UTM

UNIVERSITI TEKNOLOGI MALAYSIA

UNIVERSITI TEKNOLOGI MALAYSIA

FACULTY OF ENGINEERING

SCHOOL OF COMPUTING

SCSJ3553 ARTIFICIAL INTELLIGENCE SECTION 07

PROJECT: FINAL REPORT

PROJECT NAME: FARMSMART

GROUP: 02

1.	Adib Bin Morshed	A20EC4008
2.	Islam Mohammed Ruzhan	A20EC4028
3.	Mir Tamzid Hasan	A20EC4037
4.	Md Shafiur Rahman	A20EC4034
5.	Aaraf Islam	A20EC4001

Contents

Introduction:

Agriculture is an important economic contributor in many countries. Agriculture influences many people globally. Farmers are those who raise food and animals. Much of agriculture's progress depends on the efforts of farmers. Farmers in industrialized countries are prosperous. In underdeveloped countries, farmers are disregarded. In almost every country, agricultural technology is limited. Agricultural techniques in underdeveloped countries are obsolete. As a result of advances in science and technology, several agricultural technologies have been produced. There are a variety of expensive technologies that farmers cannot afford. They lack technological gear. Farmers cannot produce effectively, and the economy cannot expand. Agricultural production presents several challenges for farmers. Unknown diseases harm the crops of farmers. Some farmers are oblivious to soil quality, resulting in significant losses. Farmers are not always aware of which fertilizers to apply. By analyzing the farmers' difficulties, we've discovered that they need a framework centered on finding solutions. They need a method for evaluating soil quality and learning about crop diseases. Additionally, the system must predict when farmers will harvest each crop.

Crop	Sowing day (1-365)	Harvesting day (1-365)
Corn	150	254
Miscanthus	150	285
Giant Reed	150	285
Sunflower	75	245
Sorghum	120	250
Rapeseed	274	170
Cardoon	100	244

2.3 Energy scenarios

Once the total biomass produced yearly by the potentially cultivable areas found before have been calculated it has been supposed how this biomass will be used. An example is proposed in the following table.

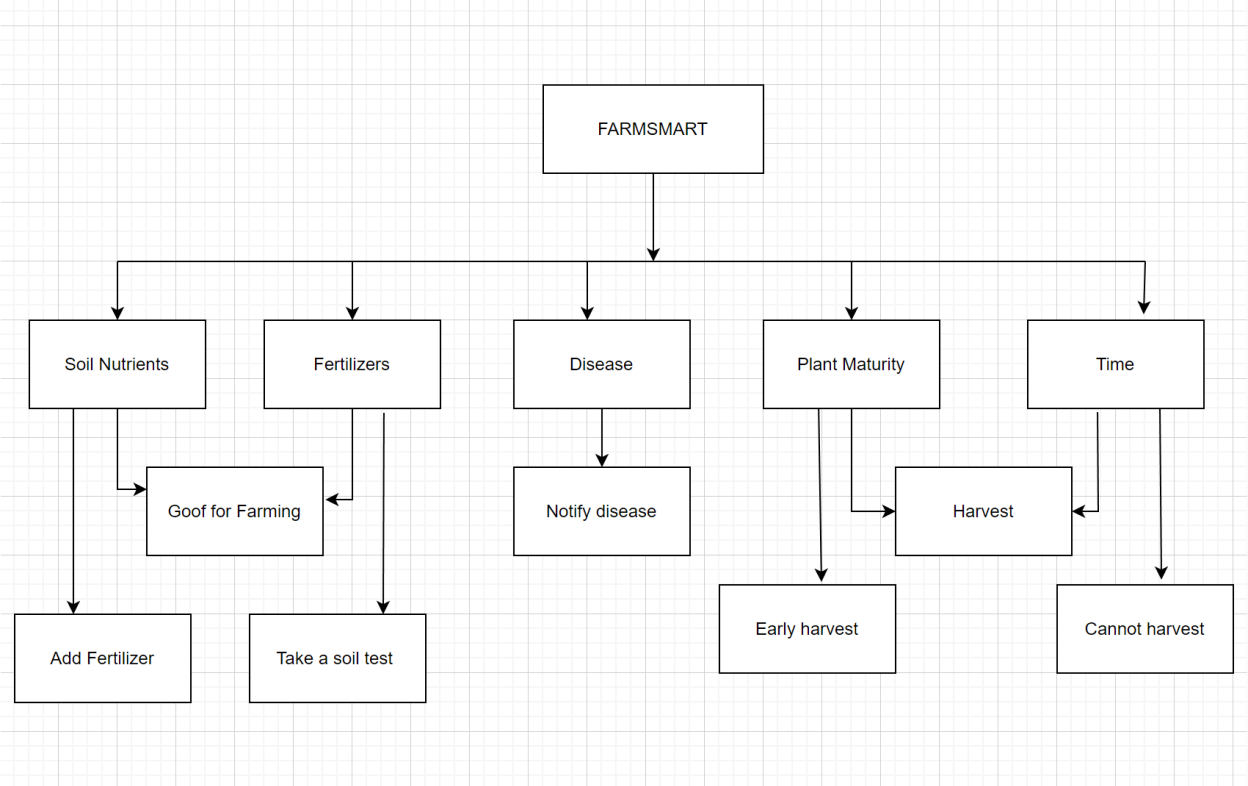
Therefore, farmers want a system that can assist them and solve their agricultural challenges. Thus, farmers' pains and woes may be alleviated, and the nation's agricultural business may expand, resulting in an increase in crop yield.

