just monitored moisture ,salinity, ph completely ignored nutrients

Soil moisture monitoring using IoT enabled arduino sensors with neural networks for improving soil management for farmers and predict seasonal rainfall for planning future harvest in North Karnataka - India

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***Abstract*—Suitable soil water amount is an obligatory condition for ideal plant growth. Also, water being a crucial element for life nourishment, there is the prerequisite to circumvent its excessive use. Irrigation is a supreme consumer of water. This calls for the need to control water supply for irrigation purposes. Pasture should neither be over-irrigated nor under-irrigated. Soil Monitoring is one tool to provide soil information. Over time, systems have been applied so as to approach register this aim of which computerized procedure are the most accepted as they permit data to be gathered at high persistence with less work demand. Size of the current structure engage micro-processor based systems. These systems provide several technological supremacy but are high-priced, large, hard to sustain and less welcomed by the technologically untrained operators in the pastoral scheme. The objective of this project is to outline a manageable, facile to install technique to detect and specify the level of soil moisture that is endlessly managed with a view to attain pinnacle plant growth and concomitantly augment the obtainable irrigation resources. In this project we use the information obtained from the input sensors which is handled using the neural networks algorithm and correction factors for monitoring. Soil monitoring, providing a series of assessments showing how soil conditions and/or properties change over time. The use of simple obtainable components decreases the manufacturing and maintenance costs. This makes this system more economical, appropriate and a low maintenance solution for applications, mainly in rural areas and for small scale agriculturists.**

Keywords—* *Soil Moisture sensor, Ph sensor, Salinity sensor, arduino, wifi shield, power supply, neural networks.

I. INTRODUCTION

The Soil monitoring system for precision agriculture is a new system that replaces the current system for soil moisture, salinity and PH value testing. This setup will have two parts: one mobile application which is used to alert or give suggestion to the farmers (users) whether the soil moisture, salinity and PH value are low or high as compared to standard values and used for supervise the data about the process as full. The mobile application will need to commune to a wifi shield. The serviceability provided by the wifi shield will be implanted into the application in order to help the user to use the functions in the application in a smooth manner. Since this is a data-centric system it has to store the data. For that, a database will be used.

Soil nutrient monitoring system is to master the nutrient status of the bare ground, and quickly extract the information of farmland nutrient. Because of having a significant impact on the crop, the soil nutrient monitoring is important. Lack of monitoring soil nutrient because people suffer from various disease due to chemical fertilizers. The benefits of optimizing irrigation scheduling with soil moisture sensors includes increasing crop yields, saving water, protecting local water resources from runoff, saving on energy costs, saving on fertilizer costs and increasing the farm's profitability.

A. Objectives

There are mainly four objectives which describes the complete working of this project.

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- To develop a cost effective and automated model to monitor and regulate the moisture level of a soil sample mainly aimed to cater to the needs of technologically ignorant rural farmers.
- To identify the impacts of fertilizers and soil nutrients in agriculture.
- To test the feasibility of indigenous sensors (resistance blocks) instead of using commercially available ones.
- Improving the effectiveness of soil protection measures; and Raising public awareness on soil degradation.

II. System Information

A. Literature review

First, we will look at the different types of soil based on the pH levels. Soil classes based on pH level

- Extremely acidic soil less than 4.5
- Very strongly acid 4.5 to 5.0
- Strongly acid 5.1 to 5.5
- Medium acid 5.6 to 6.0
- Slightly acid 6.1 to 6.5
- Neutral soil 6.6 to 7.3
- Alkaline 7.4 to 8.0
- Strongly alkaline 8.1 to 9.0
- Very strongly alkaline greater than 9.0

Second, we will look at the different types of soil based on the salt content in them. The Soil salinity classes are

- up to 0.2 ds/m- Normal soil
- 2-3 ds/m- Critical to sensitive crops
- -4 ds/m- Very critical to tolerant crops
- greater than 4 ds/m- Injurious to crops

B. Existing Systems and their Advantages or Disadvantages

1) Feel and Appearance method using shovel or soil auger: This method is intuitive and requires experienced monitoring. Also it is vague.

