Providing Smart Agricultural Solutions to Farmers for better yielding using IoT

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***Abstract* - The field of Cloud computing is helping in leaps and bounds to improvise our age old business - Agriculture. Practical applications can be built from the economic consumption of cloud computing devices that can create a whole computing ecosystem, from sensors to tools that observe data from agricultural field images and from human actors on the ground and accurately feed the data into repositories along with their location as GPS co-ordinates. In reality, sensors are now able to detect the position of water sources in a subject that is being investigated. Issues related to farmers are always hampering the course of our evolution. One of the answer to these types of problems is to help the farmers using modernization techniques. This paper proposes an approach combining the advantages of the major characteristics of emerging technologies such as Internet of Things(IoT) and Web Services inorder to construct an efficient approach to handle the enormous data involved in agrarian output.The approach uses the combination of IoT and cloud computing that promotes the fast development of agricultural modernization and helps to realize smart solution for agriculture and efficiently solve the issues related to farmers.**

***Keywords*- IOT, Smart Agriculture, Virtualization, Cloud Computing, Information Cloud**

I. INTRODUCTION

There has been much research and several exploits to use new IOT technology in agriculture areas. However, IoT for the agriculture has to be considered in a different aspect for various fields such as industrial, logistics. This report shows the IoT-based agricultural production for supply chain stabilizement and all the reqirements that are needed for the production of agriculture at the time of environmental sensors development and prediction system for the maturation and the amount that was spent for the production of crops by gathering all the needed information regarding environment. Precision agriculture ia a field that uses analytic measurements to optimize farming decisions, is a greatest of opportunities for innovation of IoT. Nowadays, it's more necessary than ever to increase the crop yields food grain production.Cloud-connected, wireless systems aid in this crop yield maximization, which automates day-to-dayagricultural tasks and offers real-time monitoring for smart decision making, day-to-day. Connected equipment from companies possess various GPS connections, monitors and controls electronic machines to help farmers analyze and for better operation of the crop field. Once the organic industry gains popularity,most of the food and farming industries will adopt an increased production in obtaining efficient and cheap alternatives to pesticides. With the usage of embedded wireless devices and other automated electronic systems, many son-of the soil can detect leaks , measure moisture, and efficiently manage energy usage. It is mandatory to take a keen notice about all the large scale solutions.

A. Internet of Things

The Internet of Things (IoT) is one network which contains physical objects that are embedded with the electronic devices,softwares,connectivity and sensors to achieve a higher value and provide some services regarding exchange of details with the product manufacturer, operator.

Typically, it is needed to provide sophisticated and advanced connections between the devices for its proper communication and handles a variety of protocols, applications and knowledge bases. The communication between devices is expected to use in a virtually automated manner in almost all the countries. The general ideas, in the IoT, can refer to a broad usage of devices such as heart monitoring implants, electric clams in coastal waters, biochip transponders on farm animals , built-in sensors used in automobile systems. These automated and embedded devices contain useful information which helps in improving several existing technologies. The plethora of new application areas for the automated connection of internet is also expected to generate higher quantities of details from various locations inorder to increase the speed ,thereby to obtain better index and computer memory.

B. Cloud Computing

Cloud computing enables IT and companies to utilize all the computing resources. Cloud computing consists of several advantages in commercial enterprises and industries. Some of the advantages of cloud computing are:

• Elasticity: If the computing demands increases,the companies scale up and if the computing demands decreases then the companies scales down.

• Self-service provisioning: End users can use the computing resources for any type of work to be balanced on demand

• Pay per usage: All the computing resources all given with a validity level allowing the customers for compensation of resources. The services of cloud computing resources can be either hybrid,public or private. This model offers more conveniency and versality. Internal customers sometimes are not given with any charge in the case of IT chargeback. In the public type of cloud, a third-party vendor offers the services through the internet. The task of clients is to pay the bill for the number of cycles used and bandwidth used.The major and widely known cloud providers are Microsoft Azure,AWS,IBM and Google Compute Engine. Hybrid type of cloud is said to be the combination of both the private and the public cloud.Most of the companies can run complicated applications and various heavy workloads on the private cloud. While the hybrid cloud generates a scalable and automated environment inorder to provide maintanence and control over the mission-critical information.

