Household Water Storage Management System

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1.1 Introduction:

One of the most prevalent home issues are empty water tanks Water is consumed and always leave the homeowner with issues Such as air going through the pipe and causing pressure that prevent the waterflow , Or water PH levels could change, and this could harm the consumers Additionally, contaminated water tanks may exist. Our project is intended for underground water storage units, and we opted to construct three primary sensors, each of which will have a mission to do. We refer to it as the household water storage management system. Water level sensors will be the first sensor used; they can detect both water levels and leaks. The second sensor will be a hydrogen potential (PH) sensor, which measures the water's acidity or alkalinity, and the third sensor will be a water contamination sensor, which finds any contaminants in the water. Feedback from all of these sensors will be sent to a fixed tablet within the home. In its own software and app, it will display water levels and PH levels. The app will have access to all of this information and will provide notifications if water levels were low or there was a specific change in PH, as well as warning if there were any contamination.

1.2 Project description

A household water storage management system is a smart system that monitors and controls the water levels and quality in household storage tanks. This system can be integrated with sensors to detect water levels and control valves to manage the distribution of water. It can also provide real-time alerts and notifications to homeowners about the status of their water storage tanks. The system can help households save water and reduce their water bills by detecting and fixing leaks, as well as managing the water supply efficiently. It can also improve the overall quality of water by detecting contaminants and recommending treatment options, if necessary.

2. Information Gathering

2.1 Interview description

Person/ Company	Questions	Answers
Person	Do you have a problems in your water tank?	Yes, sometimes the water tank got empty in bad situations.
Company	Do water pollution problems affect you financially?	Yes of course, when our tanks got polluted it cost us a lot of money.
Person	Would you prefer to know how much PH in your water?	Yes, so I can know if the water drinkable.
Company	What is the problems you are facing in your water tanks?	In our tanks we are facing a lot of problems such as empty tanks and polluted water.

2.3 Interview analysis:

Interviewee	Interviewer	Analys comment
Ali Mohsen.	Abdulkarim Mohammed.	Ali is owner of a series of restaurant and facing a lot of problems in water tanks that might cost him a lot of money
Muhannd Assiri.	Ibrahim Khalid.	Muhammed is working in a job which has a lot of mobility and some time when he is out of town his family complaining about the water when it got empty and he thinks our system will be helpful .
Hassan Alharbi.	Omar Khalid.	Hassan and his family prefer to drink the water from the tanks , and they find our system is useful .
Mansour Abdullah.	Saeed Hadi.	Some people loves to clean their tanks by themselves such as Mansour and he think the system will help him to know in what time he should clean it .
Majed Abdulqader.	Abdulelah Mohammed.	In many cities and villages they plants irrigation using the water tanks such as the farmer Majed and he cares about the PH percentage .

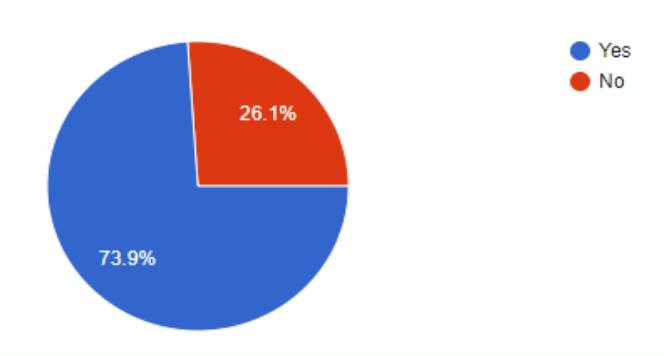
Conclusion:

We see from the interviews above that , our system will be helpful for different kind of needs and people and will save a lot of time and effort.

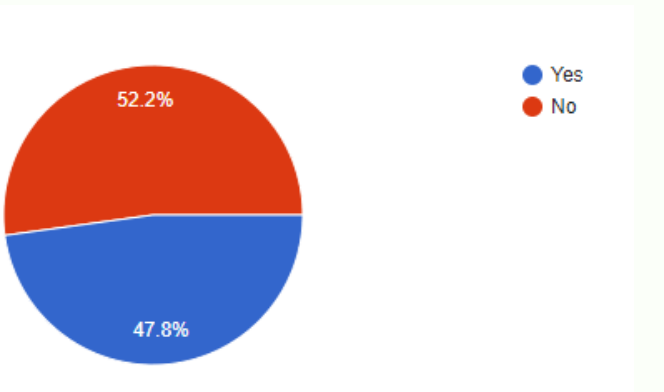
2.4 Questionnaire:

We did a questionnaire for the people to see if they have problem with their household water storage management system and we received 23 responses)

Have you ever had a trouble in the water flow?

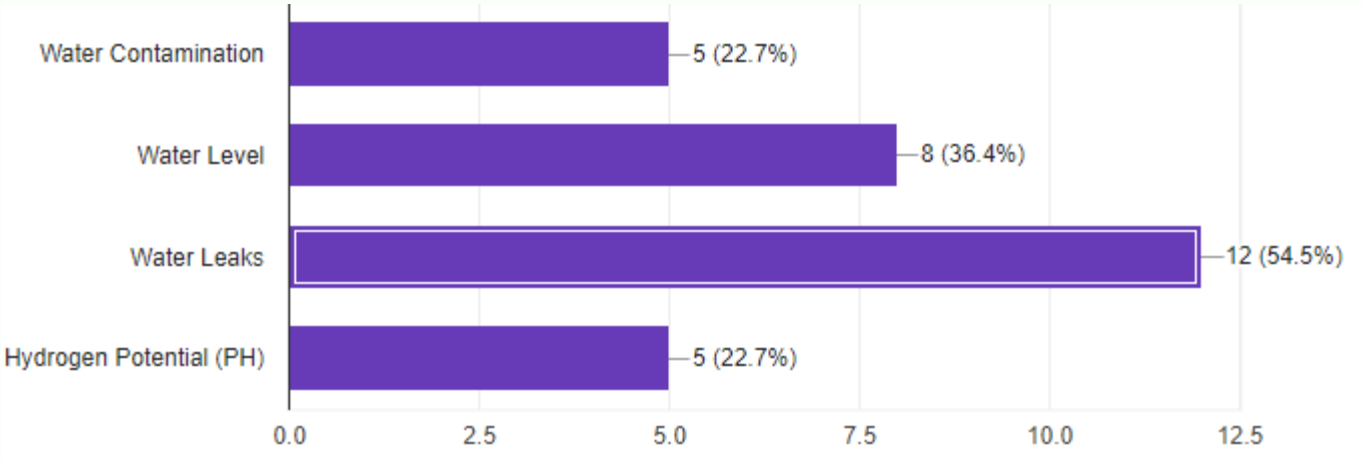


Do you have a contract with a third party insurance company for your household water storage?



