POLITECNICO
MILANO 1863

DREAM

Data-driven Predictive Farming in Telengana

RASD

Requirement Analysis and Specification Document

Version 1.0 - 29/11/2021

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1. Introduction

1.1. Purpose

One of the most important sectors in each countries' economy is agriculture. Thus, the governments should keep it alive. On the other hand, many issues such as global warming, population increase and COVID-19 pandemic may have negative impacts on this vital sector. Scientists have predicted a significant loss in food supply by the end of century.

It was like a warning to the Telengana's government to come up with the idea of "DREAM". This idea is about designing and implementing a system which can prevent the mentioned disaster with the help of stakeholders, policy makers, farmers, market analysts, agronomists and even normal citizens.

First, in order to achieve the goals of the system, some specific data about Telengana's state have been collected. For example, meteorological forecasts, humidity of the soil, amount of water which use for irrigation, type of products and amount of products which produced by farmers. Then, with respect to this data, the DREAM system should allow policy makers to identify farmers with good performance and poor performance. Also the system should allow farmers to access to collected data and use them to improve their performance. The farmers should be allowed to share their problems with others and request for help.

This document focuses on ***Requirements Analysis and Specification Document (RASD)*** of the system and describes the main goals, the domain assumptions, the scenarios which may happen, the uses cases, the list of functional and non-functional requirements which system should fulfill and finally the diagrams to visualize the interactions between components and performance of the system.

1.1.1. Goals

Goals	Description
G1	Allow policy makers to identify farmers who are performing well.
G2	Allow policy makers to identify farmers who need help.
G3	Allow policy makers to see the result of the steering initiatives.
G4	Allow farmers to see weather forecast.
G5	Allow farmers to see humidity of soil.
G6	Allow farmers to see suggestions relating to specific crop to plan or specific fertilizer to use.
G7	Allow farmers to insert their type of products and produced amount per product.
G8	Allow farmers to insert their problems.
G9	Allow farmers to request for help and suggestion.
G10	Allow farmers to create discussion forums.

1.2. Scope

To manage farmers and help them this application provided and contains 3 main parts:

- Farmers login in the application and then insert their information such as location, amount of production, type of production, and so on. By inserting this information, they could get guides from governments and other farmers for improving the quality of the product.
- Policy makers use this application to identify the good and bad farmers by their performance, then they help farmers by giving solutions and guides.
- Accessing information collected by sensors, water irrigation systems, and governmental agronomists and allowing the farmers to use this information.

Farmers use information collected to improve their product quality and then they insert their information such as the amount of production, quality of production, problems, and solutions. Then policy makers could identify the farmers that worked well or worse and send some solutions and guides to them to improve their production. As well as, farmers get a chance to create forums and discuss problems and get solutions.

1.2.1. World Phenomena

World Phenomena	Description
WP1	Farmer plans crops.
WP2	Farmer irrigates crops.
WP3	Farmer uses fertilizers.
WP4	Sensors measure the humidity of soil.
WP5	Irrigation system measures the amount of water used by each farmer.
WP6	Meteorological adverse events such as flood, storm, lightening fire, etc. happen.
WP7	Farmer faces problems.

1.2.2. Shared Phenomena

Shared Phenomena	Description	Control
SP1	Farmer selects to see weather forecast.	World
SP2	System shows weather forecast to farmer.	System
SP3	Farmer selects to see humidity of soil.	World
SP4	System shows humidity of soil to farmer.	System
SP5	Farmers selects to see suggestions relating to specific crop to plan or specific fertilizer to use.	World
SP6	System shows suggestions relating to specific crop to plan or specific fertilizer to use.	System
SP7	Farmer inserts his/her type of products.	World