C. Farmers Issues

Nowadays,incase of markets of farmers,many offerings of local food grains are becoming more popular on both sides of the vendors and buyers. Also,Consumers are eagerly involved to know the healthy contents in organic foods and experiences the sources of their food.

Farmers have emerged as an important part of the social network. Steve Ingham, who is the administrator of the division of food safety, at the Department of Agriculture, Trade and Consumer Protection (DATCP), revealed an important information that today's farm markets are not relics of simpler past agriculture.Lacking in refrigeration and the samples which was eaten by the consumers are the two main challenges revealed by Ingham. Vendors will surely find a greater difficulty to preserve the dangerous food grains and foods at refrigeration temperature.The reason behind this is that electricity is a major problem.These statements were given by Ingham. Also, the food and sample handling matters more of consumers who eat before and after they establish the decision to buy.

II. PROPOSED WORK

A. Smart Agricultural Solutions

Smart Agricultural solutions are the evolving trend in day to day lives. The technology has completed a full circle by giving back to agriculture the latest trends and techniques that have been developed. Connectivity using existing 3G, 4G networks using the available hardwares is one major advantage for Smart agriculture.

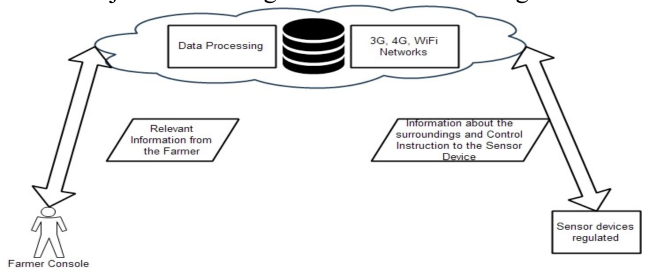

Fig. 1. Outline of the Smart Agriculture Solution

It helps to save time on hardware set up for smart agriculture solutions and thus would lead to the successful growth of Internet of Things implementation in the field of Agriculture. That evolution is that which overcomes the existing traditional mobile computing scenario of smart phones and their apps and innovate into connecting of the devices in the surrounding to help with a solution for the realistic problem that had to be dealt with.

B. Construction of Sensors

Sensors are the real need of the world that help to sense their surroundings and thus help humans to control the surroundings without their presence. Given their utility, they are the most complicated devices that are being used more frequently everywhere. Agriculture sensors need to be more sensitive to weather changes and also robust in nature of the exposure they are ought to confront. Many commercial sensors are available in the market and we just need to select the appropriate one that will suit the need of the day.

Many factors affect the selection of sensors. Few of them that need to be mentioned are quality, the surroundings in which they will be applied, the measurability range of the sensor, readings that are observed by the sensor, sensitivity response time, identification of the reading that varies in a static environment and last but not the least the cost of the detector.

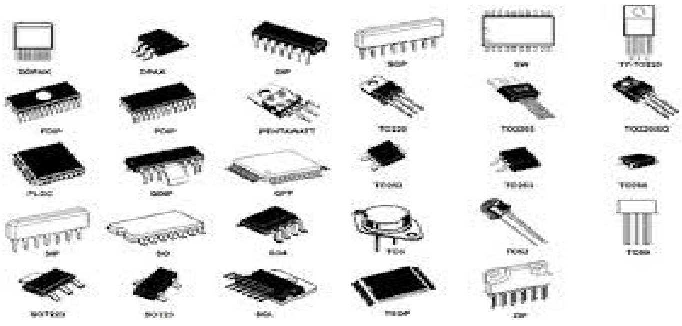

Fig. 2. Different types of Sensors

Variations of sensors is done using various factors like their principle of transduction, input parameter, property it has to measure, Application for which they are used, or based on the type of material they are made of or the technology they use to sense the surroundings.Sensors like DHT11 could predict the temperature and humidity at the same time. Enormous examples can be discussed for the type of sensors based on their classification but that is not the scope of our paper.

The sensor construction for the smart agriculture solutions involves sensors in all classes. ZigBee[4] is an organization that provides the standardization of Internet of Things industry by providing an authoritative standard to the things used in Wireless Sensor Networks. The ZigBee sensor nodes obtain the natural parameters like temperature, humidity and illumination information which are transmitted to the remote monitoring centre. A sensor node is designed as described in [4] with slight customizations to match the need of the farmer in our case. The customizations that are carried out are non-localisation of memory, the input data is directly tranferred to the datacenter in the cloud for processing.

