AN AUTOMATED SYSTEM FOR FUEL MEASUREMENT AND FORECAST IN UNDERGROUND TANKS

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Declaration and Approval

I declare that this work has not been previously submitted and approved for the award of a bachelor's degree by this or any other University. To the best of my knowledge and belief, the work contains no material previously published or written by another person except where due reference is made in the work itself.

Student's signature:

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Approval

The work of 101046 was reviewed and approved *(for examination)* by:

Supervisor's signature:

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Abstract

The use of dip rods has over the years been in most fuel stations within most developing countries in the measurement of fuel levels in undergrounds tanks. It has been challenged by high inaccuracies resulting from the lack of experienced or honest personnel tasked with the duty of conducting these measurements. Additionally, inability to forecast fuel shortage in these tanks in real-time is a challenge.

This research therefore proposes an automated fuel level measurement system in underground tanks in petrol stations. The proposed solution aims to solve the problem of inaccuracy and time wastage faced by managers at petrol stations and also attendants. This shall be achieved through the use of a light sensor which in the long run shall aid in the accountancy for every amount of fuel that is used in the petrol station. Additionally, data collected shall be used in analysing the fuel usage trend and send forecast reports to the concern parties.

The system development methodology that will be used to design the project is system prototyping due to the reason that upon the completion of the research the proposed solution will not be deployable though a working proof of concept. The research methodology shall be qualitative and design methodology (OOAD).

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Chapter 1: Introduction

1.1 Background

This project focuses on the measurement of the fuel level in an underground tank that are usually in petrol stations or depots. When the level of fuel is being measured in either a petrol station or a depot, dip sticks are used to measure the level of fuel. The use of dip rods brings about inaccuracy when measuring the level as this can be easily altered by the attendants or the people assigned to measure. The fuel is measured during the day, at night or both times in a day (Chen & Gu, 2006).

The personnel for this may be insufficient hence no details are provided on the level of fuel for a day or two. At times, when the measurement is given by the attendants may be inaccurate leading the business losing funds as there is fuel that is not accounted for and lots of finances are lost. This also wastes a lot of time that could be used to serve other purposes as it takes a while to measure all tanks such as kerosene, diesel, premium unleaded petrol and super unleaded petrol. Fuel dispensers are used to measure the amount of fuel pumped thereby using a flow measurement system to measure the amount of fuel level dispensed. Customers are also dissatisfied as there are delays in fuel supply as well as the owners'/shareholders having expectations that are not fulfilled. (Palmatier, 2003)

The system will help do away with some of the challenges facing this industry. As it will use a sensor to show the level of fuel in the tanks or tanks. Fuel forecast will help in fuel display fuel consumption in real-time. This will help the client managers to be aware when the level is at its lowest and they need to inform the suppliers to refill the bunks. This does away with the problem of the petrol stations lacking oil. The information on the level of fuel will be shown hourly. It shows the date and time the fuel got that specific level as well as charts on rate of fuel consumption. It will also help solve the problem of inaccuracy as it leads to satisfaction of customers as they are not faced with lack of fuel. The system also shows that every amount of fuel used is accounted. The finances that the attendants at the petrol stations come up with are well balanced with the amount of fuel used by the end of that day. The data collected shall be used in analysing the fuel usage trend and send forecast reports to the concern parties.

1.2 Problem Statement

The problem in the industry is the inaccuracy that comes along with the manually measuring the amount of fuel by use of dip sticks hence no accurate amount of fuel shown. Failure to predict fuel level as a result of the inaccuracies as it also affects the sales. In a few countries the problem has been solved, such as China and Japan. The problem has been in existence since petrol stations were developed. This leads to some of the businesses in the industry degrading and only getting losses yet that should not be happening in such situations. (Chen & Gu, 2006).

The attendants might alter the level of fuel measured as the use dip sticks is manually recorded. The amounted that is at times recorded does not exactly balance with the amount of fuel that was supplied hence it raises questions that are barely answered since they lead to errors when reconciliation takes place. As well as, inability to forecast fuel shortage in these tanks in real-time is a challenge. (Butler, 1976)

1.3 Aim

The project aims at displaying fuel consumption in real time which leads to fuel efficiency as the rate of fuel consumption is well known. The user can easily maintain the performance in the trend of fuel consumption. The project also aims at improving the accuracy in fuel measurement as well as fuel monitoring. Moreover, there is automatic reconciliation of fuel errors that will be handled in real-time. Hence, the forecasting will lead to customer satisfaction as fuel is supplied on time with no delays. This also leads to fully understanding the rate of fuel consumption.

1.4 Specific Objectives

i. To investigate the challenges faced by users while monitoring consumption of fuel.

ii. To review techniques used for fuel forecasting.

iii. To design a system that forecasts fuel level, as well as an alert to managers when the level of fuel is low.

iv. To test the proposed system.

1.5 Justification

A petrol station is one of the essential things that are needed by most people since a third of the people in the country have cars hence they need a place to fill the tanks of their cars. There are people who will definitely take part to ensure that their industry prospers, the stakeholders. These are such as the client managers and the system end-users as they ensure that customers are fully satisfied. Moreover, there is evidence in case there is a problem with the amount of fuel or something is wrong, they can get to the root source easily.

1.6 Scope and Limitations

The system proposes to forecast fuel consumption in real-time. It as well proposes to show the level of fuel in the petroleum bunks and they can easily know the date and the time the amount of fuel got to that specific level. The level of inaccuracy will be reduced.

The system will not show that there is a fuel leakage or show the temperature of the fuel in the tanks.

Chapter 2: Literature Review

2.1 Introduction

This chapter reviews the existing literature on the petroleum industry. It shows what has been done before by other researchers. The challenges that the industry has been going through, the developments that have been done in the industry. As well as the challenges that have faced even after the development. There will also be a review of the technologies that have been introduced in the developed systems.

2.2 Use of Dip Sticks

The system being used at the moment is measurement of fuel in underground tanks using underground tanks. The measurements are then manually recorded by the attendants. The amount of fuel measured if low it's then ordered from the supplier. This system also has its challenges.

2.2.1 Low fuel level without users' knowledge

This challenge comes about since the user does not know when the fuel level is low. Hence the petrol station might go for a long while before a refill is made leading to reduced income for the business. (Riaz, et al., 2017)

2.2.2 Time wastage and huge financial expenses

The level of fuel is measured a couple of times in a day hence leading to time wastage. This also needs more personnel for it to happen. The owner has to employ more personal leading to too many expenses.(SIR-Based Oil Tanks Leak Detection Method, 2011)

2.2.3 Inaccuracy in fuel level measurement

This comes about since the fuel level is measured using dip sticks hence the fuel level is not accurate. This challenge leads to failure of tallying results. When an account of the dispensed fuel is done and compared to the remain fuel in the underground storage tank is done usually is not in sync. (The Institution of Engineering and Technology , 2006)

2.3 Existing solution used to solve the problem

The problem has been in existence for quite some time now and there are various projects that have been designed to solve the problem.

2.3.1 Analysis of underground storage tank system materials to increased leak potential

This research focuses more on what causes leakage in underground tanks and how it can be handled. The research shows that the materials used to make the underground takes are such as metal, aluminium, stainless steel and in some occasions plastic pipes. Metal, aluminium and stainless steel are bound to rust or corrode due to the aqueous liquids in the fluids. Plastic piping are mostly used since the chances of corrosion are low. The types of plastics used are flexible plastic piping and fibre-reinforced plastic. This research proves that use of plastic materials for underground storage tanks is more efficient than use of metals, aluminium and stainless steel as it reduces the rate of corrosion leading to leakage. (Kass, Theiss, Janke, & Pawel, 2012)

2.3.2 Using Statistical models to detect leaks in Underground Storage Tanks

The research focuses on the use of level-sensing technology where small leaks are detected the minute a change in the fluid level changes. The level-sensing technology shows an estimate of the height of gasoline in the tank using a meter calibration equation. The equation uses measured volumes of the gasoline in the underground storage tank and the volume of the gasoline that is dispensed. The equations predict/ detect whether there are leaks or not. One of the limitations of using this system is that, in case there is ‘still time’ (when there is no gasoline dispensed in a long time ie. 24 hours), then it can be ineffective. This is because the meters are not in use. (Keating & Mason, 2000)

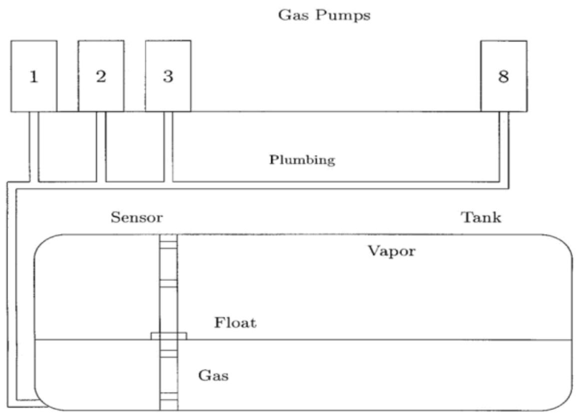


Figure 1. Multiple Island Gas Station (Keating & Mason, 2000)

2.3.3 Review of Underground Storage Tank Condition Monitoring Techniques

This research proves with proper quality maintenance and operations management 30% of underground storage tank damages can be avoided. This is by the use Non-destructive Evaluation signal as it has 3 main intermediates which are material screening, signal processing and machine learning. This is system the amplitude of the waveform energy shows abnormal events. The system is meant to highlight anomalies within an area that has effective scanning. Machine learning algorithms are used to perform automated pattern recognition using Artificial Neural Network if any outliers are detected. (Ooi, Ngui, Hui, Lim, & Leong, 2018)