2.5 Questionnaire:

If you ever had a problem with the household water storage what were the cause?



Conclusion:

As you can see must of the people need a management system for their water tanks so they can about the level of the PH and if their any problem with the tanks like water leaks etc…

3. Planning Phase

3.1 The purpose of the project :

a. The user business or background of the project effort

Content:

Our system is developed to fix a lot of common issues in water tanks as we mentioned in the problem definition such as air going through the pipe and causing pressure that prevent the waterflow , Or water PH levels could change , or it can help you to find the water level in your tank .

Motivation:

Our system should be in every house to save a lot of effort and time.

Considerations:
In some cases, there is people usually check the tanks by themselves and this is too dangerous , and the system might reduce these cases.

b. Goals of the project:

The main reason behind this project is to make sure that the water you use in your house is save and to check if there’s any leak in the pipes or water PH level changing.

3.2 Preliminary report:

1- The problem:

Some people use their water without knowing if it’s good for them or not they don’t know the level of the PH or if there’s any infection inside the pipes.

2- Finding:

It’s hard for people to do the maintenance by themselves because it’s dangers and maybe they waste their time finding that everything is good so that’s why you need a sensors.

3- Recommendation or proposed solution:
people these days maybe don’t know what’s going inside their pipes until they smell something bad inside the pipes and that’s the worst stage so my idea for solving this problem is to put some sensors with every pipes also with the main tanks to detect any dangers.

Cost & schedule estimates:

This project will cost around 276k RS with 6 months works with a total of 280 hours the table will include everything.

3.3 Table of the preliminary report

Phases	Description	Time Week/Hours	Cost
Phase 1 : Specification	Defining what the system will do and the requirements of the systems	3 weeks/40 hours	10.000 SR
Phase 2: Design the system	Designing the structure of the system	5 weeks/80 hours	60.000 SR
Phase 3: implementation	Building	8 weeks/120 hours	150.000
Phase 4: validation	Verify the system and verify that it meets the requirements	3 weeks/40 hours	20.000
Phase 5 : maintenance	System checks and problem fix	8 weeks	-
Total	-	6 months/280 hours	VAT(15%)+Total = 276.000

4. Planning Phase 2

4.1 MANDATED CONSTRAINS:

DESCRIPTION: the water storage management system will have a database for each client and will give access to the client to keep track of their water storages.

fit criterion: the water storage management system will use an optical water level sensor to detect water levels and will use a PH sensor to detect water acidity and a total organic carbon sensor(TOC) to detect any chemicals in the water.

SCHEDUAL CONSTRAINT: The project will be available on the fifth of May 2024.

BUDGET CONSTRAINTS: The project will cost roughly around 276k SR.

5. Planning Phase 3

5.1 The feasibility study:

- The idea of the project is to help consumers to manage their household water storage system in the easiest and most affordable way.

- Evaluate the technical requirements of the system, such as the type of storage tanks needed, the sensors and control system required for water level monitoring, and the communication technology needed for data transmission. It would also consider the compatibility of the system with existing water supply infrastructure and any potential technical challenges that might arise during the installation or operation of the system.

- Assess the cost-effectiveness of the system by analyzing the expected costs and benefits. This could include estimating the total cost of installation, maintenance, and operation, as well as the potential savings that could be achieved through more efficient water usage.

5. Planning Phase 3

5.1 The feasibility study2 :

- Determine whether the proposed system is practical and workable within the household environment. This could include assessing the skills and knowledge required to operate the system and the potential impact on daily routines and activities.

- By considering these factors, a feasibility study can provide valuable insights into the potential success of a household water storage management system, as well as identify potential challenges and areas for improvement.

5. Planning Phase 3

5.2 Report writing :

Treating water and safely storing it in the home are commonly referred to as “household water treatment and safe storage” (HWTS) or treating water at the “point of use”.

1- Problem Definition:

safe drinking-water:
As water moves through the water cycle, it naturally picks up and carries many things along its path. Water quality will naturally change from place to place, with the seasons, and with the kinds of medium (rocks, soil, etc.) through which it moves. Water quality is also impacted by naturally occurring contaminants, including animal excreta.

5. Planning Phase 3

5.2 Report writing 2 :

2- Scope Objectives of “new system”: treatment technologies: is Different household water treatment technologies remove different types of contaminants to different levels. Understanding the local water quality and contaminants will influence the selection of appropriate household water treatment options.

3- Alternative Solutions:

- Use bottle of water from super market to drink safe .
- Stormwater Capture and Reuse Cost

4- Cost and benefits of Alternatives: Stormwater Capture and Reuse Cost in California

	Sample Size	Stormwater Capture and Recharge Facility ($/AF)			Groundwater Pumping and Treatment ($/AF)	Total Cost ($/AF)		
		Low	Median	High		Low	Median	High
Small Project (≤1,500 AF)	8	$590	$1,200	$1,300	$340	$930	$1,500	$1,600
Large Project (>6,500 AF)	2	$230	$250	$260		$570	$590	$600

5. Planning Phase 3

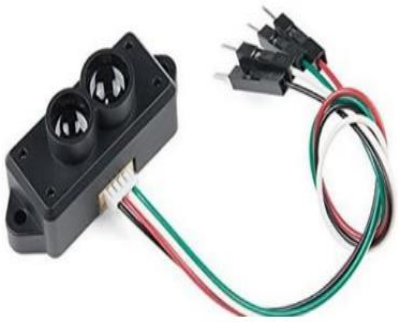
5.2 Report writing 3 :

