INTELLIGENT SOIL FERTILITY DETECTION SYSTEM (ISFDS)

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INTELLIGENT SOIL FERTILITY DETECTION SYSTEM (ISFDS)

ABDUL RAHMAN BIN AHMAD PUAAD

This report is submitted in partial fulfillment of the requirement for the Bachelor of Computer Science (Artificial Intelligence)

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2017

DECLARATION

I hereby declare that this project report entitled

INTELLIGENT SOIL FERTILITY DETECTION SYSTEM (ISFDS)

is written by me and is my own effort and that no part has been plagiarized without citations.

STUDENT: ____ Date: _________

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DEDICATION

I dedicate my final year project report to my family and friends. To my supervisor, Profesor Madya Dr. Abd Samad Bin Hasan Basari for guiding and helping me to finish up this project. I would like to express deep gratitude to my beloved parents for an affection and life-long love. They have been very encouraging and supportive in completion of my thesis and throughout the years of my studies in UTeM. Hence, I also would like to dedicate this report to my close friends and my family who have been very supportive throughout the project development.

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ABSTRACT

Research on methods and technologies to improve the efficiency of water use has been conducted using various control techniques. However, most of the consumer of this global asset are gardeners. This project uses an Arduino as its microcontroller which can help the gardener that usually used a normal method of planting for their vegetables or fruits. Due to its flexibility, it also compatible with MATLAB software to do data analysis. ISFDS will eliminate the use of a timer to water the plant, which may damage the plant due to excessive watering. The process involves testing the ISFDS using a real-world simulation problem, where the AI technique implemented by using a fuzzy logic. The advanced version of ISFDS includes the implementation of IoT to give an alert through smartphone about the plant condition.

ABSTRAK

Penyelidikan mengenai kaedah dan teknologi untuk meningkatkan kecekapan penggunaan air telah dilakukan dengan menggunakan pelbagai teknik kawalan. Walau bagaimanapun, sebahagian besar pengguna aset global ini adalah tukang kebun. Projek ini menggunakan Arduino sebagai pengawal mikro yang yang boleh membantu tukang kebun yang biasanya menggunakan kaedah biasa penanaman untuk sayur-sayuran atau buah-buahan mereka. Kerana fleksibilitinya, Arduino juga boleh di laksanakan dengan mengunakan perisian MATLAB bagi membuat analisis data. ISFDS akan menukar cara penggunaan pemasa bagi penyiramana air pada tumbuhan, yang boleh merosakkan tumbuhan atas faktor air yang berlebihan. Proses ISFDS ini akan diuji dengan menggunakan satu masalah simulasi dunia sebenar, di mana teknik AI yang dilaksanakan dengan menggunakan logik kabur. Bagi penambah baikan ISFDS, pelaksanaan IOT akan di lakukan dengan memberi amaran melalui telefon pintar mengenai keadaan sesuatu tumbuhan itu.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

1.1 Project Background

Intelligent Soil Fertility Detection System (ISFDS) is a mechanism that use a moisture sensor as a main significant potential source of information for checking the level of water in the soil. It is difficult to gauge how much water needed for plants to germinate. Moisture sensor is one of the technologies that used in numerous research application for handling the volumetric water content in soil. Measuring soil dampness is essential for rural applications to help agriculturists deal with their water system frameworks more proficiently. Knowing the correct soil dampness conditions will help the farmers to generally use less water to grow a crop, also able to increment yields and improved the quality of the crop during the critical plants growth stages. The Baseline Irrigation Solutions, has studies the analysis of a properly configured soil moisture sensor that can reduce outdoor water use by up to 62 percent or more over traditional irrigation methods. By watering the plants when needed, it can improve the landscape health, give a deeper root growth, and make the plants more disease resistant. Thus, when choosing how to irrigate, individuals don't generally consider how water moves in soil, how the different sorts of soil hold dampness, and how plants needs contrast. Soil moisture sensors have been utilized for a long time to gauge how much water is held between the soil particles. The proposed of this immersive technology, Intelligent Soil Fertility Detection System (ISFDS) is a mechanism that can help the user to monitor the moisture level of the plants. Some good greenery is not only need an enough photosynthesis but it also must have a good soil to growth. The mechanism will be built using an Arduino Pro Mini 328 where it will attach with the Soil Moisture Sensor as an input for the detection and when the input is received, the analysis of the moisture will be calculated, if the moist level of the soil is less from the percentage goal the Intelligent Soil Fertility Detection System (ISFDS) will transmit the sound that will be produce by speaker to warning the user about the status of the soil health. This Intelligent Soil Fertility Detection System (ISFDS) also can help the farmer that usually used a normal method of planting for their vegetables or fruits. Intelligent Soil Fertility Detection System (ISFDS) will use a different method from the farmer where they need to use a timer or manually to watering their plants. This may cause the overwater or less water where it affects the plants to breathe through their roots. By using Intelligent Soil Fertility Detection System (ISFDS) it can tell us if the soil is at normal state, wet, moist or dry at the root level and this will be a method to control the water level for a perfect temperature of planting. The perfect temperature for planting varies dependent upon the variety of plants. The soil moisture sensor is inserted in the soil. Contingent upon the nature of the sensor, it must be embedded close to the underlying foundations of the plants. The soil moisture sensor will measure the conductivity of the soil. The main factor that drives the plants to germination, blooming and composting is the soil temperature and a variety of other process. But learning how to check the soil temperature will help the home gardener know when to start sowing seeds, the knowledge about the soil temperature also will help the plants to grow a more bountiful and beautiful garden.

