SMART PLANT DISORDER IDENTIFICATION SYSTEM USING COMPUTER VISION TECHNOLOGY

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Developing an IOT device to measure NPK level of soil

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ABSTRACT

Soil analysis before beginning cultivation is an essential part, as soil nutrients are one of the main factors influencing plant disorders. Most plants are susceptible to soil alkalinity and acidity and may not yield better harvest if they fail to meet the requirements necessary. Farmers basically lack the understanding of soil nutrient rates and there's also no simple way to evaluate soil nutrient levels in a property. Because of this in the current structure, most farmers begin their rising by trusting in the misconceptions of society. Trusting myths is harmful since myth-related crops can not necessarily be the most acceptable crop for growing on that specific property. If the ground is flooded with fresh dirt, it is futile to accept theories as well. With current soil nutrients, farmers are thus unable to deliver optimal harvest. Furthermore, only few farmers use scientific methods to find the most effective crop for the property. For that, farmers need to measure soil samples with the aid of the agriculture department. People have to travel long distances to test soil in their land by sending agricultural department soil samples and it is not a successful way as a laboratory test will take several days to generate data. This also needs very high costs and we should not accept it as the average soil product of the soil as the nutrient amounts in a soil differ from location to location. It triggers the farmer to waste both his time and money. Another big issue is soil erosion due to the inability to find the best crop that can be grown on a given land with minimal use of fertilizer. Since farmers struggle to find the right crop for current soil nutrient levels in the soil, they will need to use additional fertilizer which would have a bad impact on soil health. New farmers who are fresh to the agriculture sector are facing serious issues because they do not have a deep understanding of the crops. Unless they fell at the outset, they're not going to invest more in the agriculture sector. Therefore it is easier for both farmers and new beginners to provide a more reliable and productive approach to determine the best crop that can be cultivated on a given soil and a parallel fertilizer plan dependent on the current soil nutrients, as it prevents wasting their time and money.
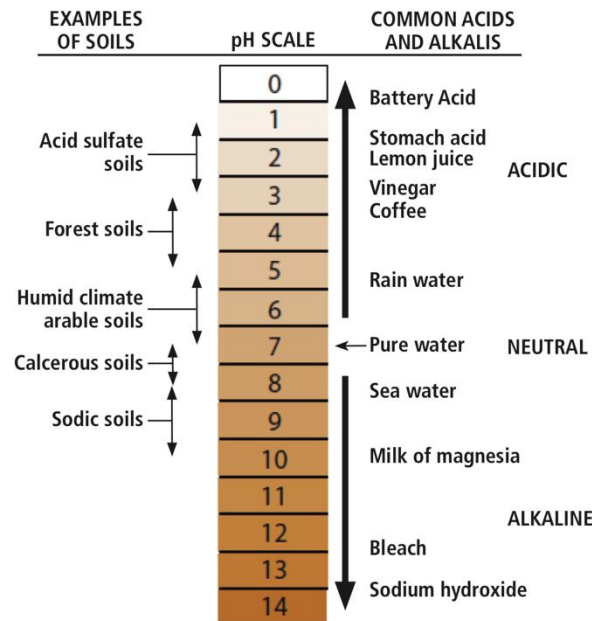
ACKNOWLEDGEMENT

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1. INTRODUCTION

1.1.Background Literature

As noted in Nutrient Management Modules 2 to 7, soil pH and natural issue intensely affect soil capacities and plant supplement comfort. In particular, pH impacts solvency and comfort of plant supplements, execution of pesticides), and natural issue deterioration. In spite of the fact that dirt pH is generally comparative in Montana and Wyoming (pH 6.5-8.0), it will differ from 4.5 to 8.5, exacting clean fruitfulness and creation challenges at these limits. In this way, to get a handle on supplement accommodation and best developing conditions for explicit yields, it's indispensable to comprehend factors that affect soil pH, and furthermore the impacts of pH on supplement comfort.

Soil pH scale is set by the grouping of hydrogen particles (H+). it's a proportion of the dirt arrangement's corrosiveness and pH scale, on a scale from 0 to 14 Acidic arrangements have pH scale under 7, though essential or pH scale arrangements have a pH scale more prominent than seven.

By definition, pH is estimated on a negative size of the hydrogen ion fixation [H+], i.e., pH scale = - log [H+]. Hence, as hydrogen particle (and acidity) goes up, pH scale value goes down. Additionally, because of pH is a logarithmic capacity, each unit on the pH is multiple times more acidic than the unit on head of it. for example, a pH scale 6 arrangement joins a 10 times bigger grouping of H+ particles than a pH scale seven arrangement, and a 100 times higher fixation than a pH scale 8 arrangement.

EXAMPLES OF SOILS	pH SCALE	COMMON ACIDS AND ALKALIS

Acid sulfate soils

Forest soils

Humid climate arable soils

Calcerous soils

Sodic soils

0 — Battery Acid
1
2 — Stomach acid / Lemon juice — ACIDIC
3 — Vinegar
4 — Coffee
5 — Rain water
6
7 — Pure water — NEUTRAL
8 — Sea water
9
10 — Milk of magnesia
11 — ALKALINE
12 — Bleach
13 — Sodium hydroxide
14

Absorption of moisture during capacity and taking care of will lessen the physical quality. Knowing at which dampness the evaluations begin to retain enormous amounts of water is significant.

