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A RESEARCH PAPER ON IOT BASED SMART AGRICULTURAL SYSTEM

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Abstract - *Agriculture is an evolving practice, right from the primitive practices to the present day mechanized practices, we have seen constant improvement in the methods and tools used in agriculture. In line to this development, we are now using IoT to make agriculture a smart application. The hallmark of this paper is to introduce multiple sensors at different levels of agriculture process and to develop a user friendly system. As we all know "Better the Informed, Better the decision made". This project provides real time data to the farmer about his farm, so that he can take a least disadvantageous decision. Further, it acts as a one stop solution to the farmer by enhancing them with smart agriculture applications. By using these smart applications, farmer can improve his income (i.e. high yield and better livestock management).*

***Key Words*: Internet of Things (IoT), Long range Radio (LoRa), Soil Moisture sensor, PH sensor, Alarm, Perimeter Security sensor, Rain Drop sensor, Arduino module, Livestock tracker sensor, National Agriculture Market (E-NAM).**

1. INTRODUCTION

In India around 52% of population is directly or indirectly depend on agricultural activities, but the agriculture sector contributes only 22% of GDP. From this data we can come to the conclusion that there is a huge unutilized potential in this sector.

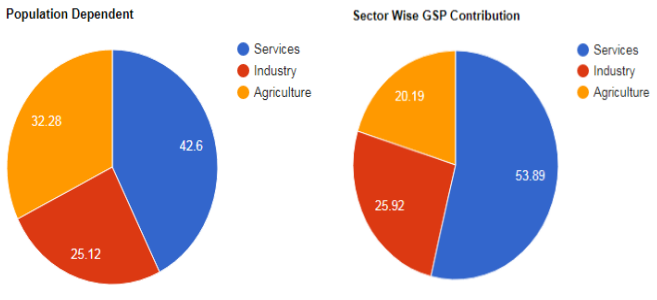


Figure 1: Data on agriculture sector

The Best way to tap this potential is by enabling the agriculture sector with cutting edge technologies, one of them is IoT based applications.

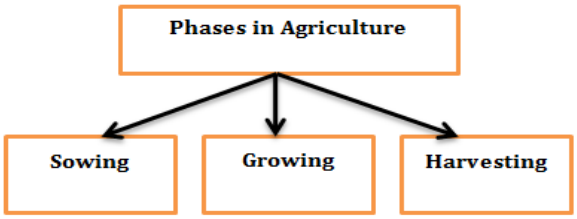
Smart Agriculture System: - This project focuses on two most important agricultural activities.

(a) Farming

(b) Livestock Management

1.1 Farming :

Agriculture mainly comprises of three different phases viz. Sowing, Growing & Harvesting.



1.1.1 Sowing :-

Scenario I

During this stage, farmers remove the weeds and plough the land to make it fertile. As the farmer has no data regarding his farmland (i.e. PH Level, NPK level) puts him in a disadvantageous position.

Scenarios II

By installing PH, Temperature, Humidity, NPK sensors, the farmer will be better informed about his land, so that farmer will optimize his choices of suitable crops to avoid unseasoned /low yield plantation.

1.1.2 Growing

Scenario I

During this phase, farmer applies different manures, pesticides and fertilizers to his crop, making conditions favorable for the growth. In the absence of valid data about his land, he discriminately uses fertilizers and pesticides which in turn make the land unfertile.

Scenario II

By installing PH, NPK Sensors, farmer knows the required amount of Nitrogen, Phosphorous, and Potassium content to his crop. By this he will limit the usage of pesticides and fertilizers.

1.1.3 Harvesting

Scenario I

During this phase, farmer harvest his crop, with less Knowledge about the market prices and dynamics involved. He usually tends to be in unfavorable position to earn profit.