2) Electronic India 1160 soil and water testing analysis kit: This kit is comparatively of higher cost (approx. 35000) then our product.

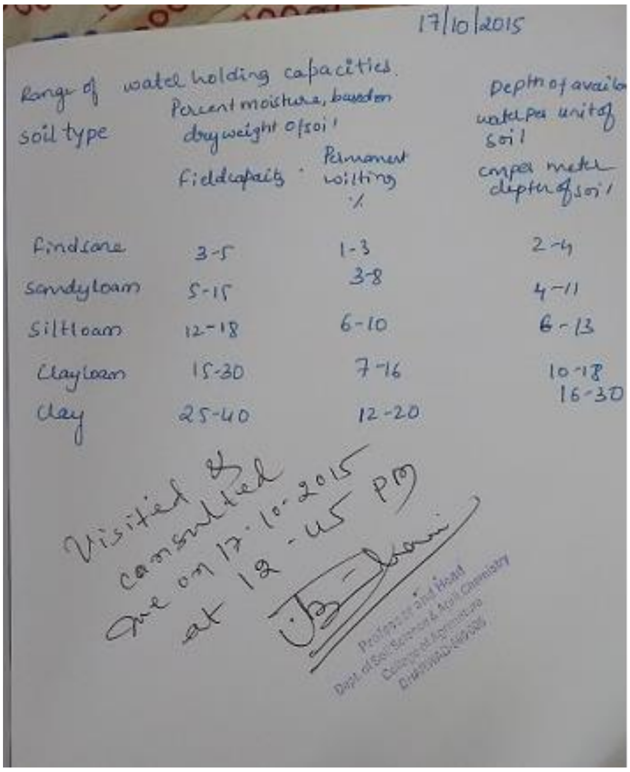

Fig. 1. The ph level and soil salinity as instructed by Dept of Soil Science, Univeristy of Agricultural Sciences, Dharwad.

3) Various methods have earlier been proposed to determine the moisture and salinity levels [2] [1] which use similar mechanisms.

All the present systems available do not use neural networks for preprocessing. Our project tries to overcome the input variations due to malfunctioning of sensors and micro climate activities. Also, an attempt is made to understand historical data to predict future rain.

Against the fundamental benchmark for planning irrigation on various crops are well specified and comprehended by the majority of farmers, their implementation under field conditions, i.e. amount of water required, are often challenging tasks due to a number of uncertainties related to crop features, soil characteristics, and dynamics of water flow through the soil and uptake by the crop. Farmers often face challenges in irrigating adequately and efficiently, regardless of the irrigation methods used, due to a combination of factors related to crop features (depth of rooting systems, indeterminate growth, periodic cutting and re-growth cycles), soil hydraulic properties and farming operations (harvesting schedules) that together with uncertainties of soil-water relations often lead to improper irrigation management and sub-optimal yields.

C. Proposed System

When moisture sensor is placed in soil, soil moisture sensor takes soil as input and gives output in measure of moisture content. Soil moisture sensor is connected to an arduino which is in turn interfaced with android application using wifi shield. Soil moisture is continuously being

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monitored by the sensor and the output values are stored in database. The same is processed using Correction factors and neural network algorithm. The output values are fetched from database and displayed in android application.

III. Implementation of Proposed System

A. System Model

The pipe and filter Architecture is the one where data processing in a system is organized so that each processing component (filter) is distinct and conveys one type of data transformation. It makes the data flows (as in a pipe) from one component to another for processing.
The description of above model is as follows:

- Soil Parameters is given as input.
- This input is tested using sensors.