5- Software impacts:

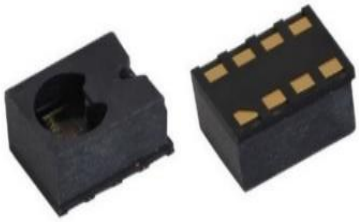
Water Level Monitoring

Monitoring the water level in the tank is considered an essential parameter in smart monitoring of water storage tanks. As both cemented and portable tanks exist in different capacities and heights, precise water level measurement may be challenging due to the sensors' range limitations. As per contemporary literature [65,69,101,102,103,107,109], some commonly used devices for level monitoring are a water sensor (Figure 4), magnetic float sensor (Figure 6), ultrasonic sensor (Figure 7a), and light detection and range (LIDAR) sensors (Figure 7b).

(a)



(b)



(c)

5. Planning Phase 3

5.2 Report writing 4 :

6- Potential Changes in the Organization:

Criteria influencing technology choice There are several criteria that one should take into consideration when deciding which household water treatment technology is most suitable.

Some of these include:
1. Effectiveness—How well does the technology perform?

2. Appropriateness—How well does the technology fit into people's daily lives?

3. Acceptability—What will people think of the technology?

4. Cost—What are the costs for the household?

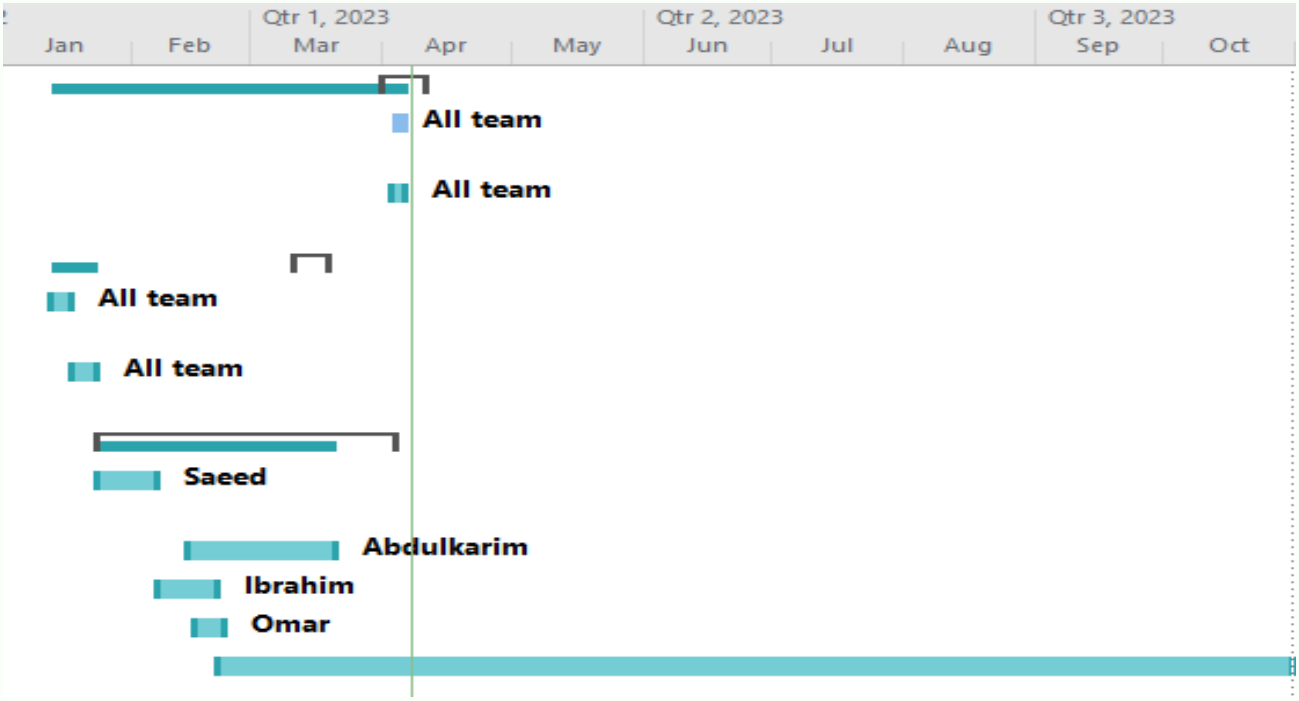
7- Recommended Alternative of the course of Action:

Stormwater Capture and Reuse Cost

5. Planning Phase 3

5.3 Project Plan(by using Microsoft Project)

Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
	Planning	**7 days**	**Sat 4/1/23**	**Mon 4/10/23**		
	Project Defination	4 days	Mon 4/3/23	Thu 4/6/23		All team
	Define requirements	3 days	Mon 4/3/23	Wed 4/5/23		All team
	Analysis	**7 days**	**Sat 3/11/23**	**Sat 3/18/23**		
	Requirement analysis	3 days	Fri 1/13/23	Tue 1/17/23		All team
	Information gathering	4 days	Wed 1/18/23	Mon 1/23/23		All team
	Design&Developmei	**50 days**	**Tue 1/24/23**	**Mon 4/3/23**		
	Develop Functional	10 days	Tue 1/24/23	Mon 2/6/23		Saeed
	Develpo system	25 days	Tue 2/14/23	Mon 3/20/23		Abdulkarim
	Install system	10 days	Tue 2/7/23	Mon 2/20/23		Ibrahim
	testing	5 days	Thu 2/16/23	Wed 2/22/23		Omar
	Maintenance	180 days	Tue 2/21/23	Mon 10/30/2		



6. Analysis Phase 1

6.1 Stakeholders:

The client:

NATIONAL WATER COMPANY(NWC).

The customer:

Every company that uses a water storage unit and needs to track water level and water cleanliness.

OTHERSTACKEHOLDERS:

SAUDI ARAMCO.

User of the product:

Company

Restaurants

Houses

6. Analysis Phase 1

6.2 The scope of the work:

The current situation:

It’s hard work for people to track the level of the water in tanks also it’s dangers for them and they can’t be good sometimes in tracking the level of the water.