Water vapour will move from both high to low water vapour pressure

• Water vapour

25°C

NPK
p H_2O: 15.7 mbar

Water
p H_2O: 31.7 mbar
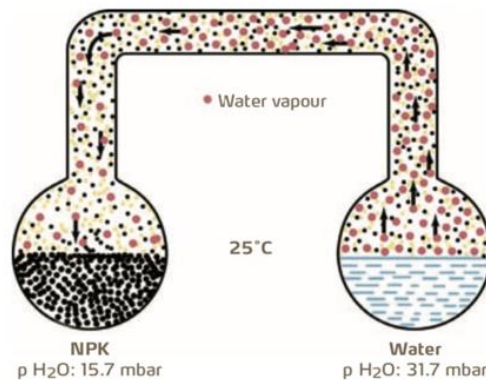
In Sri Lanka, there are both laboratory testing for pH and digital pH testing currently used. Other than other countries all around the world Sri Lanka have high variation of pH and humidity so that it is a hard task to give a medium value for pH or humidity

A group of researchers Komal Abhang, Surabhi Chaughule, Pranali Chavan, Shraddha Ganjave has done a research on soil analysis and furthermore, crop fruitfulness expectation subsequent

to alluding results assembled by testing the specific ground soil by ordinary lab tests done by the rural office.

The primary point of our device is to Atomize current manual soil testing method. In our framework we are building handheld gadget utilizing pH meter which will give pH estimation of soil. pH is negative log of hydronium particle mole per liter pH = - log [H3O+]. With assistance of this pH esteem we will appraise NPK of that dirt, which are essential Macronutrients of soil.
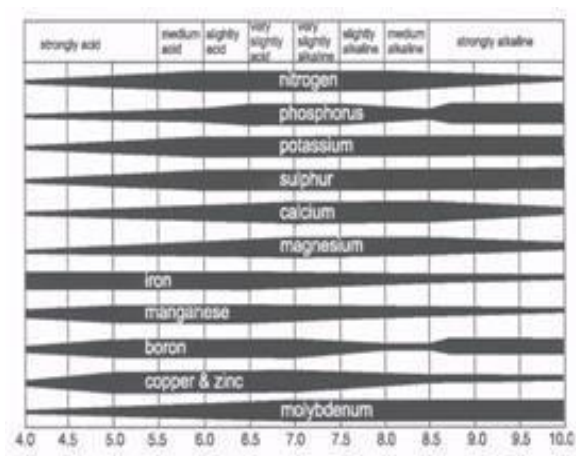
Traditional soil testing presents a nearly insurmountable problem for farmers of small parcels. A second simplification tool for site-specific nutrient management for small farmers is the soil test kit. Access to soil test results such as those used to develop maps of soil properties are very difficult or impossible for farmers of small land parcels. Soil testing laboratories often do not even exist in most developing countries of the tropics. The soil test kit is not intended to serve as a replacement for standard soil testing but designed to enable extension officers and farmers to diagnose nutrient extreme deficiencies and excesses. Even when standard laboratories are available, the delay between sample collection and when the results are received may often preclude use of the results in the fertilizer decision making. It is an unusual farmer manager who anticipates the fertilization decision and sends in a soil sample in preparation for the decision.

Nitrogen (N) assurance in the research center as per John Kjeldahl (1883) technique:

Test pre-treatment: It is major that all guides to be pretreated to agree to the norm in the field of soil. Care was taken during the preparing so that not to incident proportion of nitrogen, along these lines, the temperature was under 400°C. The philosophy: Right off the bat, the homogeneity of the laboratory test similarly as the test was guaranteed

Digestion:

Dried and crushed example segment of 0.2 gram (expected nitrogen content equivalent to 0.5%) to one gram (expected nitrogen content roughly 0.1%) was utilized. At the point when 10 ml sulfuric corrosive (4.2) was included, whirled until the corrosive was altogether blended with the example. The blend was permitted to represent cooling. At that point 2,5 g of the impetus blend 4.3 was included and warmed till the assimilation blend turned out to be clear. The blend was bubbled delicately for 5 hours to permit the sulfuric corrosive gathers around 1/3 as far as possible of the cylinder. The temperature of the arrangement was kept up underneath 400 °C

Titration:

After processing was finished, the cylinder was left to cool; and 20 ml of water was included with gradually shaking. At that point the suspension was exchange to the refining device 5.4. At the point when; 5 ml of boric corrosive 4.5 was added to a 200 ml cone shaped jar and set under the condenser of the refining contraption so that the finish of the condenser dunks into the arrangement. At that point 20 ml of sodium hydroxide 4.4 was added to the pipe of the mechanical assembly and ran the antacid gradually into the refining chamber. From that point, around 100 ml of condensate was refined, wash the finish of the condenser, at that point few drops of blended marker 4.6 were added to the distillated and titrated with sulfuric corrosive 4.7 to a violet endpoint. Steam refining was utilized. Refining was ceased when 100 ml of refining was gathered.

