ProGas

Fuel Prediction Application

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Acknowledgments

We want to extend our sincerest gratitude and appreciation to everyone who helped make this project a success.

First and foremost, we want to extend our warmest thanks to our project supervisor, Dr. Ahmad Altamimi, whose advice and expertise have been both insightful and invaluable throughout this process.

We are also appreciative of our respective families and friends who extended their unwavering support and champion throughout this process.

This project would not have been possible without the support and guidance of all of you.

Thank you.

Abstract

In economic planning and consumer forecasting, predicting fuel prices accurately is a challenge. This project's main purpose is to predict fuel price fluctuations in the Jordanian market using a Machine-Learning approach to predict future prices. Aiming to tackle the issue of the best refuel time and staying up to date with current and potential future fuel prices. Typically citizens find out about changes in fuel prices at the beginning of each month via unreliable sources against a backdrop of prominent uncertainty. Hence, highlighting a glaring gap in the market and a need for this application. Using various algorithms we aim to train a model that can forecast fuel trends in both the short-term and long-term, utilizing historical datasets, relevant current events - political and otherwise, and local economic indices.

List of Abbreviations

SRS: Software Requirements Specification

WBS: Work Breakdown Structure

SDLC: Software Development Life Cycle

TOE: Tonne of oil equivalent

MMcf: One million cubic feet

NLP: Natural Language Processing

ML: Machine Learning

SVM: Support Vector Machine

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Chapter 1: Introduction

1.1 Overview

Gasoline, diesel, and natural gas have been the most important sources of energy in Jordan since the 1950s. Gasoline and diesel are used mainly for road transport. They serve as the primary source of fuel for combustion engines employed in various sectors such as transportation, aviation, recreation, power tools, and emergency power generation. Natural gas, on the other hand, finds its primary applications in heating and electricity generation. These applications span across individual, organizational, and governmental levels, showcasing the diverse and widespread utilization of these energy sources.

ProGas is a mobile application that aims to predict gasoline, diesel, and natural gas prices and give an accurate and effective estimate ahead of time using machine learning (ML). Aiming to benefit any Jordanian individual or organization that consumes gasoline, diesel, or natural gas. Typically, fuel prices fluctuate on a daily basis due to several global and local factors, widely ranging from weather conditions to political developments. ProGas takes these dynamic variables in mind by acquiring news from trusted sources in order to give consistently precise predictions.

ProGas was developed to inform and advise users on optimally when to purchase gasoline, diesel, and natural gas, aiming to mitigate costs of individuals and public and private organizations in Jordan. In addition, focusing on providing a user-friendly experience.

1.2 Problem Statement

Jordan's fuel consumption data was reported at 8,726.000 tonnes of oil equivalent (TOE) in 2021. In 2017, Jordan's annual natural gas consumption amounted to 184,661 million cubic feet (MMcf). The apparent high demand places a significant financial burden on both businesses and individuals. Moreover, many businesses find it challenging to engage in financial forecasting due to the volatility of fuel prices, which constitutes a central cost factor. As a result, businesses often tend to go over budget when calculating gasoline costs, leading to a cost overrun.

ProGas will assist users in **cost planning** by enabling them to calculate future expenses more accurately and effectively. Enhancing companies' ability to prepare for changes in cost related to gasoline, diesel, and natural gas. Additionally, for individuals planning a road trip, the application sends a notification if fuel prices are predicted to drop below or increase above a certain threshold, therefore optimizing refueling times, in addition to providing coordinates to the nearest places for refueling.

ProGas offers premium users the opportunity to benefit from exclusive discounts on gasoline, diesel, and natural gas purchases from local businesses in Jordan. Discounts are provided by sponsors of **ProGas.** Finally, **ProGas** helps in the data visualization of gasoline, diesel, and natural gas prices. Hence empowering the Jordanian government or any interested organization to analyze and interpret this data more effectively.

1.3 Methodology

This methodology describes the step-by-step process of developing **ProGas**, an application designed to predict gas prices in Jordan. The development process encompasses stages starting from data collection and preprocessing to model training, ultimately integrating these components into a user mobile app for the Jordanian market.

- **Data Collection**
    - **Historical Gas Prices Data in Jordan**

        Use a dataset containing gas prices specific to Jordan.
    - **News Data:**

        Collect historical and current news from trusted sources about the economic conditions, geopolitical events, and industry advancements that happened in Jordan, and make sure that the news that was collected is relevant to what affects gas prices in Jordan. This information will be used in **ProGas** to assist the application in accurately predicting gas prices in Jordan.
- **Data Preprocessing**
    - **Cleaning and Transforming Gas Price Data**

        Points out any missing outliers or values in the dataset of the gas prices in Jordan
    - **NLP Processing for News Data**

        Tokenize news articles while utilizing a natural language processing (NLP) model specifically tailored for analyzing content related to the market.
- **Model Selection and Training:**
    - **Model Selection**

        When selecting a prediction model for gas prices, we will consider commonly used options such as Linear Regression – a straightforward and easily interpretable model[1]. Additionally, we will explore models like Decision Trees, XGBoost, and Support Vector Machine (SVM). There are advantages and disadvantages to each of these models. We will evaluate which one is most suitable for predicting gas prices.

[1] *Yale University Department of Statistics. "Introduction to Linear Regression Analysis." Yale University, 1997-98.*
[2] *Jahanshahi, H., et al. "Artificial Intelligence-Based Prediction of Crude Oil Prices." Mathematics, vol. 10, 2022*
[3] *Dept. of CSE, Kallam Haranadhareddy Inst. of Tech., Guntur, AP, India. "Forecasting Natural Gas Prices Using Statistical Modeling Methods." Int. Res. J. Mod. Eng. Tech. Sci., 04(05/May-2022), 2022.*

- **Model Training**

  We will train the chosen model using data on gas prices and news datasets.

- **Real-Time Prediction Pipeline**

  Our aim is to create a gas price prediction system that will extract information from news articles and, using the information it extracts, accurately predict the gas prices in Jordan.

To summarize, this methodology presents a strategy for developing **ProGas**, which is designed specifically to predict gas prices in Jordan. Our purpose is to create an easy-to-use application targeting users in Jordan.

1.4 Existing Systems

Artificial Intelligence-Based Prediction of Crude Oil Prices Using Multiple Features under the Effect of Russia–Ukraine War and COVID-19 Pandemic: This paper addresses the challenging task of predicting crude oil price changes by incorporating the global effects of the COVID-19 pandemic and the Russia–Ukraine war, as the impact of the COVID-19 pandemic on crude oil prices subsides. The study applies machine learning algorithms, including support vector machine, linear regression, and rain forest, as well as deep learning algorithms.[2]

Forecasting natural gas prices using statistical modeling methods: This paper explores the prediction of natural gas prices in US markets through statistical modeling, specifically comparing Random Forest and Decision Tree models for linear regression. The Random Forest model, a supervised learning algorithm, is employed for regression analysis, providing insights into potential forecasting capabilities[3].

[1] *Yale University Department of Statistics. "Introduction to Linear Regression Analysis." Yale University, 1997-98.*
[2] *Jahanshahi, H., et al. "Artificial Intelligence-Based Prediction of Crude Oil Prices." Mathematics, vol. 10, 2022*
[3] *Dept. of CSE, Kallam Haranadhareddy Inst. of Tech., Guntur, AP, India. "Forecasting Natural Gas Prices Using Statistical Modeling Methods." Int. Res. J. Mod. Eng. Tech. Sci., 04(05/May-2022), 2022.*

1.4.1 Gap Analysis

Aspect	Current State	Desired State	Actions to Bridge the Gap
Data Source	- Relies on historical gas price data - Economic indicator - Supply & Demand	- An integration of real-time news, geopolitical events, weather, and economic indicators.	- Access to up-to-date news can greatly enhance the model's accuracy.
Model Complexity	- Use of a simple Machine Learning Model with historical data.	- Using more advanced Models with real-time news to enhance the prediction.	- Stay updated with the latest Machine Learning models.
Geographic Coverage	- Aims on specific areas/regions	- More accurate prediction by expanding the coverage from local news to global and local news	- Access to global gas prices data

Table 1: Gap Analysis Table

1.5 Methods for Tracking Gas Prices

- **Gas station signs:** Traditional gas station signs still display the current price of gas for the drivers to see while passing by.
- **Local news website:** There are some local news that display the current price of gas for the given area.
- **Gas station websites:** Most gas station companies have their own website with their own gas prices for users to check.
- **Different applications:** There are different applications (like GasBuddy) that allow users to search for the area in which they want to see the gas price. It relies on user contributions to keep the prices up to date.

1.6 Objectives

1. Give users a quick, dependable, and affordable way to learn about impending changes in gas prices.
2. Develop a system that can accurately predict future fuel prices.
3. Utilize past data along with global and local news to make precise predictions about fuel costs.
4. Give users access to forecasts and real-time gasoline price updates.
5. Inform the user when it's best to refuel and about any changes in the price of fuel.
6. Assist users in making cost-effective judgments on fuel prices and when to refuel.
7. Incentives can be offered to premium users by sponsors. Moreover, our app will facilitate communication between sponsors and premium users so that incentives can be taken advantage of.

1.7 Stakeholder Analysis

Stakeholder	Role
End Users	Use the system to make decisions about when to refuel and save costs.
Sponsors	Provide financial support and promotional backing for the app and may also offer valuable real-time data on fuel prices and trends for enhanced accuracy and user engagement.
Admin	Manage and maintain the application, ensuring its smooth operation, overseeing data accuracy, user access, and security, and responding to user feedback and technical issues.
Project Supervisor	Supervises the team during the project and provides assistance in decision-making and consulting.
Project Manager	Keeps track of project progress, divides tasks equally, and leads the project to success.
Test Manager:	Make sure the software fulfills its intended purpose and provides the right functionalities without errors.
Project Team:	Develop the application, the functionalities, and the GUI for the application.

Table 2: Stakeholders Table

Chapter 2: Project Management Plan

2.1 Project Charter

Project Title	Fuel Price Prediction
Date of Authorization **Project Start Date** **Project Finish Date**	October 15th, 2023 October 25th, 2023 June 1st, 2024
Milestones	• Deliver a complete SRS by January 2024 • Deliver an abstract high-level design of the system by January 2024 • Deliver a medium-fidelity prototype by March 2024 • Deliver a final working version of the application by June 2024
Budget Information	The budget is 150JDs. It will be spent on purchasing the required data sets for the model, in addition to a Figma subscription for interface design. Development is done by team members, and necessary hardware is provided by the University.
Project Manager	Laith Abusada lai20200812@std.psut.edu.jo +970 598 917 725 +962 798 595 763
Project Objectives:	The main objective of this project is to deliver a fully functional fuel price prediction application in Jordan, with complete focus on gasoline. We aim to benefit users by notifying them about the best times to refuel based on an accurate AI model. In addition, we plan to design and provide a user-friendly interface that accommodates multiple types of users. Finally, we intend to enhance the user experience by implementing fuel price visualization techniques.
Main Project Success Criteria	To deliver a fuel prediction application with an accuracy above 75% that has a user-friendly interface by June 2024. Making sure to Satisfy user requirements while not exceeding the budget.

