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Soil Sensors as a Service: Low Cost Soil Diagnostics System using Sensors

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ABSTRACT:

In agriculture to grow healthier yield nutrients existing in the soil should be managed properly. Continuous growing of plants affects the soil fertility and its fertility level goes down. Farmers should go to laboratory for testing the fertility of the soil and it's time consuming. An optical transducer is developed to measure and to detect the presence of Nitrogen (N), Phosphorus (P) and Potassium (K) of soil. Such transducer is needed to decide how much extra contents of these nutrients are to be added to the soil to increase soil fertility. This can improve the quality of soil and reduces the undesired use of fertilizers to be added to the soil. The N, P, and K value of the sample are determined by absorption light of each nutrient. The advance in the technology helps to progress even in the field of agriculture. In proposed framework, soil nutrients can be identified using IOT. PH, temperature and moisture, NPK is found using sensors. By this measure of fertilizers required for the field will be known. This helps farmers to examine soil and know its fertility level before sowing. By this large amount of yield can be gained. IOT-Internet of Things is the large domain which deals with collecting information through internet at any time, at anywhere. Which helps in monitoring system in the absence of human intervention? Which are observed by sensors, used even in farming to experiment soil, by which the fertility of soil is maintained?

Keywords: Real Time Database, DHT-11, Moisture Sensor, Cloud.

1. INTRODUCTION

Studying the variation of certain parameters within an agricultural field is the main objective of Site specific crop management (SSCM) which allows farmers and growers to ameliorate management of agricultural inputs, while taking into consideration the variability of soil attributes within their fields. And hence improves decision making about the use of those inputs (e.g. adding fertilizers, pesticides, Lime, Gypsum) in order to face the ever changing requirements of both the soil and crops. Geo-referenced soil sampling and laboratory analysis exemplify a known technique to distinguish soil properties within fields. On-the -go soil sensing is considered one of the most promising strategies for obtaining high geo-referenced results.

Many concepts about the development of on- the-go soil sensors have been hitherto presented and reported by various researchers and developers. Although the availability of commercial systems is limited, there is a mutable effort in developing and enhancing new prototypes. Soil pH is an indicator of soil acidity and basicity. Most soils have a pH range of 4 to 10 with an optimum pH range for most plants between 5.5 and 7.0. The pH of a particular soil, such as 5 or 8, reflects a certain chemical and mineralogical environment in that soil, and thus pH is of great importance to plant roots and microbial activity. For these reasons soil pH is one of the most important factors affecting soil fertility and so is regularly managed to increase crop yields.

Chemically, the pH is an expression of the H ion activity, ( ). Hydrogen ions hydrate similarly to other cations in the soil solution. The pH scale was devised to simplify the expression of ( ) and is the logarithm of the reciprocal of the ( ) or H ion concentration: =−( ). Since soil chemical properties such as pH, Cation exchange capacity (CEC), and organic matter (OM) are a foundation and an important entry in fertilizing and soil improvement, so many growers became interested in soil testing results.

In Sudan, measuring soil properties is considered an essential operation which continued to evolve fast during the past years from conventional laboratory analysis of soil samples to modern soil sensing techniques. By taking advantage of information technology and precision Agriculture practices, farmers are now able to extract and profit from almost each seed, and to minimize agricultural activates (e.g. planting, Fertilizing, irrigation) within their own fields in order to reduce the environmental impact of farming. Presently, many projects in Sudan are dealing in precision technologies in order to promote and preserve the national and international Agricultural yield which proved high efficiency and effectiveness. The objective of this study work was to design and develop an On-the-Go Soil pH Mapping System prototype to understand and grasp the most benefit of soil sensing and proximal soil sensing in particular. The work involves:

1. Brief understanding about the nature of soil pH and the concepts of soil pH measuring. Obtaining available soil pH sensors.
2. Designing of system's mechanical components.
3. Evaluation of the developed system.