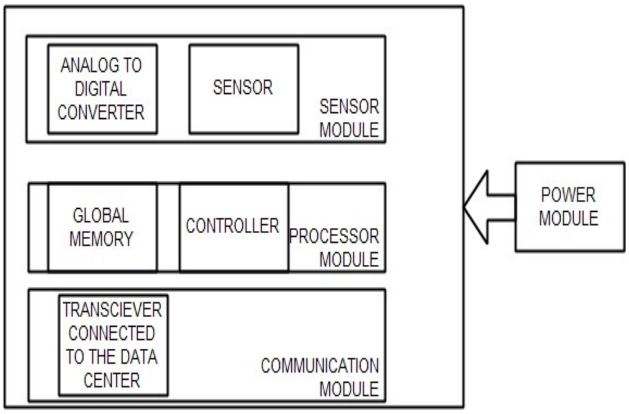

Fig. 3. Sensor Node of the Smart Agriculture Solution

Fig 3 shows the architecture of the sensor node that is going to be used as a part of the smart agricultural solution. In this we propose that the local memory that the node has is globally updated with the information about the other nodes that are also present on the field. Information regarding the peers is also stored which in turn helps to monitor the sensor node functioning. This is a part of self management and auto correction and also helps us to detect the faulty nodes if we just check the data of a single sensor node. Fault detection and recovery management are also covered by this design of sensor node. Checking for the faulty nodes by the inbuilt data that is present in each of the nodes helps the nodes to declare itself as faulty if the variation in the input data detected by that particular sensor is far below or above the threshold value for say n consecutive readings. Recovery of the faulty nodes has to be done manually by either switching off and on the power module or by checking the components of the node.

These sensors collect the data and thus pass the data to the data centers directly.

The data centers process the incoming data and compare the values to the inbuilt threshold value and pass on the information to the farmer's console application. From this point it is our design approach that decides whether the actuator could act autonomously or by the control of the farmer. It varies from scenario to scenario.

Communication between the sensor nodes and the data centers is by CDMA, 3G and 2 G wireless broadband networks. Nearest node communication is done using WLAN802.11 and Bluetooth. Datacenters are the knowledge base of the whole system that are designed to provide the farmer with the required information. They employ the major data mining techniques on the data based on the time and scenario of the incoming request and provide the appropriate solution. A real time scenario when taken into account is that a farmer is out of station and his farm needs to be watered immediately. In this case we can plan it as autonomous as the plants cannot be allowed to wither by waiting for the farmer's consent for watering them. Certain other decisions like what crop should be planted next for the soil fertility nature, water sources availability, rain dependency nature can be postponed to wait for the consent of the farmer.

The sensor control module is responsible for tracking the incoming information and process accordingly. In our example former case will be processed automatically and the water actuators will be made to water the plants immediately they sense that there is necessity for the plants to be watered. In the latter case, the farmer's decision is waited upon for the seeding actuators to act upon the soil to plant the appropriate seeds.

C. *Construction of the APP for farmer access*

Farmer console is the interface for our end user-farmer to key in or access any information about the field that is under study. It will have the unique login for each farmer. Each farmer must be able to key in the relevant information regarding the cattle, farms. One other option if the farmer is unable to input the relevant information regarding his farms and cattle farms. The application has the ability to locate the farmer lands by the GPS attributes provided the farmer is located at the same place as his farms. It is unlikely for the same to be working for the cattle where we include the scanner software to count the cattle and simultaneously decide their breed and age and thus calculate their milking capacity based on the above mentioned parameters.

III. CONCLUSION

This paper thus explained a empircal model of how the Internet of things can be applied to our Indian agriculture. We initially proposed a model outline of how the IoT concept can be illustrated with respect to our Agricultural practices. Later in the construction of sensors we discuss about the various types of sensors and the type of sensors that will be required for our Agricultural purposes. We also discuss about the types of communication that we have for near and far nodes communication. Thus we propose this idea to the son of the soil to benefit at the most.

IV. FUTURE WORK

Large potential of our Indian agriculture is yet untapped and we still have miles to travel in this arena of research as we have different soil textures in different regions of our state. Farmers can be benefitted by the actual implementation of this projected program. Real challenges that were faced and that are yet to be overcome in reality are the inter-networking of the nodes in an agricultural field and in designing a user friendly application that is easily understandable for the farmers.

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