Motivation:

You can save a lot of money by using a simple system for your water storage.

The context of the work:

Content:

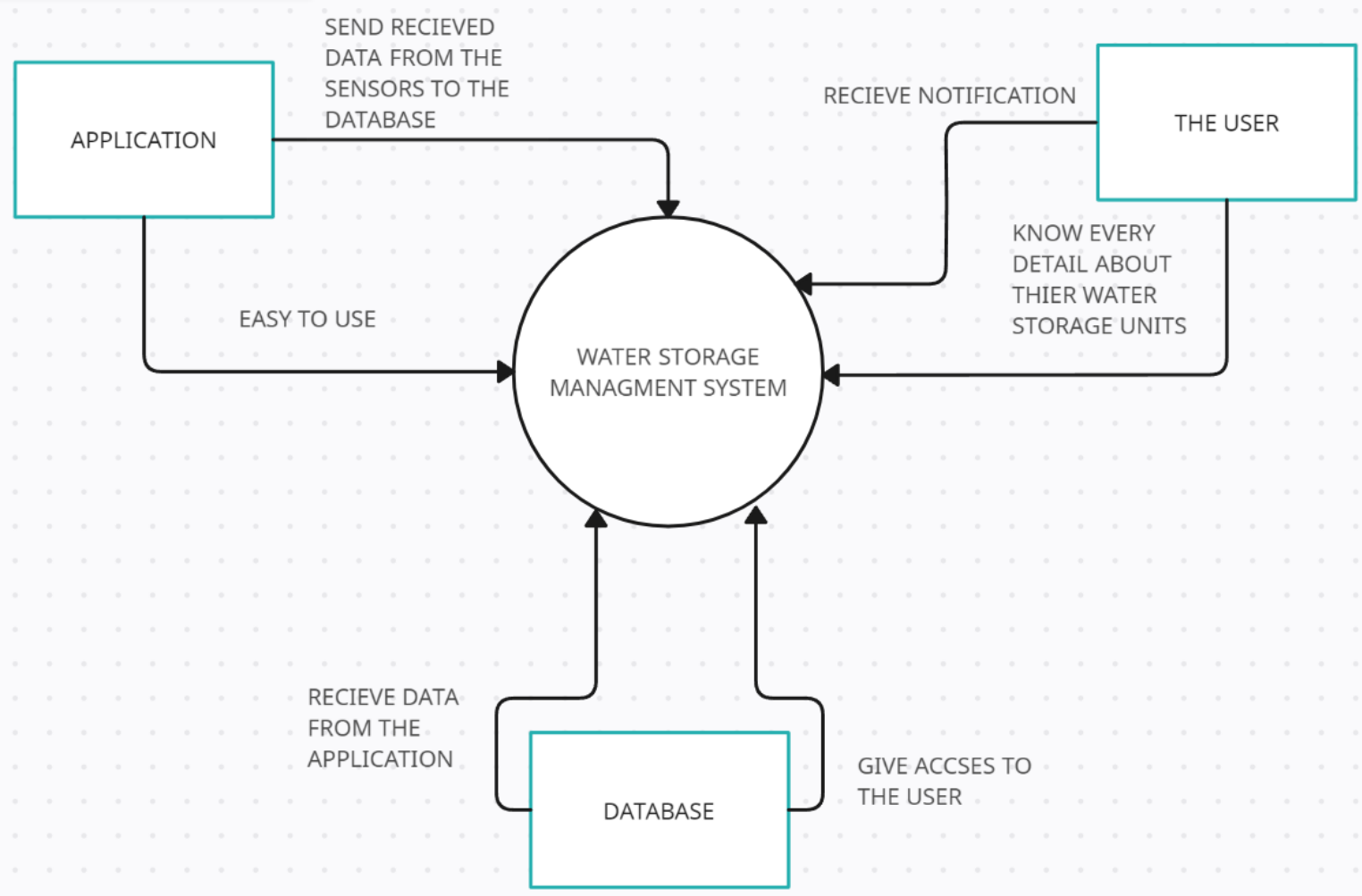
Our system will provide a powerful system to track the level of the water to see if there any pollution in the tanks or any problem.

Motivation:

This system will help you saving time and will give you a good result in the end of the day about the PH level in the water.

6. Analysis Phase 1

6.3 Context Diagram:



6. Analysis Phase 1

6.4 Event Table:

Event name	Input and output	Summary
Set up the system	**Input**	**The user set up the system**
Display water level	**Output**	**The System display water level**
Display PH percentage	**Output**	**The system display PH percentage**
Warning alert	**Output**	**The system should warn the user**
Empty tank	**Input**	**The user got notify when there is no water**

6. Analysis Phase 2

6.5 Function requirements:

ID	Requitements Definition
RD 1	Create an account
RD1.1	Each system have own model numbers to create account.
RD 2	Sign in
RD 2.1	The system will allow every actors to login using their own system model number and password to see the tanks situations.
RD 3	Sensors
RD 3.1	The system should be able to detect water levels and leaks.
RD 4	Measurement
RD 4.1	The system should be able to measure the water's acidity or alkalinity.
RD 5	Discover
RD 5.1	The system should be able to detect any contaminants in the water.
RD 6	Display
RD 6.1	The system should be able to display water levels and PH levels.

6. Analysis Phase 2

6.5 Function requirements:

ID	Requitements Definition
RD 7	Send Notification
RD 7.1	The system should be able to provide notifications if water levels were low or there was a specific change in PH.
RD 8	Warning
RD 8.1	The system should be able to provide warning if there were any contamination.

6. Analysis Phase 2

6.6 Requirement specification for functional:

Interface:

1. Show the level of the water.
2. Show if there any contamination.
3. Show if there any leaks or change in PH.

Business Requirements:

1. The user should log in to see everything about the tanks.

2. When the user ask for an early maintenance, they should provide a reason for that.

Regulatory/Compliance Requirements:

1. This system must be under scrutiny by the staff

2. Only authorized people can access the database of the system.

Security Requirements:

1. The software must ensure the integrity of the customer account information

2. The system must be free of problems to avoid any false alarms

6. Analysis Phase 2

6.7 Non-Functional requirement:

User Interface:

UI1: The user interface will be provided with two languages Arabic and English.

