Chapter 19
Web Based Automatic Soil Chemical Contents Monitoring System

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ABSTRACT

The need for finding new, more efficient and sustainable methods of agricultural cultivation and food production has become more critical especially in the developing countries. In order to facilitate this, there are needs to design a precision agriculture system capable of providing farmers with useful data about the conditions of the soil available in their farmlands in a user friendly and easily accessible manner. This work therefore presents a web based automatic soil chemical contents monitoring system. The work combined the use of pH probe, an Arduino sink node and other devices to automate the processing of soil chemical contents data obtained from farmland. Three solutions were used in testing the efficacy of the proposed method and comparing it with the existing method. The result showed that, the proposed design was able to extract the chemical contents of the soil from the farmland and transferred the same to Liquid Crystal Display and a web page.

1. INTRODUCTION

Precision Agriculture (PA) is a farming management concept based on observing, measuring and responding to inter and intra-field variability in crops (Zarco-Tejada et al., 2014; Rasher, 2015). The holy grail of precision agriculture is the ability to define a Decision Support System (DSS) for farm management with the goal of optimizing the returns on inputs while preserving resources (KTNUK, 2015; Whelan

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and McBratney, 2003). PA is technologically feasible as well as being economically and environmentally justifiable. Improving the agricultural process can maximize financial return and increases the stewardship of land, water, and related natural resources (Tayari et al., 2015). There is therefore an optimum need to know the chemical contents of the soil for different crop production (Vellidis et al., 2003). Researches on the effects of soil chemical contents for crop yield on the farms have been extensively studied in the past. With advancements in technology over the past decades, overall plants growth with crop yields have increased significantly while management practices have also changed since those earlier times (Tulberg et al., 2007; Bowman, 2008). These changes have improved the detection of soil contents for today's crops. The new technologies available to producers and researchers with weakness observed in existing knowledge however necessitates new research efforts.

The development of information technology has been having a considerable influence on agriculture. There have emerged a number of new industry-specific technologies and new applications over the past few years, including the ever-widening agricultural application of mobile communications devices and technologies (Szilágyi, 2006). The introduction of Wireless Sensor Network (WSN) technology in agriculture is also evolving rapidly (Ye et al., 2016). While WSNs provide possibilities to sense and gather information of various environmental soil and crop conditions, it remains a challenge for farmers to know real-time data of a farm soil chemical contents as well as incorporating necessary crops to cultivate on such land (Zarco-Tejada et al., 2014).

Arduino microcontroller has proven to be a useful device in precision agriculture. It can be connected with several other devices to measure the activities on the farmland such as irrigation system, soil moisture contents, soil chemical contents, green house monitoring system etc. The results of which can then be viewed on different technology platforms such as, mobile phones, web page, Liquid Crystal Display(LCD), and so on.

There are optimum needs to know the chemical contents of the soil for different crop production. For instance, if the soil is acidic, it may not be the best decision to plant some crop on such soil because such crop may not produce a reasonable yield which may result to loss in the part of farmers. Research on the effects of soil chemical contents for crop yield on the farmland has been studied extensively in the past. With improvements in the technology over the past decades, overall plant growth and crop yields can be increased significantly and management practices can also be changed.

Manipulating the soil contents however is highly dependent on the monitoring and controlling of the chemical contents of the soil (Finžgar et al., 2006). There are several ways by which soil monitoring can be carried out ranging from the traditional methods of measuring soil chemical contents with the use of pH meter to keeping a manual digital record of pH level on a digital display with the aid of pH sensor interface. Measuring and monitoring the soil contents in order to make decisions in research and/or automation is however laborious and error prone (Kumar et al., 2015). Existing works show that measuring of soil chemical contents such as lead, nitrogen, potassium, phosphorous etc. are mostly carry out in the laboratory which are time consuming. In other cases, some farmers do not even test the chemical contents of their soil until they see the output in form of yield from their farm which usually leads to lower yield from their various farm. It is then important that a system capable of monitoring the soil chemical contents with little or no human intervention be provided to help farmers in realizing better output and also in making accurate decisions in research as well as maximization of crop yield. The need to develop an automated system that monitor soil chemical content becomes a necessity.