SP8	Farmer inserts his/her produced amount per product.	World
SP9	Policy maker selects to see a farmer's detailed info.	World
SP10	System shows farmer's detailed info to policy maker.	System
SP11	Policy maker identifies that the performance of farmer is good or not, based on produced amount, humidity of soil, water consumption.	World
SP12	Farmer inserts his/her problem.	World
SP13	Farmer requests for help or suggestion.	World
SP14	Farmer creates discussion forum.	World
SP15	Policy maker selects to see the result of the steering initiatives.	World
SP16	System shows the result of the steering initiatives.	System

1.3. Definitions, Acronyms and Abbreviations

1.3.1. Definitions

Definition	Description
Steering initiatives	The provided solutions for farmers by agronomists.
Discussion forum	A meeting at which farmers can exchange ideas and opinions about a specific topic.
Notification	A message shown to the user by system when he/she must be notified about something (ex: getting new message in forum).

1.3.2. Acronyms

Acronyms	Description
DREAM	Data-dRiven prEdictive fArMing in Telengana
RASD	Requirement Analysis and Specification Document
GPS	Global Positioning System

1.3.3. Abbreviations

Abbreviations	Description
G	Goal
WP	World Phenomena
SP	Shared Phenomena
D	Domain Assumption
R	Requirement

1.4. Revision history

Version	Date	Modification
1.0	29/11/2021	First version

1.5. Reference Documents

- Specification Document: “01. Assignment RDD AY 2021-2022.pdf”
- Course slides
- IEEE/ISO/IEC 29148-2018 - ISO/IEC/IEEE International Standard - Systems and software engineering - Life cycle processes - Requirements engineering

1.6. Document Structure

- **Section1**
  Overview of the purpose of the project and defining the scope of the system. Describe the specifications such as the definitions, acronyms, abbreviations, revision history, and references. As well as introducing the goals, world and share phenomena of the software.

- **Section2**
  Defining the main scenarios and then explaining the main features in software by class diagram and statecharts. In user characteristics, the types of actors that use the application are explained. The product function subsection defined the functionalities of the application. In the end, the domain assumptions are defined.

- **Section3**
  The main part of the project which introduces interface requirements such as user interface, hardware interface, software interface, and communication interfaces. Presenting the functional requirements that are shown by use case diagrams and sequence diagrams. Then the activity diagram is defined and requirements are mapped to use cases.

- **Section4**
  Using Alloy language for analyzing the system and brief comments for clarifying the Alloy codes.

- **Section 5**
  Shows how much time spent by each member of group.

- **Section 6**
  Contains the references.

2. Overall Description

2.1. Product perspective

2.1.1. Scenarios

- **Identify farmers' performance**

  Mario is a policy maker. In order to improve the agriculture in his region, he has to check the performance of farmers every now and then. He already registered himself in DREAM application before. Opening the application, logs in as a policy maker and selects to see the list of farmers. He clicks on each farmer name to see the details of their work. Then he calculates the performance of each farmer based on their produced amount, water consumption, humidity of soil of their farm and their resilience to meteorological adverse events. Finally, if the farmer's performance is well, he clicks on green button, if not, he clicks on red button and asks an agronomist to gives some notes and suggestions to the farmer to improve his/her work. As a result, the application sends a notification to the farmer, containing congratulation message or the suggestions.

- **View steering initiatives' result**

  Jenifer is a policy maker. Last month, she used the DREAM application to identify some farmers as good performance ones and some as poor performance ones. Now she wants to check whether the guidance which agronomists give to farmers has worked. So she opens the application and logs in as a policy maker and selects to view steering initiatives' result. The application shows her some diagrams. Each diagram illustrates a specific factor (produced amount, humidity of soil, variety of products, water consumption, etc.) over time. If the results improved, she wouldn't change anything. Otherwise, she asks agronomists to update the steering initiatives and publishes them. Thus, the application sends a notification to every farmer, containing new updates.