UI2: The user interface will provide user usable and likable interface and easier on the eyes.

UI3: The user interface will have some functionality restriction according to the user authorization.

UI4:The system should be secure and reliable.

UI5:The system should be easy to use and understand.

Hardware Interface:

HI1: the hardware interface can be implemented on phones to provide the best experience.

Software Interface:

SI1: our software interface will be portable and compatible and can be implemented in several environment and operation systems.

SI2: The system should be able to provide accurate results.

6. Analysis Phase 2

6.7 Non-Functional requirement:

Security Requirements:

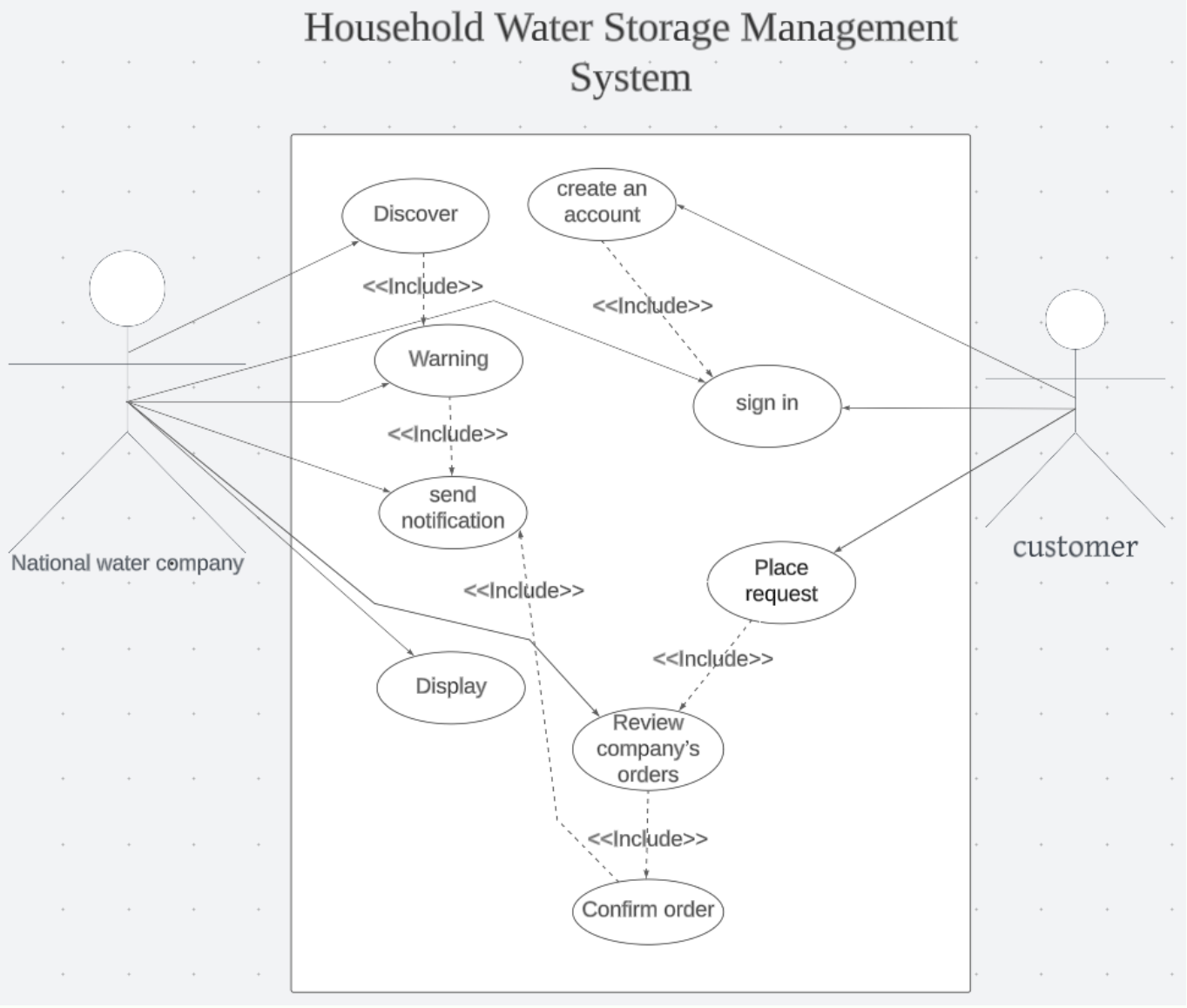
SE1: the system shall provide a login page which consist of the log username and password.

SE2: applications are intended for authorized user only, so anonymous people can’t access or operate over user’s data

SE3: only authorized people can access the system settings to upgrade the system.

7. Design Phase 1

7.1 Use case diagram:



7. Design Phase 1

7.2 Scenarios of the use cases diagram:

Create an account
UC 1
Scope: national water company system.
Level: mandatory, primitive.
Primary actor: the user .
Precondition: the user should be in the water company in the data base
Stakeholders and Interests: the user ,company staff

Scenario

1) The user fills in the form with the information needed like his/her username, password, address and email.
2) A massage will be sent to the user e-mail for conformation.

7. Design Phase 1

7.2 Scenarios of the use cases diagram:

Sign in
UC 2
Scope: The Security of water company
Level: primitive.
Primary actor: the user
Precondition: the user should be in the water company' the data base.
Stakeholders and Interests:water company system, Security staff.

Scenario
1) The security receives an access request from the user
2) Security will verify user information
3) If the information appears correct, he/she is allowed to enter, if the information is wrong, he/she will try again

7. Design Phase 1

7.2 Scenarios of the use cases diagram:

Place request
UC 3

Scope: The System of water company
Level:mandotory.
Primary actor: order
Precondition: the costumer request place
Stakeholders and Interests:water company system,costumer.

