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AN IOT FRAMEWORK FOR AGRICULTURE APPLICATION CASE STUDY

Dr. C.R. Patil
Professoer, Dept. of Mechanical Engineering,
Prof. Ram Meghe Institute of Technology and Research,
Badnera,Amravati
Amravati,Maharashtra,India
crpatil333@rediffmail.com

Prof.M.G. Trivedi
Asst.Prof. Dept. of Mechanical Engineering,
Shri Ramdeobaba College of Enginering and Management,Nagpur
Nagpur,Maharashtra,India
mogtrivedi@gmail.com

Mr. P. R. Dharpure
Research Scholor,Dept.of Mechancial Enginering,
Shri Ramdeobaba College of Enginering and Management,Nagpur
Nagpur,Maharashtra,India
dharpurepp@rknec.edu

Abstract—

Although the overall technological advancement in India, there has been less attentive towards the Agriculture sector. Due to the lack of technological awareness among the farmers in India the position of producing maximum yield crop is not satisfactory. Conventional practices are only carried out in Agriculture field, and as the literacy rates of farmers are significantly low, applying and working with new technology is a major concern. If instead of conventional practices if they implement the blend of new technological support, then this will be the major sector for employment generation as well as increasing the GDP of India. As of 2018, this sector contributes about 14.39% of the total G.D.P. of India but around 50% of the people are involved in this. The productivity of the farming industry can be increased with the help of IoT. The application of the IoT ecosystem can bring revitalization in the agricultural field. All the parameters related to soil temperature, water level, humidity, air quality, crop yield, crop price, real-time data and proper timing of crop to be delivered to market, which will help to increase productivity. The study says we will have 9.6 billion people on Earth by 2050 which will increase demand for food and IoT in agriculture should be an important driver to meet this requirement. Therefore we need to develop such a system that will enhance farming procedures. The objective of this paper is to present an idea of how the IoT ecosystem can enhance the overall farming output as well as increasing GDP.

Keywords—IoT Framework, Agriculture Framework, Sensors in Agriculture, Smart Farming, Efficiency, Productivity

INTRODUCTION

Agriculture is one of the basic livelihood providers in India. As per the Ministry of Agriculture, cooperation and Farmers welfare of India, It has about 195m ha under cultivation of which some 63 percent are rain-fed (roughly 125m ha) while 37 percent are irrigated (70m ha). With the second largest an arable area in the world and India is the largest producer of rice, wheat, cotton, sugarcane, farmed fish and tea.

As compared to international standards, India has a low yield per hectare of crops despite the overwhelming size of the agriculture sector. Global warming, insufficient rainfall, and conventional approach may be the probable reason for this.
The implementation of technology into agriculture which helps farmers to understand the requirements of the crop and take action accordingly.

When the network of wireless sensors is implemented in to the farm, which establish the network of the sensor nodes which are connected to each other. As the nodes are deployed in the farm (land), it will sense the data at a regular interval of time as per the algorithm, and perform the computations which further information is shared with the farmer about the computation.
Internet of things (IoT) is most auspicious and proper technology for this. Previously RFID is the technology available, and few are for regulating the water supply to the complete farm. In this Paper, the implementation of Internet of things (IoT) is presented to make agriculture smarter.

IoT and WSN agriculture can be connected to the Internet, which creates a network of agronomists, farmers, and crops. As a result, agronomists will have a better understanding of crop growth models and farming practices will be improved.

In this paper we are considering Sugarcane crop as an example and implemented internet of things into agricultural land where Sugarcane crop is grown.

Internet of things

The Internet of things (IoT) is the most efficient and important technique for the development of solutions to the existing problems. IoT evolves from different building blocks which include lots of sensors, software, network components, and other electronic devices. Which sense, read, collect, stores, represents, manipulate and makes data more effective. IoT allows exchanging the data over the network without human involvement.