- **Insert products**

  Mike is a farmer. He heard about the DREAM application from his colleague. He registered himself in the app as a farmer and the position of his farm was inferred by the GPS. Now he wants to insert the detail of his work into application. So he opens the app and logs in as a farmer and selects to insert new product. First, the system asks him type of his product. He enters "potato". Second, the system asks him produced amount of "potato". He enters 1000 kg/month. Then, the system shows a bar from 0% to 100% and asks him how much of his "potatoes" were lost by the recent flood. He marks 10% and confirms to publish. Now, everyone can see his detail of work in DREAM application.

- **Request for help**

  Julia is one of the farmers in the DREAM application. She has a small farm and plans cucumber, tomatoes and celery. However, she faces a problem. Her harvested crops in the recent month are less than in previous months. So she decides to discuss her problem into app. She opens the app and logs in as a farmer and selects to insert a problem. The system

asks her to discuss the problem. She explains the type of her products, the amount of water which use for irrigation, the type of fertilizers which use and any detail about the problem and confirms. Then the system asks her to select one or both of the following options: 1. Request for help from other farmers, 2. Request for help from agronomists. She checks both options and confirms. Finally, the system publishes her problem and now everyone can see her problem in DREAM application.

- **View suggestions**
  Paulo is a farmer who has been labeled as “poor performance” by a policy maker recently. The system has sent him a notification containing some suggestions from policy maker. On the other hand, he has inserted his problem in app a few days ago and has requested for help from agronomists and other farmers. Now he wants to check his suggestions to improve his performance. He opens the app and logs in as farmer and selects to view suggestions. The system shows list of suggestions and he selects each to read.

- **View weather forecast and humidity of soil**
  Sarah is a new farmer and she wants to plan her first crops. Before planning, she should check the weather and soil moisture. So she opens the app and clicks on the map icon. The systems shows map of all regions. Also the system show two button. One for weather forecast and one for humidity of soil. Sarah selects her region on the map. Then the system magnifies her region. Now, she can easily switch between weather forecast and humidity of soil buttons to see whatever she wants.

- **Create discussion forum**
  Ali is a farmer. He just runs out of fertilizer. So he goes shopping and buys a new high quality fertilizer which has a low cost. Now, he’s very excited and want to share his experience with his colleagues. He opens the DREAM app and logs in as farmer and selects to create a discussion forum. The system asks him to choose a title for discussion. He enters “The best and cheapest fertilizer” and confirms. The system asks him to write a message to start the discussion. He explains his experience by detail and sends it. Now, other farmers can see his message and reply to him.

2.1.2. Class diagram

Additional notes on the class diagram:

- As a design choice, a “Farmer” can owns only a “Farm”.
- There is an extra relationship between “Suggestion” and “Agronomist”. But, we didn’t consider “Agronomist”, because it is beyond the scope of our team for this project.

