Smart Plant Disorder Identification System

2020-025

Project Proposal Report

K.T.Ramasinghe

B.Sc. (Hons) Degree in Cyber Security

Department of Information Systems Engineering

Sri Lanka Institute of Information Technology
Sri Lanka

25th February 25, 2020

Smart Plant Disorder Identification System

2020-025

Project Proposal Report

K.T.Ramasinghe

B.Sc. (Hons) Degree in Cyber Security

Department of Information Systems Engineering

Sri Lanka Institute of Information Technology
Sri Lanka

25th February 25, 2020

DECLARATION

We declare that this is our own work and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

	STUDENT NAME	STUDENT NUMBER	SIGNATURE
01	K.T.Ramasinghe	IT15070418	

The above candidates are carrying out research for the undergraduate dissertation under my supervision.

Name of the supervisor: Dr. Janaka Wijekoon

Signature of the supervisor: Date:

ABSTRACT

Globalization is woven around the world. Money and power has become the key requirements of human. Among leading revenue industries in Sri Lanka, Agriculture industry plays a starring role in the process of economic development of our country. For a selected crop yield, farmers should be able to recognize the symptoms of insufficient or excess nutrients in the soil. Crops can be affected by many reasons such as weather condition or injury, pesticide drift, excess fertilizer, insect infestations. Nutrient deficiency and excess nutrients (Toxicity) in the soil is one of key facts among them. It is very censorious to perform a regular soil testing to measure nutrient level of selected soil sample and monitor the changes in soil nutrient status. This component mainly focusses to develop an IOT device to measure key nutrients status, EC conductivity and humidity in selected soil sample.

TABLE OF CONTENTS

TABLE OF FIGURES

1. INTRODUCTION

1.1 Background

In the modern world, people are busy with their day to day activities. Time management has become a key fact. We can see people are fond of getting things done by machinery more than manually. In the past decade, machinery techniques get more popular in the agriculture field too. In the past, this agriculture field mainly depend on human power, But with the usage of this machinery techniques, people can get things done by more cost effective and time effective

We can see nutrient deficiencies in plants due to some reasons. Main reasons are plant disorders. Nutrient absorption problems and nutrient deficiencies / toxicity in the soil. To identify a soil status, we can perform a soil test. Soil test is a process which helps to identify nutrients level of soil.

Sometimes the plantation with believing myths will be a success, but it is not a proper way or the best option in cultivation. Soil conditions will be changing time to time because of many reasons.

According to a research done by department of Economics and Social Affairs in United Nation Newyork, current population 7.3 billions will be expected to reach 8.5 billion by 2030 and 9.7 billion in 2050 [1] . So the amount of the people who need food to live will get increased day by day. In this surface, Our agriculture system need much more attention.

The proposed system is basically on using Internet of things (IOT) and so that it leads to use technology on identifying plant disorders effectively and efficiently.

1.2. Literature Review

A group of researchers Komal Abhang, Surabhi Chaughule, Pranali Chavan, Shraddha Ganjave has done a research on soil analysis and crop fertility prediction after referring results gathered by testing the particular ground soil by normal lab tests done by the agricultural department.

The main aim of our System is to Atomize current manual soil testing procedure. In our system we are building handheld device using pH meter which will give pH value of soil. pH is negative log of hydronium ion mole per liter pH = - log [H3O+]. With help of this pH value we will estimate NPK of that soil, which are necessary Macronutrients of soil.