Problem Statement:

In the agricultural field, the harvesters and the farmers face different challenges by following the traditional method of agriculture. However, with the advancement of technology, the agricultural field has expanded as well. Rainfall, temperature, and humidity play an important role in the case of harvesting, seed sowing, and planting. For the betterment of the plant, it is important to have regular updates on the plant's health, soil state, and other factors. The farmers usually harvest by predicting the temperature, climate situation, and other factors using the traditional method of agriculture. Our main goal for developing this AI is to solve the problems faced by farmers by following the conventional method of cultivation. This will not solve the entire problem faced by the farmers that are dependent on the traditional methods of cultivation, but it will minimize the amount of hassle a farmer has to go through to a large extent with our AI solution.

Proposed Solution:

● In order to notify farmers when to begin harvesting, our technology analyses when crops were planted and when they will be ready for picking.
● The systems will report back to farmers on the fertilizers they've applied, giving them a better picture of how they may optimize their fertilization strategies for maximum crop yield with little input.
● The system’s goal is to inform the farmers about the fertilizers used and will suggest so that the farmers can get an idea of using better fertilizers to improve the harvest quality and quantity.



Project Overview

1. Knowledge Representation (KR)

1.1 Knowledge Representation and Explanation

Soil Nutrients (S)	Fertilizer(A)	Recognize (R)
T	T	Good for Farming
T	F	Add Fertilizer
F	T	Take a Soil Test
F	F	Cannot do farming

KR1:

If S = True and A = True then R = Good for Farming

Explanation:

If the system detects the proper amount of soil nutrients and the proper amount of fertilizer then the system will declare the soil Good for Farming.

KR2:

If S = True and A= False then R = Add Fertilizer

Explanation:

If the system detects the proper amount of soil nutrient but no fertilizer has been used so far, then the system will suggest adding fertilizer.

KR3:

If S = False and A = True then R = Take a Soil Test

Explanation:

If the system detects no soil nutrient, then the system will ask to take a soil test.

KR4:

If S = False and A = False then R = Cannot do Farming

Explanation:

If the system detects no soil nutrient and no fertilizer has been used so far, then the system will declare that farming cannot be done in that soil.

Disease (D)	**Recognition (R)**	**Notify (N)**
T	T	Disease Detected
T	F	Cannot Detect
F	T	No Disease Detected
F	F	Not Detected

KR5 :

If D = TRUE and R = TRUE, then N = Disease Detected

Explanation:

If the plant is diseased and the system recognizes it, then the system will inform that disease is detected.

KR6:

If D = TRUE and R = FALSE, then N = Cannot Detect

Explanation:

If the plant is diseased but the system cannot recognize it, then the system cannot detect the disease.

KR7:

If D = FALSE and R = TRUE, then N = No Disease Detected

Explanation:

If the plant is not diseased and the system recognizes it, then the system will inform that no disease is detected.

KR8:

If D = FALSE and R = FALSE, then N = Not Detected

Explanation:

If the plant is not diseased and the system does not recognize it, then the system will inform that no disease has been detected.

Plant maturity (P)	**Time (E)**	**Harvest (H))**
T	T	Can Harvest
T	F	Early Harvest
F	T	Cannot harvest
F	F	Don’t harvest

KR9:

IF P = TRUE and E= TRUE, THEN H= Can Harvest

Explanation:

If the system detects the plant maturity and the input time matches with the maturity of the crop, then the system will suggest harvesting the crops.

KR10:

IF P= TRUE and E= FALSE, THEN H= Early Harvest

Explanation:

If the system detects the plant maturity and the input time doesn't match with the maturity of crops, then the system will suggest early harvest of the crops.