<table>
<tr><td>Approach</td><td>
- Study the gasoline market and become more familiar with the factors affecting fuel in Jordan
- Undergo and focus on Requirements Engineering
- Learn and become more familiar with Data Science
- Learn the necessary languages and methods needed to implement machine learning in order to develop our model
- Prepare the necessary data sets for the model
- Decide on a programming language and framework for the front-end
- Deliver a complete SRS by January 2024
- Undergo model training using an appropriate training algorithm
- Deliver a working application that satisfies user-requirements while working according to the iterative waterfall model
- Use google document sharing regarding the SRS for easy modifications between team members
- Use Git as our main VCS to track system changes throughout implementation
- Schedule weekly meeting with supervisor to monitor progress and receive feedback
</td></tr>
<tr><td>Roles and Responsibilities</td><td>
<table>
<tr><th>Name</th><th>Role</th><th>Position</th><th>Contact Information</th></tr>
<tr><td>Dr.Ahmad Altamimi</td><td>Supervisor</td><td>Supervise</td><td>a.altamimi@psut.edu.jo</td></tr>
<tr><td>Omar Alfawareh</td><td>Development Team Member, UI/UX Team Member</td><td>Developer, UX Designer,Business Analyst</td><td>oma20200516@std.psut.edu.jo</td></tr>
<tr><td>Laith Abusada</td><td>Project Manager, Development Team member, Data Science Team Member</td><td>Developer, Business Analyst, Data Analyst</td><td>lai20200812@std.psut.edu.jo</td></tr>
<tr><td>Motasem Atieh</td><td>Development Team Member, Testing Team Member</td><td>Developer, Data Engineer,Tester</td><td>mot20200337@std.psut.edu.jo</td></tr>
</table>
</td></tr>
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Table 3 : Project Charter

2.2 Scope Statement

Project title:	Fuel Price Prediction
Date of project approval:	October 25th, 2023
Date prepared:	November 25th, 2023
Prepared by:	Omar Alfawareh oma20200516@std.psut.edu.jo +962 79 114 1046
Project Justification:	As of today, there is no software application that predicts fuel prices in Jordan. People and businesses rely on traditional methods to find gas prices and use basic forecasting techniques to predict the price, such as monitoring supply and demand. Moreover, some people simply just guess whether gas will increase in price or not based on certain factors they have observed. This is uncertain and can be very random. A fuel prediction app would be beneficial as it would notify users of the best time and date to refuel based on a highly accurate model. Also, providing a user-friendly application with gas price visualization.
Project Deliverables:	*Product deliverables:* - Multiplatform Fuel Prediction Application *Project Management deliverables:* 1. Project Management Plan a. Project Charter b. Scope Statement c. Work Breakdown Structure d. Gantt Chart e. Risk Analysis 2. Software Requirements Specification 3. System Design 4. Medium Fidelity Prototype 5. System Test Plan

Project Success Criteria:	To successfully deliver an application that predicts gas prices in Jordan and has a user-friendly interface. Making sure to satisfy all user requirements in the SRS and not exceeding the budget.
Constraints:	- Time - Developers lack knowledge and experience in machine learning and flutter - Various unrelated factors affect the price of gasoline in Jordan - Resources (Only 3 developers are able to work on the project part-time)

Table 4: Scope Statement

2.3 Software Development Lifecycle

Many different approaches to developing our software were considered, such as the Waterfall, Iterative, Incremental, and Agile methodologies. After careful consideration, we opted for the Iterative Waterfall Approach.

The Waterfall Model is suitable for our project due to its sequential development process that requires detailed documentation. Our project demands a high and strict level of control over milestones and deliverables and requires extensive detailed documentation at every step, considering limited resources and an inexperienced development and testing team.

Despite the aforementioned alignment with the Waterfall Model, there are some other aspects that should be considered. The project involves requirements that can change frequently due to the team's inexperience in Flutter and Machine Learning development, leading to changes in requirements, design, and implementation. Consequently, the Waterfall Method becomes impractical due to its rigid structure. To facilitate easy and effective communication, adaptability to changes, and the need to go back and forth between the different stages of the project, **we have chosen the Iterative Waterfall Method**[4], hence addressing the rigidity issue and allowing us to develop the software in iterations and multiple increments through the development.

As shown in the table below, these are some key differences between the **Waterfall** and the **Iterative Waterfall** methodology.

Waterfall	Iterative Waterfall
Sequential Development, the development is done in clear sequential phases	Incremental Development embedded within the sequential stages of Waterfall
Difficult to accommodate change when a phase is complete, it is considered finalized, and discovering that a change is needed late in the project will result in problems.	Flexible to accommodate change, it provides flexibility to be able to go back to a phase and implement a change easily.
Detailed high documentation, this documentation serves as a basis for the subsequent phases of the project	Iterative Enhancement and Continuous Improvement, it allows for refinement of the documentation based on feedback

Table 5: Waterfall vs Iterative Waterfall

[4] *Project Management Institute. A Guide to the Project Management Body of Knowledge (PMBOK Guide) (6th ed.). Project Management Institute, 2017.*

In Figure 1, developing in increments and having feedback paths from and to each stage will allow for easier accommodation to change

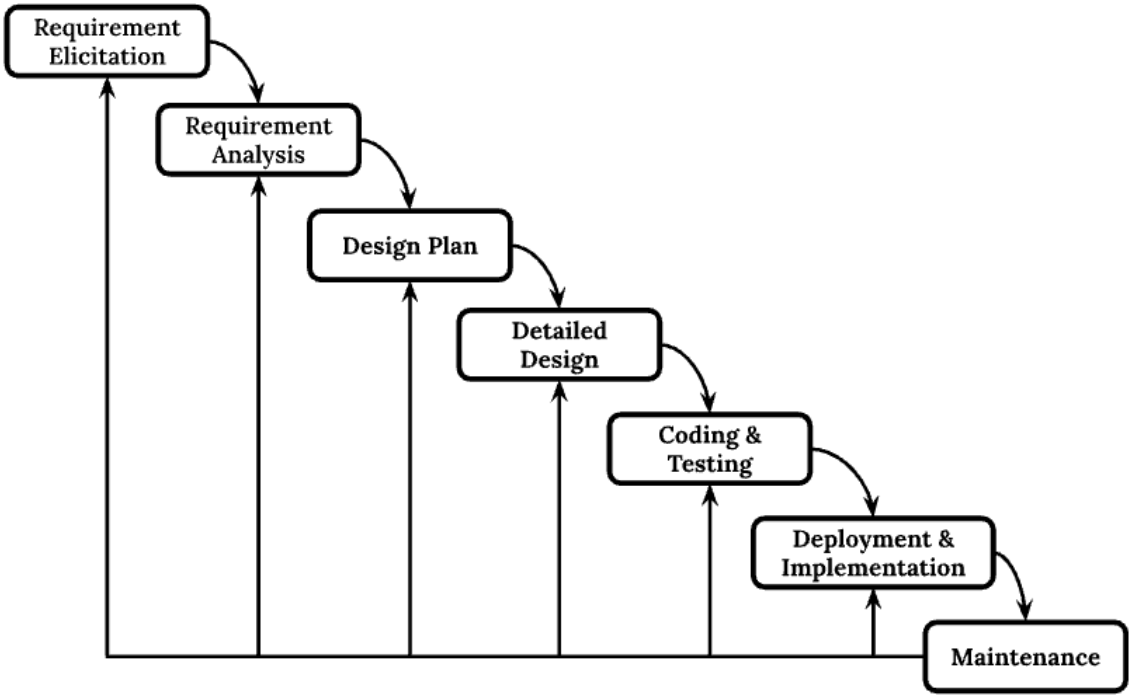


Figure 1: Iterative Waterfall SDLC

[4] *Project Management Institute. A Guide to the Project Management Body of Knowledge (PMBOK Guide) (6th ed.). Project Management Institute, 2017.*

2.4 Work Breakdown Structure (WBS)

Task Name	Begin Date	End Date	Duration (Days)
1. Initialization Phase	12/11/23	20/11/23	09
1.1. Brainstorming	12/11/23	18/11/23	07
1.2. Research existing systems	19/11/23	20/11/23	02
2. Planning Phase	21/11/23	30/11/23	10
2.1. Develop Project Charter	21/11/23	22/11/23	02
2.2. Develop Scope Statement	23/11/23	24/11/23	02
2.3. Develop WBS	25/11/23	26/11/23	02
2.4. Develop Risk Management Plan	27/11/23	30/11/23	04
3. Analysis Phase	01/12/23	29/12/23	29
3.1. SRS (Software Requirements Specifications)	01/12/23	29/12/23	29
3.1.1 Identify Stakeholders	01/12/23	02/12/23	02
3.1.2 Stakeholder Analysis	03/12/23	06/12/23	04
3.1.3 Requirements Elicitation	07/12/23	09/12/23	03
3.1.4 Requirements Documentation	10/12/23	15/12/23	06
3.1.5 Requirements Prioritization	16/12/23	18/12/23	03
3.1.6 Requirements Interdependencies	19/12/23	20/12/23	02
3.1.7 Use Case Diagram	21/12/23	24/12/23	04

3.1.8 Power-Interest Matrix	25/12/23	29/12/23	05
4. Design Phase	30/12/23	28/02/24	61
4.1. SDD (Software Design Document)	30/12/23	20/02/24	53
4.1.1 UML Design	30/12/23	20/02/24	53
4.1.1.1 Activity Diagram	30/12/23	03/01/24	05
4.1.1.2 Sequence Diagram	04/01/24	11/01/24	08
4.1.1.3 Context Diagram	12/01/24	16/01/24	05
Graduation Project 1 Submission 18/01/24			
4.1.1.3 Class Diagram	10/02/24	15/02/24	06
4.1.1.4 State Machine Diagram	16/02/24	20/02/24	05
4.2 Design Patterns	21/02/24	28/02/24	08
5. Implementation Phase	29/02/24	15/04/24	47
5.1. Gathering Datasets	29/02/24	04/03/24	05
5.2. AI Module Implementation	05/03/24	11/04/24	38
5.3. UI/UX Design	05/03/24	15/03/24	11
5.4. Flutter Implementation (1st iteration)	16/03/24	15/04/24	31
6. Design Phase (2nd iteration)	16/04/24	25/04/24	10
7. Implementation Phase (2nd iteration)	26/04/24	05/05/24	10

8. Testing Phase	06/05/24	27/05/24	22
8.1. Test Plan	06/05/24	16/05/24	11
8.1.1 Identify Test Scope	06/05/24	06/05/24	01
8.1.2 Identify acceptance criteria	07/05/24	08/05/24	02
8.1.3 Analyze Requirements and Test Cases	09/05/24	11/05/24	03
8.1.4 Identify Test Risks	12/05/24	16/05/24	05
8.2. Implement Tests	17/05/24	20/05/24	04
8.3. Execute Tests	21/05/24	23/05/24	03
8.4. Black-Box Testing	24/05/24	27/05/24	04
8.5. White-Box Testing	24/05/24	27/05/24	04
9. Design Phase (3rd Iteration)	28/05/24	01/06/24	05
10. Implementation Phase (3rd Iteration)	01/06/24	06/06/24	05
11. Testing Phase (2nd Iteration)	07/06/24	11/06/24	05