Scenario II

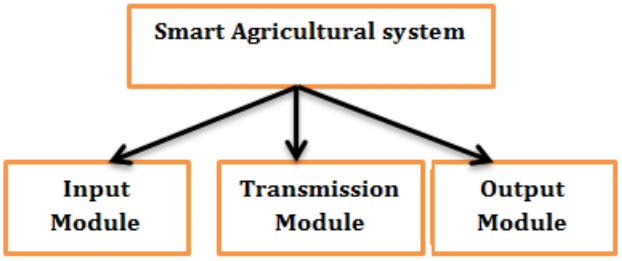
By directly linking the GoI's E-NAM data and informing about climate conditions, farmer can choose when to harvest and earn favorable outcomes.

1.2 Problem Statement

To provide farmers with reliable data about their farms and enable the agricultural process with sensors using wireless sensor network and IoT.

Present day problems faced by farmers: Poor water management, Excessive usage of fertilizers, Unable to monitor his farm from far distances, Labour-Intensive sector. Our end goal is to provide dependable solutions to the farmers using precise farming techniques.

2. Implementation



2.1 Input module:

Components: NPK sensor, Soil moisture sensor, Rain drop sensor, Temperature sensor, PH sensor, Perimeter security sensor, Arduino module.

Fertilizers acts as catalysts for the growth of any plant and in India we have seen extensive usage of these chemicals ,as per a survey conducted by the National Institute of Agricultural Extension Management, India consumes about 25.6 million tons of fertilizers, mostly Nitrogen (17 MT) followed by Phosphorous (6 MT) and Potassium (2.5 MT). According to another survey, excess usage of fertilizers results in following problems: Oxygen depletion, Weed Growth and Algae Blooms, Ammonia Toxicity, Cancers etc.. To counter this problem we can use NPK sensor.

NPK sensor: This sensor is generally used to measure the Nitrogen, Phosphorous, Potassium contents in the soil.

For different crops we require different amounts of NPK.

For example, Tomato Plantation requires N-P-K values from 6-24-24 to 8-32-16. Normally the soil naturally contains NPK contents, we have to add the deficient level to it. Any excess amount added will have negative consequences so this sensor which will help the farmer to know the right amount of NPK and add the deficient amount, which helps in healthy crop growth.

As per GOI data, ground water table is steadily decreasing over last two decades, the major problem associated with it is extensive water wastage in agriculture sector.

Usage of Soil moisture sensor helps in optimal usage of water.

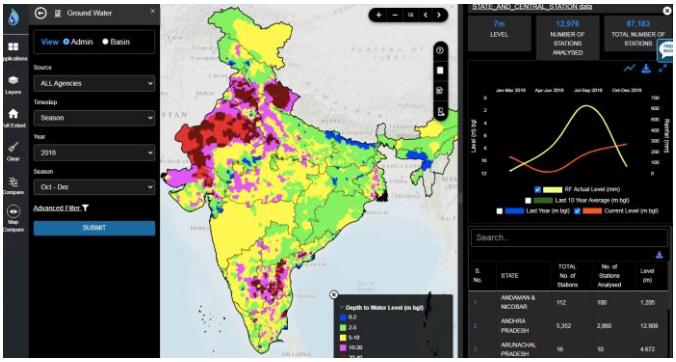


Figure 2: Data on Ground water levels

Soil moisture sensor: This sensor is used to measure the moisture content in the soil.

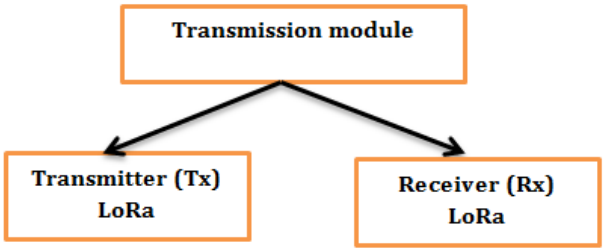
By linking it with a water pump, if the moisture content in the soil is below the threshold value then the water pump is turned on vice-a-versa. This will eventually address the problems of excess usage of ground water and improves the environmental conditions.