KR11:

IF P= FALSE and E= TRUE, THEN H= Cannot Harvest

Explanation:

If the system detects the plant isn't matured enough but the input time matches with the maturity, then the system will suggest not to harvest the crops.

KR12:

IF P = FALSE and E = FALSE then H = DON'T HARVEST

Explanation:

If the system detects the plant isn't matured enough and the input time also doesn't match with the maturity, then the system will suggest not to harvest the crops.

1.2 KR involved in achieving the goal of the product:

1. The goal of our system is mainly to let the farmers and harvesters know about the situation of the plant's condition. One of the most important goals is to let the farmers know about the soil nutrients and soil fertilizer. Our system will ensure that the soil has proper nutrients and fertilizers. If it fails to detect proper nutrients and fertilizers, it will notify the farmer to add the necessary fertilizer and nutrients for better farming. The data will be saved and can be used for future reading. The goal of this knowledge representation is to make sure that the harvesters and farmers clearly know about the quality of their crops and have complete information about the required nutrients and fertilizers.

2. One of the goals of our system is to detect diseases in plants. Sometimes, the farmers cannot detect the disease that infected their crops. Thus, they face problems in taking the

necessary steps to cure the disease. Our system will capture the image of the plant and with the help of Artificial Intelligence, it will notify the user if it has a disease not. If the system detects a disease, it will notify the user that the disease has been detected. This scenario is relevant to our KR5. And according to KR7, if the system detects that there is no disease, the system will inform that the plant is healthy.

3. Often the farmers face problems with the harvesting time of the crops, whether it is time to harvest or not. As a result, they either harvest the premature crop or harvest long after maturity. So our designed system will help the farmers to harvest the crops at the right time. The system will detect the maturity of the plants from the clicked images and also check the predicted harvesting time of the crops based on the date the crop was planted. In this way, the farmers can know if the plant can be harvested or not.

2. STATE AND ACTION

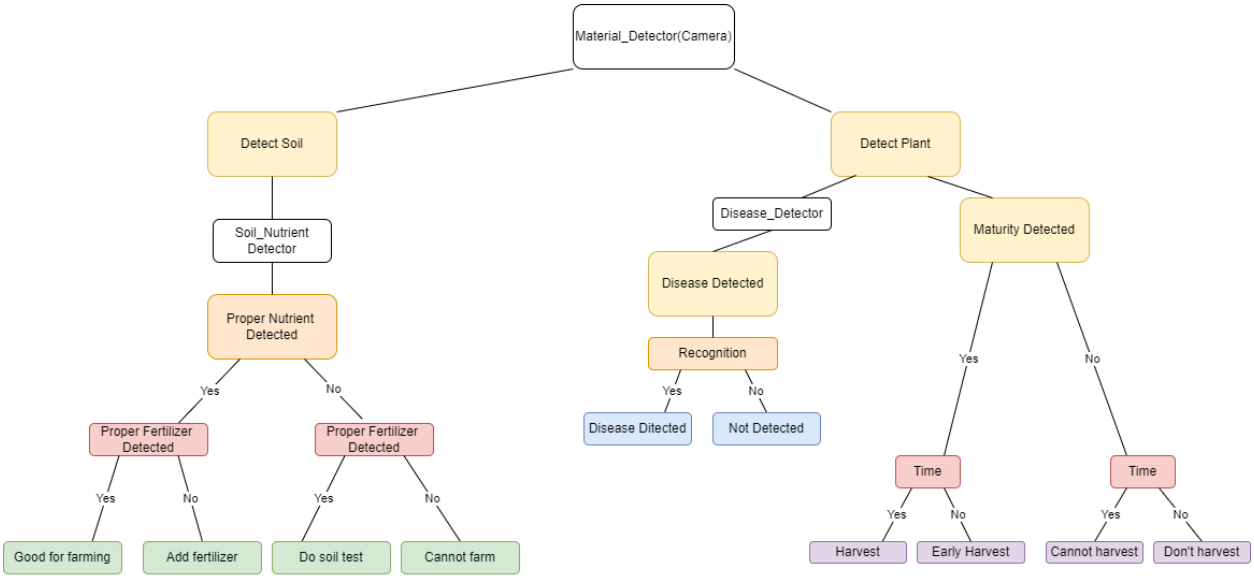


Figure 2 Overview Graph

1st State: The soil detection component will determine whether or not there is a proper nutrient detection. In order to respond to excellent farming conditions and add fertilizer, correct fertilizer detection must occur in the case of proper nutrient detection occurring.

In addition, there is no accurate way to identify fertilizer, which leads to the conclusion that there is no farming alternative available.

● If the correct nutrient and fertilizer involvement are found, the results are favorable for agricultural status.

● If the right nutrients are found but the right fertilizer involvement is not found, fertilizer should be added.