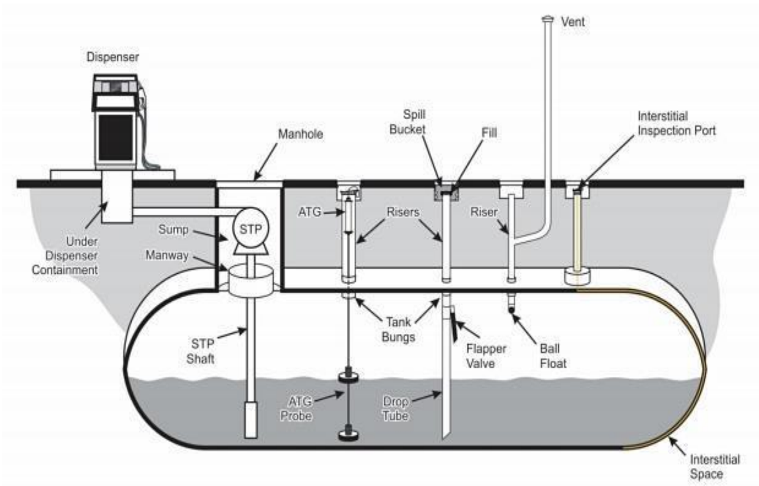


Figure 2. General Petrol Underground Storage Tanks and Refuelling Facility (Ooi, Ngui, Hui, Lim, & Leong, 2018)

2.4 Development Technologies in Data Acquisition for Leak Detection

The system detects fuel leakages. The leakages are detected by given level changes in the automatic tank gauges hence alarms are sent on the fuel level. The automatic tank gauging device collects the level of oil, the temperature, density, water level and oil gas press. The system uses quite a number of sensors to ensure that the system requirements are met. The sensors are such as VITO average temperature sensors and pressure transmitters. There is then a computer that collects the information, initiates it and shows reports on the results. (Li, Luo, & Shui, 2011)

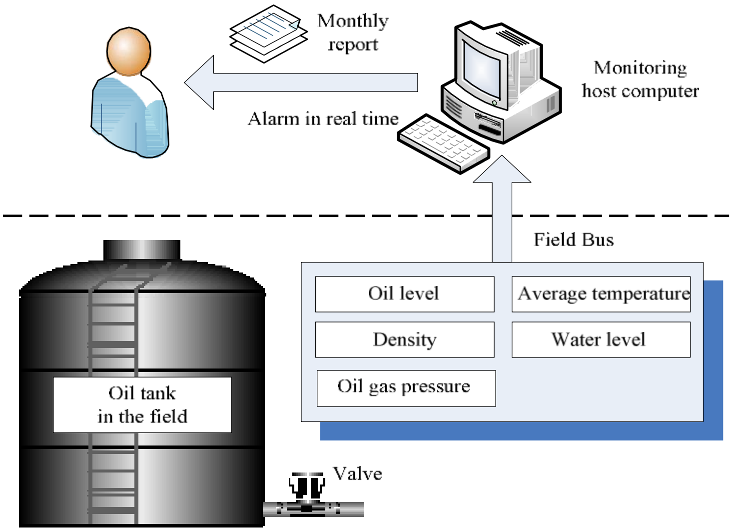
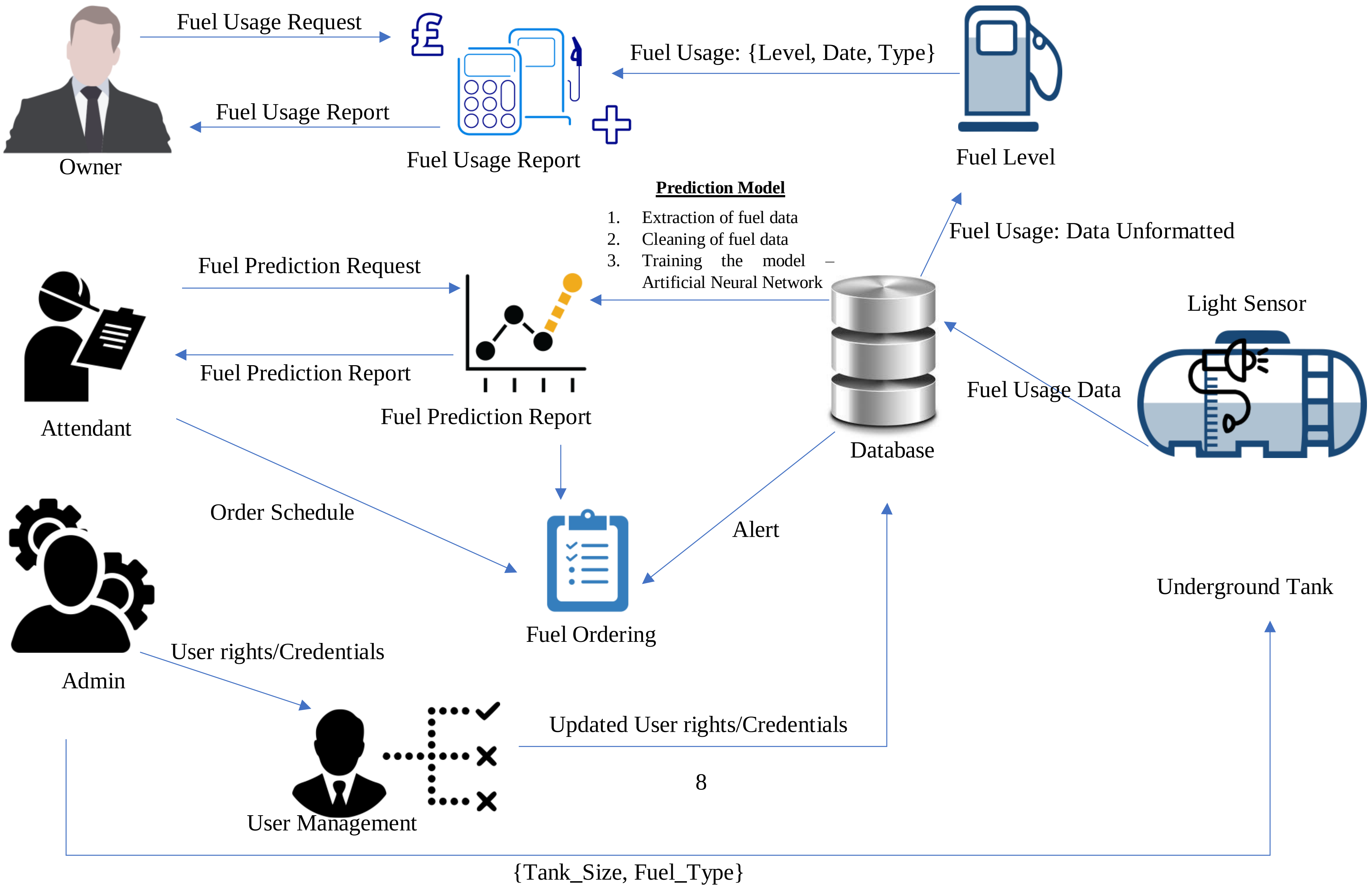


Figure 3. General Scheme for the Leak Detection System (Li, Luo, & Shui, 2011)

2.5 Conceptual Framework



2.5.1 The users

There are a couple of users to use this system such as the admin, attendant and the owner.

2.5.1.1 The Admin

The admin is a user of the system since he/she managers the system and is the only person who has got access to the database. The admin makes changes to the system. In case there is a problem with the system he/she ensures that the system is fixed and gets to do what it is meant to. When there are changes to be made, since software is dynamic, they have to ensure that the system is up to task and the system is in accordance to the company's requirements.

The admin gives rights to users of the system as well as the credentials.

2.5.1.2 The Attendant

The attendant is one who checks the level of fuel when they request for the fuel level. The attendant can request on the fuel prediction and get a report on it. This will also help keep the records of the business on track hence reducing large amounts of files on the attendant's side. The attendant confirms with the supplier when the order should be made.

2.5.1.3 The Owner

The owner is one of the system users since he /she owns the business. They are able to see the amount of fuel as well as the usage reports. Hence they need to get a record of how the business is coming along. This will help keep track of the business and the also know what type of fuel is mostly used by most of the customers hence increase its supply. It will also help keep track of the business and they are sure that fuel is not being maliciously used by the employees.

2.5.2 The Components

A sensor will be used for the project to show the level of the fuel. The users can read the fuel level from the system as well as know to what fuel type it is. A prediction on the fuel level for when the fuel level will be low. The management of tanks and users of the system is also required. An alert is sent when the fuel level is low hence an order needs to be made for a refill.

2.5.3 Data flow

The sensor gets information from the underground tank on the level of fuel for each and every level from all the tanks due to the different fuel types. This information is then sent it to the database with the level of all the fuel types, having the dates and the time. The application then reads the information from the database.

There is a machine learning algorithm that predicts low fuel level. When a request is made by any of the user, then they get a report on their request.

Chapter 3: Research Methodology

3.1 Introduction

The chapter shows the methodology that will be used. It gives a brief description on the system development methodology which is prototyping and the process involving prototyping. It addresses the methods that would be used to gather both functional requirements and non-functional requirements. It describes the list of design diagrams that are needed in that methodology. The tools of development are also involved in the chapter. There are methods that describe ways to test the system and how to execute the domain. The module that are proposed and the architecture of the system are also well discussed.

3.2 Analysis

Omondi (2018) defines Object-Oriented Analysis and Design (OOAD) as an approach used for analysing and designing a system by applying object-oriented programming hence a preferred methodology for the project since it since it uses the Object-Oriented perspective to solve the problem. With this methodology, the objects that will interact with each other so as to solve the problem. It shows the attributes, the relationship between the objects and the tasks it should be performing.

The attendant, sensor and the fuel are the objects of the project. The only way the attendant can get access to the system is if only they are registered users of the system. When the attendant is registered, they are able to tell the level of fuel that is projected by the sensors to the database and the system. The fuel level after being shown on the database, an algorithm is used to show a prediction of the fuel usage and on when the fuel level will be low. The relationship is so much easier to work with since it ensures that the level of fuel is shown and that it gets to the intended recipient. The attendant can also tell what type of fuel it is and what its level is.

3.2.1 Functional Requirements

This type of requirements show how a system should behave or respond when a couple of system inputs are made. They describe the system services in detail. The requirements are put in sub-topics to define the functionality in detail. These requirements also show what the project cannot do.

i. Interface Requirements

The first page that the user, attendant, will be viewing is the homepage where they can easily get to log in to the system if registered or sign up if not. Once the attendant is able to log in they can easily access the system according to the rights that each user has been granted.

Every other interface in the system has a certain functionality such as showing the level of fuel of diesel, kerosene and petrol. Since there are sensors to reads the fuel level.

ii. Usability Requirements

Once the attendant accesses the system, they get to see the level of fuel for each type of fuel. The fuel level should be updated in real-time. The users are also meant to see a prediction on when the fuel level is low.