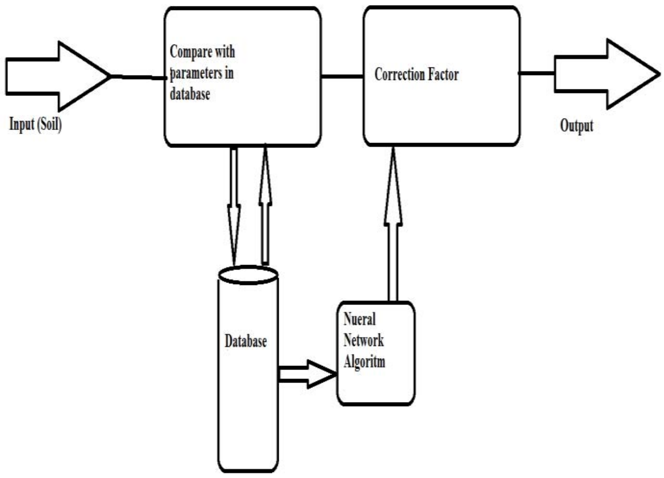

Fig. 2. The System Model.

- The test results are compared with standard soil parameters which are stored in the database.
- Comparison will result in generation of correction factor.
- The database gives data to the neural network algorithm that which also analyses data with the correction factor. However the same can be used for pre processing of data given as input. This allows to compare with the historical data and provides faster and accurate results.
- Based on this correction factor output is recommended to the farmers.

B. System Functionalities

Each filter exposes a very simple interface: it receives soil parameters as inputs on the inbound pipe, processes the parameters, and publishes the results to the outbound pipe. The pipe connects one filter to the next, sending output from one filter to the next.

Module 1:

- Input: Soil sample.
- Processing: The system shall take the inputs from the soil sample. It shall monitor the moisture content, pH content and salinity content with respective sensors.
- Output: Soil parameters will be measured from sensors.

Module 2:

- Input: Soil Parameters, standard soil parameters stored in database.
- Processing:
    - Comparator compares the soil moisture parameters with standards for dry, optimum, wet condition.
    - Comparator also compares the soil salinity parameters with standards for less, optimum, excess salt content in soil.
    - Comparator compares the soil pH parameters with standards for acid, base and neutral conditions
- Output: Comparator generates the correction factor

Module 3:

- Input: Correction factor
- Processing:
- Output: Output will be in the form of suggestion/alert which will be displayed in the mobile application.

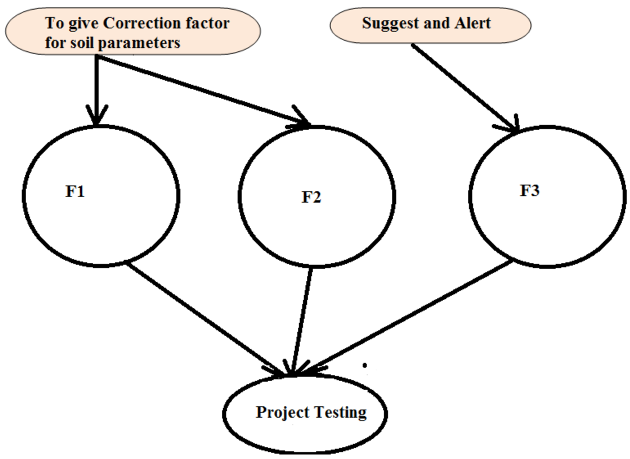

Fig. 3. The Function Means Tree.