1.2 Problem Statement

For the most part, plants become quicker with expanding air temperatures to a limited degree. Outrageous warmth will moderate development and furthermore increment dampness misfortune. The temperatures for ideal development fluctuate with the kind of plant. A few yearly blossoms and vegetables are to a great degree touchy to frosty, and transplants ought to not be planted until temperatures are reliably warm. The weather can affect the plants in many various ways, also in ways we may not noticed. With an extremely hot or cold soil temperature it can affect the hamper plant growth, as well as affect seed germination. During the hot weather, the moisture level of soil will be affect if without a good monitoring, the hot soils may happen and it will hamper the plant growth without a warning. Exposure to the intense sunlight of bright, cloudless, summer days can be too much for sensitive plants. Reflected light from dividers and different surfaces can likewise add to the issue. By using a traditional irrigation, there are critical growth periods when water stress is most detrimental. It is basic that a decent dampness supply be kept up amid seed germination and seedling rising out from the soil.

However, many newly planted trees and shrubs with a shallow-rooted suffer from a water stress when it does the water transplants immediately without a proper control. Appropriate watering techniques are seldom practiced by most planters. They either under or over water while flooding. Usually the gardeners who under-water does not realize the time needed to adequately water an area instead they applied light or daily sprinklings, this is harmful to lightly sprinkle plants every day. The user does not know how much water that the soil need. The plant will slowly be suffocating when there is too much water. When there is too much water in a soil it will cause the oxygen deficiency, which resulting in damage to the root system. It is a basic knowledge that plant roots need an oxygen to live, but when a soil remains soggy little oxygen is present in the soil. When this condition happens, the roots will die and no longer able to absorb water.

Thus, the leaves will begin to show signs of insufficient water. Hence, the gardeners will think that these signs show that the plant is lack of water and they will add more. This further will bother the circumstance and the plant typically passes on rapidly.

1.3 Objective

In order to achieve aim of the study, the study embarks on the following objectives:

1. To provide an effective way which to prevent and reduce the hot soil and overwatered plant.
2. To assist the growing of plant during the hot weather or periods of inadequate rainfall.
3. To evaluate the systems by using the real-world simulation problem.

1.4 Scopes

The scope of the study is divided into four parts, Software and Hardware Scope, Analysis Data Scope, Area of Study Scope and User Scope.

1.4.1 Software and Hardware Scope

Mainly, there are two software being used in this study. Firstly, is Arduino 1.8.2 Hourly Build firmware, which is used to generate the code inside the technology and to build the function for the water level analysis. Second is, Circuit.io which also generate the up-to-date schematic and code for this project. For the components for this project, the input will be the Soil Moisture Sensor and for the Output will be Piezo Speaker with additional transistor, rectifier and resistor. Thus, the controller will be Arduino Pro Mini 328 and the power supply for this technology will be use a 9v alkaline battery.

1.4.2 Analysis Data Scope

The data that is used for this study is from International Institute of Tropical Agriculture with a support of Food and Agriculture Organization of the United Nations (FAO). Where they make a research about the simple soil, water and plant testing techniques for soil resource management. This analysis was proceedings of a training course held in Ibadan, Nigeria in 16-27 September 1996. Many African countries have serious problems in providing effective advisory services on soil resource management to farmers, even after they have established Soil and Water Testing Laboratories (SWL). For many year, the Food and Agriculture Organization (FAO) and other international agencies have assisted less developed countries in establishing and improving Soil and Water Testing Laboratories (SWL) through project fund mobilization.

Through these efforts, many African countries are presently beset with inefficient soil testing and soil management advisory services. For the data analysis of soil structure, the relative proportion of sand, silt and clay particles in a soil contain the soil texture and how the mode in which these particles are grouped together into aggregates is called soil structure. The soil structure can be categorized into the percentage of clay, silt, and sand it contains.

Loamy soil, a generally even blend of sand, sediment, and dirt, feels fine-finished and somewhat moist. It has perfect qualities for planting, gardens, and bushes. The loamy soil has awesome structure, sufficient waste is dampness holding, loaded with supplements, effectively developed and it warms up rapidly in spring, however, doesn't dry out rapidly in summer.