The system should retain the past reports generated.

3.2.2 Non-functional Requirements

Are properties and constraints on the services that the system can offer. Applies to the whole system as it may affect system architecture. They are such as:

- The system will be user friendly and can be used with no difficulty.
- The system response-time will be fast as it gives reports.
- The system will only be accessed by registered users hence the security level being high.
- The system will give the reports in real-time.

3.3 Prototyping

Software prototyping is a better approach as one can communicate with the customers to know whether the system will be in accordance with expectations and what they would want in the system. This also helps know what one should make changes to in case the project is not up to task before they are done working on it. The steps required are prototyping plan, outline definition, Executable prototype, and evaluation report. (Shabaya, 2018)

3.3.1 Prototyping Plan

At this stage, expectations are to enquire on what the customers would require and what their needs are.

3.3.2 Outline Definition

The prototype should show some of the functionalities that the system is expected to have. The function the prototype should achieve. The function of the prototype in the fuel level measurement system is the system measuring the level of the fuel.

3.3.3 Executable Prototype

At this stage, the prototype will be developed. The prototype should is developed in a way that just a few changes or improvements have be made to come up with the ideal system. As the prototype to measure the level of fuel is being developed and is able to measure the level of the fuel. With just a couple of improvements, the system should show the time and date.

3.3.4 Evaluation Report

The prototype is already developed and the developers can present the system to the users to know whether they like the system and whether the system has the requirements that are need. The users are also trained on how to use the system and how fast they learn using the system.

3.4 List of Design Diagrams

3.4.1 Use Case Diagrams

These are diagrams that show functionality of a system illustrating possible its interactions that are meant to take place between the system and the users. This diagrams help give a flow of the sequence of events that are taking place in the system. The diagram will have an attendant, an owner and an admin showing each activity they will be doing so as to access the system functionalities.

3.4.2 Class Diagrams

The diagrams are important as the show the model of what the system will be having such as the classes, the objects, attributes, and the relationships that take place between the objects. They give a clear and an easier illustration of what the project will look like in paperwork terms and hence easier to implement. It will involve the fuel types, user (attendant, owner), alert, measurement, and a prediction.

3.4.3 System Sequence Diagram

A system sequence diagram behaves more like a use case diagram as it shows the activities and the flow of events as the user is using the system and external factors come about. It shows the interrupts or rather the inter-system that might occur as the user is using the system and how they are dealt with. This will be more or less like the use case diagram but involves the interrupts that will be involved in the system. (Neri, 2018)

3.4.4 Database Schema

A database schema is a structure that represents a collection of logically related data and their description as they are designed to meet specific objectives. It organizes data and shows the relations among the tables and shows the constraints. It will have tables of the user, fuel measurement, order, tank management, user management and a prediction showing their attributes and the relationship among them.

3.5 System Development Tools and Techniques

The project uses sensors to so show the level of fuel in the tank. The information is then sent to the database where the information is sent to the system and hence the user can view the data. The user can also view a prediction on when the level of fuel will be low. The system will be implemented using a machine learning algorithm that is used to predict when the fuel level is low using historical data. After the information is sent to the sensor it is then sent to the database. The database to be used is the MySQL. The data then reflects in the system where the user views the data. The system will be developed using PyCharm Professional as the Integrated Development Environment (IDE). The language to use is Python.

3.5.1 PyCharm Professional

Pycharm Professional is the IDE that will be used for the development of the system. PyCharm Professional allows the use of a framework hence making it easier for the development of the project.

3.5.2 Python and Arduino

The language that will be used is python since there is presence of third party modules, if one wants work on a system is a possibility that someone else has a system of the same. Python is an easy to use language as it is easy to learn and less code is used. It is supported by a large and active community since there are constant upgrades and patches. Python also supports Internet of Things (IoT).

Since there is the use of sensors involved, the use of Arduino as to be incorporated. For the sensor to give the required response, it has to be programmed using Arduino.

3.5.3 Django

Django is the framework that will be used to development of this system. It is easy to extend and scale. Django supported by large and active community. It is easy to learn. There is less code to write.

3.5.4 MySQL

MySQL is the database that will be used for the development of this project.

3.6 Testing Techniques

To test the development of the system, system testing and unit testing would be the best way. System testing ensures that the complete software system is able to conduct all the requirements that it has. This will ensure that the system is able to measure the level of fuel in the tank and also show the time. It also helps show the areas that have problem and those that are not performing the tasks as should.

Unit testing ensures that every module in the system is able to perform the tasks that they should. It ensures that the sensor can send the data on the level of fuel to the database as well as confirming that the predictions are being seen.

3.7 Domain of Execution

The system will be web-based. One can access a web-based system from any web browser with access to the internet with a lot of ease and from any location what so ever. Web-based systems support the existence of Internet of Things (IoT) devices. The use of sensors has promoted development of web-based system there is need for the use of an IoT device to communicate with the system which is the arduino board. The arduino board gives a gate way for the sensor to communicate with the system.

3.8 Proposed Modules and System of Architecture

The modules for the system are fuel reading, order, manage tanks, manage users, prediction and usage. The front-end modules are fuel reading, ordering, prediction and usage. On the back-end, the modules are managing the tanks and managing users.

3.8.1 Fuel Reading

The fuel level is sent to the database then formatted to readable data for the users of the system.

3.8.2 Prediction

The fuel usage data being sent to the database. The fuel data is cleaned by converting the data types to either JSON or CSV as well as replacing the null values. The data is then trained. This takes place by using Machine Learning Algorithm using historical data.

3.8.3 Usage

The level of fuel is sent from the sensor to the database. The level of fuel then reflects on the system showing the type of fuel, the fuel level, the date and the time.

3.8.4 Manage Users

The admin gives credentials to users, the rights on what they can and cannot view as well as updating the users on the system.

3.8.5 Manage Tanks

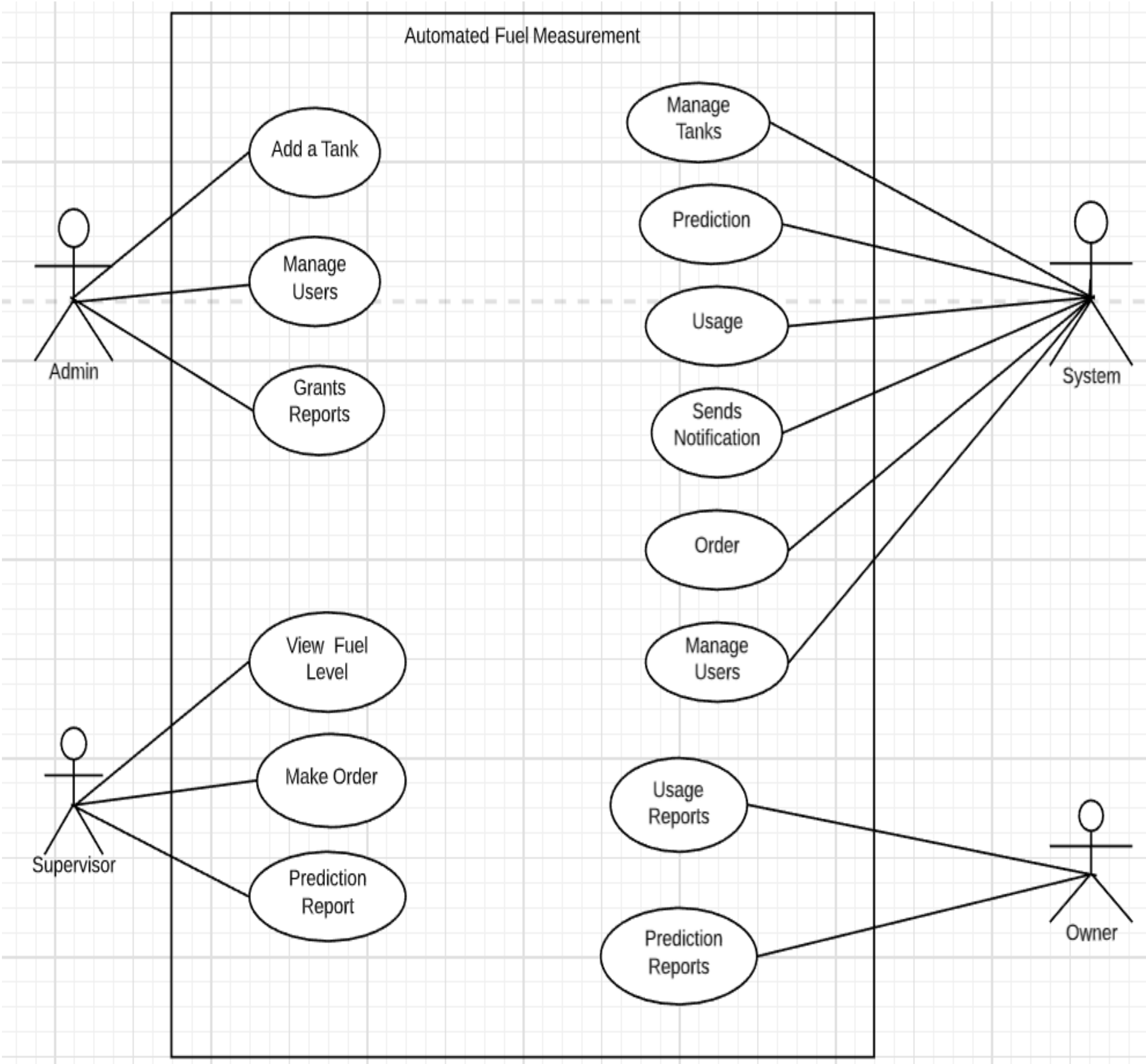
The admin manages the tanks by knowing the size of the tanks and making the necessary changes according to the size of the tank. The admin also checks on the fuel type in every tank hence ensures that the level shown on the system is for the exact fuel type.

