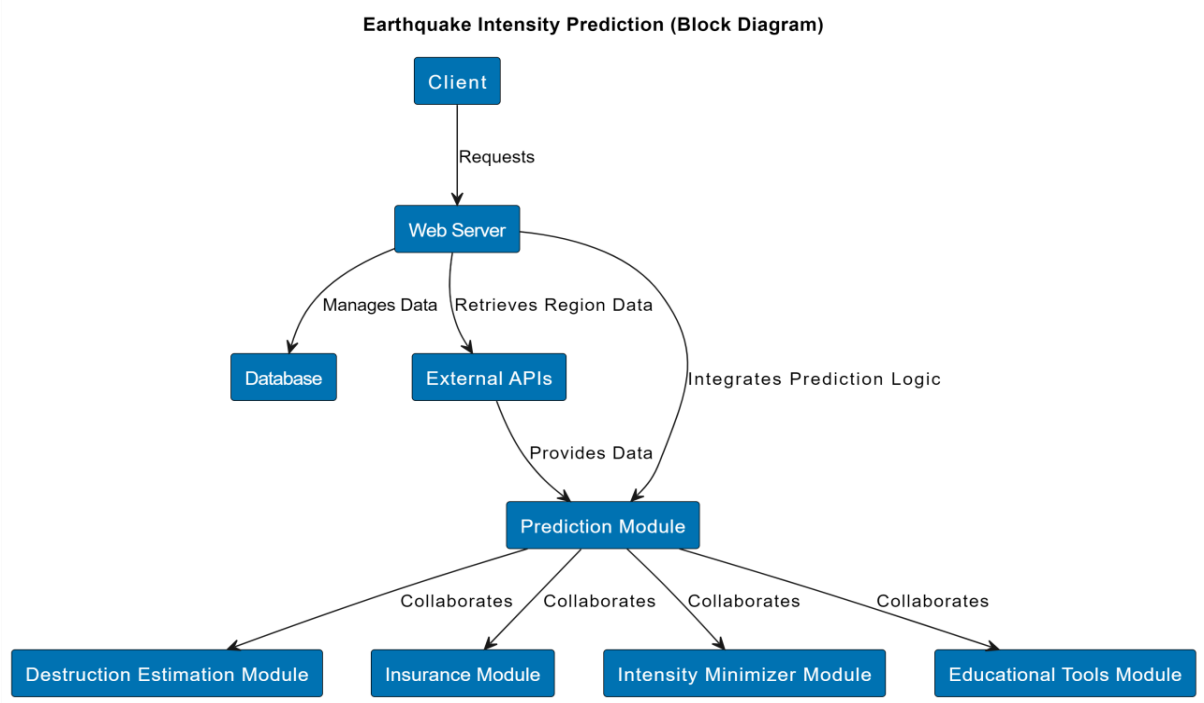


Figure 4.33 System Block Diagram

Test Cases Document

Test Case Name	Sign Up test case	Test Case Description	This test case is used to Test the Sign up feature.		
Created By	Qirat Sohail, Prerna Rohra	Verion	1.1	Date Tested	5-11-2023

S #	Prerequisites:
1	The application is installed and running.
2	The user has access to the sign-up page.

Step #	Step Details	Expected Results	Actual Results	Pass / Fail / Not executed / Suspended
1	Navigate to the sign-up page.	The sign-up page is displayed.	"	"
2	Enter valid user information into the corresponding input fields (First Name, Last Name, Email Address, Password, and Confirm Password).	The user information is entered without errors.	"	"
3	Click on the "Create Account" button.	The system attempts to create a user account.	"	"
4	Check for a successful sign-up.	The user account is successfully created, and the application displays a success message.	"	"
5	Verify that the user can log in using the provided credentials.	The user can log in with the registered email and password.		

Test Case Name	LogIn	Test Case Description	This test case is use to test the functionality of LogIn feature.		
Created By	Qirat Sohail, Prerna Rohra	Verion	1.1	Date Tested	5-11-2023

S #	Prerequisites:
1	User must have an account.
2	Account must be active.

Step #	Step Details	Expected Results	Actual Results	Pass / Fail / Not executed / Suspended
1	Navigate to the login page.	The login page is displayed.	"	"
2	Enter valid login credentials (Email Address and Password) into the corresponding input fields.	The login credentials are entered without errors.	"	"
3	Click on the "Login" button.	The system attempts to authenticate the user.	"	"
4	Check for a successful login.	The user is successfully authenticated, and the application redirects to the main dashboard or home page.	"	"
5	Verify that the user can access their account and perform post-login actions.	The user can access their account and use the features provided by the application.		

