International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 05 | May 2022 www.irjet.net p-ISSN: 2395-0072

Agriculture Sensing using IoT

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Abstract – *We had plan to develop a system to monitor agriculture process parameters, for that we had understand the plant development cycle and key parameter to start understand the science of pattern and observation on data that will make us understand a lot of field and forest scenario's. We had look the actual hardware and software part interface and system for actual running system.*

Key Words: Smart Agriculture, Monitoring.

1. Introduction

This document present the work we had done for the agriculture monitoring and solutions what are there and what new advance technology can provide to the societies.

People can take help of technology to make it problem solve and make it efficient and reliable hence we are make machine from one can check, identify and learn from it to make it required changes accordingly. All the technology used for hardware and software are powerful and advance stable design considering all industrial looks.

2. Background of Work

Agricultural development was started about 12,000 years ago which changes the way humans live. Humans switched from hunters' lifestyles to permanent settlements.

Farming is the primary industry worldwide, and the maximum population occupation is directly or indirectly dependent on agriculture.

Innovation and evolution in agriculture made a path for cities and civilizations to grow, and because crops and animals could now be farmed to meet demand, the global population rocketed — we increase from five million people 10,000 years ago, to more than seven billion today.

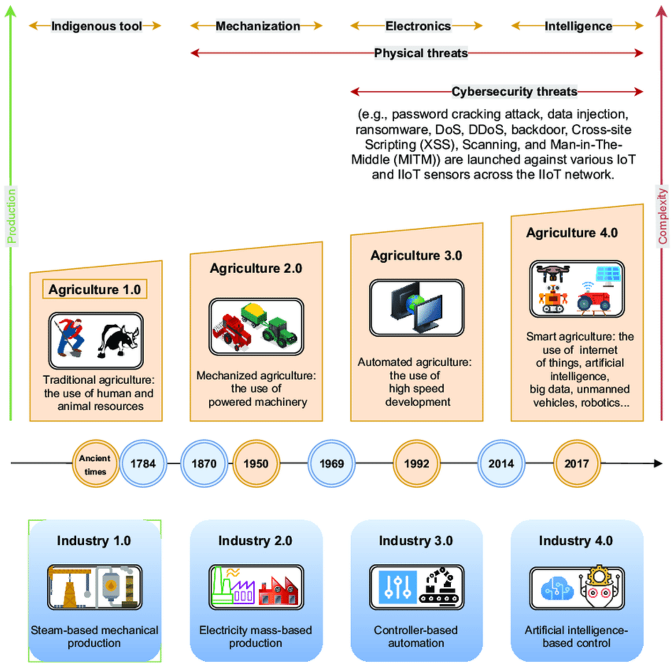

Fig -1: Revolutions in Agriculture

3. Related Works

Today we humans had developed a lot of technology and product for solving issue and giving a boost to production.

Some are GIS-based (Geographic information system) agriculture, drone and aerial imagery, satellite photography, IoT sensor networks, phase tracking, Weather forecasting, automated irrigation, light and heat control, intelligent software analysis for pest and disease prediction, soil management and other involved analytical tasks, hydroponics and soilless farming technology.

The new era for long-range, low power modulation technology began in 2009 and in 2010, Semtech presented SX1301, SX1272 and SX1276 chips in which improved technology and proprietary MAC protocol were introduced as "LoraMAC". In 2015 Lora (Long Range) Alliance was founded and it was renamed LoraWAN. After that, problems related to long-distance communication were resolved and new ideas, products & solutions were ready to deploy.

Some real-world deployments which enabled business are Cattle Tracking, Plant Care, Aquaculture, Soil Irrigation Monitoring, Soil Moisture Monitoring, Autonomous Irrigation, and Smart Soil Sensors Network.

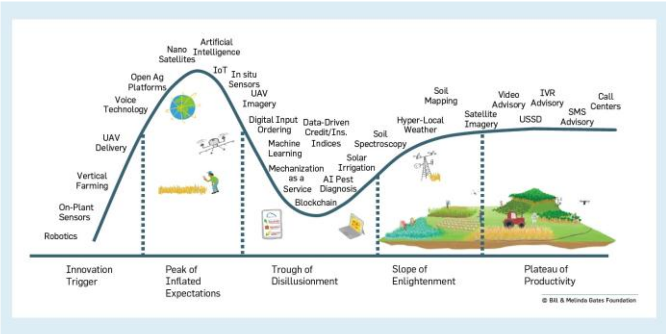

Fig -2: Agricultural Technology

4. Proposed System

The aim of this paper is to provide the architecture of the IoT base real-time cloud monitoring, intelligent & low power device using under and over ground sensors to measure data for various parameters related to cultivation.

We kept our plan to make flexible & simple architecture with solar and battery base devices and dashboard gateway. We work on an MPPT base solar battery charger with wide voltage range input and sufficient current output to make it work a week with a single charge and a week is more than enough to recharge the battery using solar energy.