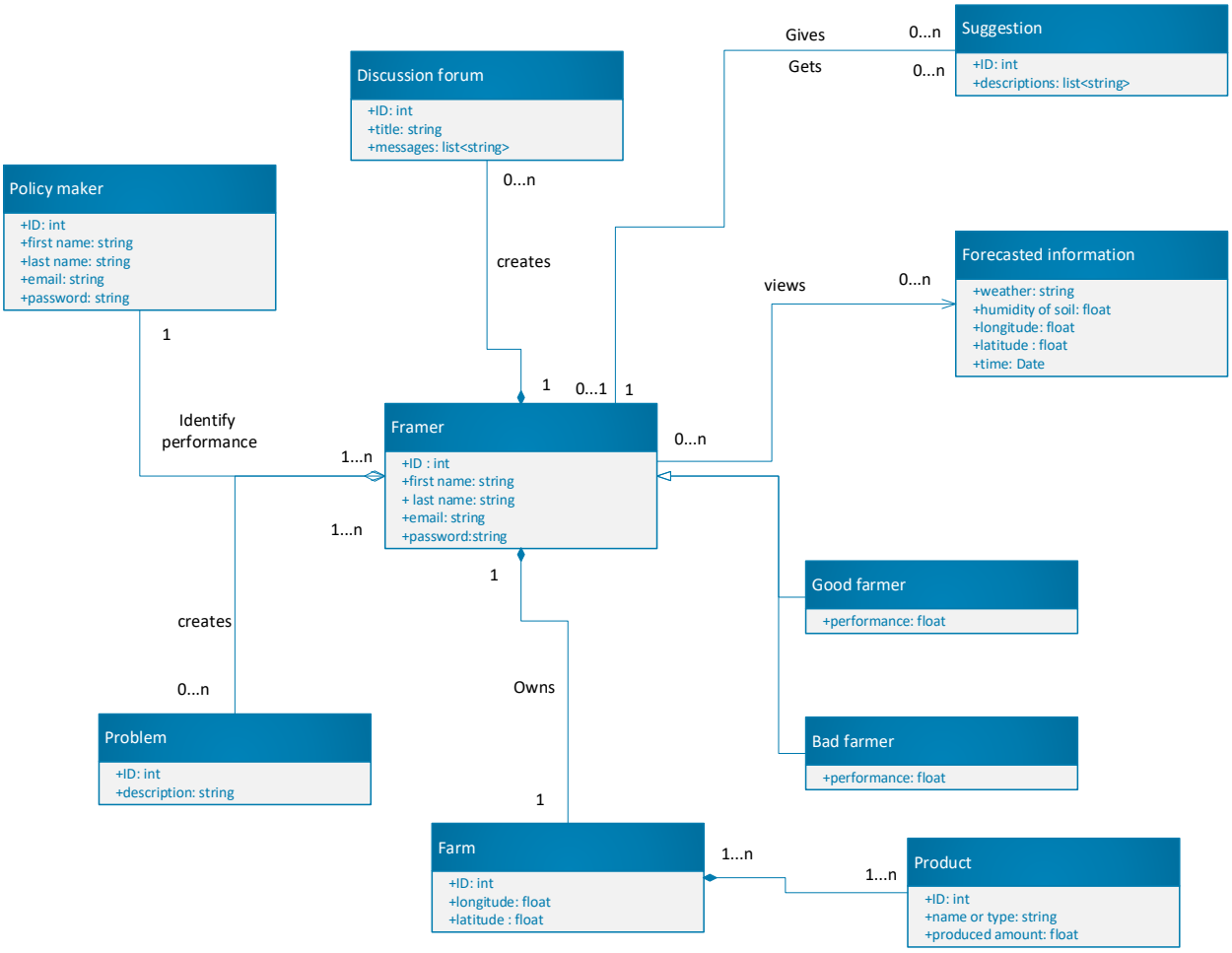

Figure 1 - Class diagram

2.1.3. Statecharts

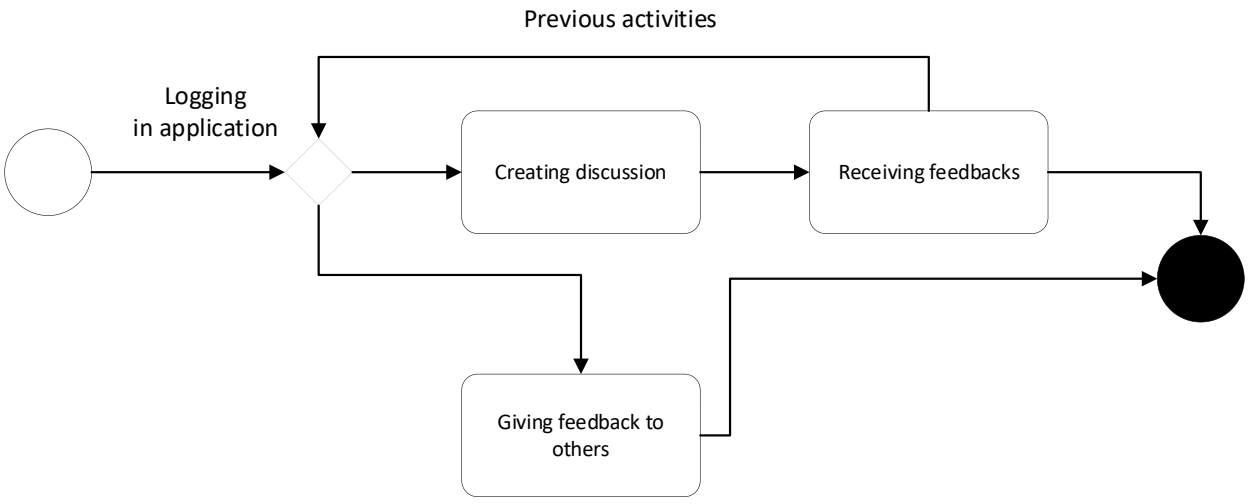

Figure 2 - Statechart 1

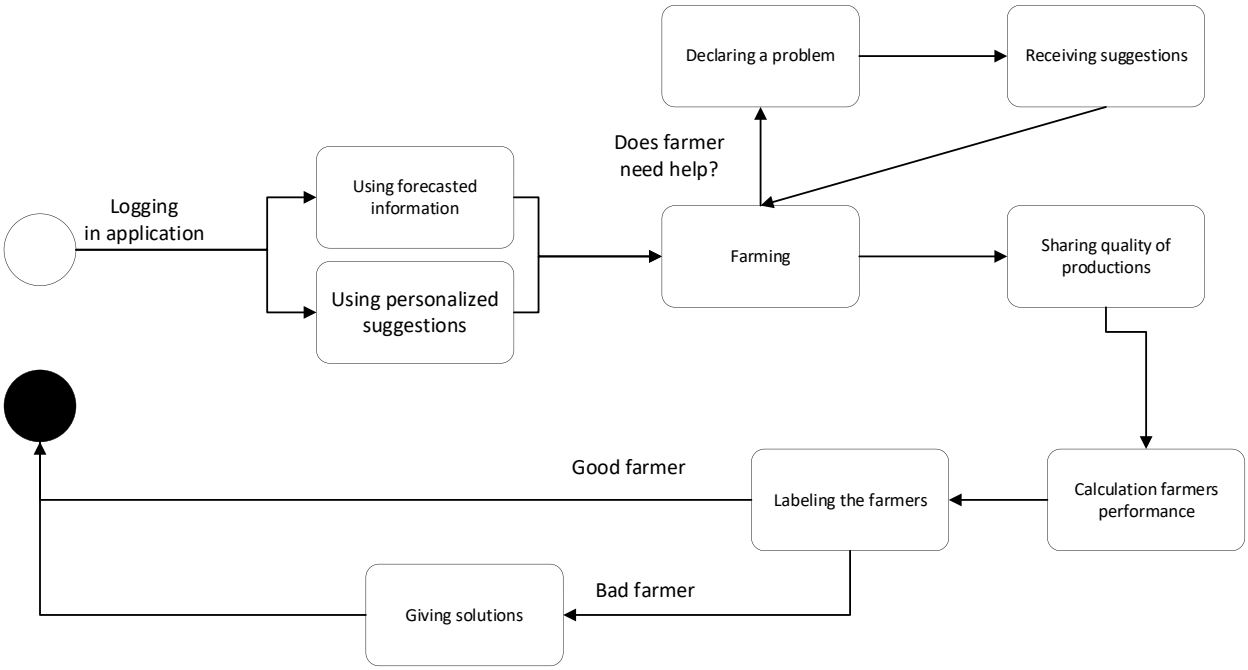

Figure 3 - Statechart 2

2.2. Product functions

Here are described the majority of functions of the system. The less important ones are mentioned in other sections as well.

- **Request for help**
  The most important functionality of the DREAM application for farmers is requesting for help. Farmers can ask for help from other farmers or even agronomists whenever they face a new problem in their work. They should enter the detailed information about their work and the specific problem which happened. Then others can see the request and give any relevant suggestion if they have any experience in it.