Test Case Name	Access of Hiatoric Datasets of Earthquake	Test Case Description	This test case is used to test the visibility of Earthquake Datasets.		
Created By	Qirat Sohail, Prerna Rohra	Verion	1.1	Date Tested	21-01-2024

S #	Prerequisites:
1	Device is connected to the internet.
2	The user has access to the Dataset access.
3	Reliable seismic datasets are accessible.

Step #	Step Details	Expected Results	Actual Results	Pass / Fail / Not executed / Suspended
1	Launch the application.	The application launches successfully and displays the main interface.	"	"
2	Navigate to the "Real-Time Data" section.	The application displays an interface specifically designed for earthquake data access.	"	"
3	User can scroll and view datasets.	Datasets are displayed.	"	"

Test Case Name	Access Educational Content about Earthquake	Test Case Description	This test case is used to test the access of educational content related to earthquake.		
Created By	Qirat Sohail, Prerna Rohra	Verion	1.1	Date Tested	21-01-2024

S #	Prerequisites:
1	Device is connected to the internet.
2	Educational content is loaded and available within the application.

Step #	Step Details	Expected Results	Actual Results	Pass / Fail / Not executed / Suspended
1	Access the educational content section.	The application displays a section dedicated to educational content, organized into categories.	"	"
2	View a list of available content categories.	The categories are clearly presented and navigable.	"	"
3	Select a content item (article, video, or tutorial).	The application opens and displays the selected content in a clear and user-friendly format.	"	"
4	Navigate within the content.	The application allows for seamless navigation within and between content items.	"	"

Test Case Name	Earthquake Intensity Prediction	Test Case Description	This test case is used to test the feature of intensity prediction.		
Created By	Qirat Sohail, Prerna Rohra	Verion	1.1	Date Tested	21-01-2024

S #	Prerequisites:
1	User have access to predictor page through logging.
2	Predictive algorithms for intensity estimations are functional.

Step #	Step Details	Expected Results	Actual Results	Pass / Fail / Not executed / Suspended
1	Enter magnitude, depth and location.	The user interface clearly guides the user through data input and entered data is validated for accuracy and completeness.	"	"
2	Initiate the intensity prediction process by clicking calculate result.	The intensity prediction process is initiated without errors.	"	"
3	User can view predicted intensity.	The predicted earthquake intensity is displayed clearly and prominently.	"	"

Test Case Name	Intensity Minimization	Test Case Description	This test case is used to test the updated intensity after solutions applications and also display solution.		
Created By	Qirat Sohail, Prerna Rohra	Verion	1.1	Date Tested	21-01-2024

S #	Prerequisites:
1	Earthquake intensity prediction has been completed.
2	Algorithms for intensity minimization are implemented.

Step #	Step Details	Expected Results	Actual Results	Pass / Fail / Not executed / Suspended
1	User navigates to the predictor page.	Displays interface to minimize intensity.	"	"
2	User selects the standard to view reduced intensity.	Reduced intensity along with a suggestion is displayed.	"	"

Test Case Name	Destruction Assessment	Test Case Description	This test case is used to test the assessed destruction estimated fter intensity is minimized.		
Created By	Qirat Sohail, Prerna Rohra	Verion	1.1	Date Tested	21-01-2024

S #	Prerequisites:
1	Minimized Intensity is being predicted.
2	The user has access to view destruction estimation.

Step #	Step Details	Expected Results	Actual Results	Pass / Fail / Not executed / Suspended
1	Access results of intensity minimization.	Destruction assessment report is generated.	"	"
2	Initiate destruction assessment.	Report includes evaluation of potential destruction.	"	"
3	Review report content.	Estimated report is being visible.	"	"

Test Case Name	Insurance Policy Listing	Test Case Description	This test case is used to verify comprehensive insurance plan details are displayed.		
Created By	Qirat Sohail, Prerna Rohra	Verion	1.1	Date Tested	21-01-2024

S #	Prerequisites:
1	System has access to cooperative insurance plan data.
2	The user has access to view destruction estimation.