Calibration:

Adjustment substances with known and unchangeable substance of nitrogen were utilized to control the processing and the mechanical assembly. Sulfanil corrosive with realized nitrogen content was utilized. Other than these substances ensured reference materials were utilized also to control the entire method

K-mean in Agriculture:

The K-means algorithm is separation based grouping methods. By applying this algorithm, K group are shaped. In light of Euclidean separation, object is put into the individual group. The k-implies calculation is utilized to characterize soil in blend with GPS. Grouping of plant and soil, reviewing apples before showcasing, Monitoring water quality change, recognizing weeds in accuracy horticulture, and the forecast of wine aging issues can be performed by utilizing a k-means approach.

K-nearest neighbour in Agriculture:

In pattern recognition, the k-Nearest Neighbours algorithm is a non-parametric technique utilized for grouping and relapse. In Agriculture, k-NN calculation is utilized in mimicking day by day precipitations and other climate factors and Estimating soil water boundaries and Climate anticipating.

Neural Networks in Agriculture:

In information mining a factual model known as Artificial Neural Network is a Non-direct prescient model that learns through preparing and looks like natural neural organizations in structure.
The neural network is used in Prediction of flowering and maturity dates of soybean and in forecasting of water resources variables in agriculture.

SVMs in Agriculture:

SVMs are one of the most current regulated AI procedures.
The current examination explored the materials of help vector machine in horticulture is in the harvest grouping and in the investigation of the environmental change situations
The current study investigated the applicability of support vector machine in agriculture is in the crop classification and in the analysis of the climate change scenarios.

Decision Tree in Agriculture:

Decision Tree will be tree-formed structures that speak to sets of choices and create rules for the order of a dataset. Explicit choice tree techniques incorporate Classification and Regression Trees (CART) and Chi Square Automatic Interaction Detection (CHAID).
In farming, Decision tree calculation is utilized for foreseeing soil richness.
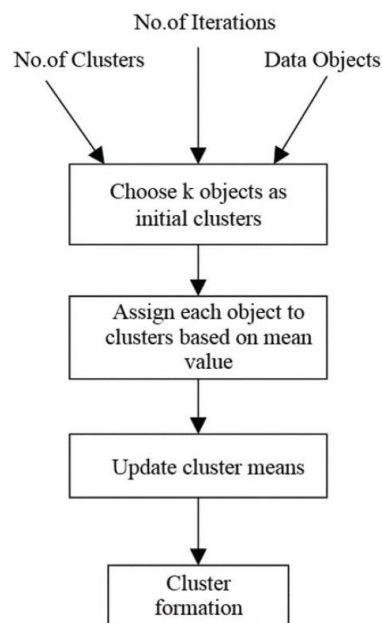
- **Deep Learning**

  Deep learning technique, which shows the PC to channel contributions through layers so as to anticipate and characterize data, has become truly famous recently. It is for the most part utilize neural organization engineering, which are composed in layers comprising of a lot of interconnected hubs. These organizations can have tens or several those concealed layers.
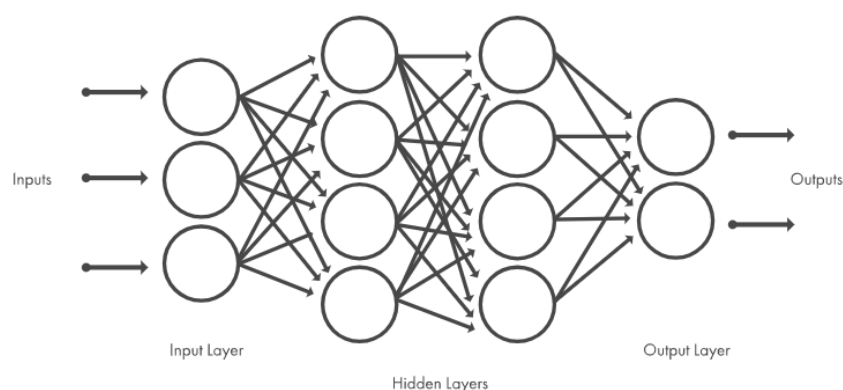
1.2 Research gap

There are enormous quantities of examination considers that have been completed by this investigation, which has been distinguished in this examination, gotten from the writing overview. Essentially the entirety of the investigations have been completed by running lab explores different avenues regarding various substances or utilizing advanced sensors to check the dirt dietary status. Anyway so as to do a lab assessment, people need to direct the dirt examples to the agricultural divisions and it requires some investment and use. We have consequently consented to manufacture an appending sensor strategy that will quantify the key factors, for example, electrical conductivity (EC) and soil moisture.

We also found, according to the literature analysis, that using sensors to measure the nutrient factors of the soil would result in a lot of cash being expended by the customer. Yet we plan on making this proposed solution that can be used by a lot of people with less money utilized. The soil nutrient elements such as nitrogen (N), phosphorus (P), and potassium (K) are then intended to be evaluated with regard to the values of evolving pH levels.

Many researchers have obtained the soil samples by collecting it from the same spot on the ground in various layers. Despite the fact that we will utilize the crisscross soil test approach which requires taking soil tests in a crisscross example from the different situations in the field. Utilizing this device can be valuable in creating the most fitting soil supplement results as it gauges the dirt sorts for the entire soil.