Table 6: Work Breakdown Structure (WBS) Table

2.5 Project Tasks

Phase	ID	Task Name	Description	Pred	Task Allocation
Initialization Phase	A	Brainstorming	Generate Ideas for potential solutions	-	Motasem
	B	Existing Systems	Investigate and analyze existing systems	A	Laith Motasem
Planning Phase	C	Develop Project Charter	Develop a project charter	A, B	Laith
	D	Develop Scope Statement	Develop a scope statement	C	Omar
	E	Develop Work Breakdown Structure	Develop a Work Breakdown Structure	C, D	Motasem Omar
	F	Develop Risk Management Plan	Identify and Analyze Potential Risk	D,E	Laith
Analysis Phase	G	Identify Stakeholders	Identify individuals or groups affected by or influencing the project	D,F	Motasem Laith
	H	Requirements Elicitation and Specification	Conduct an Interview with people that may benefit from the system to collect requirements and specify the system requirements	G	Omar
	I	Requirements Prioritization and Interdependencies	Prioritize Requirements based on urgencies and dependencies	H	Laith Motasem
	J	UI Prototypes	Develop visual prototypes for the user interface	I	Omar

	K	Checklist	Create a checklist to ensure all requirements are considered	J	Motasem
	L	Use Case Diagram	Illustrates the actors, the functional requirements, and the connection between them.	H,K	Motasem
	M	Power-Interest Matrix	Evaluate the stakeholder's power and interest in the project	L	Laith
Design Phase	N	System Architecture	Define the high-level structure and components of the system	H, L	Laith Omar Motasem
	O	User Interface Flow Diagram	Illustrates the design and layout of the UI	L	Omar
	P	UML Design	Create UML diagrams (class, sequence, state-machine)	O	Omar Motasem Laith
	Q	Design Patterns	Identify the design patterns that were used in the project	P	Laith Omar Motasem
Implementation Phase	R	AI Module Implementation	Develop and integrate AI Module	Q	Laith Motasem Omar
	S	Gathering Datasets	Collecting Datasets that can be used to train the AI Module	R	Laith Motasem
	T	UX/UI Design	Implement UX/UI Design	Q	Omar
	U	Flutter Implementation	Implement the requirements that were collected into code	T	Omar Laith Motasem
Testing Phase	V	Create Test Plan	Develop a plan for system testing	U	Laith Omar

	W	Implement Test	Develop test cases for system evaluation	V	Laith Omar
	X	Execute Test	Execute test cases on implemented system	W	Laith Motasem
	Y	Black-Box Testing	Evaluate system without looking in the code	X	Omar Laith
	Z	White-Box Testing	Evaluate system while looking in the code	Y	Omar Motasem

Table 7 : Project tasks

2.6 Gantt Chart

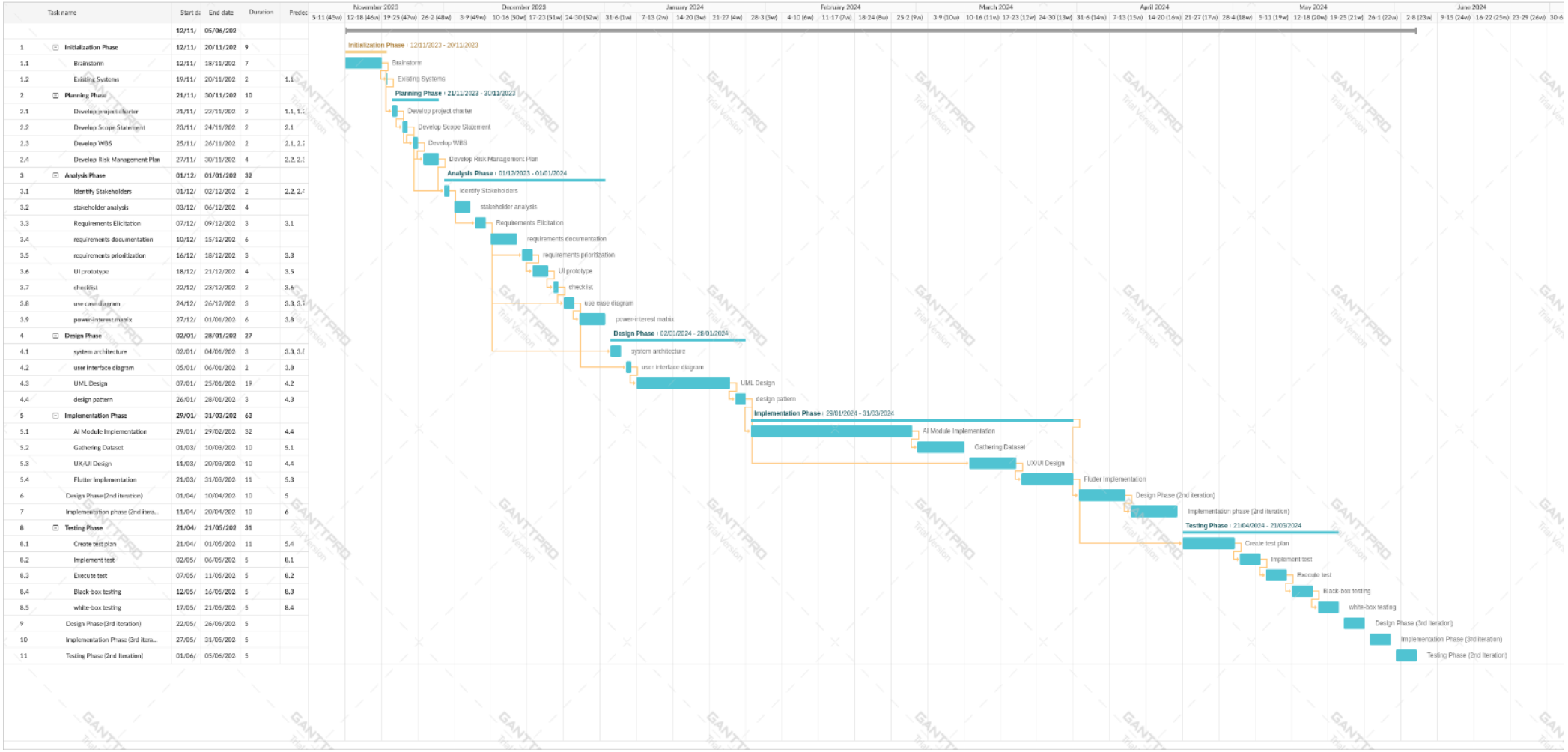


Figure 2: Gantt Chart

2.7 RACI Matrix

Roles / Responsibility	Project Team	Project Manager	Project Supervisor
Research and Initiation Phase	R	R	C, A
Planning Phase	R	A, C	C, A
Analysis Phase	R	R, A	C, I
Design Phase	R	A	C, I
Implementation Phase	R	A, C	C, I
Testing and Integration Phase	R, A	R, A	C, I
Deployment and Maintenance Phase	R, A	R, A	C, I

Table 8: RACI Matrix Table

- **R - Responsibility**: The person or group who completes the deliverable.
- **A - Accountability**: The person or group who signs off on the deliverable and will be held accountable for the deliverable.
- **C - Consultation**: The person or group providing you with information necessary to decide or initiate an action.
- **I - Informed**: The person or group must be informed of the deliverable status.

2.8 Risk Management

2.8.1 Risk Source:

The project team used brainstorming and analyzing stakeholders existing systems to analyze the risks, classify them according to the pattern, and assess the likelihood and impact of each risk.

2.8.2 Risk Identification

Risk ID	Risk Description	Risk Category	Issue Date
R1	Failure to deliver a final documentation and a final working software before the deadline	Business	23/11/2023
R2	Failure in retaining customers in the long term	Business	23/11/2023
R3	Threat of conflicts arising and misunderstandings among team members	Organizational	23/11/2023
R4	Lack of experienced members able to deliver the project within the right scope and duration	Organizational	23/11/2023
R5	Threat of losing a team member due to unavoidable circumstances	Organizational	23/11/2023
R6	Team members do not have experience in Flutter and FireBase	Technical	23/11/2023
R7	Team members not have experience in Machine Learning	Technical	23/11/2023
R8	Difficulty in integrating Machine Learning with Flutter	Technical	24/11/2023
R9	Failure to meet stakeholders and customers expectations	Product	24/11/2023
R10	Failure in providing accurate predictions about future gasoline prices	Product	24/11/2023
R11	Possible Security breaches on the system	Product	24/11/2023

Table 9: Risks Identification Table

2.8.3 Risk Metric

Priority	Probability	Impact
High	> 50% chance of occuring	Terminate project activities immediately if the issue is not resolved right away
Medium	50% chance of occuring	Terminate project activities if the issue is not solved
Low	< 50% chance of occuring	Proceed with project activities, may be resolved eventually or consider alternative temporary solutions

Table 10: Risk-Probability-Impact Metric Table

2.8.4 Risk Analysis

Impact	**Probability**		
	Low	**Medium**	**High**
Low			
Medium	R3	R8,R11	R4
High	R5	R1,R9	R2,R6,R7,R10

Table 11: Impact-Probability Matrix

Risk ID	Probability	Impact	Priority
R1	Medium	High	High
R2	High	High	High
R3	Low	Medium	Low
R4	High	Medium	High
R5	Low	High	Medium
R6	High	High	High
R7	High	High	High
R8	Medium	Medium	Medium
R9	Medium	High	High
R10	High	High	High
R11	Medium	Medium	Medium

Table 12: Risk Probability-Impact Analysis Table

2.8.5 Risk Response

Risk ID	Response	Response Description
R1	**Mitigation**	This can be mitigated by conducting thorough project planning and regular progress monitoring controls, with regular review meetings with the project supervisor.
R2	**Mitigation**	This can be mitigated by applying quality assurance mechanisms and making sure the customers are actively engaging and sending feedback and that the feedback is considered.
R3	**Avoid**	This can be avoided by having clear roles and responsibilities, with regular check-ins and clear communication between team members.
R4	**Mitigation**	This can be mitigated by applying a prioritization technique to the task and finishing the critical ones first, studying the schedule to assess which parts of the schedule can problems most happen.
R5	**Acceptance**	If a volatile event happens, and we lose a team member due to an unprecedented event and not conflicts, we can only work with what we have and move on.
R6	**Mitigation**	Taking online Flutter and Firebase Courses and consulting experts when needed, attending hands-on workshops, and using pair programming as a way to enhance understanding of Flutter and make sure every member of the team understands the code.

Risk ID	Response	Response Description
R7	**Mitigation**	Taking online Machine Learning Courses and consulting experts when needed, attending hands-on workshops, and using Pair programming as a way to enhance understanding of flutter and make sure every member of the team understands the code.
R8	**Mitigation**	Looking up resources, skills, and trial and error will be sufficient to integrate flutter with machine learning.
R9	**Mitigation**	Conducting surveys, making sure stakeholders are engaged, using feedback loops throughout the SDLC, and having regular check-ins with the project supervisor and stakeholders.
R10	**Mitigation**	Using high quality datasets, consulting experts, utilizing advanced data analytics techniques and machine learning algorithms.
R11	**Mitigation**	Implementing encryption techniques, using access controls, conducting regular security audits, and regularly backing up critical data.