Step #	Step Details	Expected Results	Actual Results	Pass / Fail / Not executed / Suspended
1	Access insurance feature according to region.	Comprehensive insurance plan details are displayed.	"	"
2	View list of available insurance plans.	Location-based precautionary measures are provided.	"	"
3	Select a plan and view detailed information.	Users can select and review insurance plans.	"	"
4	Access full policy documentation.	Full policy documentation is accessible.	"	"

Test Case Name	Feedback Analysis	Test Case Description	This test case is used to test the feedback(contact) form.		
Created By	Qirat Sohail, Prerna Rohra	Verion	1.1	Date Tested	21-01-2024

S #	Prerequisites:
1	User have access to contact page.
2	User have experienced the app's functionality.

Step #	Step Details	Expected Results	Actual Results	Pass / Fail / Not executed / Suspended
1	User enters contact form information.	Information is being correctly validated.	"	"
2	User inputs feedback(message) regards to the application or other concerns.	Message and form is being submitted.	"	"
3	User receives submitted alert.	Submission successful message is being displayed.	"	"

Test Case Name	Magnitude Reduction	Test Case Description	This test case is used to minimize the magnitude of the earthquake using a solution.		
Created By	Qirat Sohail, Prerna Rohra	Verion	1.1	Date Tested	21-01-2024

S #	Prerequisites:
1	User should be navigated to solutions page.
2	

Step #	Step Details	Expected Results	Actual Results	Pass / Fail / Not executed / Suspended
1	User enters magnitude.	A modal window is opened with the results and description.	"	"
2	User scrolls through the result.	Result is displayed.	"	"

Earthquake Intensity Minimizer User Manual

Version: v 1.0

Date: 22/01/2024

1. Introduction

- **Purpose of the User Manual:** This manual provides clear and concise instructions on how to use the Earthquake Intensity Minimizer web application effectively.
- **Target Audience:** The application is designed for:
    - Laypersons interested in learning about earthquakes and mitigation measures.
    - Geologists and researchers studying earthquake patterns and prediction techniques.
    - Educational institutes seeking resources for teaching about earthquakes.
- **Scope of the Software:** The application offers features for:
    - Accessing historic earthquake data.
    - Exploring educational content about earthquakes.
    - Predicting earthquake intensity for specific locations.
    - Identifying solutions to minimize potential intensity.
    - Assessing destruction based on predicted intensity.
    - Exploring insurance policies for earthquake-related events.
    - Providing feedback on prediction accuracy, mitigation suggestions or others.

2. Getting Started

- **System Requirements:**
    - A web browser (e.g., Chrome, Firefox, Edge).
    - An active internet connection.

- **Installation Instructions:** No installation is required. Access the application directly through its web address.
- **User Account Creation:**
    - Click "Sign Up" on the homepage.
    - Provide necessary information (name, email, password).
    - Click "Create Account."
- **Logging In:**
    - Click "Login" on the homepage.
    - Enter your email and password.
    - Click "Sign In."

3. User Interface Overview

- **Description of Main Interface Components**:
    - Navigation Bar: Located at the top, providing access to all features.
    - Main Content Area: Displays information and interactive elements for each feature.
    - Footer: Contains contact information and links to support.
- **Navigation Guide:**
    - Use the navigation bar to access different features.
    - Click on feature names to open them.

4. Functionality Overview

List of Key Features:

1. Earthquake Data
2. Educational Content
3. Intensity Prediction
4. Intensity Minimization and Solutions
5. Destruction Assessment

6. Insurance Policies
7. Feedback on Analysis

How to Use Each Feature

Earthquake Data

1. Click Datasets in the prediction drop down.
2. Access Datasets available to view and download.

Educational Content

1. Click "Educational Content" in the solutions drop down.
2. Explore a library of articles, videos, and tutorials about earthquakes.
3. Navigate between categories and content items.
4. Interact with multimedia elements (play videos, view images).

Intensity Prediction

1. Click "Predictor" in the navigation bar (requires login).
2. Enter Magnitude and Depth of earthquake within knowledge.
3. Enter region. Regional suggestions are available.
4. Click Calculate result.
5. View the predicted intensity value and any range.

Intensity Minimization and Solutions

1. Access this feature through the Solutions page.
2. Enter region and updated intensity to view solutions.
3. Verify that solutions align with the region's characteristics.
4. Scroll to view precautionary measures.
5. Compare initial and simulated intensity levels.