Figure 1.1 Loamy Soil example

1.4.3 User Scope

The outcome of this project will be useful for researches, students or lecturers, gardener and plantation owner. The output will be used as research and reference materials in future studies. The proposed technique and output will be useful during the teaching and learning process. The gardener and plantation owners can also use the result of analysis to decide the watering process for the plants. This may could help to protect the agriculture in the future from the unstable condition of weather and help for the plant growth and development.

1.5 Project Significance

The project was implemented to develop a mechanism that use a moisture sensor as a main significant potential source of information to classify the level water or humidity of the soil for the planting. This method is efficient for the plant that need a high maintenance management or a garden that need a good care of it humidity. This result will be very useful as most people do not know how much they need to water their plant on certain condition. Thus, the minimum soil temperature for plant growth and the optimum temperature is the realistic soil temperature. By using the Intelligent Soil Fertility Detection System (ISFDS) it can save the time for the plants to germinate or flowering. The moisture sensor inside the technology will get the information about the reading of soil temperature and it will transmit to the piezo speaker alert message, the response for the output will be different depends on the reading of soil condition. This project result can also be a research reference in the future studies on ideal soil temperatures for planting.

1.6 Expected Output

The result of this project, Intelligent Soil Fertility Detection System (ISFDS) will shows the user what is the current level temperature that depends on 4 different type of condition. If the soil is wet or in normal condition, the Piezo speaker will be quiet. Otherwise, if the soil is less water but condition is not critical, the Piezo speaker will be not too long for the alert message. If the soil is dry but almost to critical condition then the Piezo speaker will change the tone which is more longer than the first alert. However, if the soil is very dry and the condition is in critical state, the alert from Piezo speaker will be longer than others tone.

1.7 Conclusion

In conclusion, this project has the potential to become a helpful technology that can be used to sense the moisture level of the plants and the user can supply the water with a correct amount if the plant required. The hot weather is not anymore problem to have a good plant in our garden. This Intelligent Soil Fertility Detection System (ISFDS) technology will come soon to reduce the hamper plant that cause by the hot soil. Fuzzy Logic Technique will be used for this classification. The soil temperature will be classified or categorized into several classes by using the moisture sensor. This result of project will be significant for researches, students or lecturers, gardener and plantation owner to achieve the objectives in chapter 1, the study process will be explained in the following chapter.

CHAPTER II

LITERATURE REVIEW AND ANALYSIS

2.1 Introduction

A literature review can be interpreted as a review of an abstract accomplishment. It is a review of summary of previous researches on related topic for this project. In my project, literature reviews are a staple as these review guides in proposing a technique with broad background study. Through review of the scholarly literature relevant to my project, this project will be assisted in writing analysis to get clearer view of the project developed.

In this chapter, the literature review is focus more on results and discussions of the research papers and journals being used for this project. The main purpose of this literature review and analysis is as a guideline or guidance of the project with reference of valid and trustworthy sources. Analysis is also an essential element in my project study as it discusses and identifies the problem encountered with traditional technique or procedure that is currently being used.

2.2 Plant Watering System

Irrigation is the artificial application of water to the land or soil. It is used to help in maintenance of landscapes, growing of agricultural crops, and re-vegetation of disturbed soils during periods of inadequate rainfall and dry areas. The soil is the plant's water and food supply. Soil is made up of mineral particles weathered out of rock. These particles are identified by their size as clay, silt, or sand. The mineral particles are mix together by organic matter. Soil is classified based on the relative proportions of clay, silt, and sand.

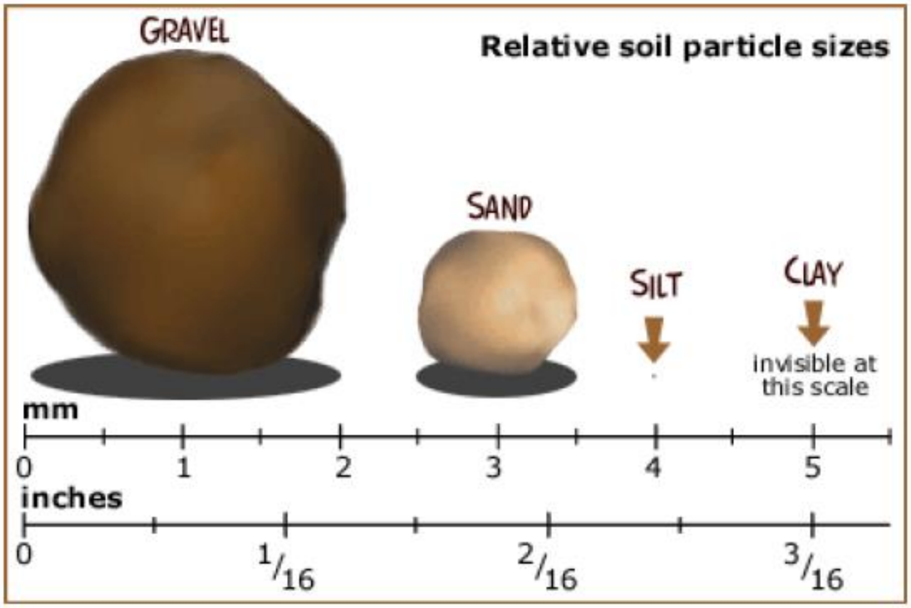

Figure 2.1 Watering with moisture sensor (Baselin Irrigation Solution, 2011)