● If the correct nutrient and fertilizer participation are not found, the response is that the farm cannot be operated.

2nd state: Material detector will detect whether it is a plant or not, if it detects it to be a plant then it will proceed to detect whether it has diseases or not. Then the disease detector will proceed to detect whether the plant has diseases or not. The following events will occur once the disease detector gets into action:

• If the plant is diseased, the disease detector will recognize and will notify saying the plant is diseased.

• If the detector does not give the recognition that the plant is diseased, then it will notify saying ‘no disease detected’.

3rd state: The detector will detect if the plant is matured, and the sowing time has been reached or not.

• If the detector detects that the plant is matured and the sowing time has been reached, then the system will inform that the plant is prepared for harvesting.

• If the detector detects the maturity of the plant but sowing time has not reached, then the system informs to harvest early

• If the detector detects the plant is not matured but matches with sowing time, then system informs not to harvest

• If the plant is not matured and the time is not reached, then system informs not to harvest

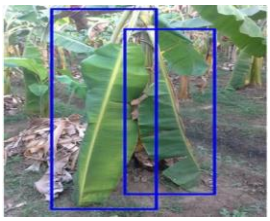
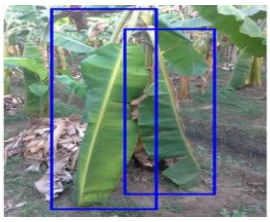
2.1 Problem formulation

1. Initial State: The material detecting component (camera) is opened.
2. Action: The right nutrients are either found or not found. The time of sowing is detected and not detected, and there is also a diseased and maturity detector, in that order.

3. Goal: The soil detection and plant detection for farming and harvesting is based on the components after detection.
4. Path cost: 1 unit of detection per action.

2.2 Problem Formulation to Support the KR

KR	Material Detector	Detector	Action
KR1		Soil Nutrient and Fertilizer detected	Show Text "Good for Farming"
KR2		Soil Nutrient detected but Fertilizer not detected	Show Text "Add Fertilizer"
KR3		Soil Nutrient not detected but Fertilizer detected	Show Text "Take a Soil Test"
KR4		Soil Nutrient and fertilizer not detected	Show Text "Cannot do farming"
KR5		Disease detected and system recognizes	Show Text "Plant is Diseased"

KR6		Disease detected but system doesn't recognize	Show Text "Cannot Detect Disease"
KR7,8		Disease not detected and system recognizes or doesn't recognize	Show Text "Plant Is disease free"
KR9		Plant maturity detected and the input time matched	Show Text "Ready to Harvest"
KR10		Plant maturity detected but input time doesn't match	Show Text "Early Harvest"
KR11, 12		Plant maturity not detected, the input time matched or input time didn't match	Show Text "Cannot Harvest"

2.3 EXPLANATION OF PROBLEM FORMULATION TO SUPPORT THE KR

1. System will declare the soil good for farming or suggest on adding fertilizers by detecting the presence of soil nutrients and fertilizer as depicted in KR1 and KR2,3,4 respectively.

2. System will notify about the specific disease by detecting and recognizing it according to the KR 5.

3. The system is unable to detect the specific disease when the plant is diseased, but the detector cannot recognize it.
4. Disease will not be notified by the system if the plant is not diseased and the detector cannot recognize it; thus, the system will declare the plant disease free as shown in KR7,8.
5. According to KR9,10 the system will show text to harvest the crops when the detector finds plant maturity and if input time matches or not.
6. System will show text “Cannot Harvest” if the detector doesn't find plant maturity and input time matches or not. This is shown in KR11,12.

3. PEAS

3.1 Formulate the Solution by Using PEAS Model

	Before FARMSMART system	After FARMSMART system
P: Performance Measure	● It is difficult for users to have an accurate diagnosis of the plant diseases. ● It is expensive for the users to implement the diagnosis of the diseases. ● Manual detection of diseases	● The users can have a proper diagnosis through the camera of the system. ● The application will be free and the users can diagnose the diseases of the plant without any additional cost. ● Diseases will be detected automatically with the help of sensors.
E: Environment	● The farmers have a tough time cultivating crops. ● Ensuring proper crop health is not possible.	● The system makes it easy for the farmers to cultivate crops.

		• The system ensures proper plant health by providing necessary instructions.
A: Actuators/Effectors	• Users have to take a long time to detect the diseases. • It is not easy to get the proper remedy for the disease. • Soil testing is difficult. • Increasing soil fertility is very difficult. • Proper time of harvesting is not known.	• The system can detect the disease very easily in less time. • The system provides proper remedy according to the detected disease. • The system provides the complete instruction on how to improve the soil fertility
S: Sensors	• The farmers have to detect diseases manually. • The soil fertility is not known easily. • The harvesting period has to be assumed manually.	• The samples of camera image can help detect diseases. • The system detects the fertility of the soil by the camera samples. • The system predicts the harvesting time of the crops according to the sowing date and the crop type and other conditions.