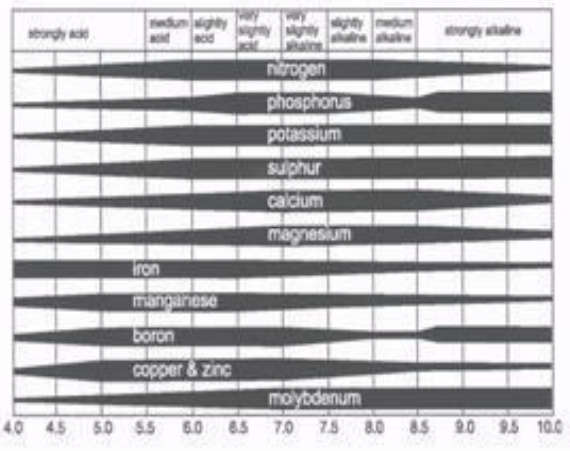


Figure 1: Nutrients present at particular pH value

These will decide fertility of soil. For our software model we will be training crop database and we will classify that particular soil sample into particular class using classification algorithm. Depending on class determined by our system we will give list of crops suitable for that particular soil sample. Also provide suggestion of fertilizer for particular crop.

Nitrogen, phosphorus, and potassium are the main components of soil fertilizer. These methods isolate each nutrient from the soil into a solution that can be analyzed using turbidity and color to determine the concentration of nutrients present in the soil sample.

Knowing present concentration informs environmental scientists of a nutrient deficiency or surplus in soils used to support plant production, and also provides general insight into basic biogeochemical cycles of an ecosystem.

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.

The soil test kit permits obtaining a measure of soil pH, nitrate and ammonium, phosphorus, and potassium within about 30 to 45 minutes and can short-circuit the lengthy delays typical of soil testing Many soil scientists disbelieve the results from soil test kits, sometimes with good reason. Seldom is there sufficient training or any training at all with commercially available test kits and seldom are users given the information about which steps of the determination are critical and which are not.[6] For example, identified through the Participatory Learning Forum, have been successfully taught to use soil test kits as part of the site-specific nutrient management process described herein.

Granary	Location (Season)	FERTO Rate				Farmer Rate		
		N	P_2O_5	K_2O	CM (kg/ha)	N	P_2O_5	K_2O
MADA KADA	Kobah (1/2000)	197	95	150	1568	135	75	55
	Ketereh (1/2001)	137	49	129	3400	149	89	69
	Meranti (1/2002)	188	85	195	3400	192	110	124
	Meranti (2/2002)	124	94	221	2393	192	110	124
	Meranti (1/2003)	124	94	221	800	192	110	124
	Senor (1/2003)	149	95	222	2418	150	90	70

Figure 2 : FERTO package and farmer fertilizer rates used in the study locations [2]

Figure 2 shows the fertilizer recommendation rates that were generated by FERTO package for plots in MADA and KADA areas, based on the physico-chemical properties of the soils and the set yield target. The recommendations had fertilizer rates ranging between 124 and 197 kg/ha for N, 45 and 95 kg/ha for P_2O_5, 129 and 222 kg/ha for K_2O, and between 800 and 3400 kg/ha for chicken manure (CM). Generally, potassium fertilizer and chicken manure are recommended in higher amounts for crop in KADA, than in MADA. It is due to low potassium and cation exchange capacity (CEC) status of KADA soils, thus inability to enhance high yield. Soils originating from riverine alluvium with 1:1 parent material clay like KADA are generally of low inherent fertility status. MADA soil with marine 2:1 clay are always better in fertility status as indicated by their high organic matter content and CEC status. These two parameters are important to ensure that the fertilizer applied can be held by the soil before it can be taken up by the crop. Otherwise, the crop has less opportunity to absorb the applied fertilizer because most of it will be lost through leaching process.