3.8.6 Order

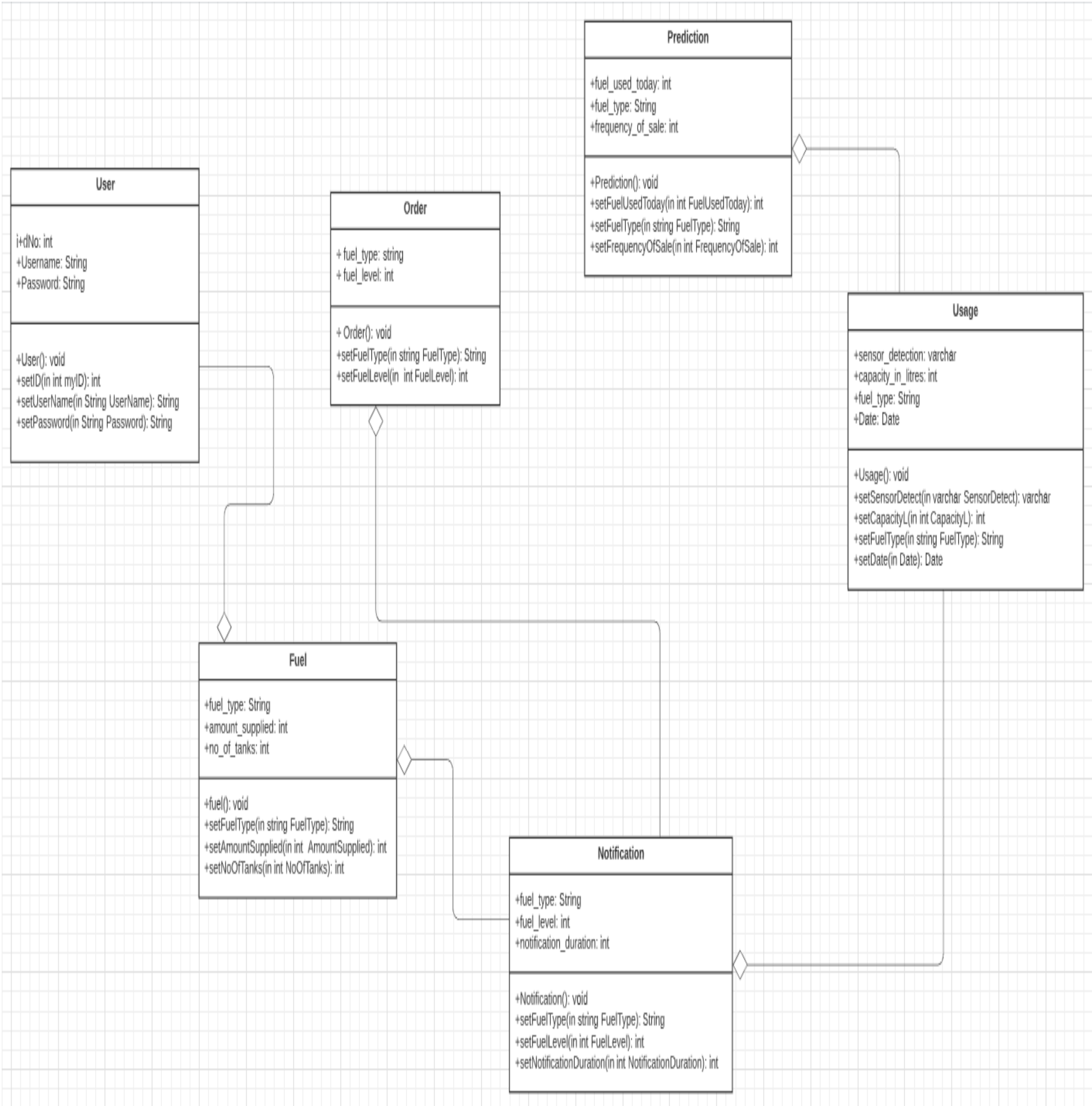
The system predicts low fuel levels hence an alert is sent to the suppliers to show that a refill is needed. The attendant then organizes when the order should be brought.