IoT technology is more efficient due to the following reasons:

- Faster Access
- Minimum human efforts
- Efficient Communication
- Global Connectivity through any devices

RELATED WORK

Smash and at el have proposed an approach to direct water in rural fields [1].

Zhou Zhongwei and at al have proposed a technique to picture and follow rural items in inventory network [2].

Li Sanbo and at el center around the equipment engineering, arrange design and programming process control of the exactness water system framework [3].

Ayush Kumar and at el utilized IoT and picture handling (image processing) to locate the supplement and mineral insufficiencies that influence the yield development [4].

Bo Yifan and at el has concentrated on the investigation on the use of distributed computing and the web of things in horticulture and ranger service [5].

Sugarcane crop

India is the second-largest producer of sugar cane. The crop of Sugarcane takes around 12 to 18 months to grow. Generally, January to March is the period of sowing and December to March is the period of harvesting.

According to an estimate published in Krishi Jagran, as of 2018-2019, in India, a total of 5.6 million ha land was under sugarcane cultivation. Sugarcane is extensively grown in the states of Karnataka, Maharashtra, Tamil Nadu, Andhra Pradesh, Gujarat, and Kerala.[6]

For the Sugarcane crop, the various soil parameters and environmental parameters have to be considered to ensure maximum and healthy yield. Various parameters and the optimal range are shown in table 1 and table 2 taken from Krishi Jagran.

Table 1: Soil Parameters and their ranges [6]

Parameter	Optimum range	Critical Value
Ph	6-8	------
Nitrogen	2.00-2.60%	1.8%
Calcium	0.22-0.45%	0.20%
Phosphorus	0.22-0.30%	0.19%

Table 2: Environmental Parameters and their ranges [6]

When the parameters mentioned in table 1 and table 2 are not met, we may not get the required yield capacity, along with it the obtained crop may be infected by the diseases like Ca deficiency, P deficiency, N deficiency.

Parameter	Optimum range	
Temperature	30˚C(Initially)	32˚C-38˚C(Stem Cutting)
Rainfall	70-150 cms	-------
Humidity	45-65%(Ripening period)	8085%(elongation period)

. Proposed System

The work proposes an intelligent technology based on IoT for agriculture with the following objectives:

- Sensing the various parameters of the Soil for better growth of Plants.
  - Applying better data mining technique, in order to detect the timely requirements for better growth of cops.\
  - Diseases predictions which affect the crop, based on sensed information and presentation of the diseases.

The working of the proposed technique is shown in fig 1. Fig 2 shows the proposed architecture.

Fig 1: Working of proposed approach [7]

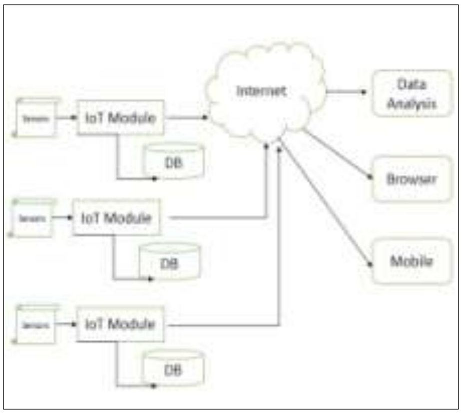

Fig 2: Proposed Architecture [7]

At the sensor node level

Node Deployment.

The farm is divided into equal-sized grids. In each grid, the soil sensor node and the environmental sensor node is deployed at a suitable location. The soil sensor nodes are placed partially inside the soil and environmental sensor nodes are deployed on the surface. In each grid, one grid head is deployed to gather the data from soil and environmental sensor nodes.

- Sensing of Environmental and Soil parameters.

Once the nodes have been deployed and the network has been established, the environmental sensors sense environmental parameters which are temperature, humidity, etc., whereas the soil sensor senses soil parameters which are ph level, calcium content, etc.