2. EXISTING SYSTEM

Fig shows a model of the system. We consider an indoor environment, such as a museum, where multiple APs providing WLAN and Bluetooth are deployed. Cameras are placed in each room and corridor mainly for surveillance, but the images obtained by the cameras can also be used for geo-f Traditional soil samples and lab techniques take days to weeks to get results back, are expensive to obtain, and as a result, problems manifest in the plant before results are returned. KVK Soil Testing Laboratories, Mobile Soil Testing Kits, Private Soil Testing agencies Colorimetric Testing Strips. All plastic ion selective electrode origami based on electrophoresisencing.

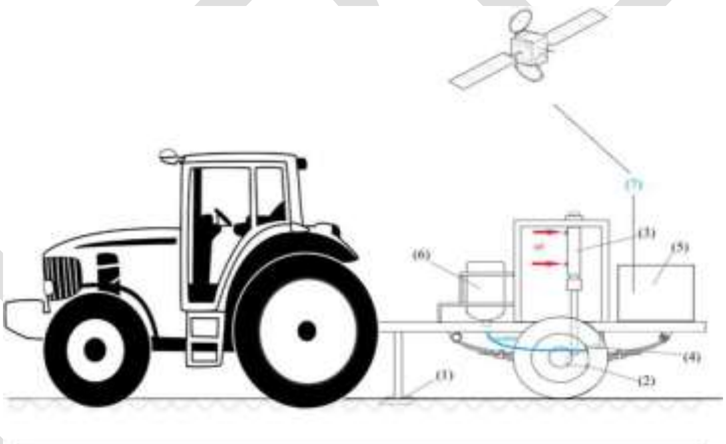

Fig. 1 Mobile Soil Testing

A smart sensor (FieldScout® pH110 meter) was obtained as a test module and a reference for the system with data logging and geo-referenced data capabilities. Another pH Analog sensing kit which consists of pH electrode, pH interface, was obtained and merged with a microcontroller via laptop. As for mechanical components, the following de sign criteria were considered:

1. Strength, Stability and Versatility of the system
2. Simplicity in design and high operational reliability

3. High robustness
4. Low cost components
5. Safety and low environmental impact

3. PROPOSED SYSTEM

Soil diagnostic sensor that uses planar ion selective electrodes to detect N, P, K, and pH contents in a soil sample; combined with recommendation service that returns an actionable fertilization recommendation to the farmer.

From measuring environmental conditions that influence crop production to tracking livestock health indicators, Internet of Things (IoT) technology for agriculture enables efficiencies which reduce environmental impact, maximize yield and minimize expenses.

2 Module's:

1. Phase: I
    - NPK Soil Data Set
    - Preprocessing
    - Clustering
    - Feature Extraction
    - Classification
    - Cloud Storage Server

Sampling Procedure

The designed Soil sampler of the system consisted of a double acting hydraulic cylinder which acquires its power from the tractor's external hydraulic connections. The cylinder is connected to a sampling shoe which collects the needed samples. During the tractor's movement in the field while the hydraulic cylinder in extension phase, the soil will flow into the sampling shoe, and when the shoe reaches 0.003m3 capacity of soil, the hydraulic cylinder retracts and the sample is taken up to the electrodes holders.

2. Phase: II
    - Preprocessing
    - Clustering
    - Feature Extraction

- Live NPK Data Set
- Classification
- Prediction

The work is still in progress to finalize the complete proposed image of the system; by integrating a full GPS unit, studying the availability of adding external soil sensors (e.g. OM, Moisture, soil EC) and full automatizing the watering unit. In addition, further studies and tests are to be made in order to grasp the most benefit of this technology and to complete and comprehend the aspects of the developed mapping system.

User Interface:

1. Farmer Login
2. Geologist Login
3. Location Search

4. CONCLUSION

The following conclusions were deduced from obtained results:

- A soil pH mapping system was designed and developed using local and available technologies with a suitable especially made platform and a designed soil sampler.
- The designed system proved high reliability with acceptable error ranges, in on road and off road transportation.
- Laboratory and field measurements were compared and related to the obtained commercial pH sensor, and error corrections were made under lab controlled environment and field semi controlled conditions in (10×3 m2) field area using grid sampling method.
- With an external proposed GPS unit, the system can be used to map soil pH values within fields using any sampling standard method.

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