Table 13: Planning response strategies for identified risks

Chapter 3: Software Requirements Specification

3.1 Stakeholders

Stakeholder	Role
End Users	Use the system to make decisions about when to refuel and save costs.
Sponsors	Provide financial support and promotional backing for the app and may also offer valuable real-time data on fuel prices and trends for enhanced accuracy and user engagement.
Admin	Manage and maintain the application, ensuring its smooth operation, overseeing data accuracy, user access, and security, and responding to user feedback and technical issues.
Project Supervisor	Supervises the team during the project and provides assistance in decision-making and consulting. The
Project Manager	Keeps track of project progress, divides tasks equally, and leads the project to success.
Test Manager:	Make sure the software is fulfilling its intended purpose and provides the right functionalities without errors.
Project Team	Develop the application and develop the functionalities and the GUI for the application.

Table 14: Stakeholders

3.2 Power-Interest Matrix

The Power-Interest Matrix is used to show how each of the stakeholders differ in their power, interest, and role in the project and how they will influence or be influenced by the project.

- Low Interest/Low Power: stakeholders who do not have much interest in the application and can not affect the project highly.
- Low Interest/High Power: stakeholders who do not have much interest in the application but can affect the project highly.
- High Interest/Low Power: stakeholders who have a high interest in the application but can not affect the project highly.
- High Interest/High Power: stakeholders who have a high interest in the application and can affect the application highly.

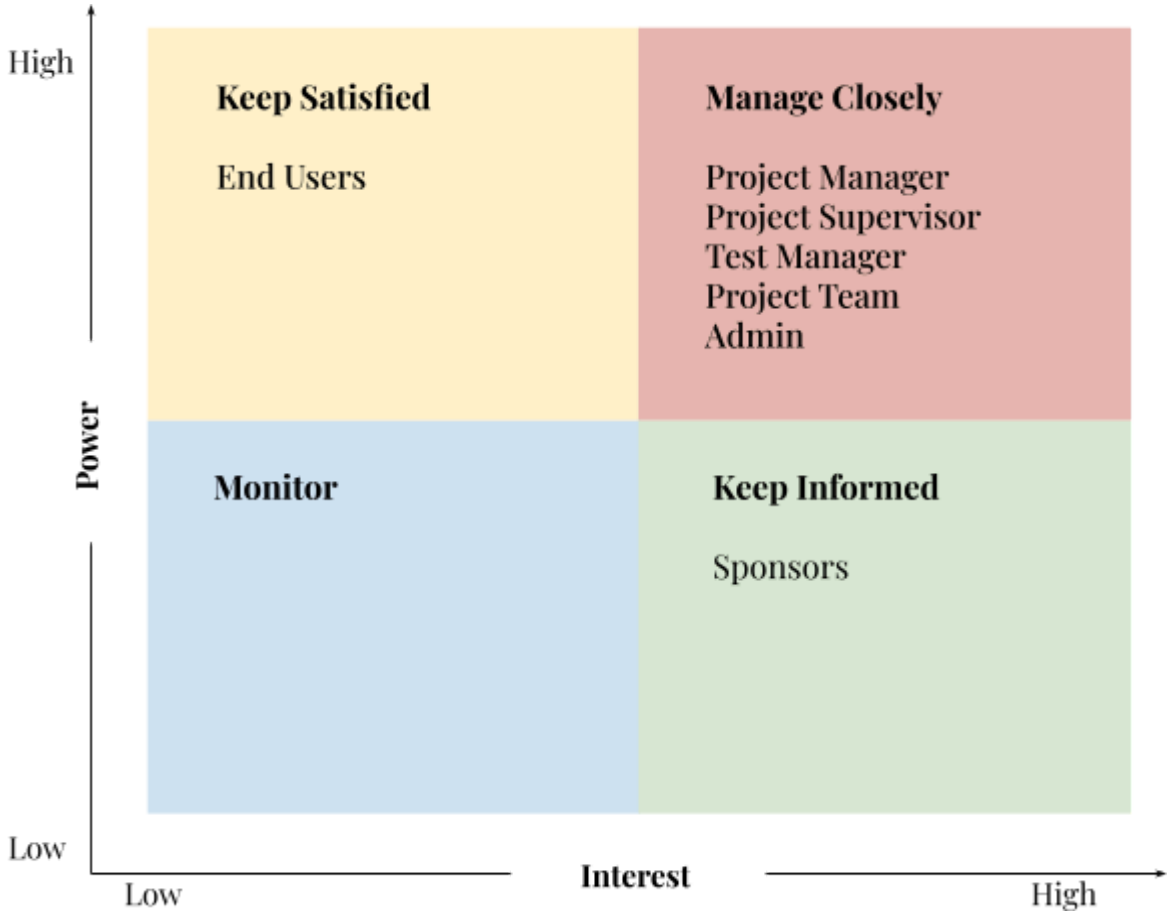


Figure 3: Power-Interest Matrix

3.3 Requirements Elicitation

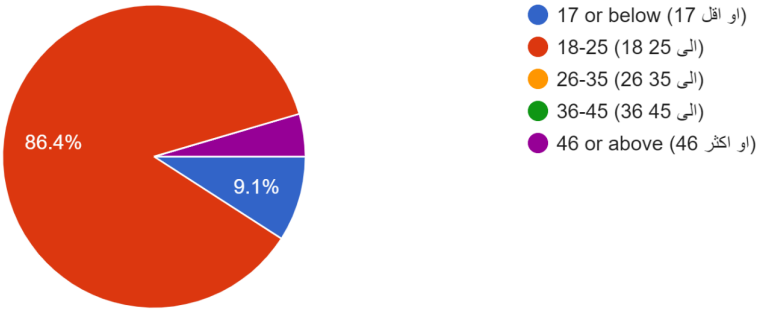
3.3.1 Survey

We used this technique to gather data that helped us confirm the need for our application, as well as gather input on some possible features to integrate within our application.

3.3.2 Survey Results

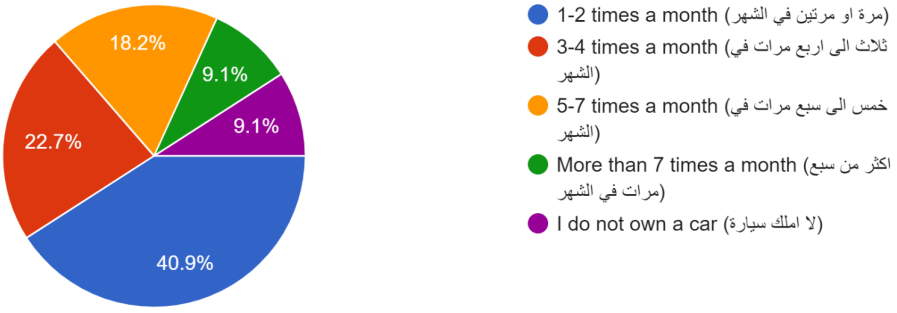
Age العمر

22 responses



How often do you fill your car with gasoline? كم مرة تقوم بتعبئة سيارتك بالبنزين

22 responses



How often do you check fuel prices? كم مرة تقوم بالاطلاع على اسعار البنزين

22 responses

How do you check fuel prices? كيف تقوم بالاطلاع على اسعار البنزين

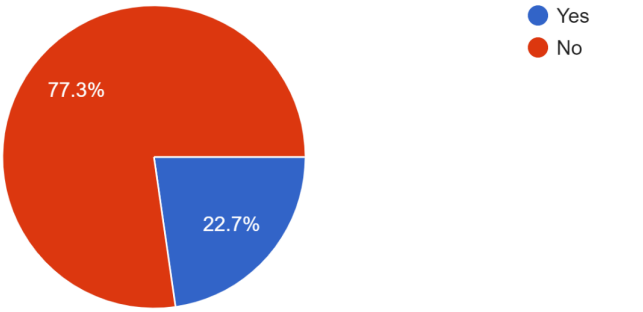
22 responses

How challenging do you find managing and staying informed about fuel prices and optimal refueling times? من وجهة نظرك, ما هي مدى صعوبة البقاء على الاطلاع على اسعار البنزين

22 responses

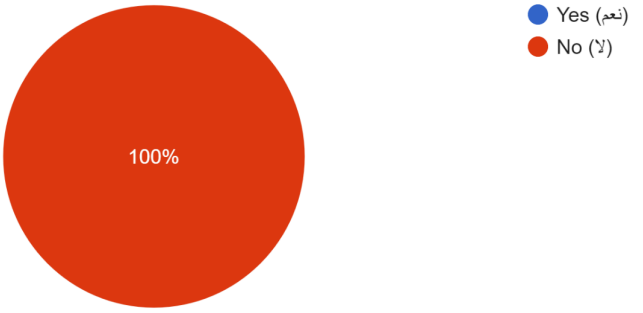
Do you try to anticipate fuel prices? هل تحاول ان تتوقع اسعار البنزين المستقبلية؟

22 responses



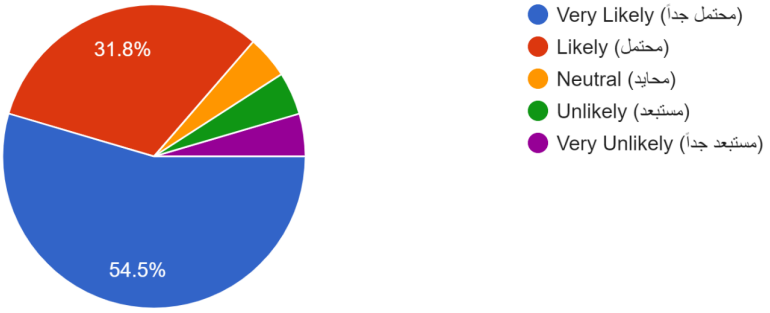
Have you ever used a software that predicts future fuel prices? هل سبق لك استخدام برنامج يتنبأ بأسعار الوقود المستقبلية؟

22 responses



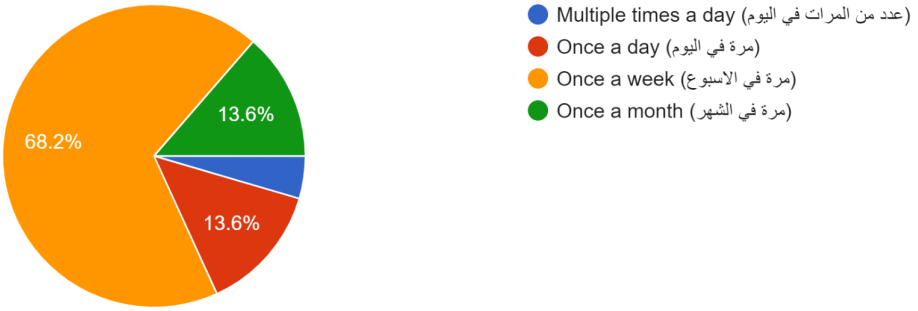
How likely are you to try a Fuel Price Prediction App once it is developed? ما مدى احتمالية ان تجرب تطبيق التنبؤ بأسعار الوقود بمجرد تطويره؟

22 responses



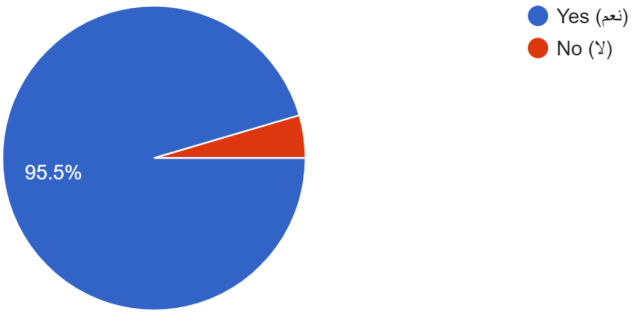
How often do you anticipate using a Fuel Price Prediction App? كم مرة تتوقع ان تستخدم تطبيق يتنبأ بالوقود

22 responses



Do you think adding a real-time fuel price chart to the system for dynamic updates and predictions would be beneficial? هل تعتقد أن إضافة مخطط لأسعار الوقود ...لى النظام للحصول على تحديثات وتنبؤات ديناميكية ستكون مفيدة؟

22 responses



The survey helped us confirm that our application will solve a problem that people will face and helped us gather information and elicit requirements from the response.