The framework used for image processing methods for investigators Joon-Goo Lee and Haedong Lee, Aekyung Moon. But it requires specific persons who are trained in the field to collect image evidence about a particular field. The Researchers, B. MiloviC and V. RadojeviC have applied their method using data mining methods based on the ground's laboratory test findings. These strategies need particular people who have aptitude in picture investigation or scientific experts who need to do research facility tests dependent on the dirt examples given by the rancher, which requires more assets and endeavors to get the dirt supplement points of interest in a field.

1.3 Research problem

When a disorder in plant is detected, it is essential to check the nutrient level of soil. when we concluded the analysis of current techniques used by farmers to pick the appropriate crop for a specific place, we perceived there is a major issue which ought to be contemplated which doesn't have a solid and reliable method of deciding the most fitting harvest for a particular spot/state . Since we are advancing with the technologies, we have concluded that to resolve this challenge, it is safer to have good mechanism that can be used adequately in the agricultural sector. Soil analysis before starting development is a fundamental part, as soil supplements are one of the primary components impacting plant advancement. Most plants are helpless to soil alkalinity and sharpness, and may not yield better gather in the event that they neglect to meet the prerequisites vital. Farmers essentially do not have the comprehension of soil supplement rates and there's likewise no basic method to assess soil supplement levels in a property. Due to this in the current structure, most farmers start their ascending by confiding in the misguided judgments of society.

Trusting myths is harmful since myth-related crops can not necessarily be the most acceptable crop for growing on that specific property. If the ground is flooded with fresh dirt, it is futile to accept theories as well. With current soil supplements, farmers are in this manner incapable to convey ideal reap. Besides, just scarcely any ranchers utilize logical strategies to locate the best harvest for the property. For that, farmers need to gauge soil tests with the guide of the farming office .People have to travel long distances to test soil in their land by sending agricultural department soil samples and it is not a successful way as a laboratory test will take several days to generate data. This also needs very high costs and we should not accept it as the average soil product of the soil as the nutrient amounts in a soil differ from location to location. It triggers the farmer to waste both his time and money.

Another big issue is soil disintegration because of the powerlessness to locate the best yield that can be developed on a given land with insignificant utilization of manure. Since farmers battle to locate the correct harvest for current soil supplement levels in the dirt, they should utilize extra compost which would badly affect soil wellbeing.

New farmers who are fresh to the agriculture sector are facing serious issues because they do not have a deep understanding of the crops. Unless they fell at the outset, they're not going to invest more in the agriculture sector. Therefore it is easier for both farmers and new beginners to provide a more reliable and productive approach to determine the best crop that can be cultivated on a given soil and a parallel fertilizer plan dependent on the current soil nutrients, as it prevents wasting their time and money.

1.4 Research objectives

- To estimate fertility status of soil and can easily identify the best crop that can plant in that land.

- To change nutrient level in soil according to crop we need to grow. So, can gain good result.

- To use by any person to start their own plantation.

- To provide a basis for fertilizer recommendation for a given crop.

- To reduce the risk of not being able to have good result from plantations.

- To make people encouraged to start plantation more.

- Save the soil by applying the accurate amount of fertilizer

- To estimate fertility status of soil and can easily identify the best crop that can plant in that land

    o Using the sensor readings and compare them with relevant data sets people can identify the best option for plant, we gather data sets to maintain best environment and fertility levels for main commercial crops such as paddy, rubber, coconut and tea.

- To change nutrient level in soil according to crop we need to grow. So, can gain good result

    o Using this method, we can reduce the failure of plantations according to law and unbalance fertility level. Most common method in current using is believe in myths. But with the relevant information farmers have more confidence to plant and they can check and maintain plantation with major stages of the crop in case of low growing.

- To use by any person to start their own plantation

    o With the help of this method famers can start plantation without having any basic knowledge about the crops they going to plant. So that most of time and

cost is reducing with the help of this method. As an example, farmer only want a minimum knowledge about operate the tool. It will suggest everything which necessary to plant the relevant crop. In the beginning of plantation every farmer may have doubts about the fertilizer levels. In present, farmers have to go for agriculture department with soil samples and do lab test which take couple of days. But with the help of this method

- To provide a basis for fertilizer recommendation for a given crop

  - In plantation there are several stages which passing by the plant. so that requirements of fertilizers for plants can be vary. As an example, phosphorus percentage is more needed for plants when they come to their blooming stage. Farmers will get know what's the exact fertilizers should give more in particular stages.

- To Reduce the risk of not being able to have good result from plantations

  - By maintaining recommended fertilizer levels plants will go through their growth stages with rich required fertilizer percentages. Therefore, it will reduce the risk of failure in plantations.

- To make people encouraged to start plantation more

  - Most of people are not start plantation because of the doubts about plant growth and if any case they have to go for advises to agriculture departments. Using this tool, no need to wait for lab test results of soil testing's, can easily identify the relevant fertilizer levels and the people are encouraged to plant more. Its easy to use and easy to handle and quick responsible.

- Save the soil

  - Most of people don't have an idea about how much we apply fertilizers on land. Therefore, they might apply over the limit and soil can be damaged by it. Using the app will show the exact amount we should apply and it will be the recommended amount of fertilizer for both plant and soil.