Destruction Assessment

1. Access this feature through the Solutions drop down.
2. Initiate the destruction assessment process.

3. Review the generated report, including:
    - Evaluation of potential destruction.
    - Recommendations for further mitigation or preparedness.
4. Download report.

Insurance Policies

1. Click "Cooperative Insurance" in the navigation bar.
2. Enter region to view region wise plans.
3. View a list of available insurance plans related to earthquake events.
4. Select a plan to view detailed information, including:
    - Coverage details.
    - Contact information for insurance agents.

Feedback on Analysis

1. Click "Contact Us" in the navigation bar.
2. Provide feedback on:
    - Accuracy of earthquake intensity predictions.
    - Utility of mitigation suggestions.
    - Or any other user’s concern.
2. Enter your feedback details.
3. Submit your feedback and receive an acknowledgement message.

5. Troubleshooting

Common Issues and Solutions: App will not function if there is no internet: Ensure you have a stable internet connection.

Frequently Asked Questions (FAQs): Not available at the moment.

6. Tips and Best Practices

Tips for Efficient Use of the Application: Explore the User Manual by thoroughly reading the User Manual provided. It contains valuable instructions, tips, and insights on how to navigate through the application and utilize its various features effectively. If you encounter issues or have suggestions for improvement, provide feedback to the software developers. Your input can contribute to enhancing future versions.

7. Support and Contact Information

How to Seek Support: Contact SZABIST, Karachi for more details and support.

Contact Details: Phone Number - (021) 111 922 478.

FYP LOG FORM

FYP LOG FORM 1

SHAHEED ZULFIKAR ALI BHUTTO INSTITUTE OF SCIENCE & TECHNOLOGY KARACHI CAMPUS

Form IV: Student Log Form

Title: Earthquake intensity predictor

Supervisor: Dr. Khalid Rasheed Batch/Sec: 24|E Group #: _____

Reg. # (Group members): Qirat Sohail (20123121), Beena Batra (20123221)

Sr.	Task Assigned	Due	Task Completed (S)	Date (S)/Sign.
1	Figma design	Week 1	Done	✓
2	Use Case diagram	Week 2	Done	✓
3	SRS	Week 3	Done	✓
4	Test Case 20%	Week 4	Done	✓
5	Data Gathering and Analysis	Week 5	Done	✓
6	ERD, Class and other diagrams	Week 6	Done	✓

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7	Frontend Development	Week 7	Done	✓
8	Intensity Analysis	Week 8	Done	✓
9	SDS	Week 9	Done	✓
10	TestCase document and diagrams	Week 10	Done	✓
11	Activity diagram	Week 11	Done	✓
12	Collaboration Diagram	Week 12	Done	✓
13	Flask API integration	Week 13	Done	✓
14	Code Implementing	Week 14	Done	✓
15	Code Testing	Week 15	Done	✓

Supervisor's Authentication (Completed report): ✓ Dated: 19-1-24

FYP Coordinator Authentication: _____ Dated: _____

Figure 4.34 Student Log Form

FYP LOG FORM 2

SHAHEED ZULFIKAR ALI BHUTTO INSTITUTE OF SCIENCE & TECHNOLOGY KARACHI CAMPUS

Form IV: Student Log Form

Title: Earthquake Intensity Minimize

Supervisor: Dr. Khalid Rasheed Batch/Sec: E Group #:

Reg. # (Group members): 2012312 Rigat Sohail, 2012221 Rasheena Rehan

Sr.	Task Assigned	Due	Task Completed (S)	Date (S)/Sign.
	Login / Signup	Week 1	Done	✓
	database integration	Week 2	Done	✓
	intensity prediction	Week 3	Done	✓
	Solution research	Week 4	Done	✓
	solution prediction	Week 5	Done	✓
	magnitude reduction	Week 6	Done	✓

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7	Destruction Prediction	Week 7	Done	✓
8	UI design improvement	Week 8	Done	✓
9	Research on intensity minimization	Week 9	Done	✓
10	Intensity Minimization	Week 10	Done	✓
11	Code integration	Week 11	Done	✓
12	Flask and ui connection	Week 12	Done	✓
13	Code Testing	Week 13	Done	✓
14	Document modifications	Week 14	Done	✓
15	App demonstration and Testing	Week 15	Done	✓

Supervisor's Authentication (Completed report): ✓ Dated: 7-5-24

FYP Coordinator Authentication: Dated:

Figure 4.35 Student Log Form