- **Identify performance**
  The most important functionality of the DREAM application for policy makers is identifying farmers' performance. Policy makers should frequently monitor farmers' performance, in order to improve their policies. They can view the list of farmers and their detailed information by using this application. Then calculate their performance and label them as good or bad ones.

- **Create discussion forum**
  Another important functionality that DREAM application offers to farmers is to create a discussion forum. Farmers can start a new conversation about a specific topic with other farmers by selecting this option. They should enter a title and start messaging. Then other farmers can see and reply.

2.3. User characteristics

Generally, the actors of the system can be divided into two groups:

- Farmer: a person who registers into DREAM application as a farmer and owes a farm. They can insert their products and their problems. Both they can request for help and give suggestion to others. Also they can view forecasted information and create discussion forums.
- Policy maker: a person who registers into DREAM application as a policy maker. They should monitor farmers' work and calculate their performance. Also they should check whether steering initiatives have had positive result.

2.4. Assumptions, dependencies and constraints

Domain Assumption	Description
D1	Position of farm which is indicated by farmer during the registration process is observed.
D2	Type of product which is inserted by farmer is observed.
D3	Produced amount which is inserted by farmer is observed.
D4	Farmers' performance which is calculated by policy maker is correct.
D5	Humidity of soil which is measured by sensors is accurate.
D6	Weather which is forecasted by IT providers is correct.
D7	Amount of water used by each farmer which is obtained by water irrigation system is accurate.
D8	Problem which is inserted by farmer is observed.
D9	Suggestion which is given by farmers or agronomists is related to problem.

3. Specific Requirements

3.1. External Interface Requirements

3.1.1. User Interfaces

The following mockups illustrate the most important sections of the interactions between DREAM application and users:
(Rest of them will be mentioned in the Design Document)