2. METHODOLOGY

2.1.Methodology

As you can see in this diagram farmers has to measure soil parameters with the device. Soil parameters will be sent to farmers mobile app by a sms. Farmer has to enter those parameters to the mobile app. The machine learning algorithm which running on the mobile backend will be predicted NPK level of given soil sample.
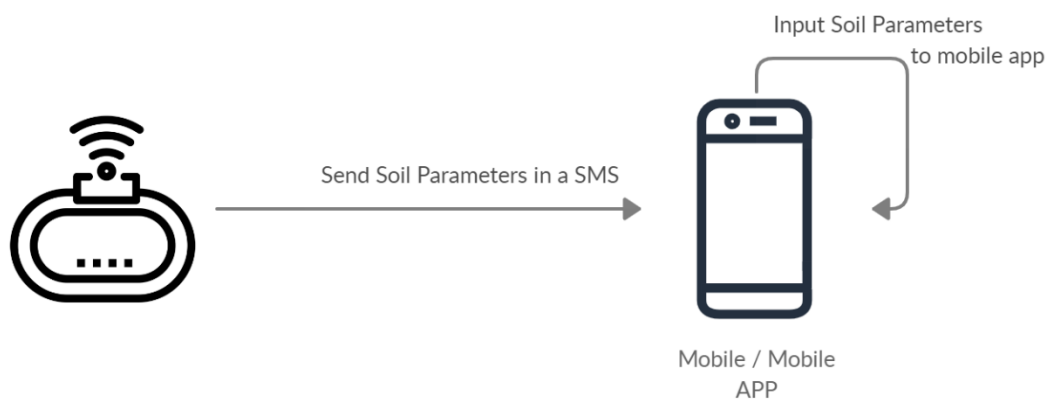
Soil temperature sensors arrive in an assortment of structures utilizing thermistors, thermocouples, thermocouple wires, and averaging thermocouples. The electrical signs transmitted from the sensors to information lumberjacks can be changed over to various units of estimation, including °C , °F, and °K. Information lumberjacks are likewise equipped for estimating most financially accessible soil temperature sensors. After gathering all the information all the data s redirecting to cloud using API gateway. Thereafter use relevant machine learning algorithm to predict the results.

In this case we use regression neural network machine learning algorithm to predicate the results with co-relationship.
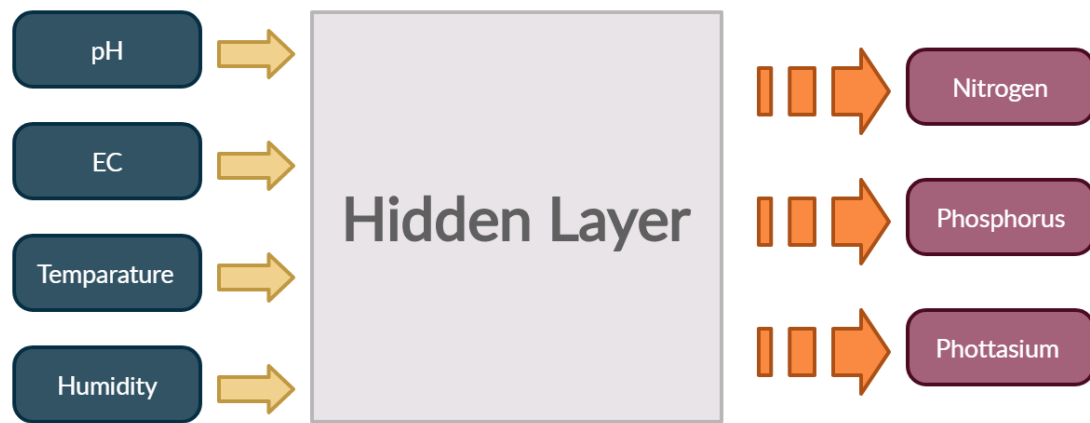
As you can see here, The model which is running in the behind layer designed based on machine learning algorithms given below.