- Transmitting collected data to sink node. All the sensed values are transmitted to the sink node for further computation at the sink node level
  - Gathering and storing the data

Sink node gathers the data from each node and stores these data in a cloud through the internet.

  - Applying mining techniques.

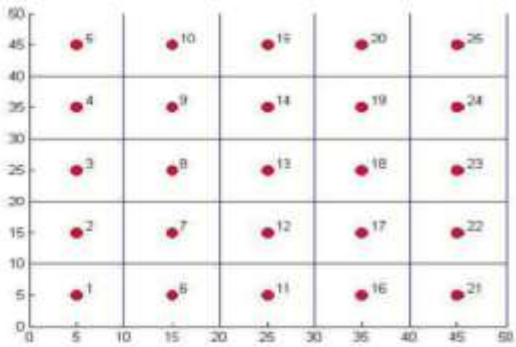

Fig 3: Test Bed [7]

- The data mining technique is applied to the received data. We apply the association mining technique. Association rule mining algorithm is used for knowledge extraction from the sensed information. Based on this information we can detect whether the available parameters are sufficient or insufficient for the proper growth of plants. We can also detect whether the plant is growing properly or not, whether the environmental conditions are suitable for crop etc. Based on Mining information proper fertilizers can be provided to the crops.
- Predictive classification algorithm.
- The predictive Classification algorithm can be applied to the sensed information to predict the diseases that can occur. Based on the predictive analysis we can take suitable measures for preventing the diseases.
- Future course of action.

After applying the data mining algorithms and retrieving useful information, we will have obtained the results. Based on this result, proper alert message is transmitted to farmers. This helps to take suitable action in order to ensure maximum and healthy crop yield.

SIMLULATIONS AND EXPERIMENTAL RESULTS

The researchers[7] proposed work is simulated using MATLAB. Table 3 describes the simulation parameters. Farmland of area 50 x 50 unit is divided into equal sized cluster of size 10 x 10 unit. In each grid 1 soil sensor and 1 environmental sensor node is deployed.

Figure 3 shows the test bed used. This represents the agricultural land. Here the red node indicates the grid head. Figure 4 shows the routing of information to sink node using inter grid routing. Table 4 shows the data gathered at the sink node and Table 5 shows the processed information representing whether the particular parameter is high, low or normal.

Table 3: Simulation Parameter [7]

Parameter	Parameter Value
Area of interest	50 x 50
Grid size	10 x 10
No. of Environmental each grid	1
No. of soil sensors in each grid	1
Data packet payload	512 Bytes
Energy level of each node	4 KJ
Transmission range	20m
Data rate	4 kbps

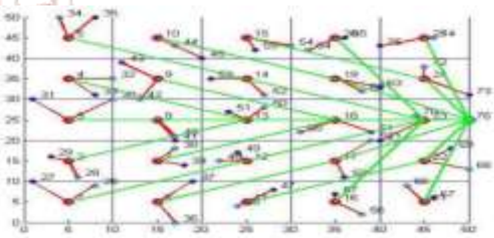

Fig 4: Inter grid routing [7]

Table 4 Data Collected [7]

Epoch	Air Temp	Humidity	Phosphorous	Nitrogen	Soil Temp	Moisture	Ph.	Calcium
1	34	94.0000	0.194354	2.2	55.0000	88.0000	7.00000	0.473
2	18	70.0000	0.269569	2.217	80.0000	78.0000	6.00000	0.329
3	30	89.0000	0.338585	2.773	5.0000	48.0000	8.00000	0.228
4	24	58.0000	0.215521	2.705	81.0000	86.0000	9.00000	0.232
5	26	68.0000	0.274914	2.543	65.0000	66.0000	5.00000	0.207
6	21	95.0000	0.196845	1.844	73.0000	87.0000	6.00000	0.254
7	36	64.0000	0.294448	2.464	47.0000	64.0000	6.00000	0.415
8	37	61.0000	0.262054	2.176	71.0000	56.0000	5.00000	0.331
9	34	73.0000	0.24505	2.59	62.0000	72.0000	8.00000	0.461
10	17	95.0000	0.249314	1.836	85.0000	49.0000	5.00000	0.381
11	38	77.0000	0.185146	2.946	71.0000	43.0000	9.00000	0.299
12	25	79.0000	0.223423	2.333	98.0000	56.0000	6.00000	0.478