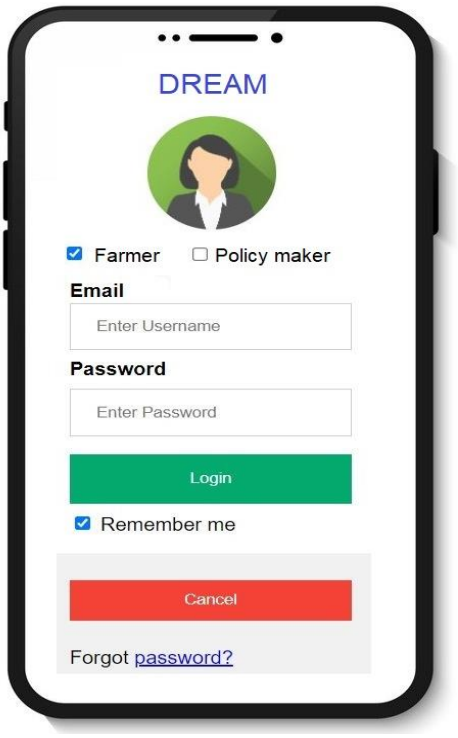

Figure 4 - Mockup: Login

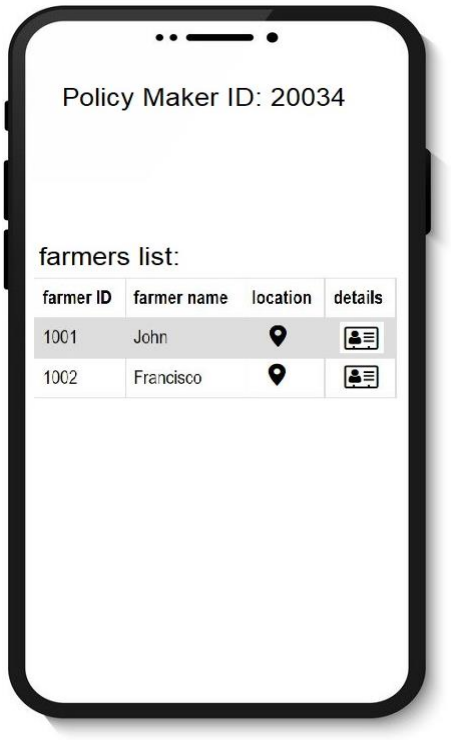

Figure 5 - Mockup: List of Farmers

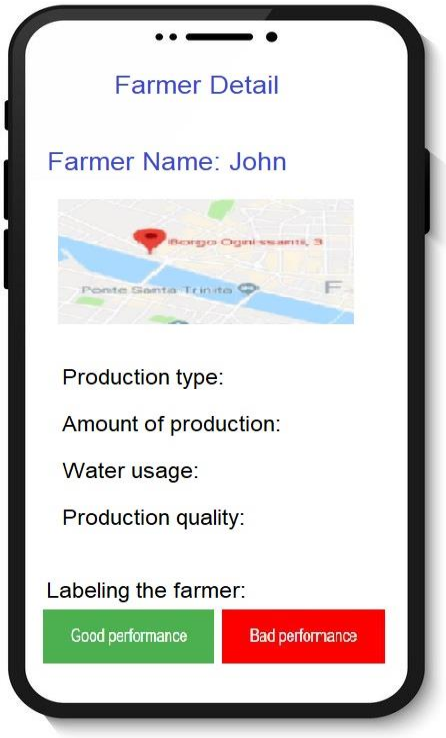

Figure 6 - Mockup: Farmer's Detail

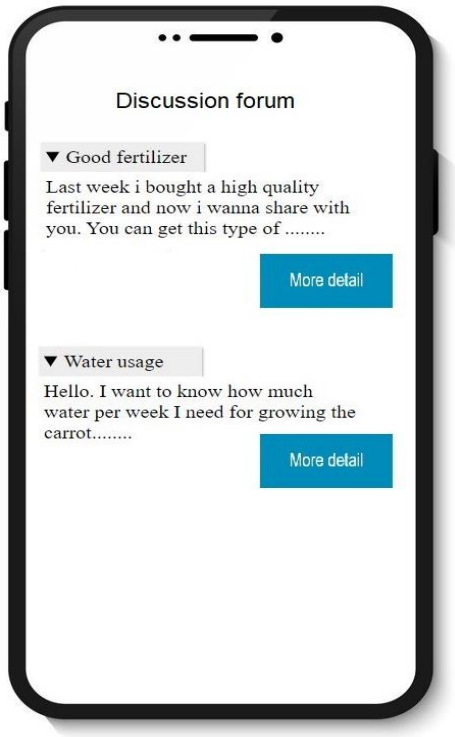

Figure 7 - Mockup: Discussion Forum

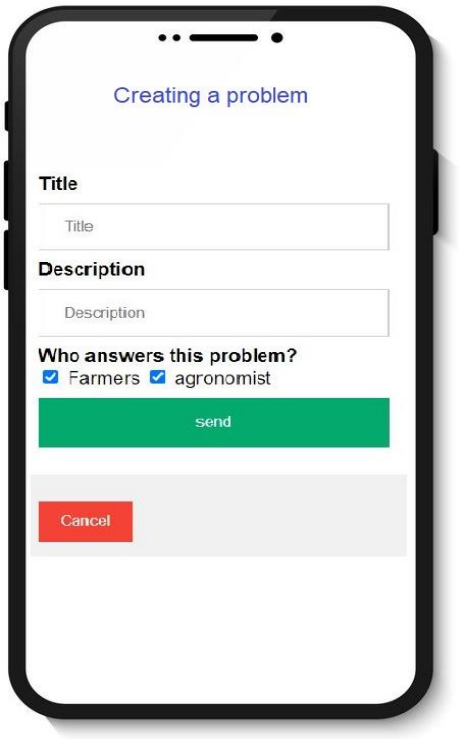

Figure 8 - Mockup: Creating a Problem

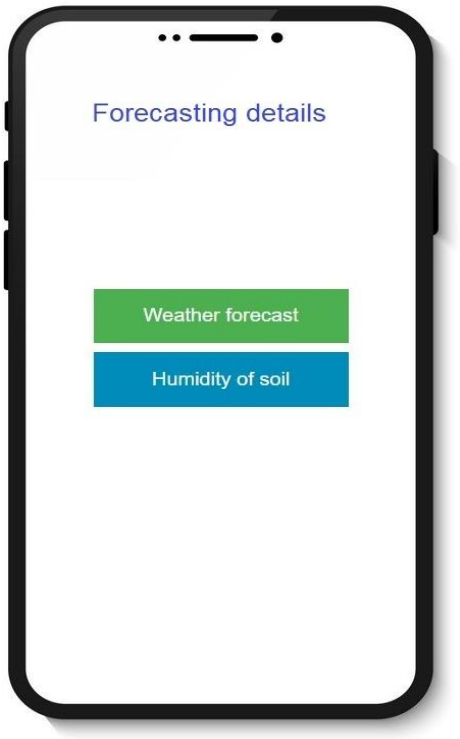

Figure 9 - Mockup: Forecasted Details

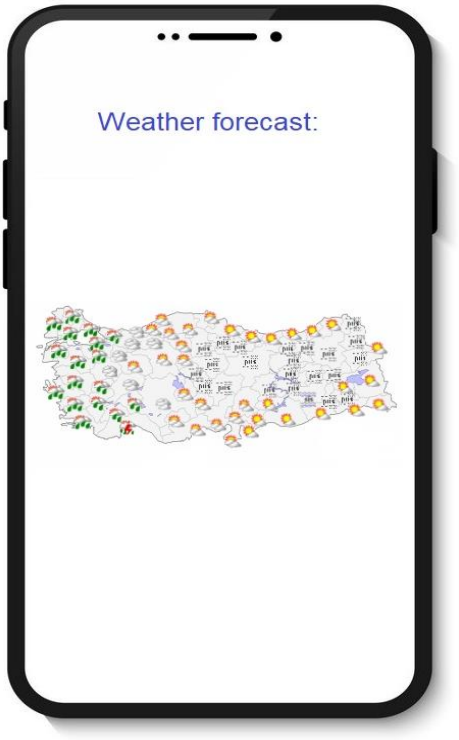