Chapter 4: System Analysis and Design

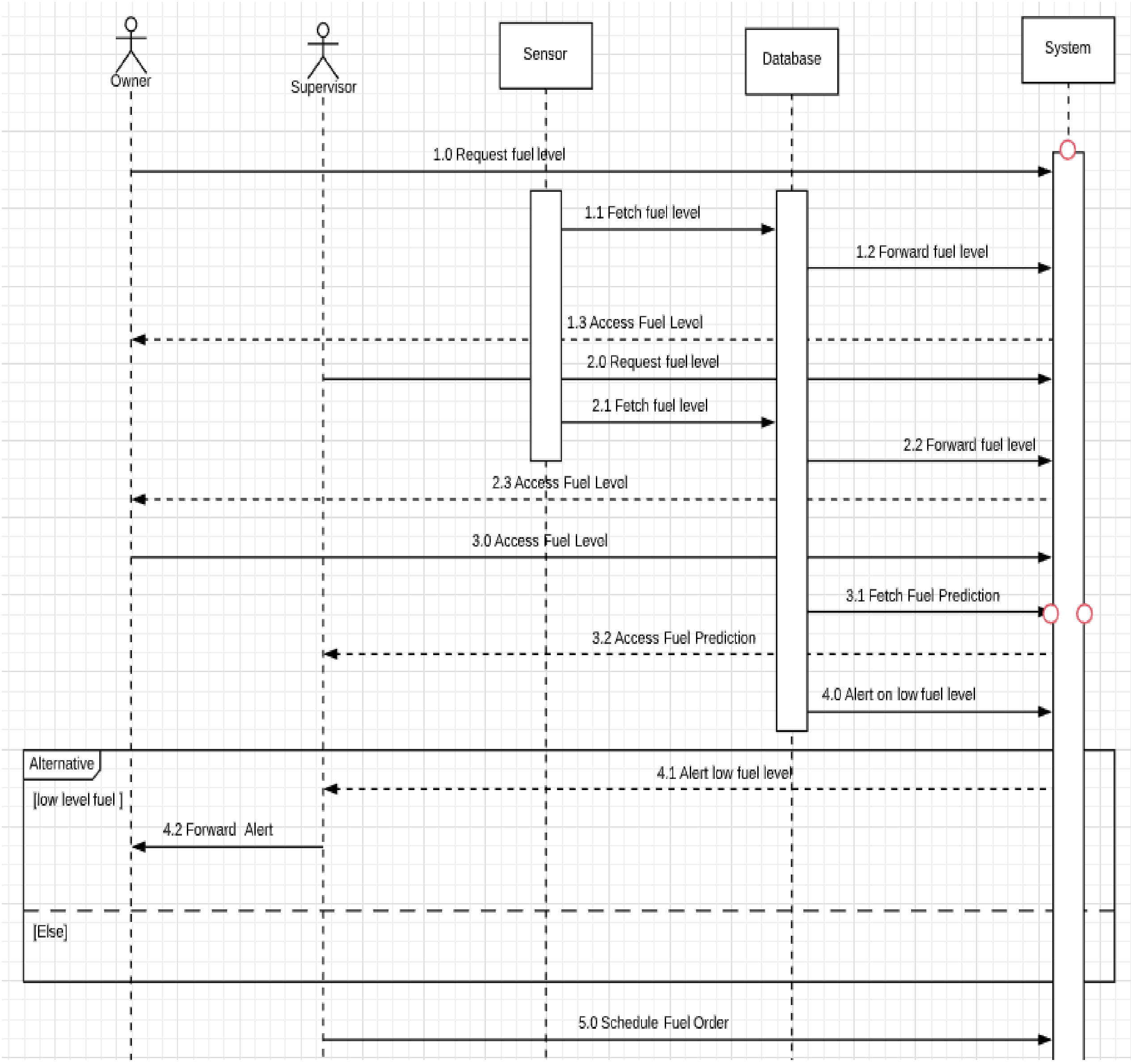
4.1 Use Case Diagram



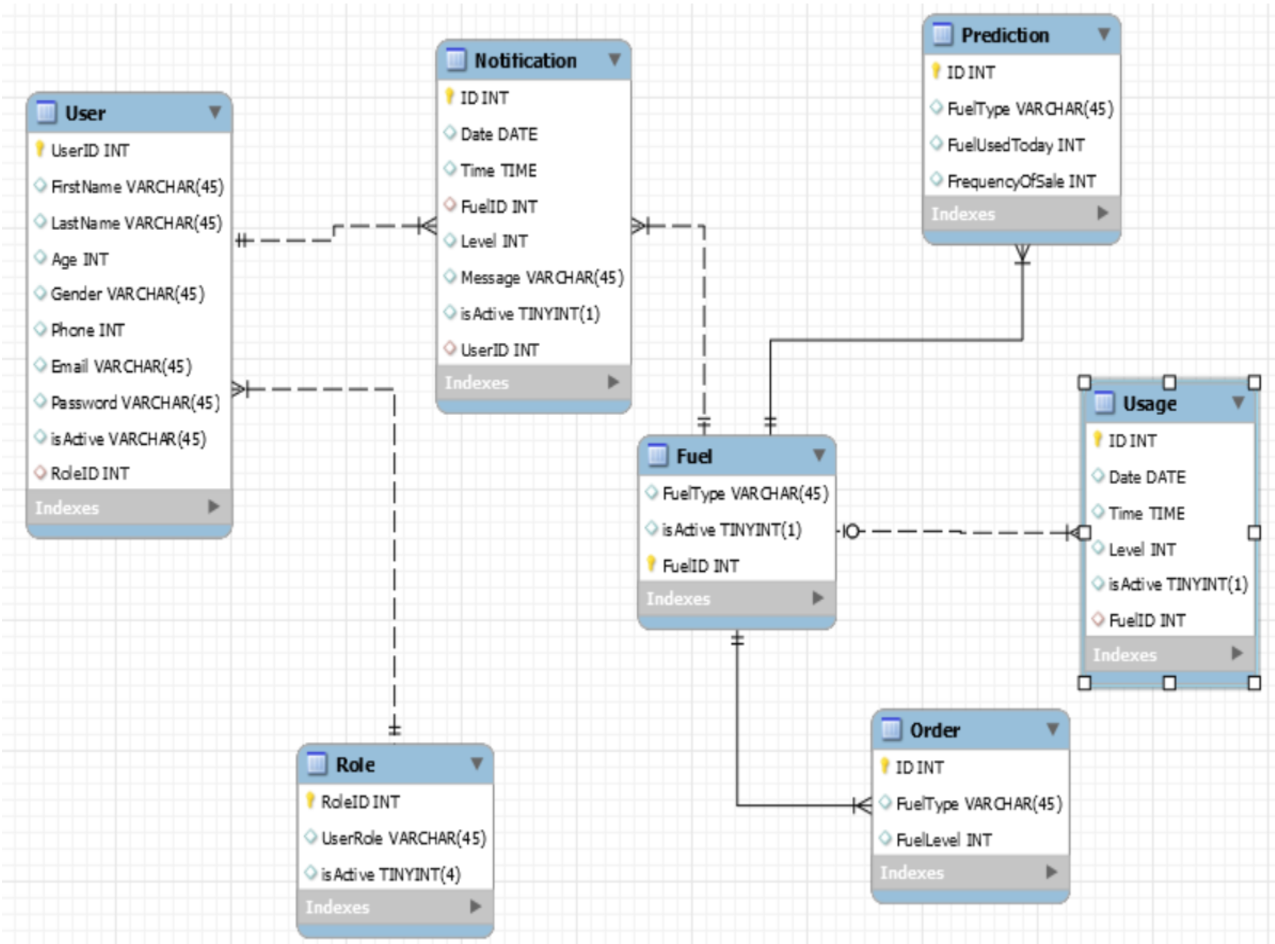
4.2 Class Diagram



4.3 Sequence Diagram



4.4 Database Schema



4.5 Graphical User Interface

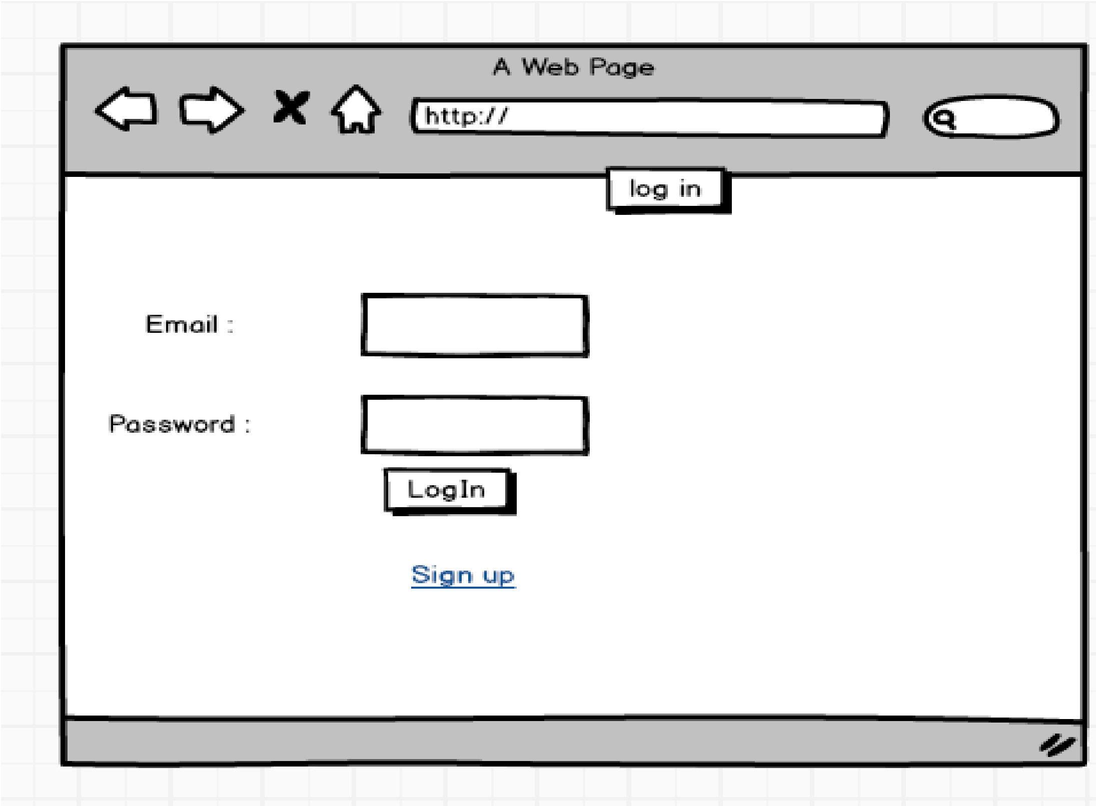


Figure 4.4.1 Log In

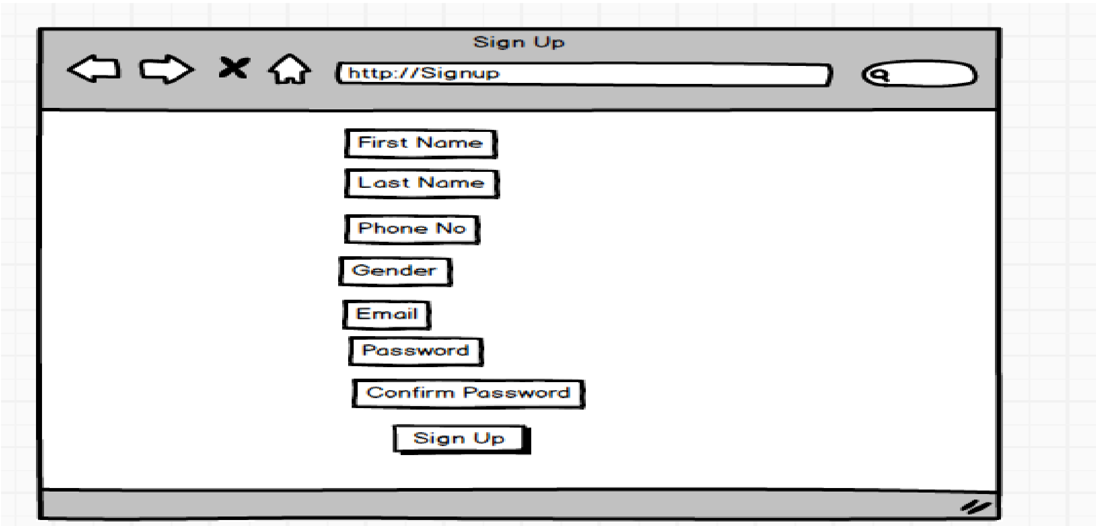


Figure 4.4.2 Sign Up

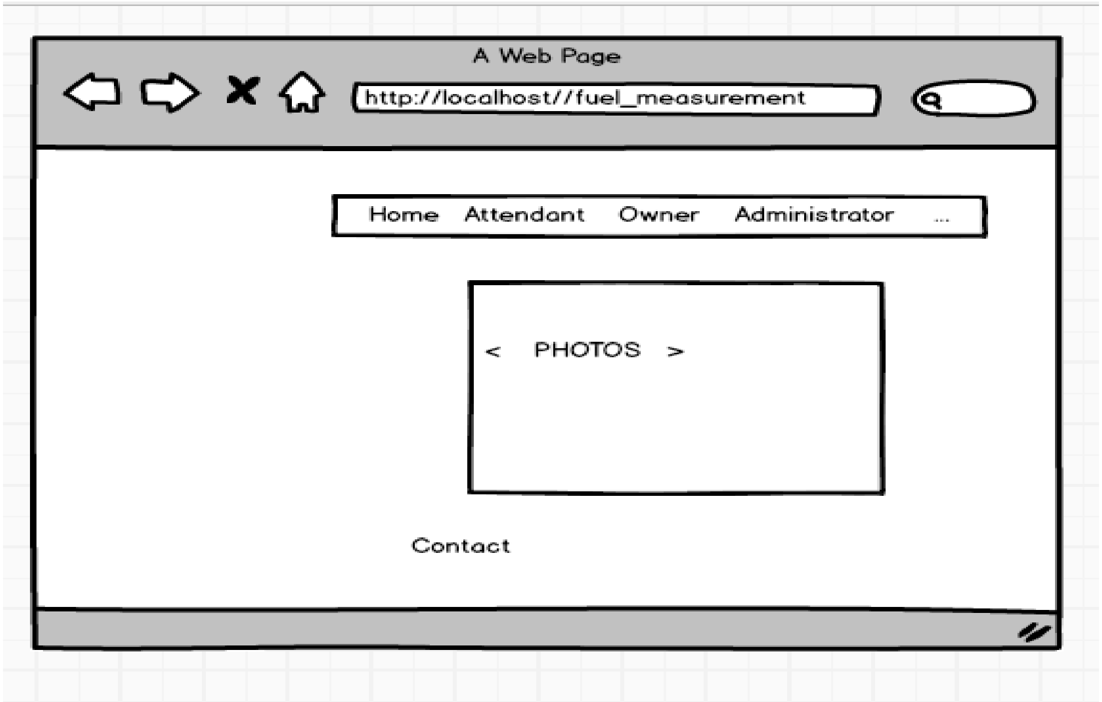


Figure 4.4.3 Homepage

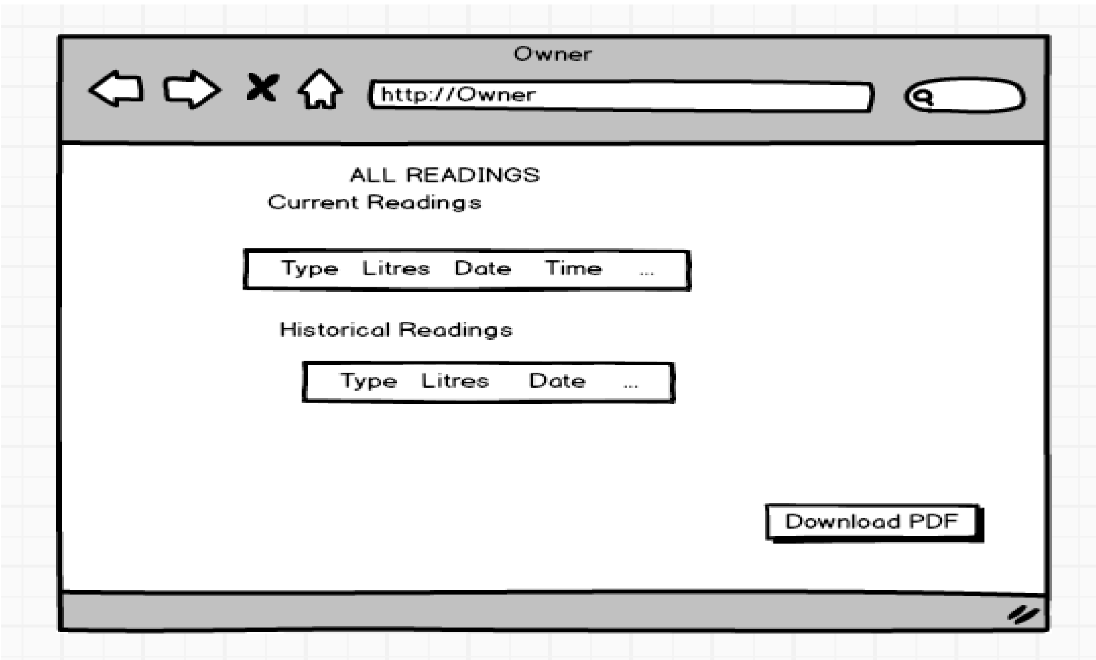


Figure 4.4.4 Readings

Chapter 5: System Testing

5.1 Implementation

As stated, python language, Django as my framework and arduino are used to come up with the system. The editor tools used are PyCharm and arduino. Arduino is used for the hardware part of the system while Python is used for the logic.