Normally, applied fertilizer is recommended to be split into various applications timing to optimize crop nutrient uptake and minimize loss through leaching and evaporation processes. Therefore, FERTO package recommends four split applications, i.e. basal dressing, first top-dressing, second top-dressing, and final top-dressing during specific crop growing stages (Table 3). For basal application, compound fertilizer (15:15:15) at a blanket rate of 200 kg/ha was applied at seedling stage, about 15 days after seeding (DAS). Split applications of straight fertilizers for top-dressing were varied according to locality, depending on the rates recommended by FERTO package (Abd Razak *et al.*,

2004). Chicken manure, if recommended, will be applied at early tillering stage, about 25 DAS. Fertilizer rate for each split application will be calculated by the model as formulated in the knowledge base. High N and K_2O rates were recommended at vegetative and reproductive stages, respectively. This will ensure development of quality tillers and productive panicles to attain high yield performance.[5]

1.3. Research Gap

According to the literature reviews we identified vast number of research projects implemented according to the proposed solutions which are analyzed below.
Nearly all the projects were implemented by performing laboratory tests by using several chemicals and by utilizing expensive sensors to identify the nutrient levels in the soil.
In order to conduct laboratory tests, people must transfer the soil samples to the agricultural department which takes lot of time and cost.
Therefore, we decided to develop a tool with attaching sensors which will experiment the key factors like Electrical Conductivity (EC) and the humidity of the soil.

As stated by the literature reviews we perceived the fact that using sensors to experiment the nutrient factors of the soil will cost a huge amount of money.
Hence, we are planning to make this proposed solution to be used by number of users and by spending a minimum amount.
Nevertheless, we have decided to experiment the soil nutrient factors such as Nitrogen(N), Phosphorus (P) and Potassium (K) with accordance to the values of the changing PH levels.

Past researchers have collected the soil samples by taking different layers from the same place in the ground. However, we will be using the zig-zag soil testing method which enable us to take soil samples from different areas in the ground in a zig-zag pattern. This method will generate more accurate results regarding the soil nutrients since it experiments different soil types from the entire ground.

1.4. Research Problem

When I am going through the details related to soil testing methods, the thing I have realized that farmers are having lack of knowledge regarding soil testing methods. Some of them aren't even know about manual soil test kits though. There should be a proper system to do soil testing technically. Farmers are continuing the process of cultivation 6 terms (nearly 2 years) based on single soil test lab reports. The main thing is within this period nutrients level of soil can be changed day to day due to many reasons.

Analyzing soil status when you can see a disorder symptoms in a plant is an important fact. Soil nutrient staus is one of the major facts that affects growth of a plant. Some plant

are sensitive to alkalinity and acidity of soil and may not give a better harvest if failed to fulfill the needed conditions. Practically farmers haven't an easy way to measure soil nutrient status in a selected plant. The proposed device will pave the way to scientifically approach with benefits of cost efficiency and time efficiency.

2. OBJECTIVES

2.1. Main Objectives

The main objective is this component to measure NPK level, EC conductivity, Humidity of soil and convert NPK level to RGB ratio depend on color intensity of selected soil sample and make that color ratio in proper method as inputs to the main algorithm.

2.2. Specific Objectives

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

- 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

3. METHODOLOGY

The challenge of my device is to make input to main algorithm. Except measuring the NPK level of soil the proposed device has to pass input to main algorithm. In the proposed system, color intensity of soil will be calculated,

Here I am going to use soil test capsules. There different soil test capsule for each soil nutrients. Once you have added capsule for selected soil sample, the color will be more brighter. The soil research scientists have invented color chart for color variation.

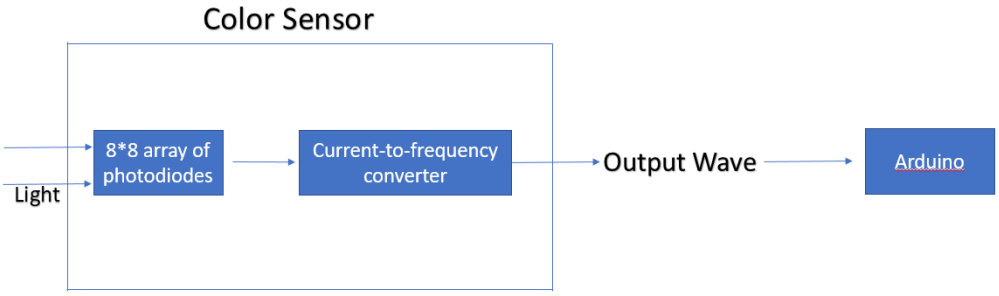
Soil Sample 1 = Color Sample 1 = RX1 * GY1 * BZ1