3.2 PEAS Model

Agent: Plant disease and Plant maturity detector

Performance measure: Healthy Plant, Good Soil, Cost Minimization, Reduce through monitoring

- Healthy Plants are ensured.
- Cost is minimized by ensuring healthy and disease free plants.
- Timely harvesting of the plants is ensured through maturity detection.
- Proper nutrient presence in soil is also ensured.

Environment: Crop field, Farms, Green House, Nursery.

- The system will work around Crop fields, Farms and nurseries.
- System will work when there is a crop placed in front of the sensors.
- The system will be able to give a clear response if the picture of the soil is clear.

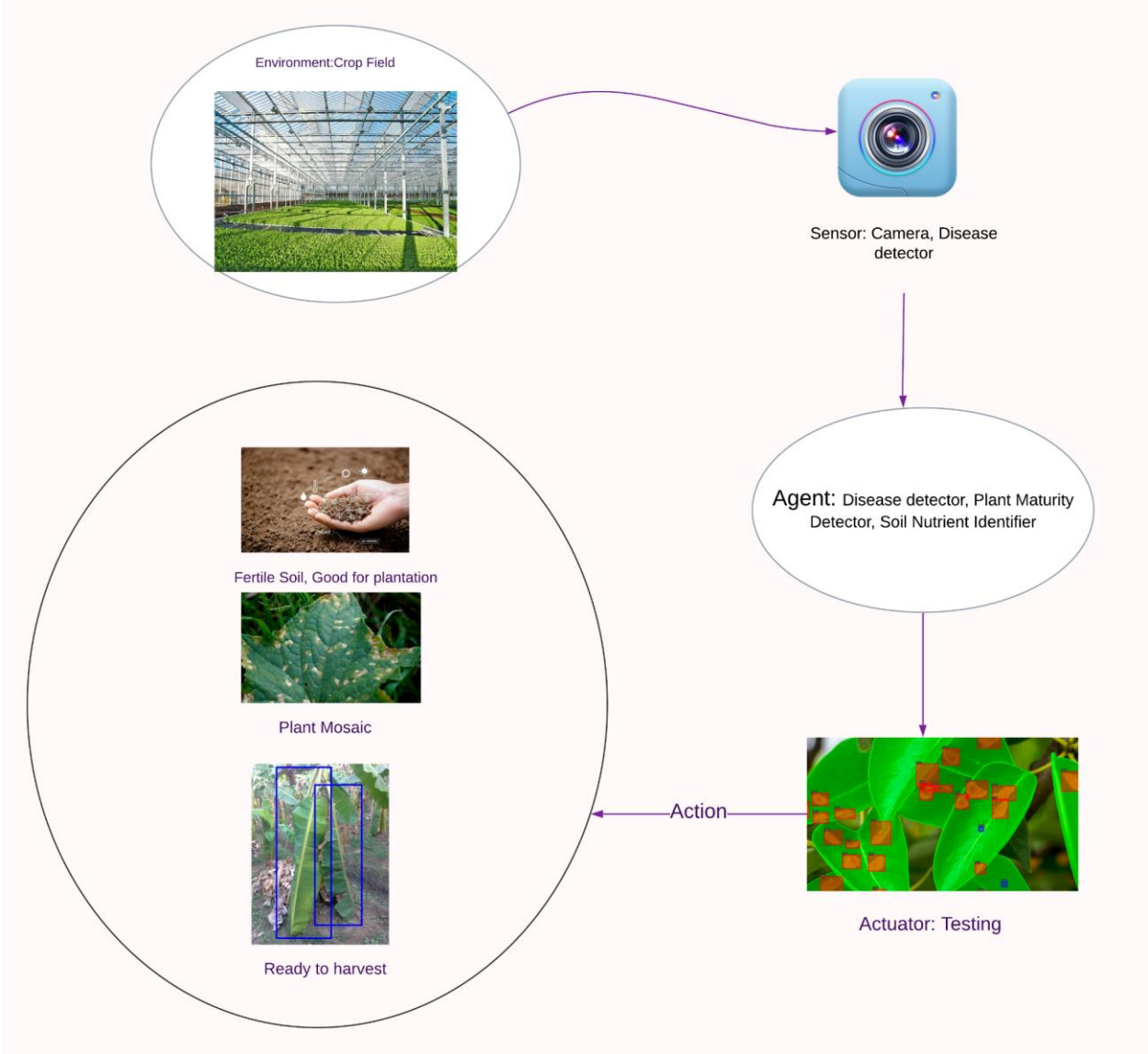
Actuators: Testing, Treatment

- Analyzes plant condition, structure and detects the disease of the plant.
- Provides remedy for the specific disease.
- Prescribes necessary actions for increasing soil fertility
- Provides appropriate time schedule for crop harvesting

S**ensors:** Camera, Disease detection sensor, image classification, image segmentation.