In this literature review and analysis, many researchers have done the studies on how to improve the potential of plant growth. They did the examined for improving the plant's water-use efficiency and most of the plant's water use can be optimized by good irrigation practices. The water level can be classified in five level which is, saturation, field capacity, maximum allowed depletion(MAD), permanent wilting point, and oven dry. At saturation level, most of the spaces between soil particles are loaded with water. After a dirt has achieved immersion, it doesn't turn out to be more soaked; even though, in a few circumstances where water is caught, it can end up plainly overflowed. When in doubt, irrigators would prefer not to soak the dirt since it removes the plant's supply of oxygen, which, as a result, suffocates the plant. In any case, at the immersion level, gravity pulls water descending through the dirt more quickly. An expert irrigator may immerse the surface layer of the dirt keeping in mind the end goal to move water further into the dirt and relax the impacts of poor circulation consistency.

When soil is at the field capacity level, it implies that all abundance dampness has emptied openly out of that dirt. The measure of outstanding dampness is the field limit. Envision plunging a wipe in a container and enabling it to splash up water. When you pull the wipe from the can, water trickles unreservedly. At the point when the dribbling stops, the wipe has achieved field limit. To have a proper irrigate in this level, turn off the water when the soil in the root zone of the plants where it reaches field capacity. A moisture soil sensor measures field limit in the alignment procedure and utilizations this incentive as the reason for different settings.

At the maximum allowed depletion(MAD) level, the irrigation need to start when the soil moisture content reaches this stage. Usually, the most extreme permitted consumption level is simply before the plants start to hint at noticeable anxiety. Irrigators normally begin watering at or before (MAD) level is reached, this is because they do not need their scenes to hint at stress. (MAD) level is not measured because it depends on perception and sentiment. The moisture soil sensor can consequently set the (MAD) level edge for the view of an estimation field limit. Thus, on the permanent wilting point, the level water in the soil is not necessary for the plant's needs. This term is of little significance to most scene irrigators unless it is about a genuine high shortage water system methodology. In the soil moisture sensor system is to accomplish a high deficiency water system technique and might want agronomic exhortation.

When the soil is dried in an oven, almost all water is removed. For this moisture content level is was used to provide a reference for measuring and reporting volumetric soil moisture content (VMC). VMC is used to see the soil moisture point as a common way to show the result. On the off chance that you uncover a volume of soil, measure it, then cook it until it's dry, and afterward measure it once more, the VMC is the percent of progress in weight. A few terms are utilized to portray the water held between these diverse water substances. Gravitational water alludes to the measure of water held by the dirt amongst immersion and field limit. Water holding limit alludes to the measure of water held between field limit and shrinking point. Plant accessible water is that part of the water holding limit that can be consumed by a plant. When in doubt, plant accessible water is thought to be 50 percent of the water holding limit.

Maintaining the good plant, we must understand properly the capacity of plant available water in our soil. Depending on the main type of particles present in the water, soil will either penetrate and drain quickly as in coarse-textured soil made up largely of sand or water will penetrate and drain slowly. However, when you already have a soil that properly identified from a qualified lab, there still a factor which complicate the ability to estimate the plant available water capacity such as compaction, soil depth, layering, or slope. By using a moisture soil sensor, it makes this process mush easier by simply measuring the moisture content in the soil.

Table 2.1 Plant and Soil Sciences eLibrary-University of Nebraska

Textural Class	Plant Available Water Holding Capacity inches/foot of soil
Coarse sand	0.25 – 0.75
Fine sand	0.75 – 1.00
Loamy sand	1.10 – 1.20
Sandy loam	1.25 – 1.40
Fine sandy loam	1.50 – 2.00
Silt loam	2.00 – 2.50
Silty clay loam	1.80 – 2.00
Silty clay	1.50 – 1.70
Clay	1.20 – 1.50

2.3 How Distribution Uniformity Affect the Watering Goals

Having a perfect distribution uniformity is no really practical in landscape irrigation, but it does help the irrigator understand the ideal situation. When the distribution is 100% uniformity, the applied water infiltrates the soil consistently both vertically and laterally where all plants would respond to the soil moisture condition equally.