Scenario

1)If request of costumer is confirmed accept order
2)If request of costumer is not confirmed reject order

7. Design Phase 1

7.2 Scenarios of the use cases diagram:

Discover ,warning,send notefiction
UC 4.5.6

Scope:costumer
Level:mandotory.
Primary actor: costumer id
Precondition: the company contact with maintenance to solve problems
Stakeholders and Interests:company staff ,maintenance staff

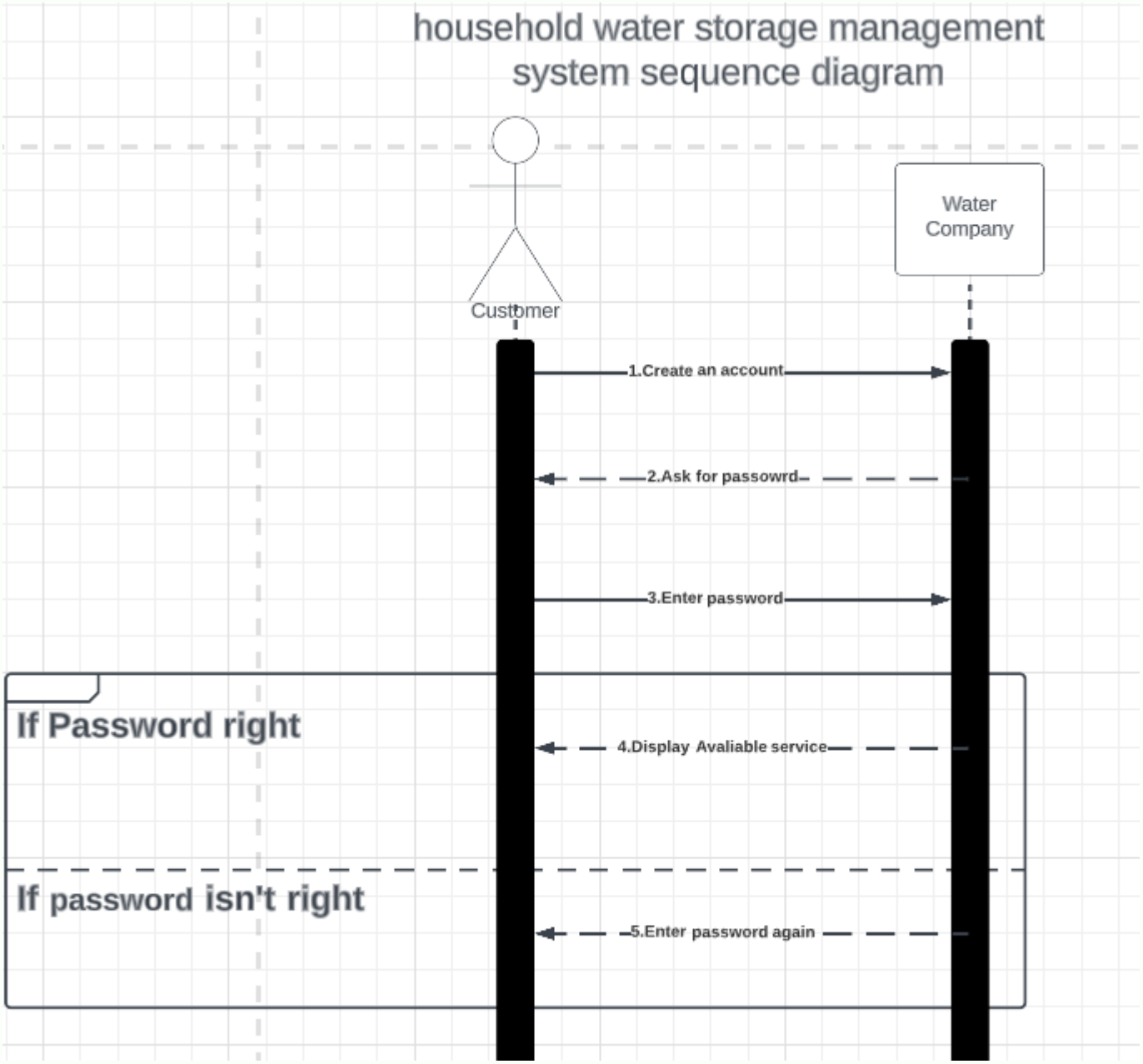
Scenario

1)Company discover the problems in the houses
2)The company contact with maintenance term to fix problem
3)The company send notification to costumer