- Camera captures an image of a plant.
- Disease detection sensor detects the condition of the plants if it is alright or affected with any sort of disease.
- Image classification differentiates the soil nutrients and lets users know about the fertility.
- Image segmentation analyzes the length, condition of the plant and provides the decision to either harvest, early harvest or not harvest the plant.

3.3 PEAS Model Diagram



PEAS Model Diagram

3.4 Property Representation in Proof of Concept (POC)

Performance: The goal of our system is to ensure that the crops are healthy and the cultivation of the crops becomes easy for the farmers. After implementing our AI based system, the farmers can easily monitor their crops health and also the health of the crops can be maintained easily.

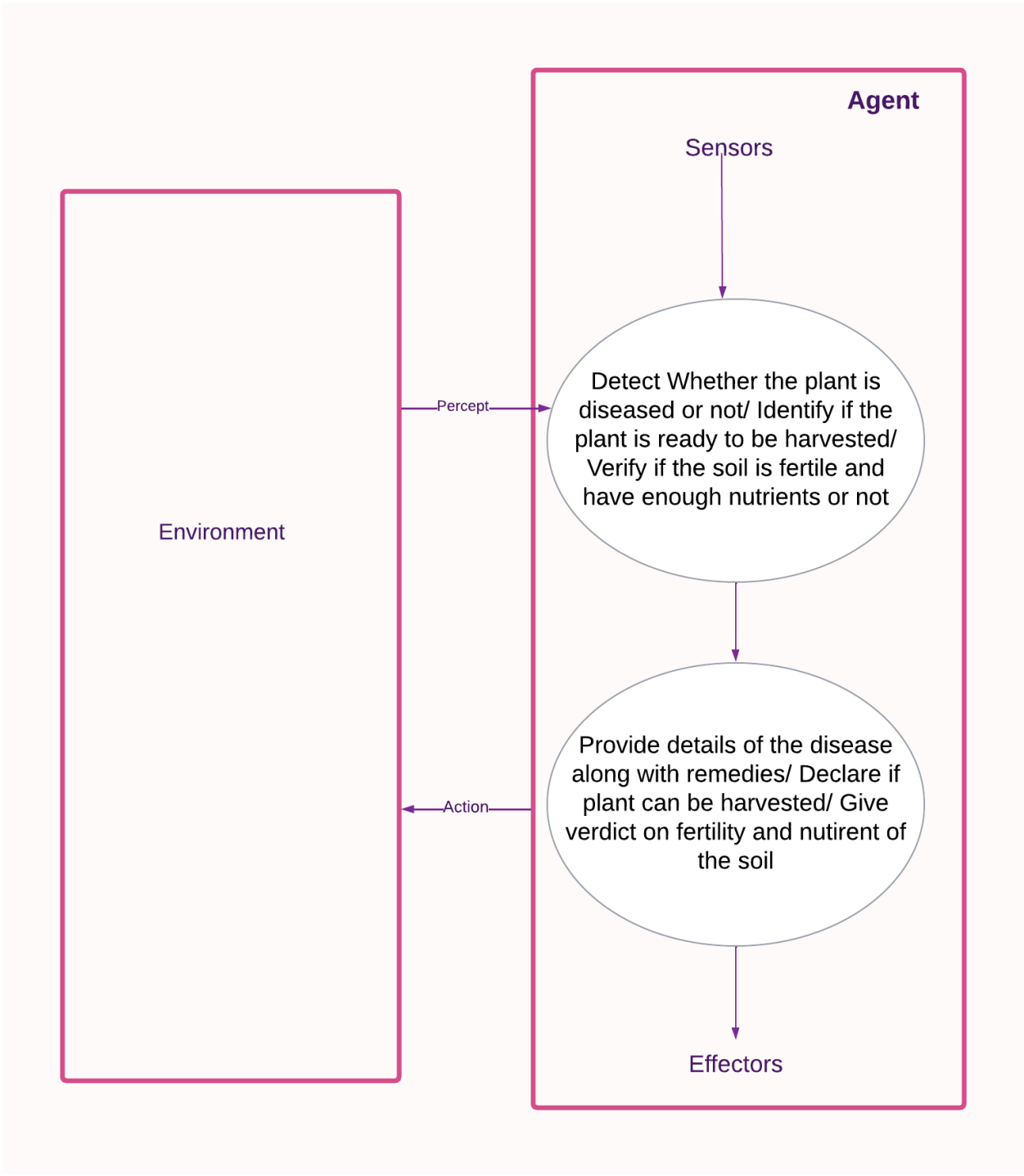
Environment: The system is not suitable for all kinds of environments. It is specially designed for farming. So the system has to be used ion such an environment which is friendly with the system and the environment consists of soils, crops, greenhouse or nursery.