The important part is multiple and various sensor integrations with the single master device. Parameters such as temperature and humidity for soil, air and water and other chemical index are the main output of the Research to help us to understand the process and cycle of any cultivation.

A lot of industries and agriculture sensors are made tested in terms of true results we had made a list of sensors which can be extended for practical use by the simple method of integration with the single master device. For research, development and integration design is a fully flexible, advanced and robust system.

A sensor data are collected in master device and share through configured Wi-Fi and user can connect to view data on local webserver page.

1. Master

A state an art design, craft and technology are combined in a system. Its main purpose is to collect data from sensors and from system then sends it over the LORA channel to the gateway. For that to connect the Lora chipset to the micro-controller we had chosen to ESP32 chipset which is open source and user friendly with a lot of specifications such as Wi-Fi, BLE and various functions in low power consumption.

Data play an important role in a Research so we had integrated SD Card support for data logging. For indications and alert, an RGB led and Buzzer is mounted. Also, GPS is mounted on board but functionality has been turned OFF using a switch for battery saving. An RTC system is kept for timekeeping purposes. The whole power system is capable to run on a battery with extension support for the worst power case scenario base design. For batteries, a Solar MPPT based and external battery charger circuit is added. For addition and unknown future uses RS232 support is kept closed. For system powering linear and boost regulators are used for flexible use with better efficiency chips.

There are two removable battery slots for 18650 type batteries which can upgradable up to 20000mAh capacity. Memory support is up to 16GB, but all tests and development are done using an 8GB card which is pretty huge for the application. For on-board debugging and firmware upgrading you can find a USB to UART Bridge IC for faster and more reliable development operation.

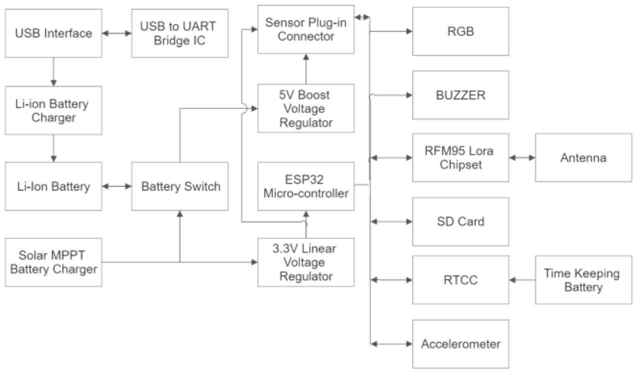

Fig -3: System Block diagram of Master

Fig -4: Actual Device Photo of Master

2. Sensors Plug-In.

It is not a separate part but for practical and better performance, we plan to make separate and free, wired connected sensors with I2C network with canvewave so it can be mounted anyway as required based on scenarios.

For basic and to kick start the Research we choose BME280 humidity & pressure sensor and BME680 low power gas, pressure, temperature & humidity sensor, MAX44009 ambient light sensor, BH1750 ambient light sensor and two DS18B20 1-wire digital thermometer sensors.

Basically, we had to use a couple sets of sensors for parameters just to get better accuracy, and backup sense and the main reason is to calibrate each other from time to time. Considering the tolerance to each sensor the algorithm for averaging is used to get end results.

Based on cultivation type and parameters requirement different sensors can be attached or combined with Plugin board with simple integration with the existing system this plays the main role and make different and best of any scenario usages and business management so supporting changes can be done with cultivation.

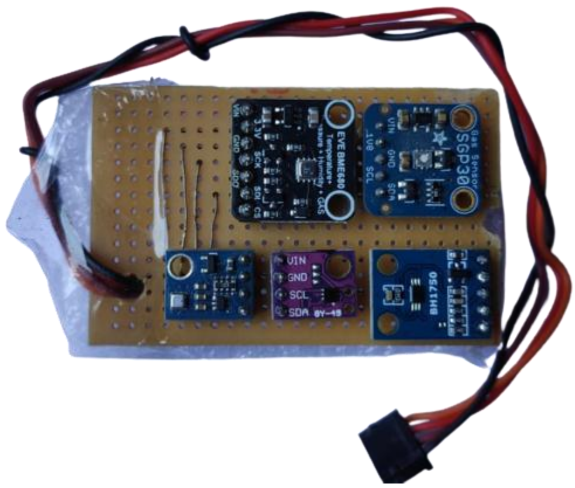

Fig -5: Actual Sensor Plug-in Board

5. SYSTEM ARCHITECTURE

We plan to keep the architecture simple and small for required plan output as first step for proof of concept. The Master device hold responsibility to check and store sensor value data and share over webpage, considering power saving.

Once the device is boot up or start up, all power supply regulators turn switched on. Micro-controller starts booting system and proceed for hardware test and check all hardware & sensors are checked. All test are done and all sensor are ok then system will collect and store the data otherwise error will print on serial port. After that Wi-Fi service starts and turn on Wi-Fi network radio and search for configured network and connect to it and it will created there a local server webpage contain a simple table a data of sensor value.

