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Crop Monitoring System using IoT

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Abstract - As new technologies have been introduced and utilized in modern world, there is a need to bring advancement in the field of agriculture also. Various Researches have been undergone to improve crop cultivation and have been widely used. In order to improve the crop productivity efficiently, it is necessary to monitor the environmental conditions in and around the field. The parameters that have to be properly monitored to enhance the yield are soil characteristics, weather conditions, moisture, temperature, etc.; Internet of Things (IoT) is being used in several real time applications. An introduction of IoT along with the sensor network in agriculture refurbishes the traditional way of farming. This paper endorses sensible IoT based Agriculture to farmer's aid by obtaining live knowledge of farm data.

***Key Words*:** - Arduino, Internet of Things, K-Means Sensors and Wi-Fi module

1.INTRODUCTION

The upcoming age of reasonable Agriculture is often without a doubt dependent on Internet of Things (IoT). Internet of Things is increasing a partner level of urgent situation in concentrates over the corner and corner of this worldwide quite in area of cutting-edge remote interchanges. The stage, Web of Things allude to super character of items, matters and their individual computerized portrayals in web like a structure. Web of Things is applied in chain improvement and the board by Kevin Ashton et.al. From mechanical status reason for IoT, these systems are being used in big business the executives, creation, great transportation and even in horticulture. Regular a few or distinctive product moreover acquaints the gadgets with Agriculture during various phases of reasonable and shrewdness. Horticulture area requires moreover essential space all-inclusive for creating certain security. Talking about the Asian country ranchers, they are as of now in huge amount and are at debasing execution as far as homestead length, period, exchange, government rules, and climate and so on. Horticultural production entails numerous duties like soil and plant trailing, ecological trailing of wetting and temperature upkeep, convey chain the board, foundation the executives, frameworks the executives, observation, and so on. The harvest profitability depends on great water system framework.

To keep up the water system framework successfully, Sensor is sent in the field which detects the water necessity of the dirt and gives water system consequently.

These are illustrated in the Fig.1 as follows,

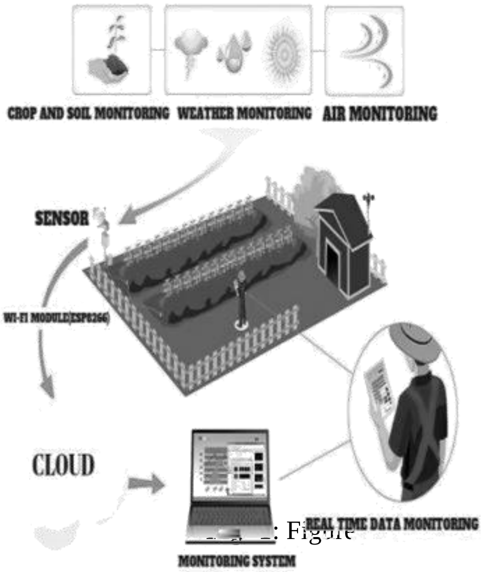

Fig. 1. Automation in Agriculture

One of the principle parts of human endurance is the agribusiness which is the primary wellspring of nourishment. Lamentably the vast majority of the ranchers in our nation utilize customary method for cultivating which is a boisterous procedure to dissect information physically identified with soil and harvests. This can be overwhelmed by present day cultivating techniques. As the agriculture business is one of the significant parts of a nation's financial development, it is important to get modernized farming which generally upgrade the harvest yield and aides in creating economy. Organization of automation in farming prompts viable yield observing without human mediation in the field. Web of things is the system of physical articles inserted with sensors, programming and electronic segments like microcontrollers, as sensors and microcontrollers can't be associated with the web legitimately.

2. LITERATURE SURVEY

Data stored on the server is subjected to intelligent processing and analysis in order to present it in different formats for different categories of end users. This paper [1] dealt with proposed the deployment of a wireless sensor network to monitor and analyze air quality in Doha.

This experiment brings out a user-friendly computation of an air quality index to disseminate the data to the general public and also the data presentation for environmental experts using dedicated software tools, for example- the R software system and its Open-air package. Depending on the target end-user the stored data can be accessed and displayed in different formats.