Actuator: The response that will be generated by the system is either if the plant is diseased or healthy, if the soil is eligible for cultivation or not , or if the plant is ready for harvesting or not. The system will also inform about the probable harvesting time. These responses will be determined by the camera and the disease detector and will be shown to the user.

Sensors: The images captured by the camera and the disease detector will act as samples. And with the help of AI will detect the soil and crop quality and also the maturity of the crops with the help of these inputs provided by the user.

3.5 Explanation of The Behavior of The Agent to Achieve the Goal

The type of agent involved with our system is a reflex agent because it takes action based on the condition of the current environment that it is suitable to work on. Our system will work only on plants and the soil. There are different diseases of plants. The agent will identify if the plant is diseased or if the soil is fertile or if the plant is matured. Then the actuator will send a response to the users through the system using the knowledge that has been provided to it by the condition rules.


Agent
Sensors
Environment
Percept
Detect Whether the plant is diseased or not/ Identify if the plant is ready to be harvested/ Verify if the soil is fertile and have enough nutrients or not
Action
Provide details of the disease along with remedies/ Declare if plant can be harvested/ Give verdict on fertility and nutirent of the soil
Effectors

POC Diagram

DEVELOPMENT ACTIVITIES

Group Discussion

Task Distribution

1.	Adib Bin Morshed	Ideating Proposal, Developing KR(1-4), Designing hypergraph, Designing Interface for Soil Testing
2.	Islam Mohammed Ruzhan	Ideating Proposal, Developing KR(5-8), Designing State Action Graph, Problem Formulating and Explaining PEAS Model, Designing Interface for Soil Testing
3.	Mir Tamzid Hasan	Ideating Proposal, Developing KR (9-12), Designing Interface for Plant Maturity Testing
4.	Md Shafiur Rahman	KR Problem Formulation, Designing Overview Graph, Designing Interface for Disease Detection
5.	Aaraf Islam	Developing State Action, Designing Interface for Homepage, Dashboard, Login Page

Conclusion

Our design was proposed to help the general people working in the agricultural sector so that their work becomes easier with the increasing value of artificial intelligence and technology. Artificial intelligence plays an important role in today's world to solve some of the most complex issues. AI has been playing a great role to solve problems in different fields including agriculture, industry, and non-industrial fields. Our proposed solution and design will certainly help the farmers to get sufficient growth and increase the harvest. Our application will also help them to detect plant diseases. By implementing the knowledge and concept of AI, we have tried to work on giving a solution that would certainly make

the life of the farmers easier than before. We have applied the knowledge of AI that we have gained throughout the course to building this project.

References

https://www.figma.com/file/6EDZgGh6OBgqvLrrQvbjrZ/AI?node-id=0%3A1&t=yk1pBY2lPDi1Pdph-0

https://www.v7labs.com/blog/ai-in-agriculture

https://www.analyticsvidhya.com/blog/2020/11/artificial-intelligence-in-agriculture-using-modern-day-ai-to-solve-traditional-farming-problems/

https://www.wipro.com/holmes/towards-future-farming-how-artificial-intelligence-is-transforming-the-agriculture-industry/

Appendix – Interface of the System Prototype.