5.1.1 Hardware Setup

It involves HXF11 Load Cell Amplifier, a weight sensor and an Arduino UNO and Genuino UNO. HXF11 Load Cell Amplifier is a precision 24-bit analog to-digital converter. The weight sensor is connected to the HXF11 Load Cell Amplifier then to the Arduino UNO and Genuino UNO so as to convert it to digital as illustrated in **Error! Reference source not found.**

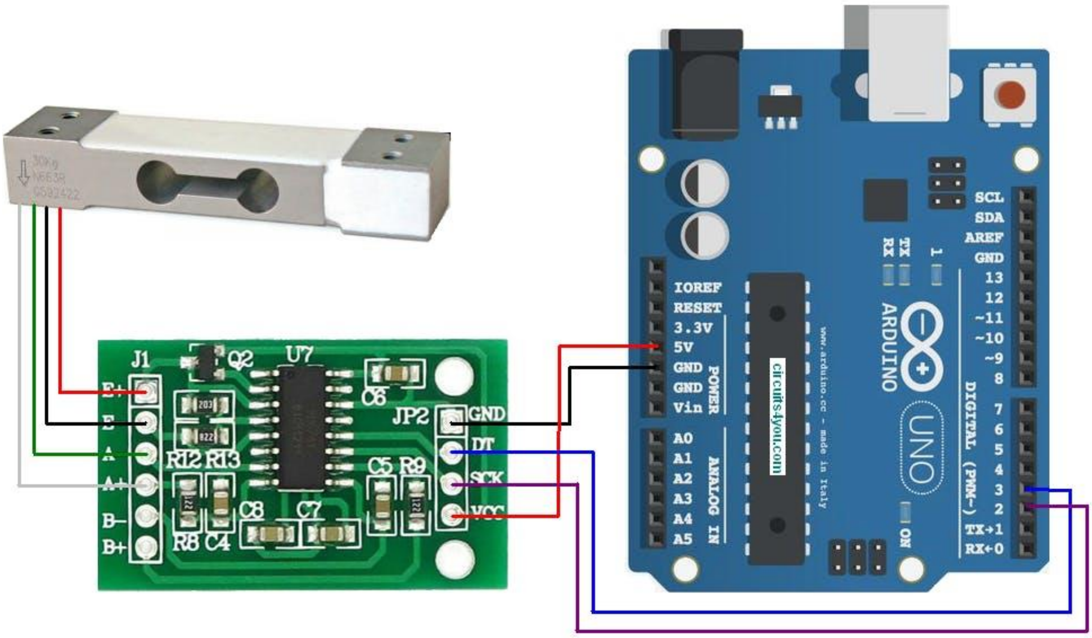


Figure 5.0.1 Arduino and Sensor Setup

5.1.2 Arduino Code Calibration

Since the weight sensor can hold 20kgs the calibration is changed in accordance to the weight sensor which is a calibration factor of (-96650) while that of 40kgs is (-106600). There is also a line of code that prints a serial of what is found in the weight sensor in kilograms and one that ensures that it is print as vertically hence showing a minimum of 3 decimal places. The weight of the wood above the sensor is also subtracted to ensure that it is only the fuel weight that is measured. After the weight has been read, the scale then resets back to zero.

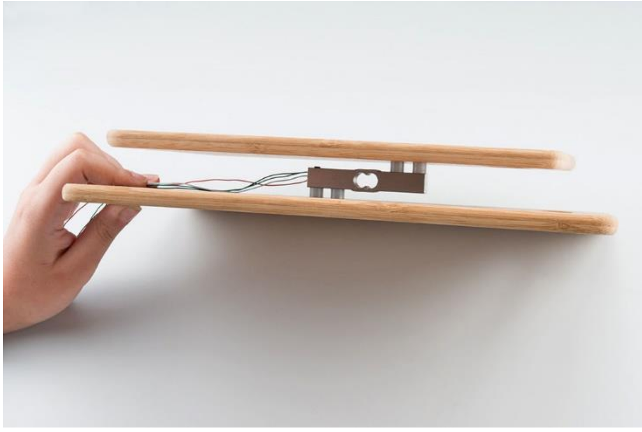


Figure 5.2 Mounted Weight Sensor

5.1.3 TeraTerm port reading and reading from text file.

The readings on the weight are read on a port called TeraTerm then writes it on a text file. A python code is then written to show only the last line or rather the latest readings that of the weight that have been caught by the sensor. The text file (weightlog.txt) is what is used to fetch the information of the level. The python code also implements on showing of the exact date and time the level of fuel got to be at that. The reason for choosing the port reader was due to the difficulty of identifying a reliable library that could aid in posting sensor readings directly into the MySQL database.

5.1.4 Saving to database.

Once the readings have been sent to the python code on PyCharm, the database then fetches the readings leading to a generation of reports on the level of the fuel.

5.2 Test Case

Table 5.1 Test case

Test ID	Related requirement	Inspection check	Pre-condition	Test data	Priority level
T1	FRQ1	Does the system show the level of fuel, date and time?	The system should show the level of fuel as well as the date and time it got to the level.	Data directly from the sensor to a readerfile.txt then to the system.	High
T2	FQR2	Does the system show the level of fuel in real time?	The system should show the level of fuel in real time.	Use of logic to have a real-time system.	Medium
T3	FQR3	Does the system verify user before accessing the system?	The system should verify user before giving access to the system to ensure security.	Username: Imelda Password: Nasimiyu@123	High
T4	NFQR1	Can the system be easily used by users with no difficulty?	The system should be easily used with no difficulty.	Developing a relatively easily understandable system.	High
T5	NFQR2	Is the response-time fast?	The response-time for the system should be fast on refreshing to show the last level of fuel.	Having a real-time logic that shows the final level of fuel.	High
T6	NFQR4	Does the system generate reports	The system should generate reports	Data from the database to the system.	Medium

		from previous results?	from previous events on weekly basis.		

5.3 Test Results

Table 5.2 Test Results

Test ID	Expected result	Actual result	Status	Remarks
T1	The system should show the fuel level, date and time	The system shows the fuel level as well as the date and time.	Pass	Successfully shows the level of fuel.
T2	The system should show real-time level of fuel	The system shows the level of fuel in real-time.	Pass	Successfully shows the real-time level of fuel.
T3	The system should be secure and only those verified can access.	The system only allows those verified to get access.	Pass	Successfully logging in only those that are verified.
T4	The system should be friendly and easily to use.	The user can easily use the system with no challenges	Pass	Successfully developed friendly system.
T5	The system’s response-time should be fast	The response time for the system is fast.	Pass	Successfully fast response time.
T6	The system should generate reports weekly on the level of fuel.	The system does not generate reports yet.	Fail	Modify a couple modules to ensure that the system reports are generated.

Chapter 6: Conclusion and Recommendation of Future Work

6.1 Conclusion

In conclusion, the system shows how much there has been a gap in the Petroleum Industry which has to be filled. The system eliminates errors experienced when measuring the level of fuel. The system is quite similar with those that have been developed before such as the use of liquid meter to measure the level of fuel.

In accordance with the System Development Methodology section, prototyping has been used for development of the system and hence used the same prototype to develop the system. Testing has also taken part in the development since some of the functional requirements have to show their functionalities.

Functional requirements such as showing the level of fuel, the date and time the fuel got to that level are functionalities that have been implemented. Non-functional requirements such as security, and a user-friendly system have been met.

The tools that have been used in the system such as the arduino uno, amplifier and the weight sensor are the best tools since they ensure that the requirements are well met and accurate. The calibration of the sensor has gone about by coding in arduino where the instructions of the required output are sent from the arduino uno to the amplifier where it is converted to analog so that the weight sensor can fetch the instructions that have been sent. The user views the level of fuel of on a particular web page as it is sent to a text file then fetched to show on the webpage as an instruction has written in the python code.

The system ensures that the owners of petrol stations do not through the problem they have been having which is inaccuracy of fuel level. The system also helps eliminate employment of too many employees in an institution since not so much work needs be done leading to saving of money.

6.2 Recommendations for Future Work

i. Mobile phones have been one thing that most people really never fail to have, hence, to make the system more accessible for more is develop the system as a mobile-based application.

ii. The system having a module that sends a notification to the supplier informing them that they need to supply fuel since the level is at its lowest.

iii. The system detecting oil leakages in case of any in the underground tanks.

iv. The system showing the temperature in the underground tank.