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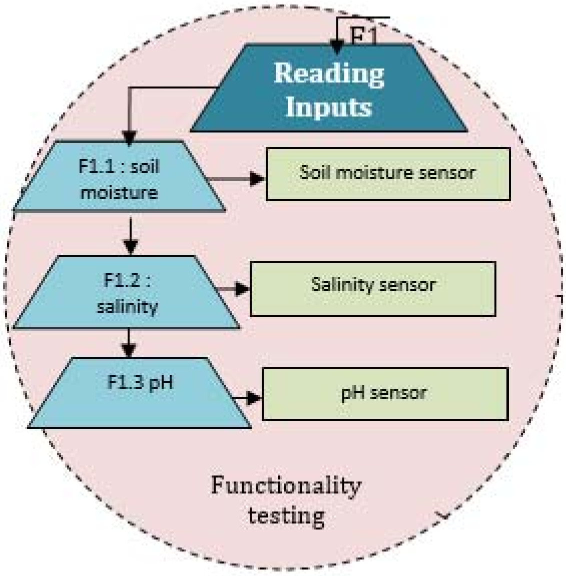

Fig. 4. The Function 1 in Funtions Means Tree.

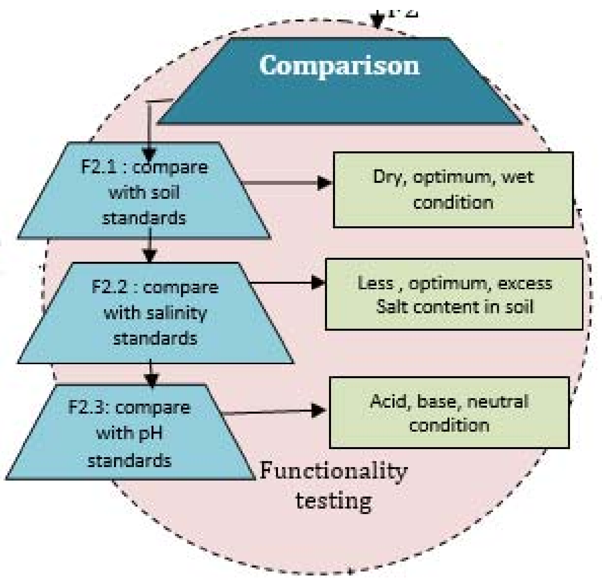

Fig. 5. The Function 2 in Function Means Tree.

C. Comparing the input soil parameters with standard values

Algorithm 1 shows the implementation details for comparing moisture parameters.

Algorithm 1 - Comparing with standard moisture parameters

- Start
- Input: Soil Parameters in voltage
- if (Input > 700)

Excess wet

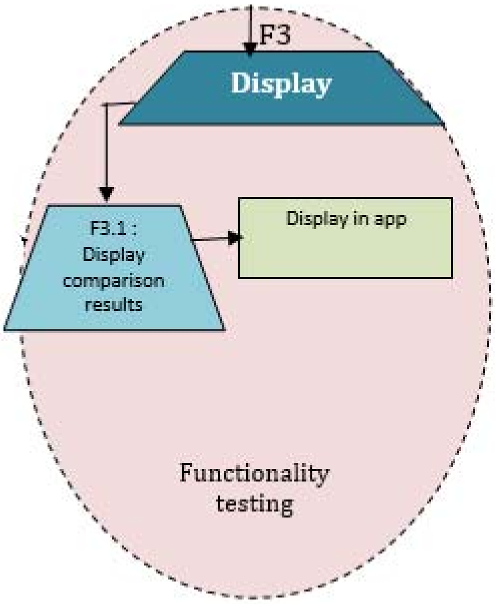

Fig. 6. The Function 3 in Function Means Tree.

if (Input > 3300 && Input < 700)

Optimally wet or optimally dry

if (Input < 300)

Dry

if(Input>0 && Input < 100)

Sensor is in air

- End

Algorithm 2 shows the implementation details for comparing Ph parameters.

Algorithm 2 - Comparing with standard pH parameters

- Start
- Input : Soil Parameters in voltage
- if (Input > 5.1 && Input < 5.5)

Acidic

if (Input > 5.6 && Input < 6.0)

Basic

if (Input >6.0 && Input < 6.5)

Neutral

- End

Algorithm 3 shows the implementation details for comparing salinity parameters.