Soil Sample 2 = Color Sample 2 = RX2 * GY2 * BZ2

Soil Sample 3 = Color Sample 3 = RX3 * GY3 * BZ3

(R=Red, B=Blue, G=Green and XYZ defines the percentages)

1) The level of nutrients need to be measured by taking sample of soil. Color sensor will help to find the level of nutrients in the soil.
2) The light sensor will help to show the correct color of the soil content so it is easy to find the level nutrients in the soil. Light sensor will project the light on the soil content so that the correct color.



Temperature Sensor

Figure 1: Temperature sensor [Source: Google]

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

, 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.

Figure 2: EC sensor [Source: Google]

The WET Sensor has crucial applications in precision horticulture and soil science research and is usable in both soils and growing substrates. It is exceptional in its ability to measure pore water conductivity (ECp), the EC of the water that is available to the plant.

Figure 3: pH sensor [Source: Google]

pH sensor

Figure 4: Humidity sensor [Source: Google]

Humidity sensor- DHT11 is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The calibration coefficients are stored as programs in the OTP memory, which are used by the sensor's internal signal detecting process. The single-wire serial interface makes system integration quick and easy. Its small size, low power consumption and up-to-20-meter signal transmission making it the best choice for various applications, including those most demanding ones. The component is 4-pin single row pin package.

Raspberry pi work as a small computer and compound with a microSD card, and a power supply and we can connect a suitable display using a HDMI cable if need.

Raspberry pi

Figure 5: Raspberry pi [Source: Google]

And can be used as a traditional computer, using USB keyboard and mouse. and also pi board has an integrated WIFI module which can connect internet. Therefore, we can easily upload our datasets to a cloud server.

Tools and Technologies

Xamarin is one of the most cost effective and time efficient cross-platform which uses .NET framework. So Xamarin, is suitable for developing mobile apps that work on multiple mobile platforms, like Android, iOS, Windows etc. It provides the advantages of native UI, access to specific-device features, and most importantly, native performance.

Boto3 is an Amazon Web Services (AWS) SDK for Python. It provides an easy to use, object-oriented API, as well as low-level access to AWS services and enables to create, configure and manage AWS services such as EC2 and S3.