User have flexibility to access webpage from any device with same Wi-Fi network access. The webpage address can be get from serial output after master device is connected to configured Wi-Fi network. Although above was software architecture but It is easy to understand the flow. For this Research the basic hardware are required are ESP32 micro-controller and it basic circuit to power up and start working and sensor connected with power and I2C network.

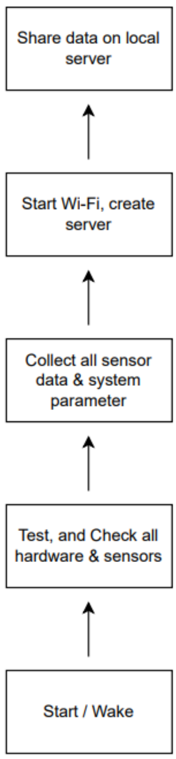

Fig -6: Software Architecture

6. IMPLIMENTATIONS

For easy and flexible testing debugging and quick alteration, we decide to test the product indoor on a pot plant, which sound like different from agriculture. But trail and test are good to test under known and control area for proper calibration and understanding of the more need required or alter required finding can be done easily.

Here we and inserted two waterproof temperature sensor one at low level and second at upper level and a close mount attachment for sensor plugin. We try to keep sensor as close to plant for better detail.

We tried checking the data of our system with other tools for cross-checking and done the final setup for continuous monitoring.

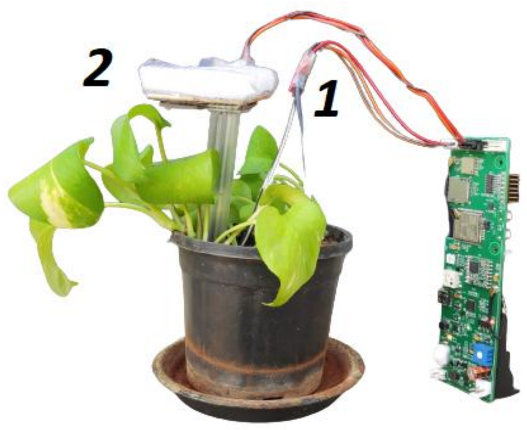

Fig -7: Actual Implementation Photo

1. Waterproof temperature sensor, 2. Contact less sensor board.

7. OPERATIONAL TESTS

As the device is powered up, as per system architecture

Device check all sensor and join Wi-Fi network, then create a local serve and present data of sensor. User can go to Local IP address of device and which is transmitted on serial port.

Once user is connected on same Wi-Fi network it can access the local serve webpage where data can be seen. Below is the snap of output sensor data on webpage machine.

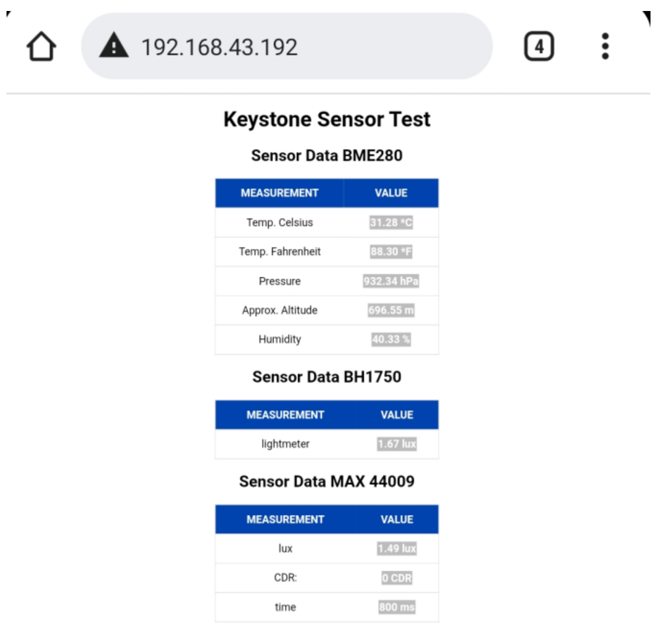

Fig -8: Output Local Server Webpage

3. CONCLUSIONS

As using above system we are able to monitor environmental data of surrounding plant and cultivation. By monitoring we can understand the pattern of grown and decay of plant and so that we can take required action to understand and support.

Future scope are huge large in term of technology, usages and business profit. Such as using Lora communication we can fetch data of miles long field and forest. After that IoT base cloud infrastructure have another power of visualization.

Machine learning, Data science and AI are the field ready to play with these sensors data so that there can present actual new generation of agriculture and control method.

ACKNOWLEDGMENT

We would like to take the opportunity to express true sense of gratitude towards our Prof. Nazish Fatima for her valuable co-operation and guidance that gave us for this research.

We would also like to thank our head of the department Prof. R. A. Barapate for inspiring us. We would also like to express our appreciation and thanks to Prof. Jayshree Phalkar for valuable help, time and support for the co-ordination with us. This research is done by guidance of Neeraj Magnani.

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