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Algorithm 3 - Comparing with standard salinity parameters

- Start
- Input : Soil Parameters in voltage
- if (Input >3 && Input < 4)

  Excess salt content

  if (Input > 0 && Input < 2)

  Optimal salt content

  if (Input >2 && Input < 3)

  Less salt content
- End

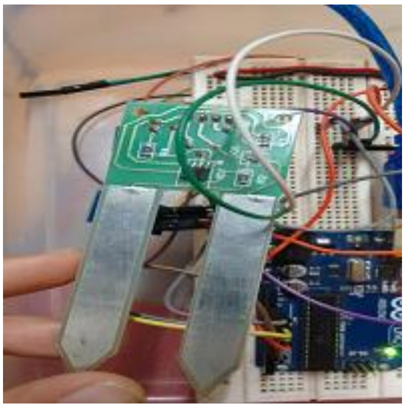

Fig. 7. The Soil Moisture Sensor.

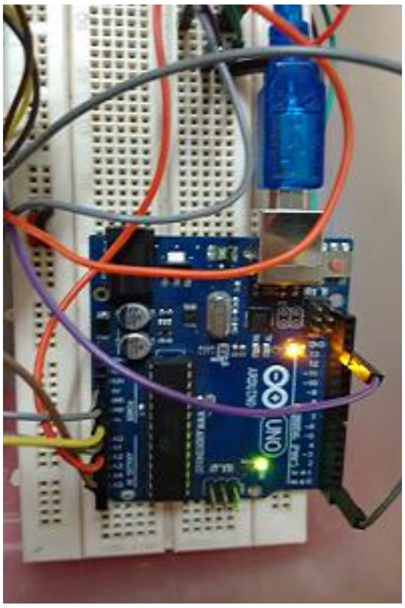

Fig. 8. The Arduino board.

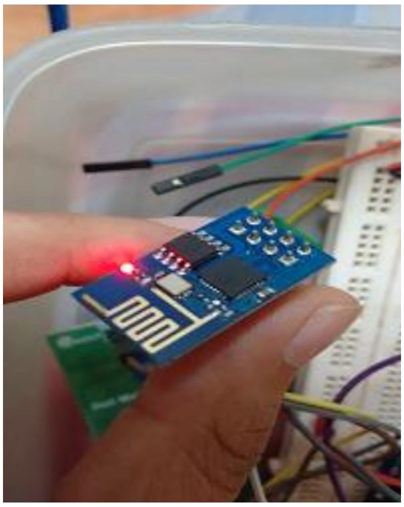

Fig. 9. The Wifi module.

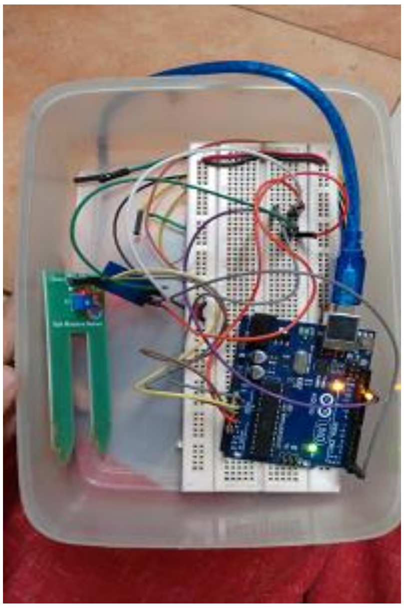

Fig. 10. The Soil Monitoring System.

IV. RESULTS DISCUSSION

Soil moisture sensor is connected to an arduino which is in turn interfaced with android application using wifi shield. Soil moisture is continuously being monitored by the sensor and the output values are stored in database. The output values are fetched from database. After fetching the moisture readings from database we are going to display the moisture readings which includes timestamp and moisture content it with the look-up table. If it is in the range 0-100 then sensor is in air, if moisture content is in the range from 100-300 dry, if moisture content ranges from 300-700 humid or optimal, if it ranges from 700-1000, it is excess.