3.3.3 Interviews

3.3.3.1 Interview Questions

- Introduction:
    - Name:
    - Age:
    - Background:
- What type of car do you drive?
- How frequently do you typically re-fuel your vehicle?
- How do you check fuel prices?
- How often do you check fuel prices?
- Do you check fuel prices before going to re-fuel?
- How likely are you to try a Fuel Price Prediction App once it is developed?
- Do you think adding a real-time fuel price chart to the system for dynamic updates and predictions would be beneficial?
- How important is it for you to receive push notifications about the best time to re-fuel?
- What other features would you like to have in the fuel prediction app we are developing?
- Would you like to be able to customize the dashboard according to your preferences?

3.3.3.2 Interview Results

After interviewing several stakeholders, namely potential customers, in the Jordanian market, we gained a rich perspective on how to move forward with **ProGas**. Customers were overall intrigued by the tool as a cost-saving prospect. Many expressed their present concerns regarding the unexpected spikes in fuel prices. This highlighted the importance of user trust in our application's predictions, hence we prioritize our requirements accordingly. The majority of our potential users also had preferences with regard to the application's design, general layout, and notifications. They favored a minimal clean design with an intuitive interface, so information can be easily accessible without overwhelming details.

3.5 User Requirements

UR-1: The user shall be able to create an account.

UR-2: The user shall be able to log in with their account.

UR-3: The user shall be able to receive notifications about the predicted gasoline, diesel, and natural gas prices.

UR-4: The user shall be able to traverse the application with ease.

UR-5: The user shall be able to view the predicted gasoline, diesel, and natural gas prices on graphs and charts.

UR-6: The user shall be able to view the actual gasoline, diesel, and natural gas prices on graphs and charts.

UR-7: The user shall be able to decide whether to refuel or not based on the predicted price of gasoline, diesel, or natural gas generated by the system.

UR-8: The user shall be able to receive precise coordinates to the nearest refueling station depending on their preferred fuel type (gasoline, diesel, or natural gas).

UR-9: The user shall be able to benefit from additional functionality within the system after purchasing a premium subscription.

UR-10: The user shall be able to customize the user interface after purchasing a premium subscription.

UR-11: The sponsor shall be able to provide incentives to premium users.

3.6 Functional Requirements

FR-1: The system shall allow the users to create an account by entering their email address, password, and phone number.

FR-1.1: The system shall permit the user to specify an account password.

FR-1.1.1: The system shall validate that the password is at least 8 characters long.

FR-1.1.2: The system shall validate that the password contains at least one special character.

FR-1.1.3: The system shall validate that the password contains at least one capital letter.

FR-2: The system shall track users' location if granted permission.

FR-3: The system shall allow sponsors to log in with a username and password given by the system administrator.

FR-4: The system shall allow the user to login with their created account using their email and password.

FR-4.1: The system shall allow users to log in anonymously without needing to create an account.

FR-4.2: The system shall allow the administrator to log in with special credentials.

FR-5: The system shall predict and display gasoline prices for the following week accurately.

FR-5.1: The system shall display the previously predicted gasoline prices as a graph.

FR-6: The system shall predict and display diesel prices for the following week accurately for premium users.

FR-6.1: The system shall display the previously predicted diesel prices as a graph only for premium users.

FR-7: The system shall predict and display natural gas prices for the following week accurately for premium users.

FR-7.1: The system shall display the previously predicted natural gas prices as a graph for premium users.

FR-8: The system shall display the actual gasoline prices on the main dashboard.

FR-9: The system shall display the actual diesel prices on the main dashboard for premium users.

FR-10: The system shall display the actual natural gas prices on the main dashboard for premium users.

FR-11: The system shall send a push notification to the user regarding the predicted gasoline prices in **FR-5**.

FR-11.1: The system shall notify users if it is predicted that gasoline prices will change.

FR-12: The system shall send a push notification to premium users regarding the predicted diesel prices in **FR-6**.

FR-12.1: The system shall notify premium users if it is predicted that diesel prices will change.

FR-13: The system shall send a push notification to the premium users regarding the predicted natural gas prices in **FR-7**.

FR-13.1: The system shall notify premium users if it is predicted that natural gas prices will change.

FR-14: The system shall identify and list nearby refueling stations.

FR-15: The system shall permit the system administrator to begin model training sessions.

FR-15.1: The system shall provide detailed feedback to the administrator after the model training sessions.

FR-15.1.1: The system shall provide the administrator with metrics regarding prediction accuracy.

FR-15.1.2: The system shall generate reports about training results for every training session.

FR-15.1.2.1: The system shall make sure that training results are viewed by the administrator only.

FR-16: The system shall allow regular users to upgrade to premium users.

FR-16.1: The system shall allow regular users to upgrade to premium users by entering payment details.

FR-17: The system shall allow premium users to manage their subscriptions.

FR-17.1: The system shall allow premium users to extend their subscription.

FR-17.2: The system shall allow premium users to cancel their subscriptions.

FR-18: The system shall display ads only for regular users.

FR-19: The system shall allow premium users to customize the user interface to their liking.

FR-19.1: The system shall allow the premium user to change the data graph color scheme.

FR-19.2: The system shall allow the premium user to change the font size.

FR-19.3: The system shall allow the premium user to add data graphs.

FR-19.3.1: The system shall allow the premium user to remove data graphs.

FR-20: The system shall allow sponsors to be able to offer promotional incentives.

FR-21: The system shall allow premium users to be able to benefit from incentives offered by sponsors.

3.7 Non-Functional Requirements

NFR-1: The system shall load the main dashboard within 10 seconds.

NFR-2: The system shall respond to user input within 2 seconds of interaction.

NFR-3: The system shall require less than 1 training hour.

NFR-4: The system shall safely store user information and protect it against various threats

NFR-4.1: The system shall use the **sha-256** hashing algorithm to store personally identifiable user information.

NFR-5: The system shall be scalable to handle a larger user base.

NFR-6: The system shall be maintainable for future updates and enhancements.

NFR-6.1: The system shall be well-documented.

NFR-6.2: The system shall have a Mean Time to Repair of 2 hours.

NFR-7: The system shall be available 98% of the time.

NFR-8: The application shall be run on the Web, Android OS, and IOS.

3.8 Requirements Prioritization

The Prioritization technique used was Numerical Assignment (**Grouping: and Ranking**). This technique was used because it was clear how to divide the requirements prioritize them into groups and rank them according to importance, which was important as a requirement for the product architecture and functionalities.

The Requirements were prioritized so the basic functionalities and the core of the system are satisfied first, so the user will be able to get an idea about how the system works and how to use it; after the basic functionalities have been developed, other requirements such as login and location tracking can be implemented, and sponsors can be implemented.

Critical:

1. FR 5
2. FR6
3. FR7
4. FR8
5. FR9
6. FR10
7. FR 11
8. FR12
9. FR13
10. NFR8
11. NFR 2
12. NFR 4
13. NFR

Standard:

1. FR1
2. FR 2
3. FR 4
4. FR 15
5. FR 16
6. FR 17
7. FR 19
8. NFR 1
9. NFR 6
10. NFR 3
11. NFR 5

Optional:

1. FR 14
2. FR 18
3. FR3
4. FR 20
5. FR21

3.9 Requirements Interdependency Matrix

Requirement ID	Refines To	Changes To	Similar To	Requires	Conflict With	Increase Cost Of	Increase Value Of	Decrease Cost Of	Decrease Value Of
FR-1	FR-1.1	-	-	-	-	-	-	-	-
FR-1.1	FR-1.1.1 FR-1.1.2 FR-1.1.3	-	-	FR-1	-	-	-	-	-
FR-1.1.1	-	-	-	FR-1.1	-	-	FR-1.1	-	-
FR-1.1.2	-	-	-	FR-1.1	-	-	FR-1.1	-	-
FR-1.1.3	-	-	-	FR-1.1	-	-	FR-1.1	-	-
FR-2	-	-	-	-	-	-	-	-	-
FR-3	-	-	-	-	-	-	-	-	-
FR-4	FR-4.1 FR-4.2	-	-	FR-1	-	-	FR-1	-	-
FR-4.1	-	-	-	-	-	-	-	-	FR-1 FR-4
FR-4.2	-	-	-	-	-	-	-	-	-
FR-5	FR-5.1	-	-	-	-	-	-	-	-

FR-5.1	-	-	-	-	-	-	-	-	-
FR-6	FR-6.1	-	-	-	-	-	-	-	-
FR-6.1	-	-	-	FR-4	-	-	-	-	-
FR-7	FR-7.1	-	-	-	-	-	-	-	-
FR-7.1	-	-	-	FR-4	-	-	-	-	-
FR-8	-	-	-	-	-	-	-	-	-
FR-9	-	-	-	FR-4	-	-	-	-	-
FR-10	-	-	-	FR-4	-	-	-	-	-
FR-11	FR-11.1	-	-	FR-5	-	-	FR-5	-	-
FR-11.1	-	-	-	FR-5	-	-	FR-5	-	-
FR-12	FR-12.1	-	-	FR-6 FR-4	-	-	FR-6	-	-
FR-12.1	-	-	-	FR-6 FR-4	-	-	FR-6	-	-
FR-13	FR-13.1	-	-	FR-7 FR-4	-	-	FR-7	-	-

FR-13.1	-	-	-	FR-7 FR-4	-	-	FR-7	-	-
FR-14	-	-	-	FR-2	-	-	FR-2	-	-
FR-15	FR-15.1	-	-	-	-	-	-	-	-
FR-15.1	FR-15.1.1 FR-15.1.2	-	-	-	-	-	FR-15	-	-
FR-15.1.1	-	-	-	-	-	-	-	-	-
FR-15.1.2	FR-15.1.2.1	-	-	-	-	-	-	-	-
FR-15.1.2.1	-	-	-	-	-	-	-	-	-
FR-16	FR-16.1	-	-	FR-4	-	-	-	-	-
FR-16.1	-	-	-	FR-4	-	-	-	-	-
FR-17	FR-17.1 FR-17.2	-	-	FR-4	-	-	-	-	-
FR-17.1	-	-	-	FR-4	-	-	-	-	-
FR-17.2	-	-	-	FR-4	-	-	-	-	-
FR-18	FR-18.1	-	-	-	-	-	-	-	-