As you researcher has developed, the machine learning algorithm reads the values under the four parameters. Below code is about reading, storing and testing those values. In the end of the code there is a method called append() which takes single argument. It is the method which use to add an single element. The key fact is that this method doesn't return itself. The element can also be a list or a dictionary which makes a nested list.

```python
pH=df['pH ']
humidity=df['humidity %']
ec=df['ec ']
temperature=df['temperature']
n=df['n %']
p=df['p %']
k=df['k %']


getData=[pH,humidity,ec,temperature,n,p,k]
list1=[]
for k in range(len(getData[0])):
    i=k
    x=[int(getData[0][i]),int(getData[1][i]),int(getData[2][i]),int(getData[3][i])]
    tot=0
    for j in range(len(x)):
        tot=float(tot)+x[j]
    x=[int(getData[0][i])/tot,int(getData[1][i])/tot,int(getData[2][i])/tot,int(getData[3][i])/tot,getData[4][i],getData[5][i],ge
    list1.append(x)
```

```python
"""   Nitrogen  """

list=list1
totPred=0
cp=0
model=None
X=None
Y=None
for i in range(10):
    shuffle(list)
    bigData=pd.DataFrame(list,columns=['','','','','label','t1','t2'])
    target=bigData['label']
    from sklearn.model_selection import  train_test_split
    X_train,X_test,Y_train,Y_test=train_test_split(bigData.drop(['label','t1','t2'],axis='columns'),target,test_size=0.2)
    model = LinearRegression()
    X=X_train
    Y=Y_train
    model.fit(X_train,Y_train)
    pred=model.score(X_test,Y_test)

    if(pred>cp):
        cp=pred
        filename = r'E:\IOT\NPK\NPK/nModel.sav'


        pickle.dump(model, open(filename, 'wb'))

    totPred=pred+totPred


print("")
print("Algorithm : LinearRegression for n")
print("Train Data Count : ",len(X_train))
print("Test Data Count : ",len(X_test))
print("Accuracy :",cp)
```

```python
""" phosphorus """

list=list1
totPred=0
cp=0
model=None
X=None
Y=None
for i in range(10):
    shuffle(list)
    bigData=pd.DataFrame(list,columns=['','','','','t1','label','t2'])
    target=bigData['label']
    from sklearn.model_selection import  train_test_split
    X_train,X_test,Y_train,Y_test=train_test_split(bigData.drop(['t1','label','t2'],axis='columns'),target,test_size=0.2)
    model = LinearRegression()
    X=X_train
    Y=Y_train
    model.fit(X_train,Y_train)
    pred=model.score(X_test,Y_test)

    if(pred>cp):
        cp=pred
        filename = r'E:\IOT\NPK\NPK/pModel.sav'
        pickle.dump(model, open(filename, 'wb'))

    totPred=pred+totPred


print("")
print("Algorithm : LinearRegression for p")
print("Train Data Count : ",len(X_train))
print("Test Data Count : ",len(X_test))
print("Accuracy :",cp)
```

```python
""" potassium """

list=list1
totPred=0
cp=0
model=None
X=None
Y=None
for i in range(10):
    shuffle(list)
    bigData=pd.DataFrame(list,columns=['','','','','t1','t2','label'])
    target=bigData['label']
    from sklearn.model_selection import  train_test_split
    X_train,X_test,Y_train,Y_test=train_test_split(bigData.drop(['t1','t2','label'],axis='columns'),target,test_size=0.2)
    model = LinearRegression()
    X=X_train
    Y=Y_train
    model.fit(X_train,Y_train)
    pred=model.score(X_test,Y_test)

    if(pred>cp):
        cp=pred
        filename = r'E:\IOT\NPK\NPK/kModel.sav'
        pickle.dump(model, open(filename, 'wb'))

    totPred=pred+totPred


print("")
print("Algorithm : LinearRegression for k")
print("Train Data Count : ",len(X_train))
print("Test Data Count : ",len(X_test))
print("Accuracy :",cp)
print("")
```

IOT Device : Hardware Component.

When creating IOT device, measuring Electrical conductivity was being a major part. There are no sensors in the market which measure the electrical conductivity value and giving a numerical value. So that the researcher had to make a new sensor for measuring electrical conductivity.

The researcher has decided to go through with the resistance and resistivity. Basically sensor consists of 2 copper clads. There is a container with a known area and a known length. After filling out the container with the soil the user has to put 2 copper clads in corner of the container.

Macroscopic Ohm's Law

$$V = IR$$ Ohm's Law

V: voltage (volts = joule/coulomb) **V**
I: current (ampere = coulomb/sec) **A**
R: resistance (ohm = volt/amp) **Ω**

$$R = \rho \frac{\ell}{A}$$

$$\sigma = \frac{1}{\rho}$$
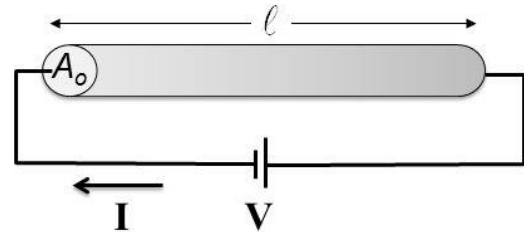
Resistivity, ρ (Ωm) and **Conductivity**, σ (Ωm)$^{-1}$
material properties are independent of sample size and geometry