Table 5 Processed Data [7]

Epoch	Node	Air Temp	Humidity	Phosphorous	Nitrogen	Soil Temp	Moisture	Ph	Calcium
1	1	Low	High	Normal	Normal	Low	Normal	Low	Normal
1	2	Normal	High	Normal	Low	Normal	High	Low	Normal
1	3	Normal	High	Low	Normal	Low	High	Low	Normal
1	4	High	High	Low	Normal	Normal	Normal	Normal	High
1	5	Normal	Normal	Low	Low	High	Normal	Normal	Normal

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1	6	High	Normal	Normal	Normal	Normal	Low	Low	Normal
1	7	Normal	Normal	Normal	Low	High	High	Normal	Normal
1	8	Normal	High	Normal	Low	Normal	Normal	Low	Normal
1	9	Low	Low	High	High	Normal	Low	Low	Normal
1	10	High	Low	Low	Low	Normal	Normal	High	Normal
1	11	Normal	Normal	Normal	Low	Normal	Normal	Low	Normal
1	12	High	Low	High	Normal	Normal	Normal	Normal	Normal
1	13	Normal	Normal	High	Normal	Normal	Normal	High	Normal
1	14	Normal	High	High	Normal	Normal	Normal	Low	Normal
1	15	Normal	Normal	High	Low	Normal	Low	Low	Normal
1	16	Normal	High	Normal	Low	High	High	Normal	Normal
1	17	Normal	Normal	Normal	Normal	Normal	Normal	Low	Normal
1	18	Normal	Normal	Normal	Normal	Low	Normal	High	Low
1	19	High	High	Normal	Normal	Normal	Normal	High	Normal
1	20	Normal	Normal	Normal	Normal	Normal	Normal	Low	High
1	21	Low	High	High	Normal	Low	Normal	Low	Normal
1	22	Low	High	Low	Normal	Normal	Normal	High	High
1	23	High	Normal	Normal	Low	Low	Normal	Normal	Normal

Figure 7 shows the processed data in the graphical representation. Processed information will be transmitted to farmers through SMS in a simple format. Based on that farmer can take suitable action

Fig 7: Temperature and humidity at various time slot in a day [7]

ADVANTAGES [8]

The key advantages of using IoT in enhancing farming are as follows:

- Water management can be efficiently done using IoT with no wastage of water using sensors.
- IoT helps to continuous monitor the land so that precautions can be taken at early stage
- It increases productivity, reduce manual work, reduce time and makes farming more efficient.
- Crop monitoring can be easily done to observe the growth of crop.
- Soil management such as PH level, Moisture content, etc. can be identified easily so that farmer can sown seeds according to soil level.
- Sensors and RFID chips aids to recognize the diseases occurred in plants and crops. RFID tags send the EPC (information) to the reader and are shared across the internet. The farmer or scientist can access this information from a remote place and take necessary actions; automatically crops can be protected from coming diseases.
- Crop sales will be increased in global market. Farmer can easily connect to the global market without restriction of any geographical area.

CONCLUSIONS

Although IoT in agriculture is in nascent stage in India still the way we are embracing technologies we can be hopeful. If farmers are provided with proper training about technologies, with a smart mobile in hand they can perform many of their agricultural tasks without even reaching there. Basically it helps farmers to stay connected with their farms from anyplace anytime. It also helps in reducing human effort with increased productivity and at the same time it boosts economy of farmers. Therefore with fully equipped software and Internet of Things, agriculture industry can provide a better vision for next generation and make India better in coming days.

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