From the Fig. 11 we can see that the results obtained from 5 sample inputs neural network included algorithm takes into

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account historical data and is more uniform. The deviations are not as much as the algorithm without neural networks.

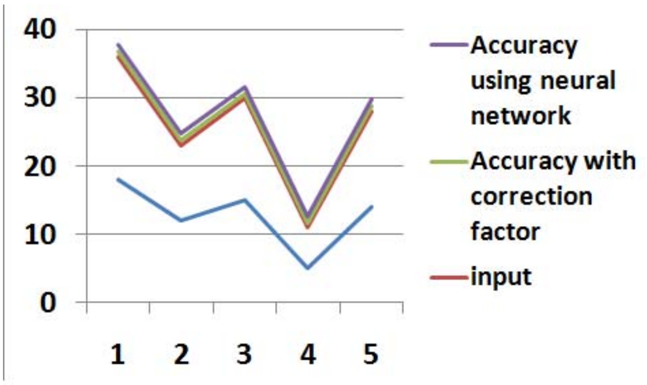
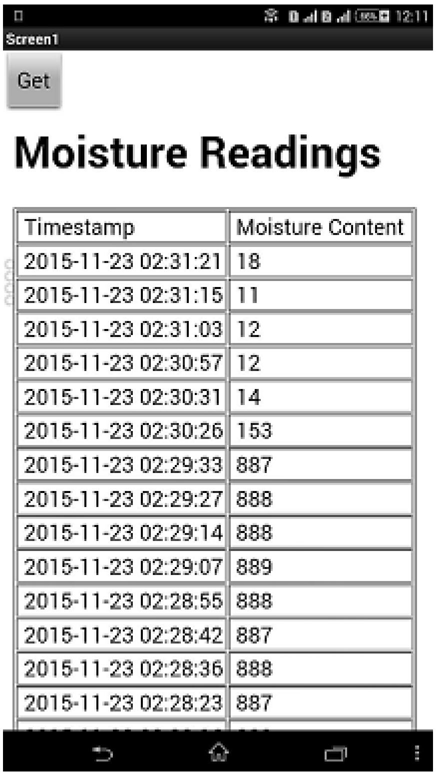


Fig. 11. The Results section discussion chart which shows 5 samples result comparison, one with Neural networks and correction factors.



Moisture Readings

Timestamp	Moisture Content
2015-11-23 02:31:21	18
2015-11-23 02:31:15	11
2015-11-23 02:31:03	12
2015-11-23 02:30:57	12
2015-11-23 02:30:31	14
2015-11-23 02:30:26	153
2015-11-23 02:29:33	887
2015-11-23 02:29:27	888
2015-11-23 02:29:14	888
2015-11-23 02:29:07	889
2015-11-23 02:28:55	888
2015-11-23 02:28:42	887
2015-11-23 02:28:36	888
2015-11-23 02:28:23	887

Fig. 12. The Output of Moisture Readings with date and time of entry using correction factors.

V. Conclusion

A specialized approach is being used to design the soil monitoring system for measurement and control of the plant growth parameter, i.e. soil moisture. The data which we get from the measurement has shown that the system performance is quite dependable and correct. Soil moisture sensors are used in detecting the changes which are required and to calibrate irrigation practices. These minor changes in irrigation practices help in increasing yield and saves water. The lead to proper irrigation management using soil moisture sensors is disciplined monitoring of the sensors to get the soil moisture level when the data obtained is in the determined range for the specific soil type. With the neural networks we can use the same to predict seasonal variations and rains in an area which can also help the farmers to plan their future harvest which can be future work on this project. However, our system abolishes the snag of the current set-ups mentioned in the previous section. It is proving to be a simple to use, flexible and economical. No attempt has been made to automate the process of soil management in North Karnataka region in India which has seen irregular rainfall in the past 4 years.

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