4

So measuring Electrical Conductivity, Macroscopic Ohm's law were being used. In addition proposed method had a good accuracy.

```cpp
int switchpin = 7;
volatile bool last = 1;

int thermoDO = 4;
int thermoCS = 5;
int thermoCLK = 6;
MAX6675 thermocouple(thermoCLK, thermoCS, thermoDO);

int conducpin = A2;

SoftwareSerial Sim800l(10, 11);

int pHSense = A0;
int samples = 10;
float adc_resolution = 1024.0;

int moistPin = A1;
int sensorValue;
int limit = 300;

String to_send = "";

float ph(float voltage) {
  return 7 + ((2.5 - voltage) / 0.18);
}




void setup() {
  Serial.begin(9600);
  Sim800l.begin(9600);
  pinMode(switchpin, INPUT);
  digitalWrite(switchpin, HIGH);
  Sim800l.write("AT+CMGF=1\n\r");
}
```

```cpp
void loop() {
  bool state = digitalRead(switchpin);
  if (state != last) {
    if (state == 0) {

      to_send = "";
      to_send += "C=";
      to_send += String(thermocouple.readCelsius());
      to_send += ",";

      int measurings = 0;
      for (int i = 0; i < samples; i++)
      {
        measurings += analogRead(pHSense);
        delay(10);
      }
      float voltage = 5 / adc_resolution * measurings / samples;
      to_send += "PH=";
      to_send += String(ph(voltage));
      to_send += ",";

      sensorValue = 0;
      for (int i = 0; i <= 100; i++)
      {
        sensorValue += analogRead(moistPin);
        delay(1);
      }
      sensorValue = sensorValue / 100.0;
      to_send += "MV=";
      to_send += String(sensorValue);
      to_send += ",";

      double cons = 0.0059459;
      long conduct = map(analogRead(conducpin),0,473,100000,400000);
      double cv = 1/(double(conduct)*cons);
      to_send += "CV=";
      to_send += String(cv,(unsigned char)'\004');


      Sim800l.write("AT+CMGS=\"+94776612147\"\n\r");
      Sim800l.write(to_send.c_str());
      Sim800l.write(26);

      Serial.println(to_send);

      delay(1000);
    }
    last = state;
  }

}
```

Sensors which have used

PH Sensor:

In this research we are basically planning on focusing the nutrient levels in soil from different areas in Sri Lanka. Because there are many varieties in the soil in our country, there is a huge variety of soil types in Sri Lanka.

As we utilizing pH sensors and moistness sensors, we have to get readings as parameters for fabricate the co-relationship which make the bury association between datasets.to get the readings and store them we use raspberry pi board as our principle sensor center point.

In horticulture, the pH is likely the most vital single property of the dampness related with a dirt, since that sign uncovers what yields will develop promptly in the dirt and what alterations must be made to adjust it for developing some other harvests.

Moisture sensor:

Moistness is the sum of water vapor noticeable all around. To an extreme or too little humidity can be hazardous. For instance, high humidity joined with hot temperatures is a blend that can be a wellbeing hazard, particularly for the extremely youthful and the exceptionally old.

Temperature Sensor

Soil temperature sensors arrive in an assortment of structures utilizing thermistors, thermocouples, thermocouple wires, and averaging thermocouples. The electrical signs transmitted from the sensors to information lumberjacks can be changed over to various units of estimation, including °C , °F, and °K. Information lumberjacks are likewise equipped for estimating most financially accessible soil temperature sensors.

EC sensor

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After gathering all the information all the data s redirecting to cloud using API gateway. Thereafter use relevant machine learning algorithm to predict the results.

2.2. Results

Final main outcome of the project is to predict Nutrient level of soil when plant disorders is detected. There is a sms display to view pH, EC, Temperature & humidity levels of soil. All data goes to cloud to process the data from sensors in order to obtain N,P,K levels of soil. Processed data goes to subsystems to obtain other outcomes from the system.

```
Algorithm : LinearRegression for n
Train Data Count :  39
Test Data Count :  10
Accuracy : 0.9778384757201466

Algorithm : LinearRegression for p
Train Data Count :  39
Test Data Count :  10
Accuracy : 0.8261193368642654


Algorithm : LinearRegression for k
Train Data Count :  39
Test Data Count :  10
Accuracy : 0.9754462177731609
```
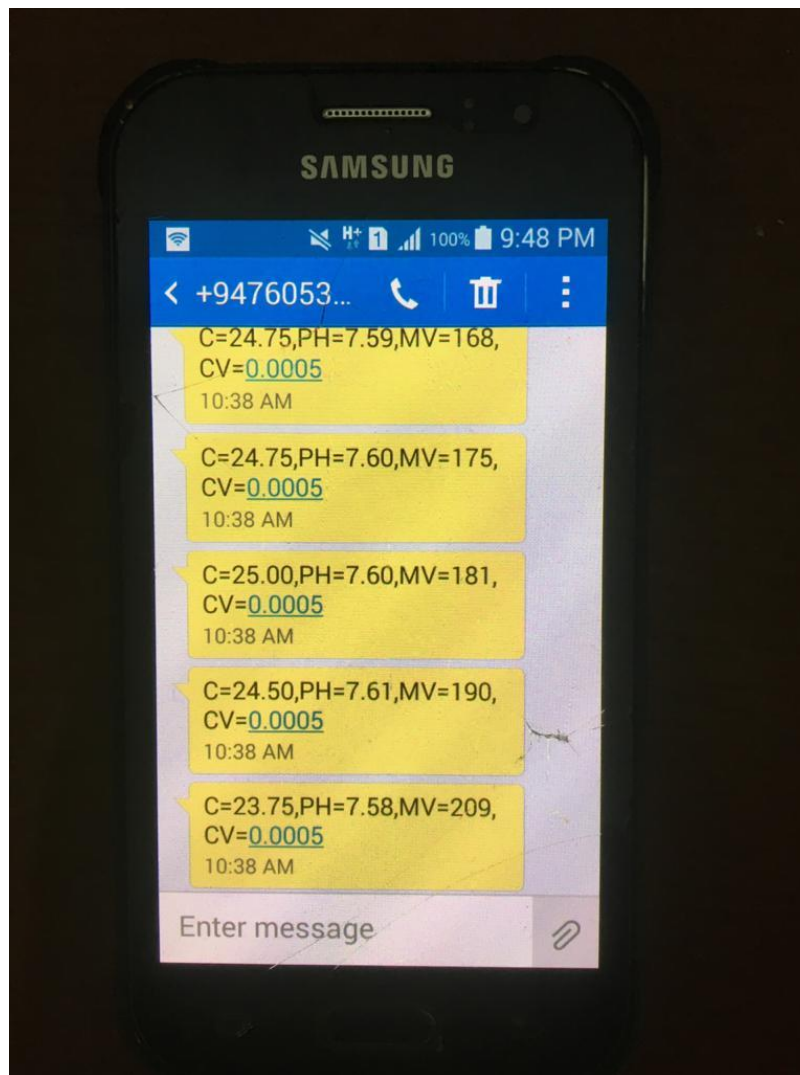
As you can see here this the sms which is sent by device to the mobile. It is included with 4 sensor readings.