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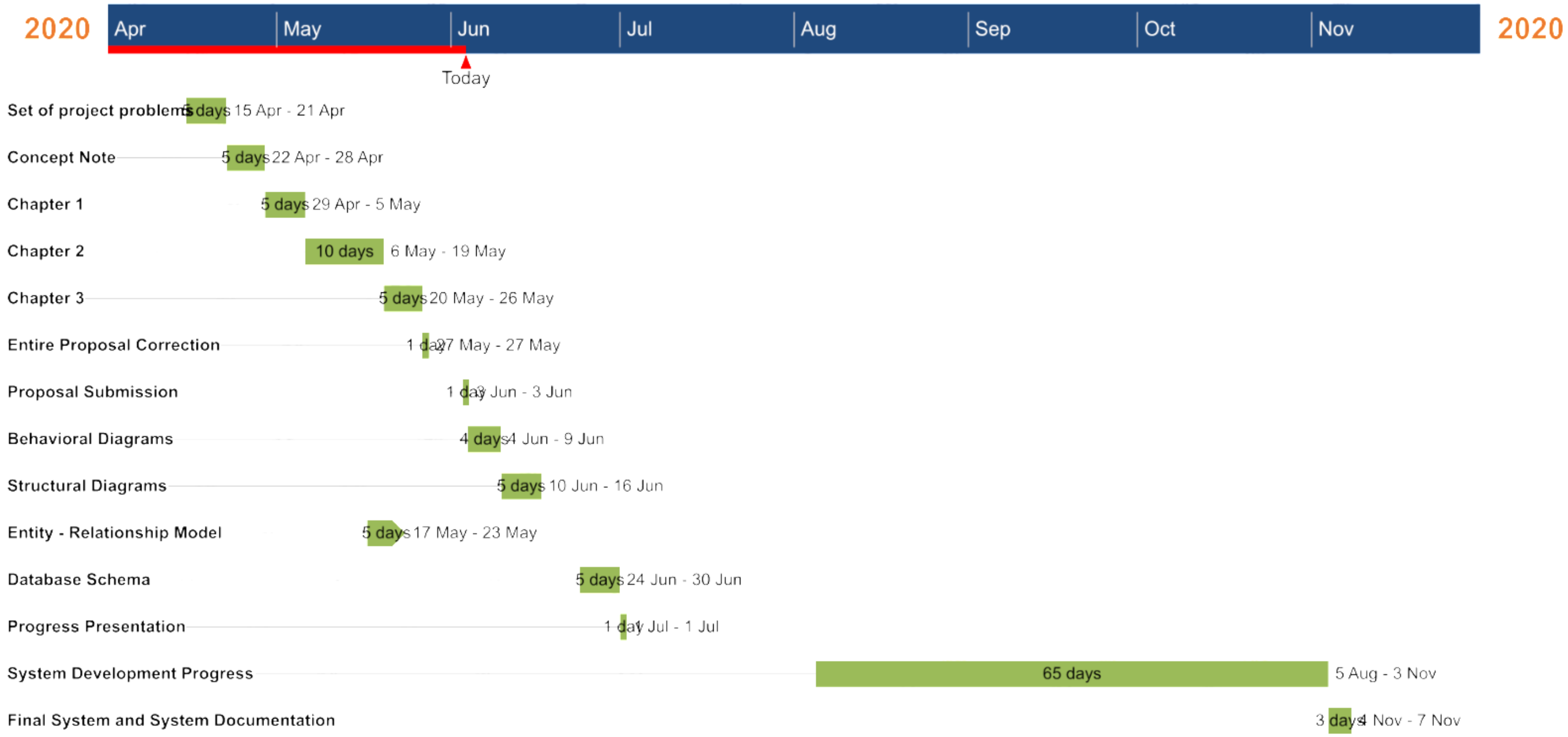
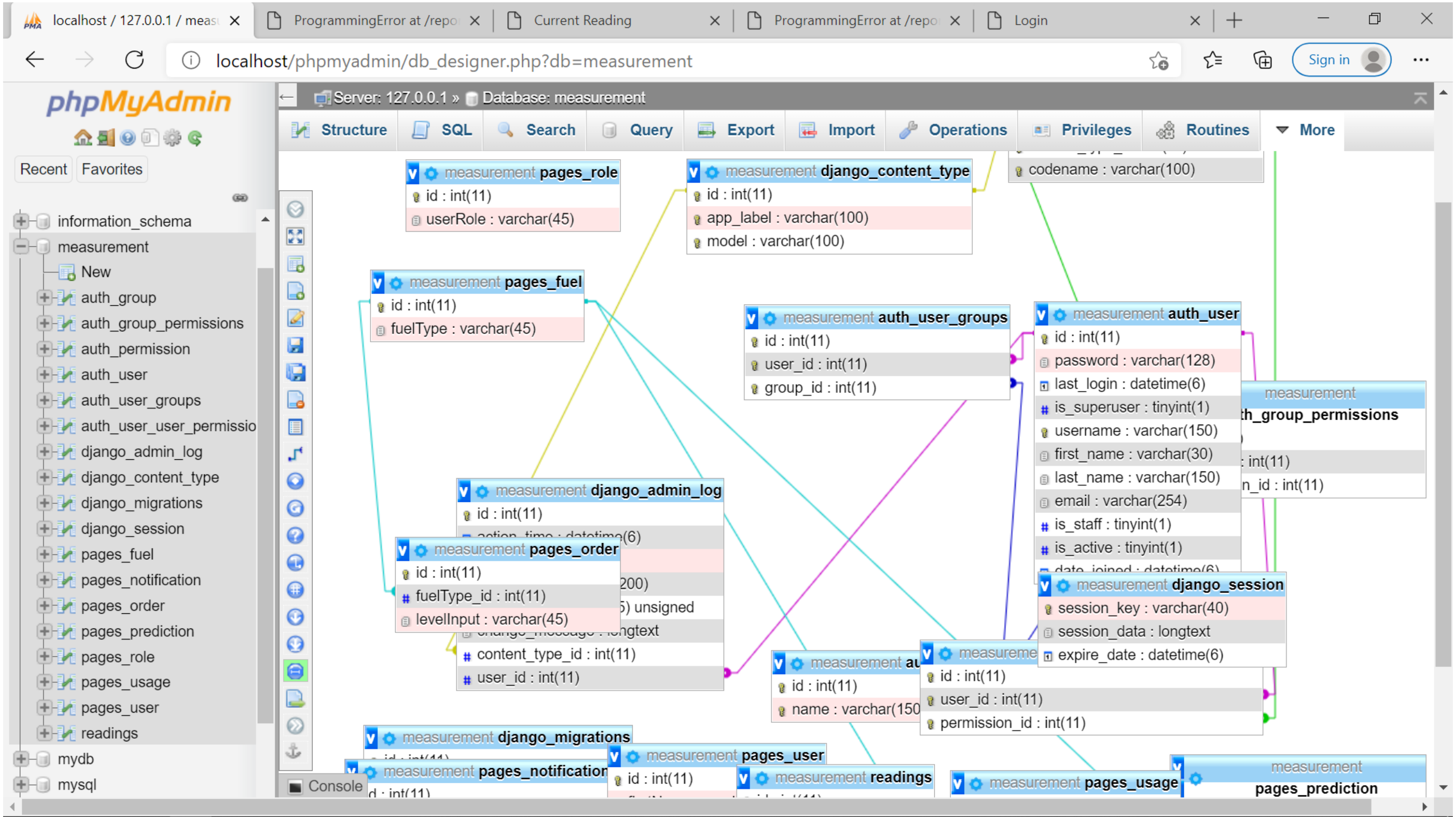
Appendix A: Timeline of Activities