7. Design Phase 2

7.3 Design phase 2 Sequence diagram

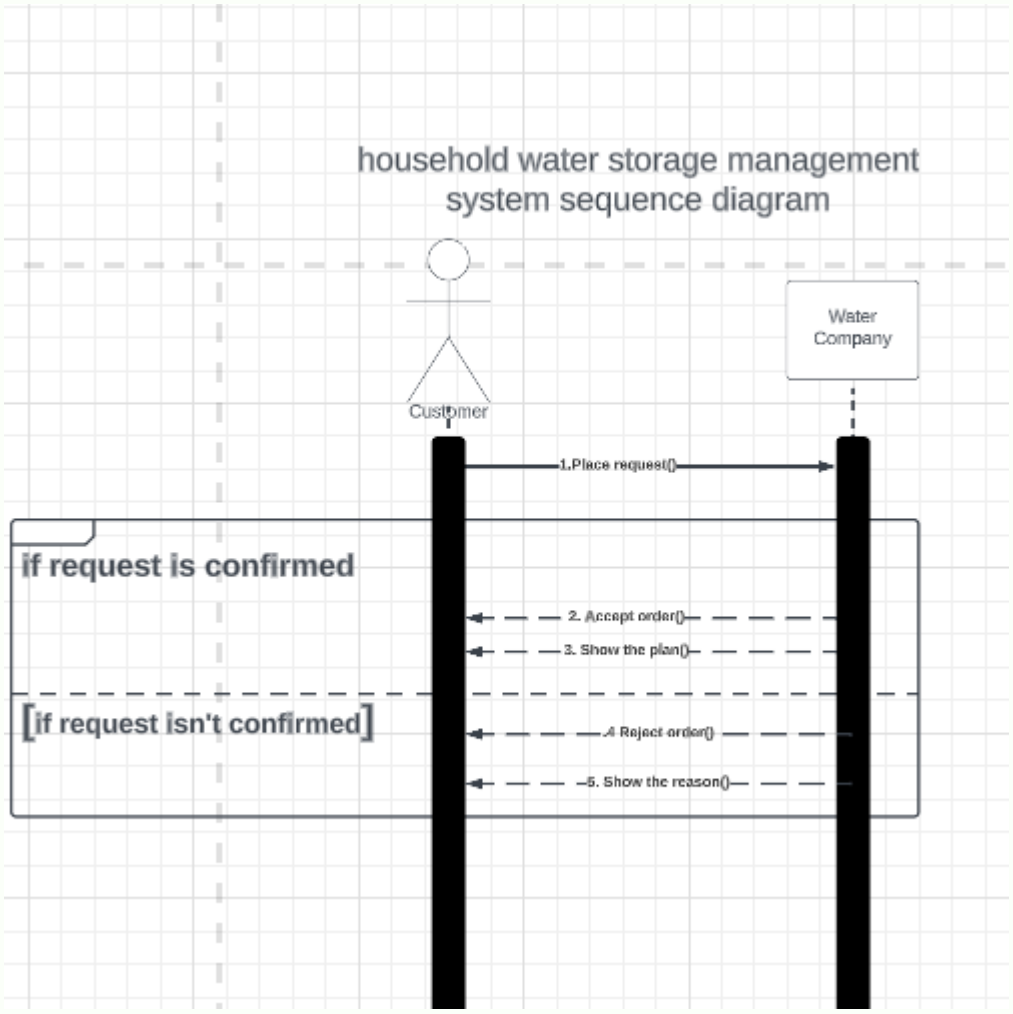
(create account, sign in and display services)



7. Design Phase 2

7.3 Design phase 2 Sequence diagram2

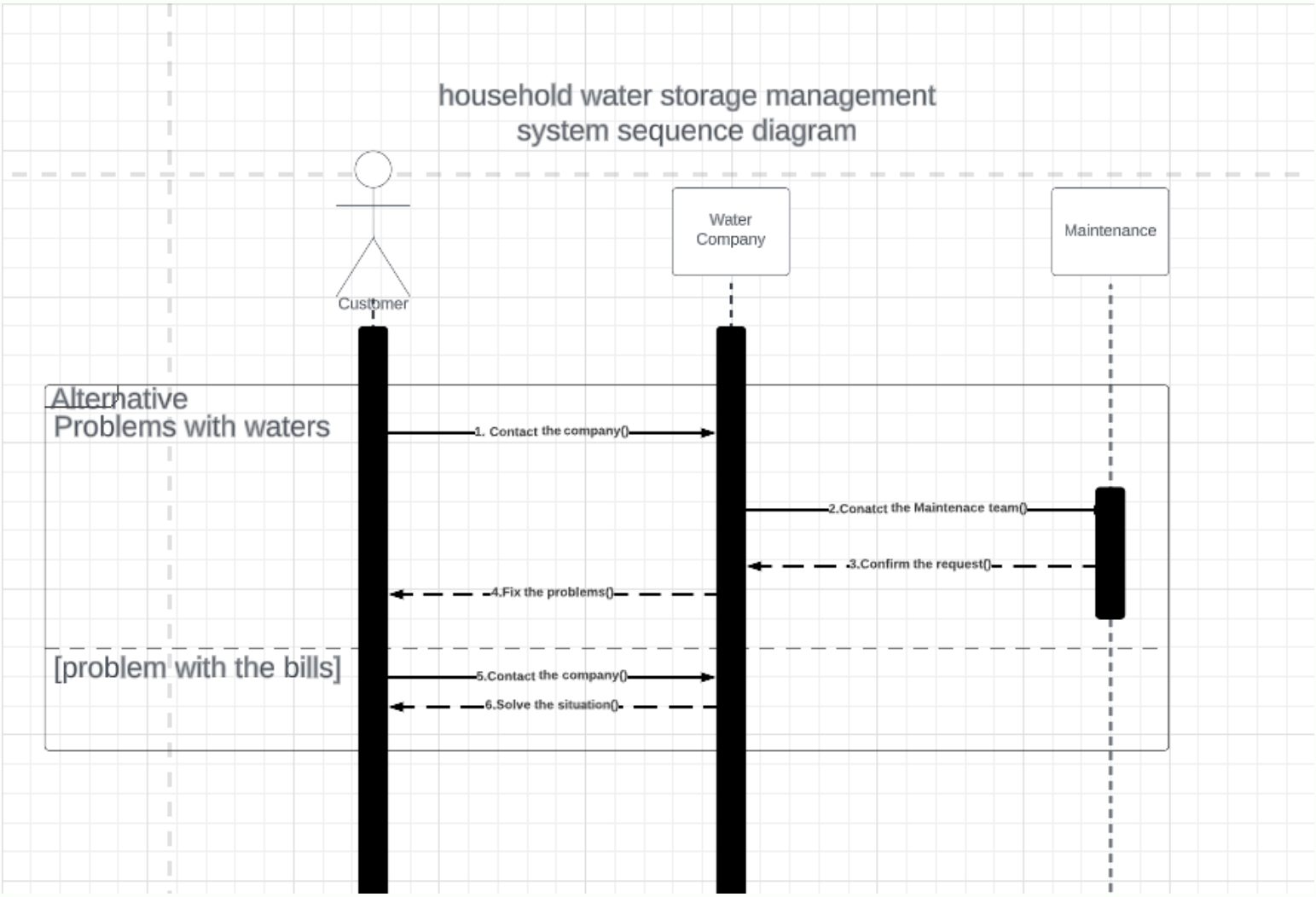
(Place request, review order, confirm order and send notification)