Commercialization Aspect

When we concluded the analysis of current techniques used by farmers to pick the appropriate crop for a specific place, we recognized there is a big problem which should be taken into consideration which does not have a reliable and consistent way of determining the most appropriate crop for a specific place / state. Since we are advancing with the technologies, we have concluded that to resolve this challenge, it is safer to have good mechanism that can be used adequately in the agricultural sector.

Soil analysis before beginning cultivation is an essential part, as soil nutrients are one of the main factors influencing plant development. Most plants are susceptible to soil alkalinity and

acidity, and may not yield better harvest if they fail to meet the requirements necessary. Farmers basically lack the understanding of soil nutrient rates and there's also no simple way to evaluate soil nutrient levels in a property. Because of this in the current structure, most farmers begin their rising by trusting in the misconceptions of society. Trusting myths is harmful since myth-related crops can not necessarily be the most acceptable crop for growing on that specific property. If the ground is flooded with fresh dirt, it is futile to accept theories as well. With current soil nutrients, farmers are thus unable to deliver optimal harvest.

Furthermore, only few farmers use scientific methods to find the most effective crop for the property. For that, farmers need to measure soil samples with the aid of the agriculture department. People have to travel long distances to test soil in their land by sending agricultural department soil samples and it is not a successful way as a laboratory test will take several days to generate data. This also needs very high costs and we should not accept it as the average soil product of the soil as the nutrient amounts in a soil differ from location to location. It triggers the farmer to waste both his time and money. Another big issue is soil erosion due to the inability to find the best crop that can be grown on a given land with minimal use of fertilizer. Since farmers struggle to find the right crop for current soil nutrient levels in the soil, they will need to use additional fertilizer which would have a bad impact on soil health. New farmers who are fresh to the agriculture sector are facing serious issues because they do not have a deep understanding of the crops. Unless they fell at the outset, they're not going to invest more in the agriculture sector. Therefore it is easier for both farmers and new beginners to provide a more reliable and productive approach to determine the best crop that can be cultivated on a given soil and a parallel fertilizer plan dependent on the current soil nutrients, as it prevents wasting their time and money.

CONCLUSION

Once we completed an analysis of the current approaches used by farmers to select the best crop for a specific region, we discovered that there is a big problem that needs to be brought into consideration that does not offer a simple and consistent way to determine the most appropriate crop for a specific place / state. If we push on with innovation, we have agreed that it is easier to have a competitive platform that can be used successfully in the agricultural field in order to overcome this issue.

Soil analysis is an vital component before planting starts, as soil nutrients are one of the main factors influencing plant development. Many crops are prone to soil alkalinity and acidity and will not yield improved harvests if they do not follow the requirements needed. In essence, farmers obviously have little knowledge of the values of soil nutrients and there is still no easy way to evaluate the amounts of soil nutrients in the soil. As a result, many farmers are beginning their development in the current framework based on the assumptions of society. Since myth-related crops can not necessarily be the most suitable crop for growing on that specific field, it is risky to believe myths. If the ground is saturated with fresh dirt, it is useless to accept possibilities as well. With established soil nutrients, farmers are frequently unable to deliver optimal harvests. Moreover, only a few farmers make use of modern methods to find the most profitable crop for the property. For that, farmers need to measure soil samples with the assistance of the agriculture department. By sending soil samples to the agriculture department, people have to travel long miles to test soil in their land, and it is not a successful way to obtain results as a laboratory test will take many days. This also entails very high costs and we should not treat it as the total soil product of the soil since the nutrient ratios in a soil differ from location to location. This results in the farmer wasting both his time and his currency. Some other key obstacle is soil degradation due to the inability to select the perfect crop with constrained use of fertilizer which can be cultivated on a particular field. Even though farmers are attempting to discover the appropriate crop in the soil with existing quantities of soil nutrients, they will also proceed to use additional fertilizer which will have a flawed impact on soil quality. Poor farmers who are poor in the field of agriculture are facing big problems because they do not have a comprehensive knowledge of the crops. They will not invest more in the agricultural sector until they have collapsed at the top. Consequently, it is easier for both farmers and new beginners to have a more reliable and successful approach to determining the

best crop that can be grown on a given soil and a parallel fertilizer strategy based on the current soil nutrients, because it prevents wasting their time and money.

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