Temperature is one of the key factors in agricultural processes as the growth of the crop is directly proportional to it. Most of the crops require a medium cardinal temperature 15° to 32°. So, to have reliable knowledge about this factor will help the farmer in answering questions such as: When to water? How much amount of water to add? when to add manure and fertilizers?

Temperature sensor:

We use this sensor to measure the climatic temperature in the region so that the farmer will have knowledge about when to water the crop, amount of water, add fertilizers etc.

2.2 Transmission Module:



For communication we are using Long range radio protocol (LoRa), this is generally used in M2M networks.

LoRa is one of the commonly used IoT protocols which helps in connecting multiple applications. Standalone feature of this protocol compared to other IoT protocols is "Long-Range Communication", and also it has long battery life.
Features:

Range: 3 – 8 Km in Urban Ares; 15 Km in Rural areas
Standard: IEEE 802.15.4g

Figure 3: LoRa Module

By connecting LoRa to the Arduino Board we enable the communication between the input and output devices.

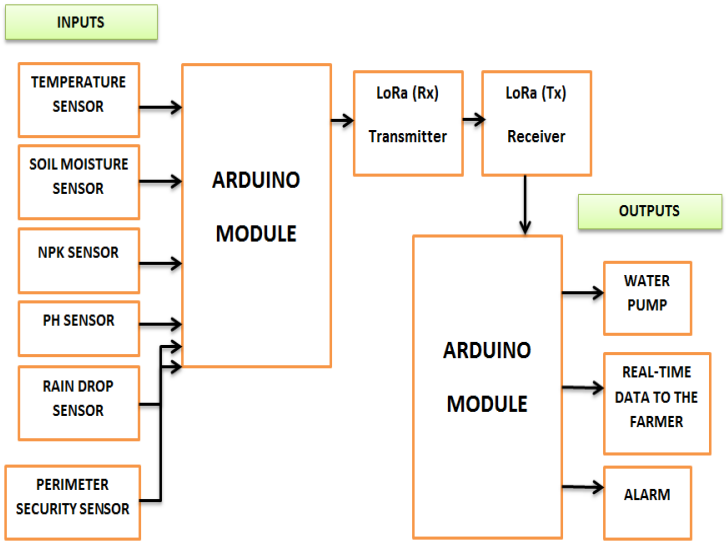
2.3 Output Module:

Components:
Water Pump, Alarm, and Livestock tracker

Under this module the farmer will be provided with Real-time data regarding his farm, so that he can make a better decision. Depending upon the humidity level in the soil the water pump is automatically turned ON/OFF.

Working:

By providing Input data to the Arduino Board it will process the data according to code given and sends the corresponding messages to the farmer vice-a-versa.



Block Diagram

Sensor	Parameters	Functions
Temperature sensor (DHT11)	Measuring Range: 0°C to 50°C Accuracy: ±1°C	Measures the temperature and sends the data to the processor.
NPK sensor	Measuring Range: 0-1999 mg/kg (mg/l) Operating Temperature: 5 to 45 °C.	Measures the Nitrogen, Phosphorous, Potassium content in the soil.
Soil Moisture sensor	Operating Voltage: 3.3V to 5V DC Operating Current: 15mA	Measures the moisture content in the soil and sends the corresponding message to the output device.
Rain Drop sensor	Working voltage 5V Output format: Digital switching output (0 and 1), and analog voltage output AO	It is used for sensing rain.
PH sensor	Operating Voltage = 10 -30 VC PH meter range: 1 - 14 Scale	Used for measuring acidic levels in the soil.

Table -1: Technical Specifications

3. CONCLUSION

Our project equips the farmers' community with new technological advancements and also helps in increasing the income. Primary objective of this project is to modify the labor-intensive agricultural practice into an automatic, advanced, efficient practice. As we have used new age technology like IoT the farmer can operate, connect to his farm from anywhere. Most Important part of this project is collection of data regarding farms, which can be utilized and analyzed by Farmer and Government for better governance. Last but not least, there is a huge scope in further development of this project by adding different new sensors and also improving communication protocols.

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