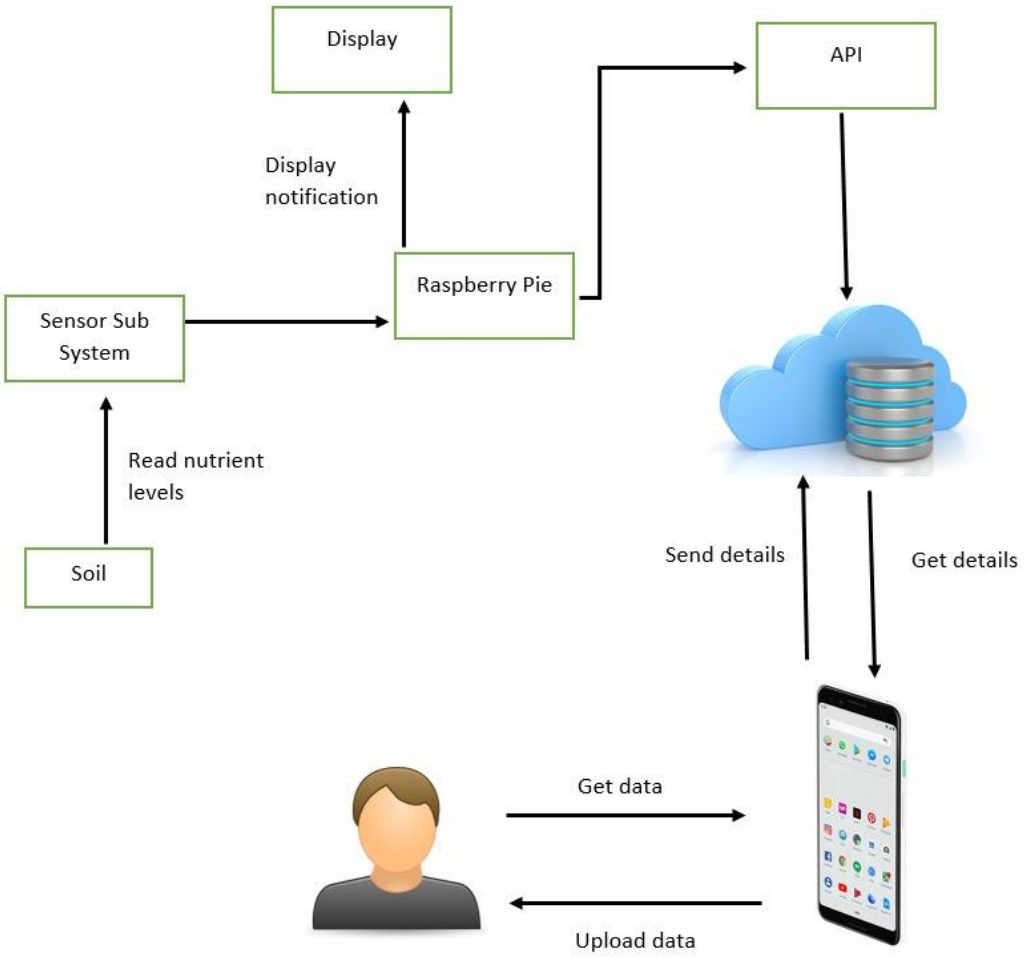
MySQL is free open source database and it is a stable ,reliable and the powerful solution with the advanced features.

It facilitate the effective management of the databases by connecting them to the software.It additionally has connectors

to languages like C#, C++, Java,Node.js,Python, and PHP, implying that it's not constrained to SQL query language.

MySQL is intended to meet even the most requesting applications while guaranteeing the ideal speed, full content record and the one of a kind memory reserves for the upgraded exhibitions.

System Architecture



References

[1]. “World Population Prospects: The 2017 Revision | Multimedia Library - United Nations Department of Economic and Social Affairs”, Un.org, June 21, 2017, Available: https://www.un.org/development/desa/publications/world-population-prospects-the-2017-revision.html. [Accessed: March 05,19]

[2]. J. G. Lee, H. Lee, and A. Moon, “Segmentation method of COI for monitoring and prediction of the crop growth,” *Int. Conf. ICT Converg.*, no. 2, pp. 640–641, 2014.

[3]. B. Milovic and V. Radojevic, “Application of data mining in agriculture,” *Bulg. J. Agric. Sci.*, vol. 21, no. 1, pp. 26–34, 2015.

[4]. A. Haroun, M. Adam, I. Mohamed, F. Abdalla, M. Abdelkreim, and A. Ibrahim, “Analysis Of Soil NPK , Ph And Electrical Conductivity At Adham Area- Renk , Upper Nile State,” *Int. J. Sientific Technol. Res.*, vol. 4, no. 12, pp. 341–347, 2015.

[5]. Amazon.com, Inc, “Boto 3 Documentation — Boto 3 Docs 1.9.115 documentation”, Boto3.amazonaws.com, 2014. Available: https://boto3.amazonaws.com/v1/documentation/api/latest/index.html. [Accessed: Feb. 25,19]

[6] S. Rajebhosale, S. Choudhari, S. Patil, A. Vyavahare, S. Khabiya, and A. Professor, “SMART CAMPUS-An Academic Web Portal with Android Application,” *Int. Res. J. Eng. Technol.*, pp. 389–394, 2016.