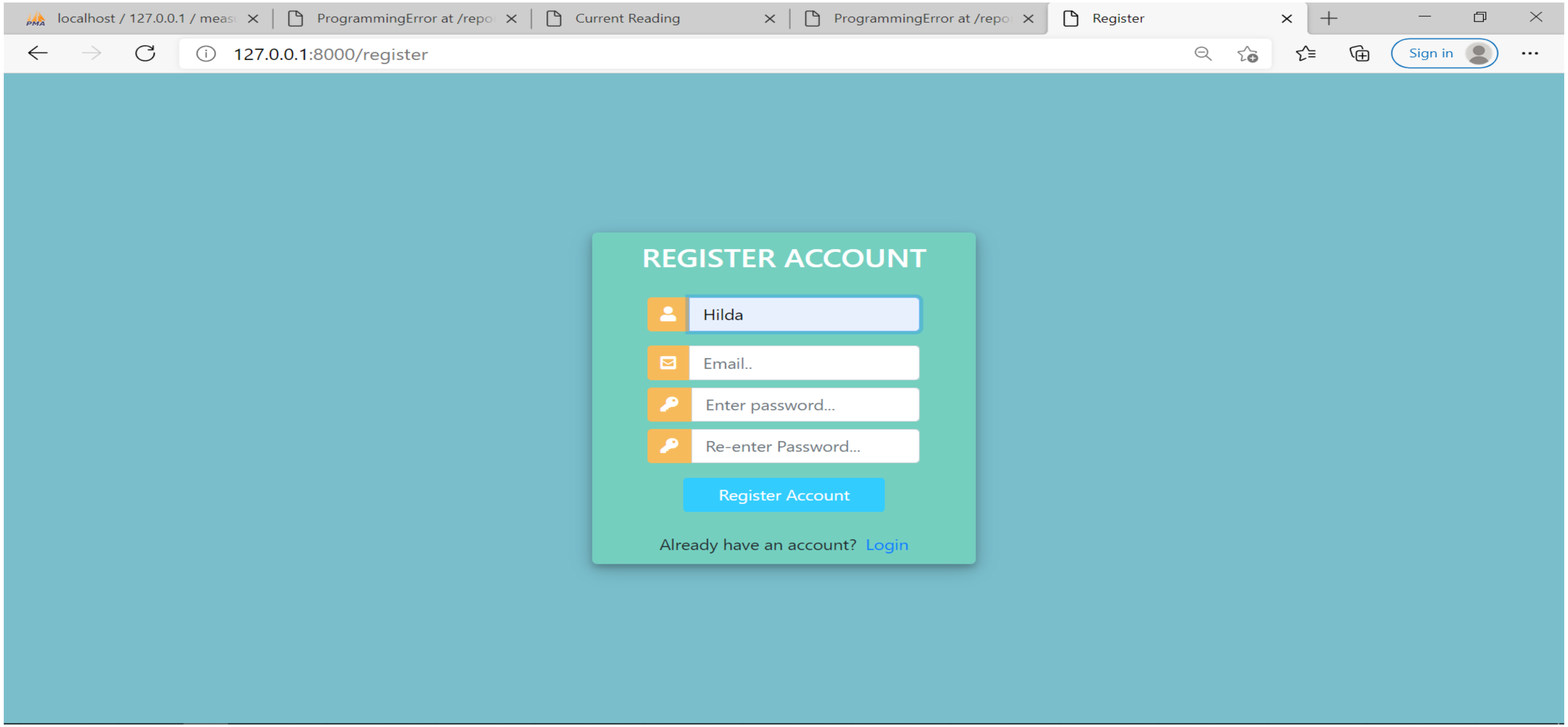
Appendix B: User Manual

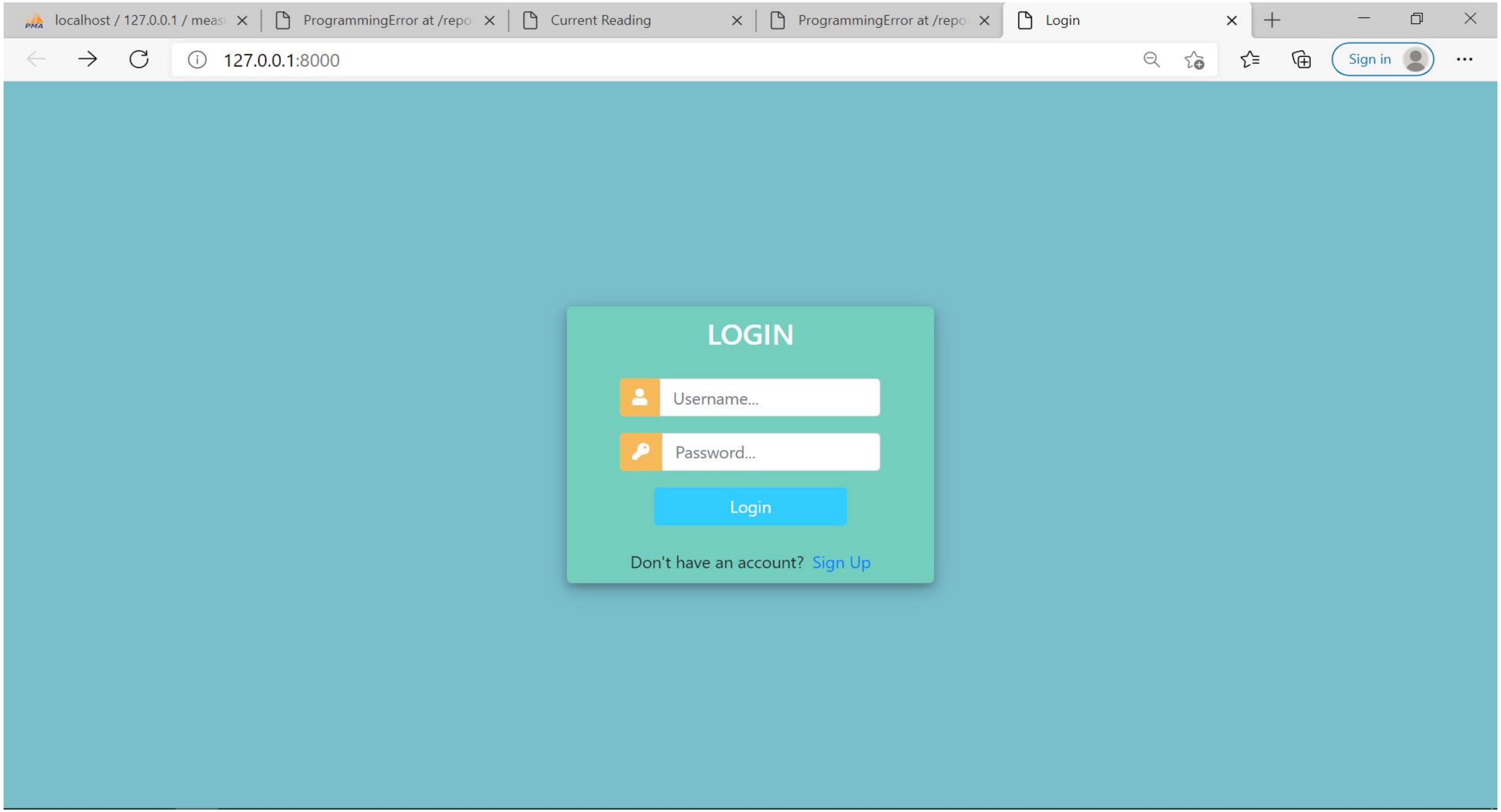
The first step of implementation was to create and develop a database by use of PhpMyAdmin localhost platform.

The diagram below shows the database during testing.

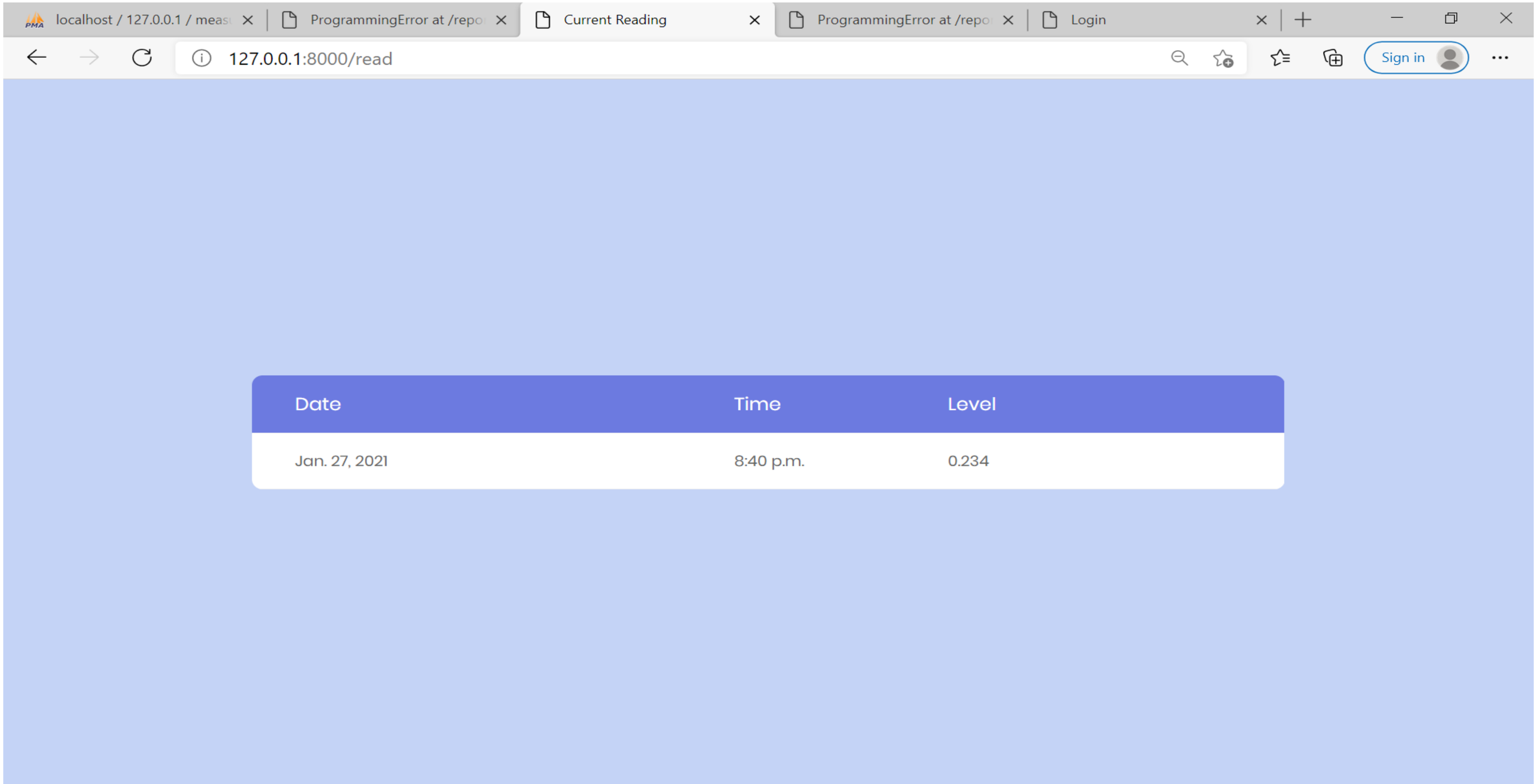

localhost / 127.0.0.1 / meas
ProgrammingError at /repo
Current Reading
ProgrammingError at /repo
Login
localhost/phpmyadmin/db_designer.php?db=measurement
Sign in
phpMyAdmin
Recent
Favorites
information_schema
measurement
New
auth_group
auth_group_permissions
auth_permission
auth_user
auth_user_groups
auth_user_user_permissio
django_admin_log
django_content_type
django_migrations
django_session
pages_fuel
pages_notification
pages_order
pages_prediction
pages_role
pages_usage
pages_user
readings
mydb
mysql
Server: 127.0.0.1 » Database: measurement
Structure
SQL
Search
Query
Export
Import
Operations
Privileges
Routines
More
measurement pages_role
id : int(11)
userRole : varchar(45)
measurement django_content_type
id : int(11)
app_label : varchar(100)
model : varchar(100)
codename : varchar(100)
measurement pages_fuel
id : int(11)
fuelType : varchar(45)
measurement auth_user_groups
id : int(11)
user_id : int(11)
group_id : int(11)
measurement auth_user
id : int(11)
password : varchar(128)
last_login : datetime(6)
is_superuser : tinyint(1)
username : varchar(150)
first_name : varchar(30)
last_name : varchar(150)
email : varchar(254)
is_staff : tinyint(1)
is_active : tinyint(1)
measurement
th_group_permissions
measurement django_admin_log
id : int(11)
measurement pages_order
id : int(11)
fuelType_id : int(11)
levelInput : varchar(45)
content_type_id : int(11)
user_id : int(11)
measurement django_session
session_key : varchar(40)
session_data : longtext
expire_date : datetime(6)
id : int(11)
user_id : int(11)
permission_id : int(11)
name : varchar(150
measurement django_migrations
measurement pages_user
id : int(11)
measurement pages_notification
measurement readings
measurement pages_usage
measurement
pages_prediction
Console

The non-functional requirements such as the security and ensuring authorization before access before getting access to the system.




localhost / 127.0.0.1 / meas
ProgrammingError at /repo
Current Reading
ProgrammingError at /repo
Login
127.0.0.1:8000
Sign in
LOGIN
Username...
Password...
Login
Don't have an account? Sign Up

As stated, the objective of the system is to show the measured level of fuel at real time. The diagrams below the interfaces and how it was achieved.



This shows the reports on a daily basis.