Implementation of the system uses RASPBERRY-Pi to control the irrigation system and connects with internet to send data to the registered mobile number. This paper [5] cannot estimate weather conditions as pollution is increasing gradually. Automatic message sending is developed using python programming in raspberry-pi. By using the automatic irrigation system it optimizes the usage of water by reducing wastage and reduces the human intervention for farmers. It saves energy also as it automatic controlling the system. Automation in irrigation system makes farmer work much easier. Sensor based automated irrigation system provides promising solution to farmers where presence of farmer in field is not compulsory.

This paper [7] dealt with the drone at anywhere and anytime. Wireless sensor networks are used for monitoring the farm conditions and micro controllers are used to control and automate the farm processes. A smart phone empowers farmer to keep updated with the ongoing conditions of his agricultural land using IoT at any time and any part of the world. IoT technology can reduce the cost and enhance the productivity of traditional farming.

3. SYSTEM ARCHITECTURE

Agriculture is the backbone of our Nation. In olden days farmers used to guess the fertility of soil and made assumptions to grow which type of crop.

The entire architecture of the systems are depicted in the following Fig. 2 as follows,

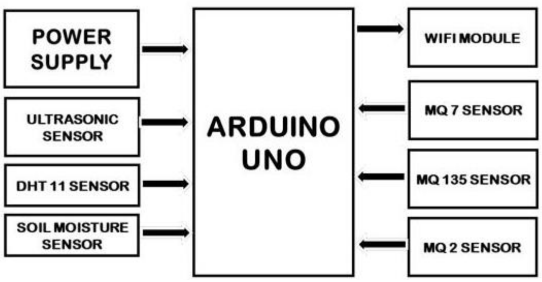

Fig. 2. System Architecture

The farmers didn't know about the moisture, level of water and particularly weather condition which troubles a farmer even more. They use pesticides based on some assumptions which made lead a serious effect to the crop if the assumption is wrong. The productivity depends on the final stage of the crop on which farmer depends. The limitation in the earlier system is that the productivity may or may not be more. To enhance the productivity of the crop there by supporting both farmer and nation and to use the technology, this estimates the quality of crop and giving suggestions. The Internet of things (IoT) is remodeling the agriculture enabling the farmers with the wide range of techniques such as precision and sustainable agriculture to face challenges in the field.

IoT technology helps in collecting information about conditions like weather, moisture, temperature and fertility of soil, Crop online monitoring enables level of water, crop growth, and agriculture. IoT leverages farmers to get connected to his farm from anywhere and anytime. Wireless sensor networks are used for monitoring the farm conditions and micro controllers are used to control and automate the farm processes.

A smart phone empowers farmer to keep updated with the ongoing conditions of his agricultural land using IOT at any time and any part of the world. IoT technology can reduce the cost and enhance the productivity of traditional farming. Environmental humidity is the very important device used to measure the humidity of the atmosphere is called hygrometer. Humidity sensors or hygrometer can be classified based on the type of humidity it is used for measuring i.e. Absolute humidity sensors or relative humidity sensors.

A. Wireless Sensor Technology

Smart agriculture also known as precision agriculture allows farmers to maximize yields using minimal resources such as water, fertilizer and seeds.

The sensors used in farming are Moisture sensors, Temperature sensors and Humidity sensors. These are illustrated in the Fig.3. along with description as follows,

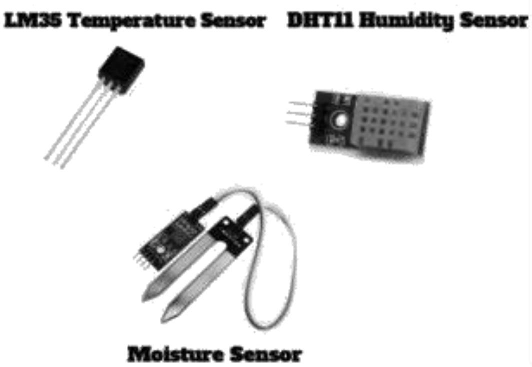

Fig. 3. Sensors used in Farming

By deploying sensors and mapping field's farmers can begin to understand their crops at a micro scale, conserve resources and reduce impact in the environment. An advance in sensor technology has also proven beneficial to the agricultural industry through its application for infield soil analysis.