7. Design Phase 2

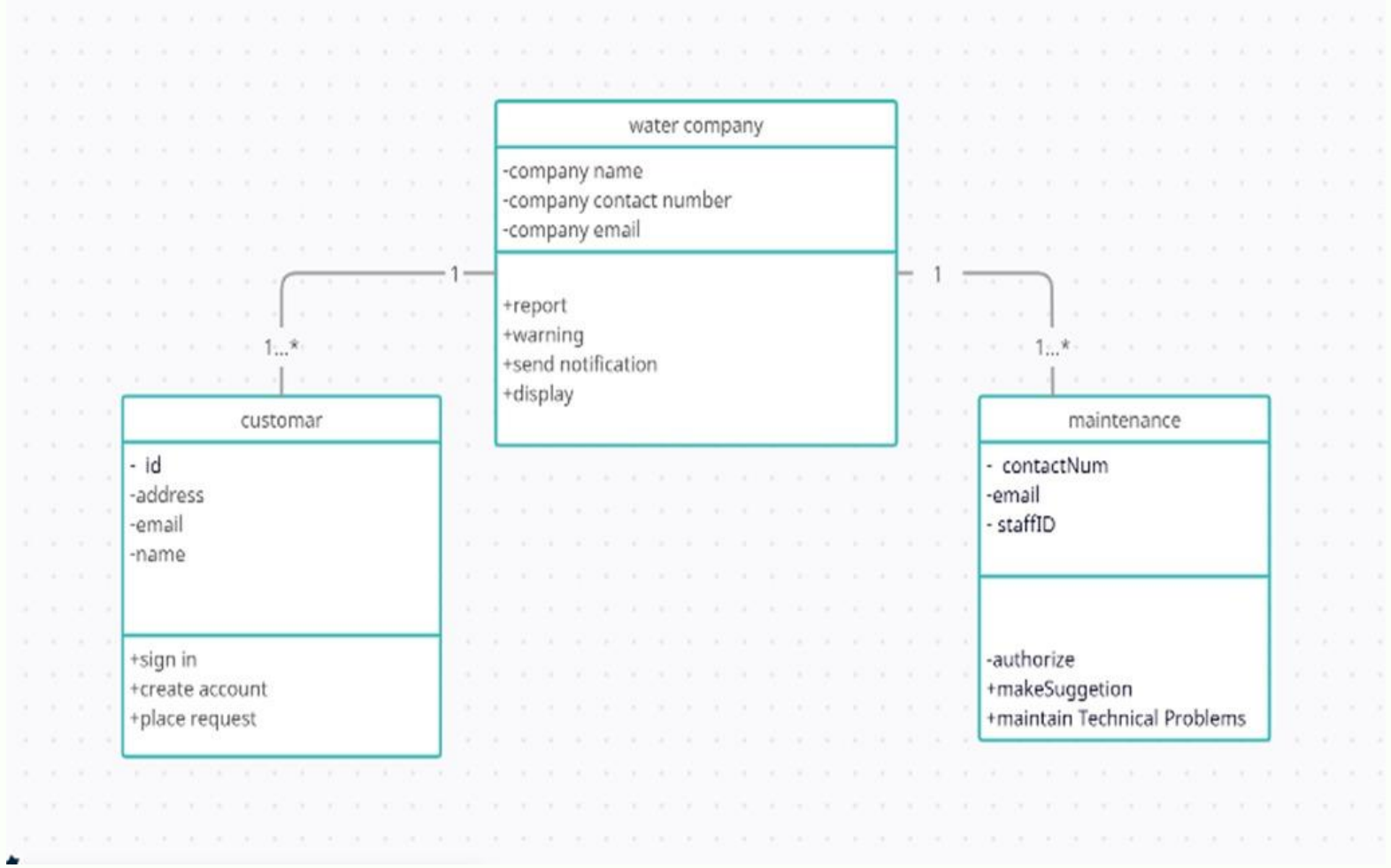
7.3 Design phase 2 Sequence diagram3

(Discover, warning and send notification)



7. Design Phase 3

7.4 Design phase 3 Class diagram



Classes Relationship

7.5 Relationship between classes

1.Relationships between classes
1- The water company can have one or more maintains
2- The maintains have only water company
3- The water company has one to many costumer
4-The costumers has only water company

Classes definition

7.6 Classes definition:

class	definition
Water company	It contain three methods to show contact and information about company ,name and number
costumer	It contain four methods to add costumer , by entering data (id and address and email)
maintenance	It contain three methods to maintenance water company by staff and make suggestion (contact num , email, staff id)

Conclusion with suggestions:

In Conclusion our project is about providing at least the clearest water to use in their life by giving them a warning if there any contamination or changing in the PH level or even any leak in the tanks by using sensors to detect any problem in the tanks because it’s dangerous for people to check by themselves if there was any problem.

It might cost you but think about it you will pay once for everything, and you will watch everything using your phone while you’re sitting in your coach isn’t better than going and rescue your life to check for any contamination, I think it’s the best deal you can make for yourself.

We also suggest the idea of this project to be in every house before building it like one of the conditions to have this system if you want to build in the future so everyone can have a good service and don’t think about the water and if there’s a water or not or any problems with it.

Task table

Lap	Task	Name
1	Project description	Abdulkarim Mohammed Ibrahim Khalid Omar Khalid Saeed Hadi Abdulelah Mohammed
2&3	Interview information Interview description Questionnaire Planning Phase 1&2	Abdulkarim Mohammed Ibrahim Khalid Omar Khalid Saeed Hadi Abdulelah Mohammed
4	5 Planning Phase 3 The feasibility study Report writing Project plan	Abdulkarim Mohammed Ibrahim Khalid Omar Khalid Saeed Hadi Abdulelah Mohammed
5&6	6. Analysis Phase 1 6. Analysis Phase 2	Abdulkarim Mohammed Ibrahim Khalid Omar Khalid Saeed Hadi Abdulelah Mohammed
7	Design Phase 1	Abdulkarim Mohammed Ibrahim Khalid Omar Khalid Saeed Hadi Abdulelah Mohammed
8&9	Design Phase 2 Design Phase 3 Classes Relationship Classes Definitions Conclusion with suggestions	Abdulkarim Mohammed Ibrahim Khalid Omar Khalid Saeed Hadi Abdulelah Mohammed