FR-19	FR-19.1 FR-19.2 FR-19.3 FR-19.4	-	-	FR-4	-	-	FR-16	-	-
FR-19.1	-	-	-	FR-4	-	-	FR-16	-	-
FR-19.2	-	-	-	FR-4	-	-	FR-16	-	-
FR-19.3	FR-19.3.1	-	-	FR-4	-	-	FR-16	-	-
FR-19.3.1	-	-	-	FR-4	-	-	FR-16	-	-
FR-20	-	-	-	FR-3	-	-	-	-	-
FR-21	-	-	-	FR-20 FR-4	-	-	FR-16	-	-

Table 15: Requirements Interdependency Matrix

3.10 Use Case Diagram

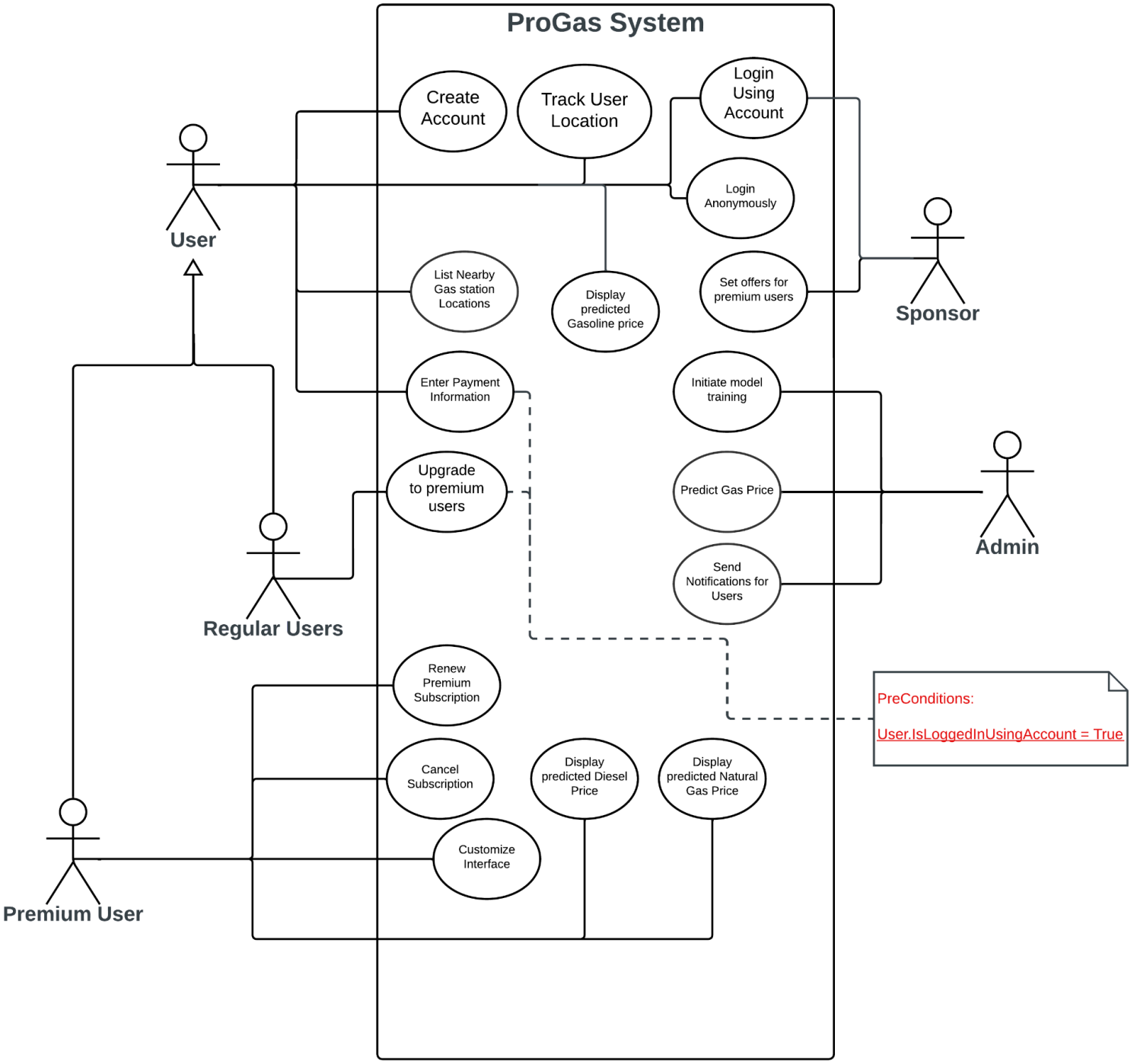


Figure 4: Use case diagram

Chapter 4: System Design

4.1 Context Diagrams

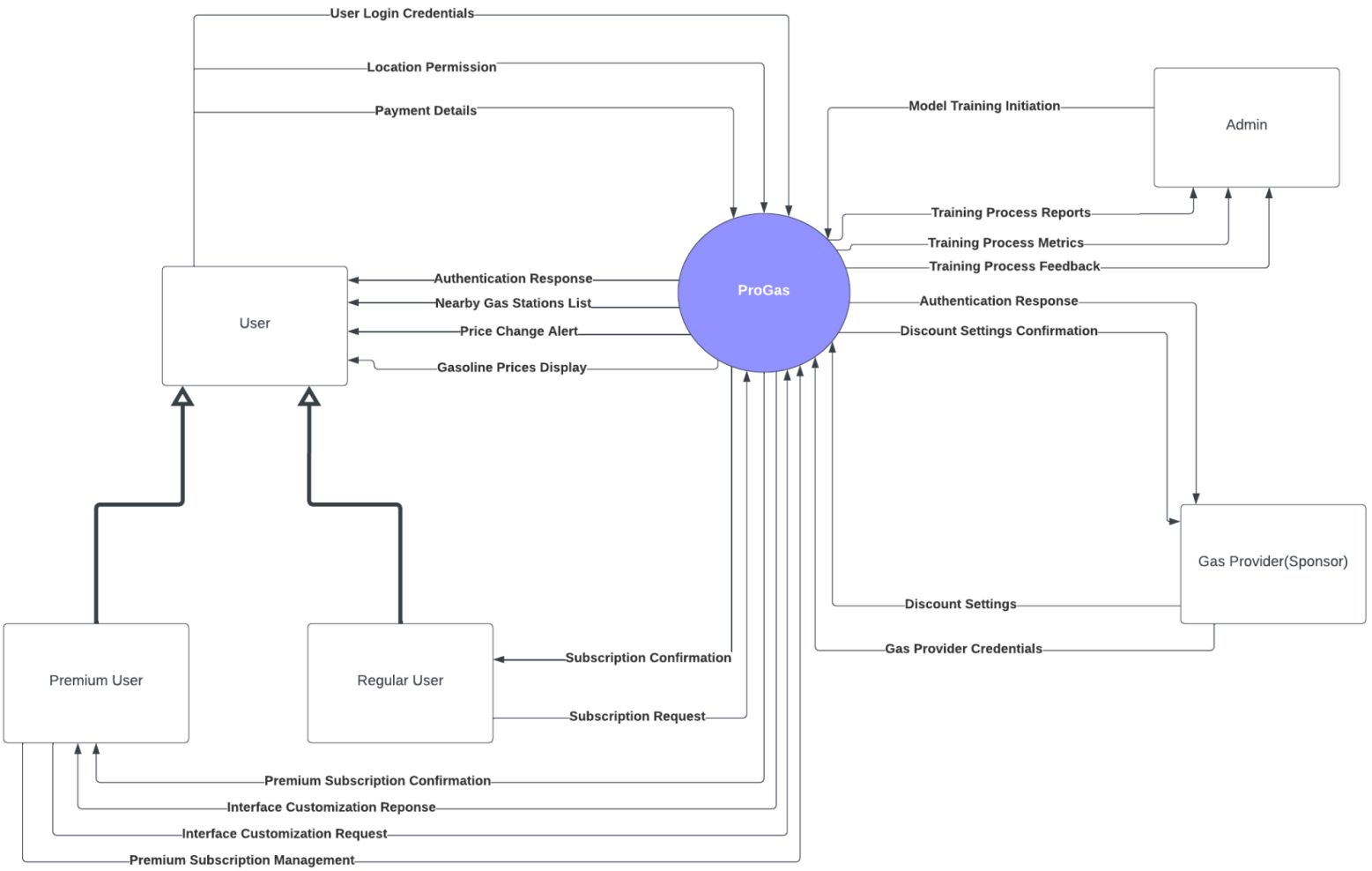


Figure 5: Context Diagram

In the context diagram shown in Figure 5 above, the user entity provides the **ProGas** system with login credentials, location permission, and Payment details if he wishes to upgrade to become a premium user. The user then responds to each request and sends back an authentication response for the login, as well as the display of gasoline prices, price change alerts, and nearby gas stations.

The user entity has two sub-entities that inherit its data flows and attributes. The regular user entity provides the **ProGas** system with its subscription request to upgrade to premium, and the system responds with the subscription confirmation.

The premium user provides the **ProGas** system with premium subscription management and interface customization requests, and the **ProGas** system responds with Interface customization response and premium subscription confirmation.

As for the Sponsor, the Sponsor logs in using Gas Provider Credentials and provides the system with the details about the discount planned on the system. The system sends back authentication responses and the confirmation of the discount settings.

The Administrator provides the system with Model training initiation to initiate the process of model training and all of its sub-processes. The system provides the administrator with information about how the training process is going, such as training process reports, metrics, and feedback.