19:02
DISEASE DETECTOR
MATURITY DETECTOR
SOIL TESTER

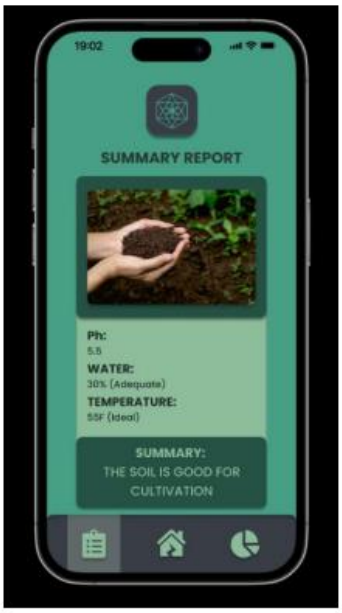

19:02
DISEASE DETECTOR

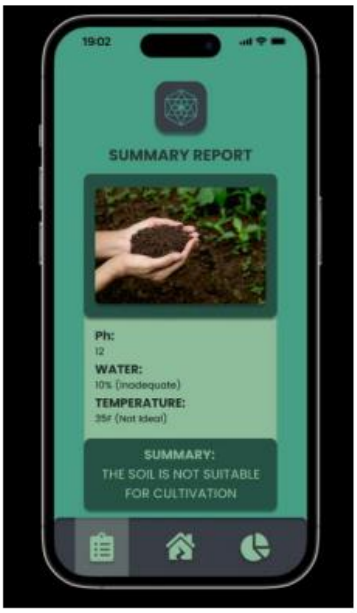

19:02
SUMMARY REPORT
DETECTED DISEASE:
PEACH BACTERIAL SPOT
CONFIDENCE:
0.983

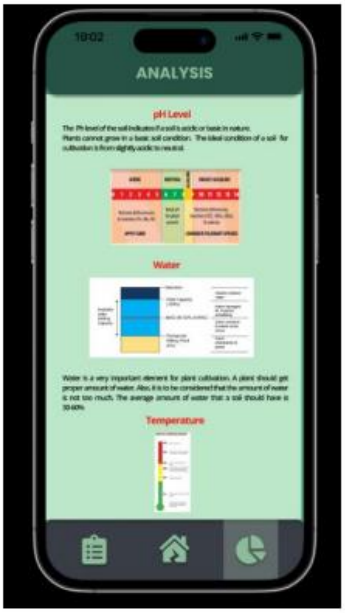

19:02
SUMMARY REPORT
DETECTED DISEASE:
NONE
CONFIDENCE:
1.00
HEALTHY


19:02
ANALYSIS

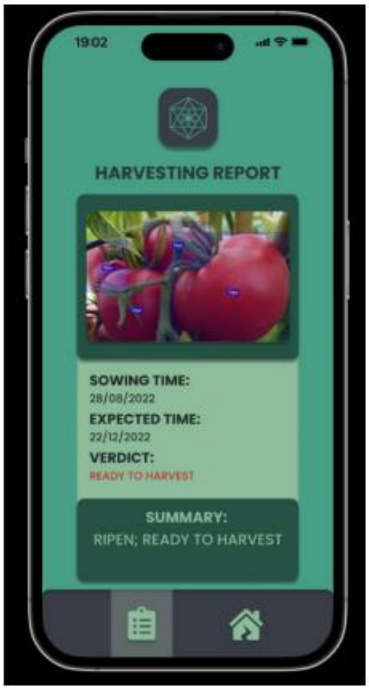

19:02
SOIL IMAGE PROESSING
Ph
No2
Mg
Ca
K
N

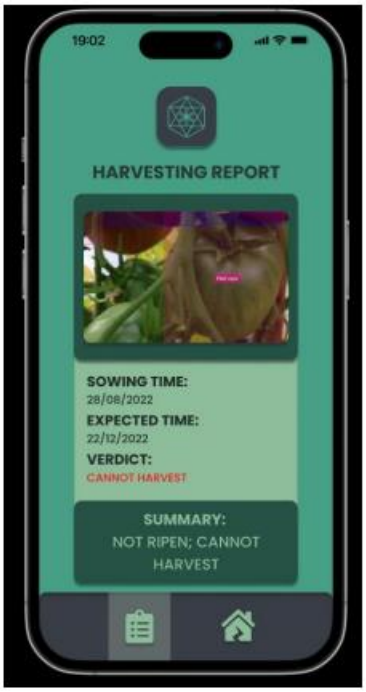

19:02
SUMMARY REPORT
Ph:
5.5
WATER:
30% (Adequate)
TEMPERATURE:
55F (Ideal)
SUMMARY:
THE SOIL IS GOOD FOR CULTIVATION


19:02
SUMMARY REPORT
Ph:
12
WATER:
10% (Inadequate)
TEMPERATURE:
35F (Not Ideal)
SUMMARY:
THE SOIL IS NOT SUITABLE FOR CULTIVATION


19:02
ANALYSIS
pH Level
Water
Temperature


19:02
MATURITY DETECTOR


19:02
HARVESTING REPORT
SOWING TIME:
28/08/2022
EXPECTED TIME:
22/12/2022
VERDICT:
READY TO HARVEST
SUMMARY:
RIPEN; READY TO HARVEST


19:02
HARVESTING REPORT
SOWING TIME:
28/08/2022
EXPECTED TIME:
22/12/2022
VERDICT:
CANNOT HARVEST
SUMMARY:
NOT RIPEN; CANNOT HARVEST