1. *Moisture Sensor* - The moisture sensor can be used to test the moisture of soil, when the soil is having water shortage the module output is at high level and else the output is at low level. By using the sensor one can automatically water the flower plant, or any other plants requiring automatic watering technique.
2. *Temperature Sensor* - Temperature is the most often measured environmental quantity. Temperature sensing can be done either through direct contact with the heating source or remotely without direct contact with the source using radiated energy instead. There are a wide variety of temperature sensors, LM35 temperature sensor is calibrated directly in Celsius (Centigrade). It is rated for full 1-55C to +150C range. It is suitable for remote applications. It is of low cost due to wafer level trimming. It operates from 4 to 3V. The sensor has low self heating.
3. *Humidity Sensor* - Humidity is defined as the amount of water present in the surrounding air. This water content in the air is a key factor in the wellness of mankind. Humidity sensors are very important devices that help in measuring the environmental humidity.

4. SYSTEM IMPLEMENTATION

K-means generates k clusters by partitioning the data. In the initial step it chooses the cluster members or centers arbitrarily then distributes the remaining elements among the clusters and modifies the new value of cluster center. The method is to categorize given data by using K clusters. K centroids have to be recognized and placed apart from each other at different locations. Each object is allocated to the nearest centroid. Group of elements allocated to a cluster forms a cluster.

Based on new objects cluster centroid will be updated to the new value. This process repeats until there is no modification in the cluster centroid. Random initialization of centroids results in different results in different execution. Selecting an initial centroid properly is an important step in k-means technique.

There are four steps involved. They are as follows,

1. Clusters k is selected as initial clusters,
2. In each stage element is allocated to the nearest centroid cluster,
3. Recalculate the centroids of modified clusters. Repeat Step 2,
4. Stop when further records movement between clusters increases cluster scattering.

There are essentially three stopping criteria that can be adopted to stop the K-means algorithm:

1. Centroids of newly formed clusters do not change
2. Points remain in the same cluster
3. Maximum number of iterations are reached

We can stop the algorithm if the centroids of newly formed clusters are not changing. Even after multiple iterations, if we are getting the same centroids for all the clusters, we can say that the algorithm is not learning any new pattern and it is a sign to stop the training. Another clear sign is that we should stop the training process is, if the points remain in the same cluster even after training the algorithm for multiple iterations.

Finally, we can stop the training if the maximum number of iterations is reached. Suppose if we have set the number of iterations as 100. The process will repeat for 100 iterations before stopping.

5. RESULT ANALYSIS

The left and the rightmost clusters are of smaller size compared to the central cluster. Now, if we apply k-means clustering on these points, the results will be something like this:

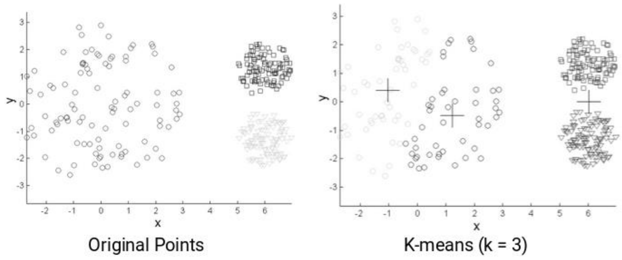

Fig. 4. Result Analysis

The points in the red cluster are spread out whereas the points in the remaining clusters are closely packed together.

6. CONCLUSION & FUTURE ENHANCEMENT

Agriculture is continuously being supplanted and improved by increasingly advanced and exact computerized and electronic gadget. A high level of farming income is lost to control misfortune, off base strategies for rehearsing. This is decreased by the utilization of keen sensors. The proposition is to play out the farming in brilliant and increasingly productive manner. What's more, this strategy advocates for the utilization of the Internet of Things. This has empowered the horticulture crop checking simple and proficient to upgrade the efficiency of the yield and subsequently benefits for the rancher.

Sensors of various sorts are utilized to gather the data of harvest conditions and ecological changes and this data is transmitted through system to the rancher/gadgets that starts restorative activities. Ranchers are associated and mindful of the states of the rural field at whenever and anyplace in the world. Wireless checking of field permits client to lessen the human force and it additionally permits client to watch exact changes in it. Cost is less and expends low force. In this way, the paper proposes a thought of joining the most recent innovation into the farming field to turn the conventional techniques for water system to present day strategies in this manner making simple profitable and conservative trimming.

Some degree of computerization is presented empowering the idea of checking the field and the harvest conditions inside some long-separation ranges utilizing cloud administrations. The favorable circumstances like water-sparing and work sparing are started utilizing sensors that work naturally as they are customized. This idea of modernization of agribusiness is basic, reasonable and operable.

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