4.2 Activity Diagrams

4.2.1 Login

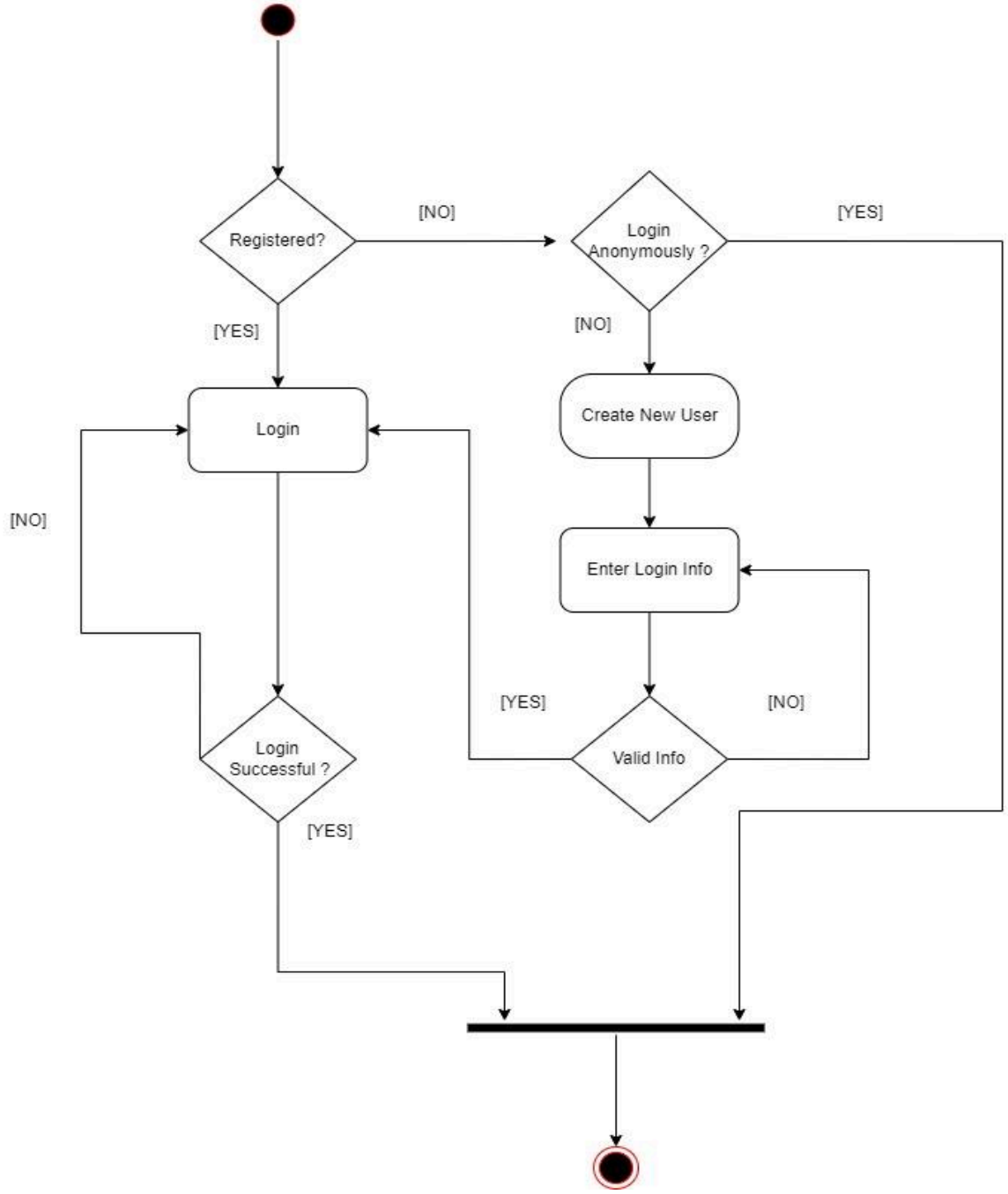


Figure 6: Login Activity Diagram

4.2.2 Display Predicted Price

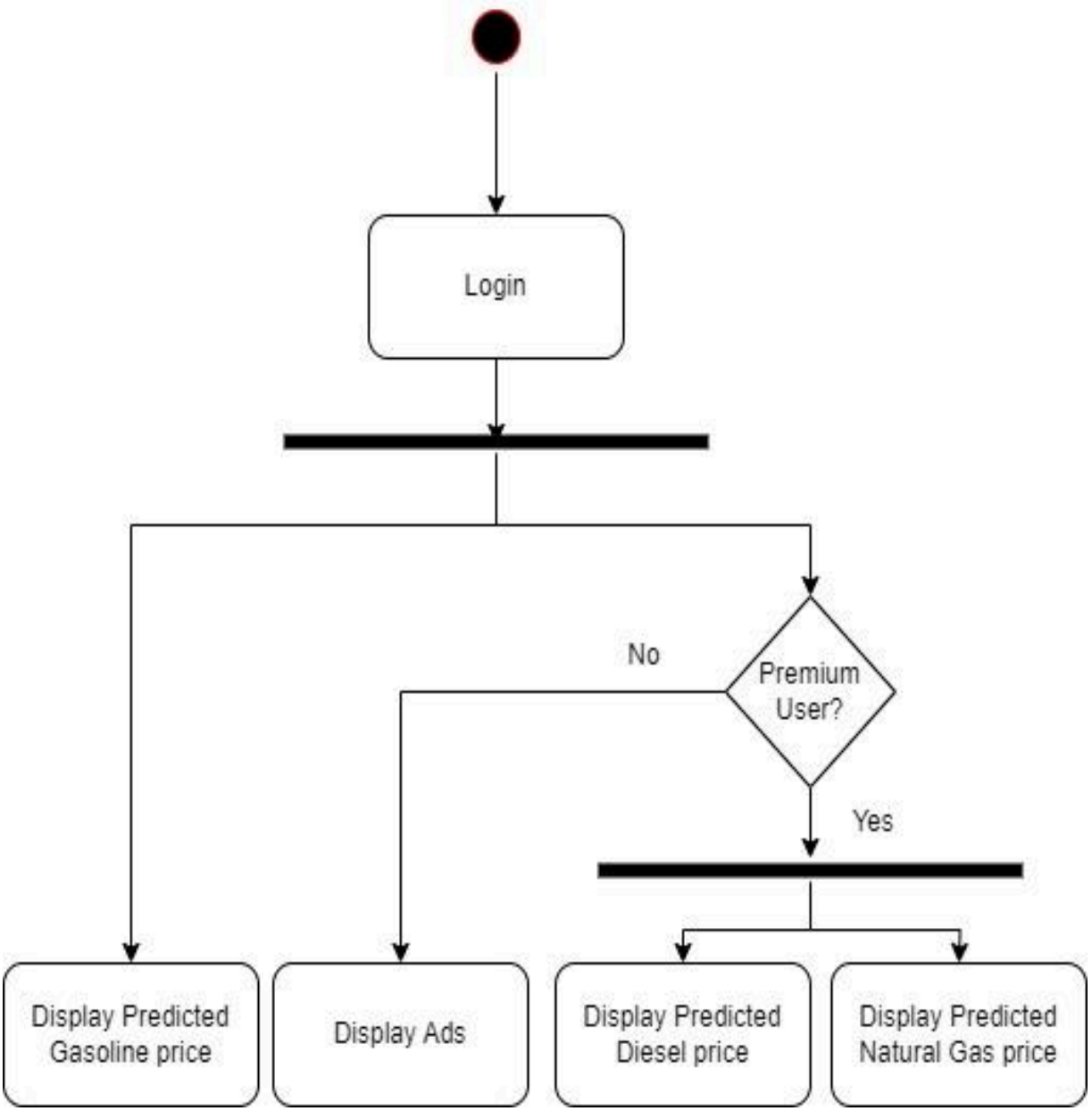


Figure 7: Display Predicted Price Activity Diagram

4.2.3 Upgrade to Premium

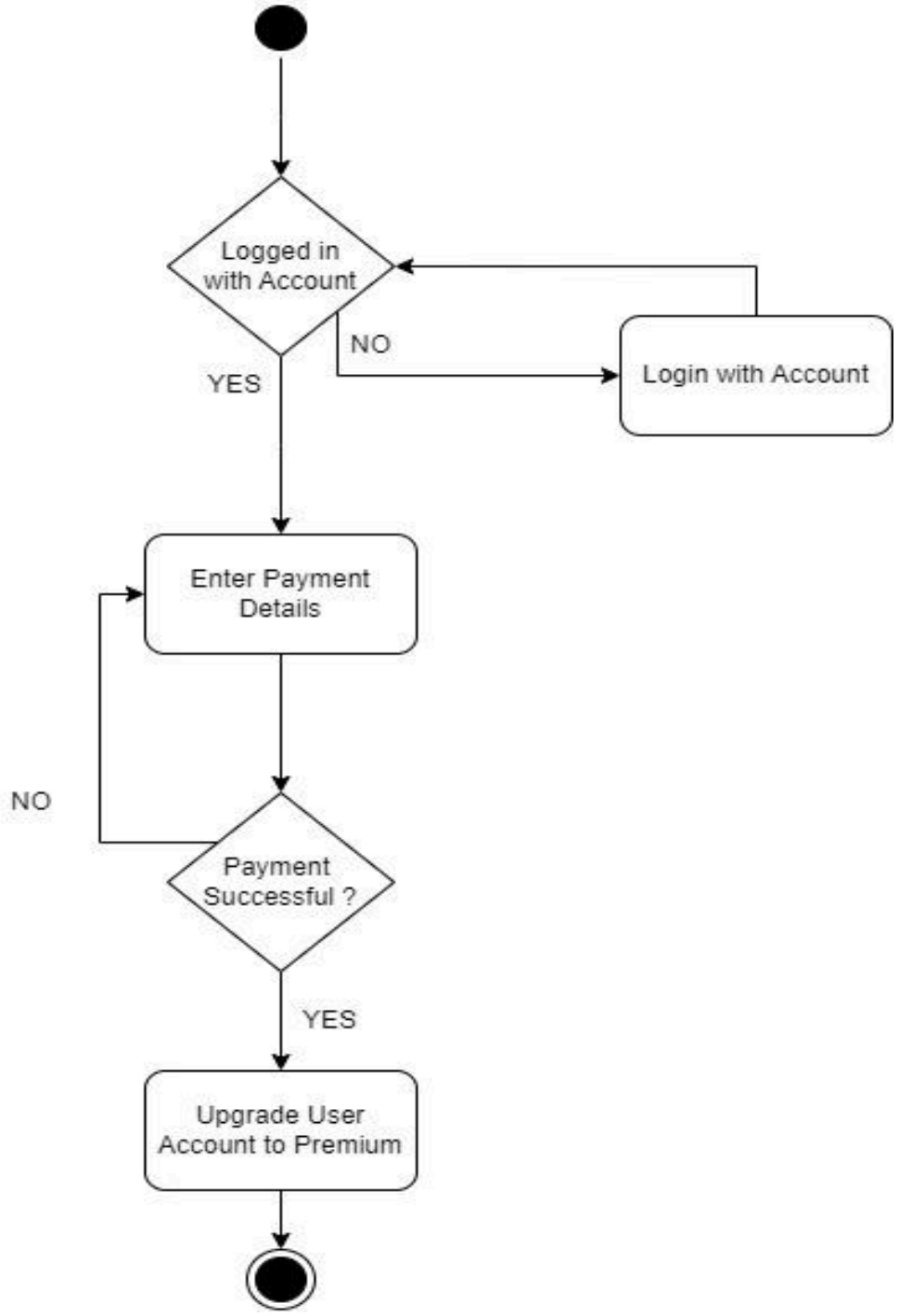


Figure 8: Upgrade to Premium Activity Diagram

4.3 Sequence Diagrams