Figure 10 - Mockup: Weather

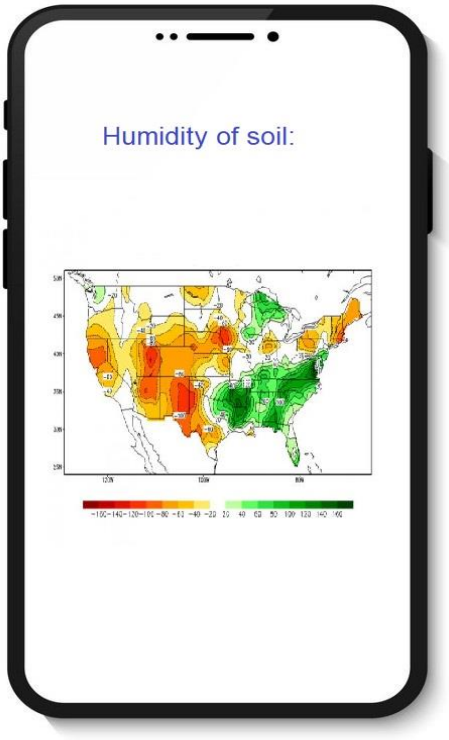

Figure 11 - Mockup: Humidity of Soil

3.1.2. Hardware Interfaces

All the hardware that the DREAM application requires is:

- Users have to use a web browser or a smartphone which can connect to the Internet and can use GPS services.
- In order to measure the humidity of soil, this app uses many sensors which already have been deployed on the territory.

3.1.3. Software Interfaces

3.1.4. Communication Interfaces