4.3.1 Creating an Account

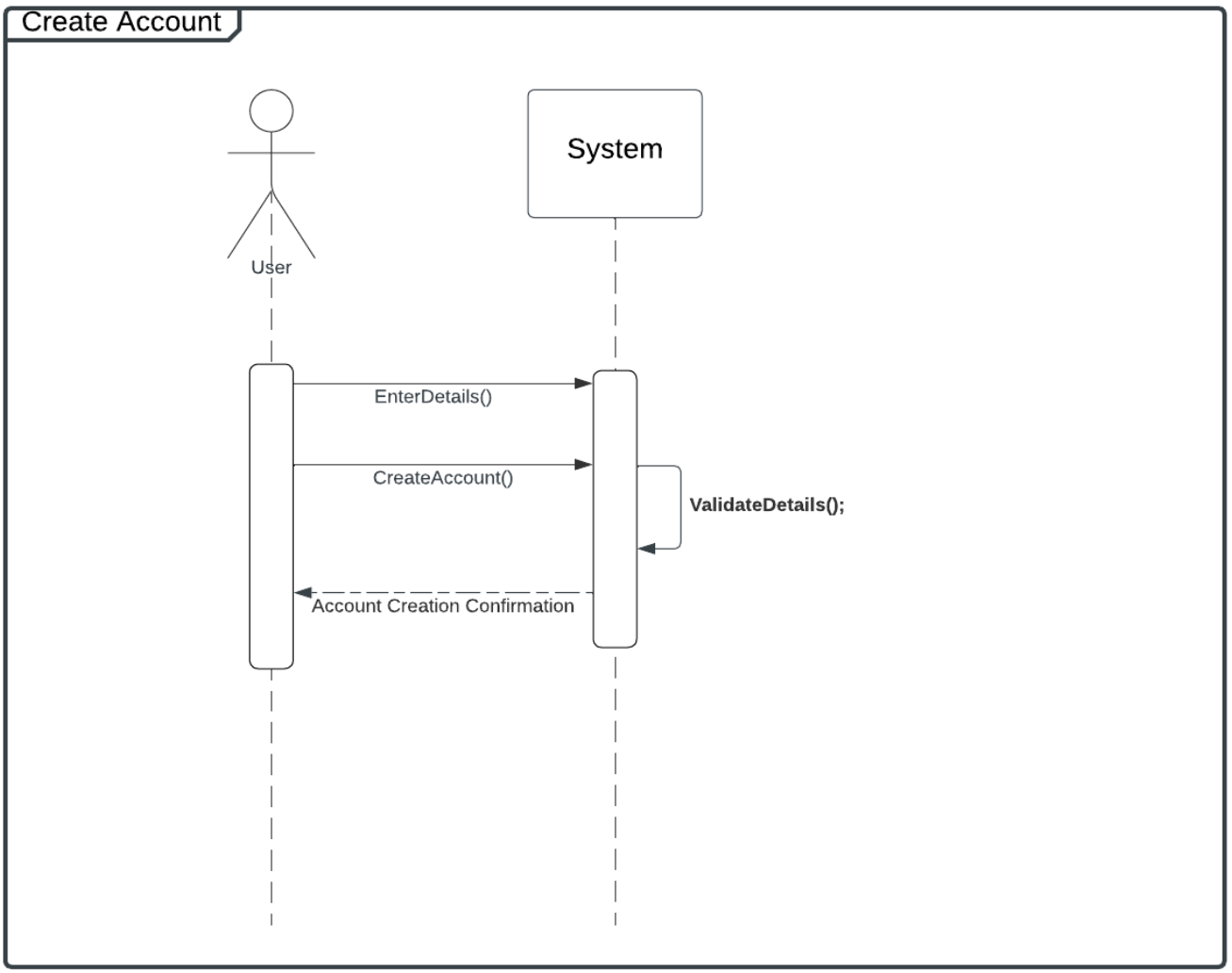


Figure 9: Sequence diagram for creating an account

4.3.2 User Login

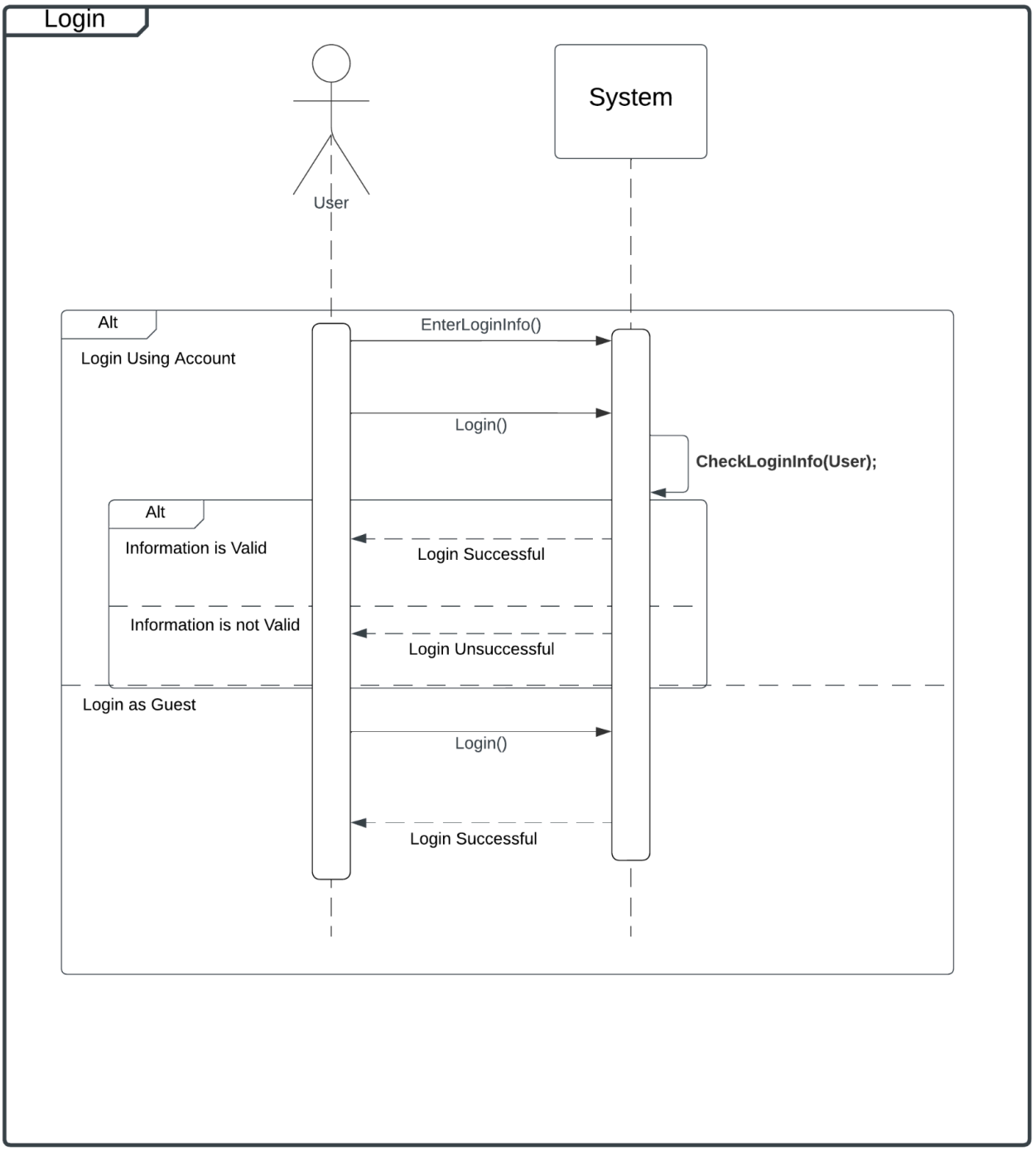


Figure 10: Sequence diagram for user Login

4.3.3 Predicting Gas Prices

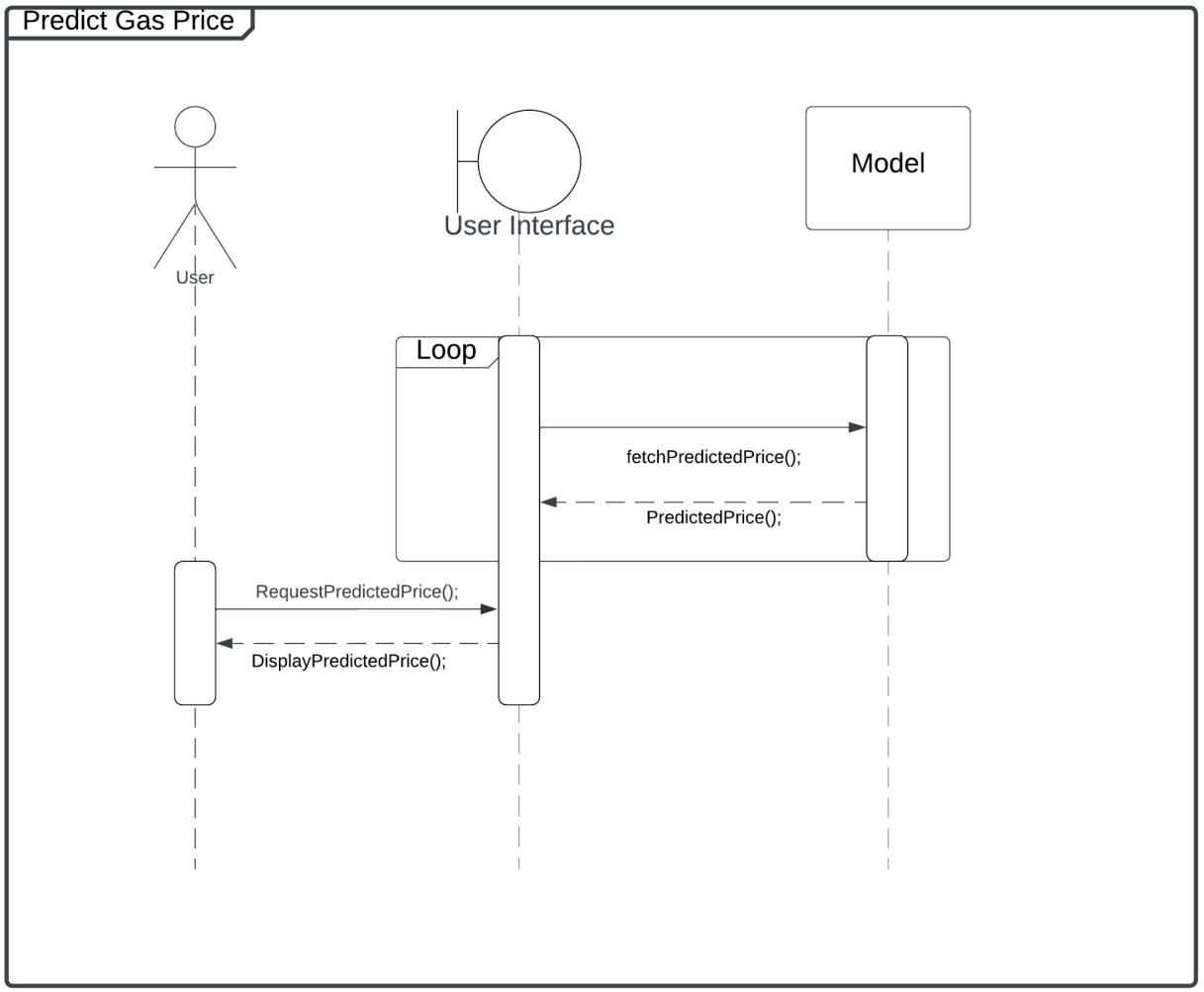


Figure 11: Sequence diagram to predict gas prices

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