International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 04 Issue: 08 | Aug -2017 www.irjet.net p-ISSN: 2395-0072

EMBEDDED DECISION SUPPORT SYSTEM FOR SMART FARMING

Mr. Rohit M Bhekane[1], Dr. Udaykumar L Naik[2]

[1] M.Tech(VLSI Design and Embedded Systems) Student, Dept. of E&C Engineering, KLE Dr.MSSCET, Belgaum-590008, Karnataka, India.
[2] Professor, Dept. of E&C Engineering, KLE Dr.MSSCET, Belgaum-590008, Karnataka, India.

Abstract - *Presently India is facing huge agrarian crisis which is affecting the productivity. Technological solutions based on Internet of Things (IoT) and information technologies helps to provide solutions to the few of the unpredictable challenges in agricultural sector. This work proposes the conceptual model and system design for decision support of smart farming with wireless sensor so that necessary decisions can be taken by farmers. We propose a comprehensive technique using IoT approach which will be applied to agriculture. Data acquisition via sensors, control and tasks management, and data analysis are considered in the development of model and system design. The data analysis of Wireless Sensor Network (WSN) based temperature, humidity, soil moisture on the fields are uploaded onto IoT site ThingSpeak. The IoT supports analysis and visualization of the uploaded data. IoT helps to visualize the data anywhere, anytime and by anyone. This technical assistance system will help farmers to improve the crop yield by providing information with regard to soil testing based on sensor network in agriculture.*

Key Words: Environmental monitoring, wireless Sensor, IoT, precision agriculture, soil testing.

1. INTRODUCTION

In recent decade's farmers are facing many problems due to shortage of soil testing units and lack of knowledge to utilize the technology. Because of wrong weather predictions desired yield is not been obtained. Soil fertility is the measure factor to be looked for getting better yield [1]. Measure constrain in promoting balanced use of fertilizers includes inadequate soil testing facilities, wide gap in dissemination of knowledge, lack of awareness among farmers about benefits of balanced fertilization.

This technical assistance system will help farmers to improve the crop yield by providing information with regard to soil testing based on sensor network in farming such as monitoring ecological conditions like soil moisture, soil temperature, soil fertility, also providing information about weather predictions.

This technical system maintains database of farmer, their field with present, previous and standard crop details. Using "Embedded Decision Support System for Smart Farming" farmers are guided to improve their agricultural production by predicting current crop and also we can analyze agricultural parameters on ThingSpeak through internet.

With the proposed work crop health and yield shall be improved and farmers are updated regularly with cultivation information. By using this system farmers can grow the suitable crop and can get desirable yield & profit.

Our objectives are to develop and implement practical embedded decision support system for smart farming with precisely implemented sensors and sensor network.

- Proposed work presents a means to identify the field parameters using wireless sensor network communication system.
- The main contribution of the project is the development of data base maintenance unit and wireless sensor network system to monitor the agriculture farm.
- Technological development in wireless sensor network (WSN) made it possible to use it in monitoring and controlling field parameters.
- Parameters are monitored and sent to the Technical Database Monitoring Station (TDMS) using ZigBee and to the IoT site ThingSpeak using GSM modem [2].
- In this entire system two interrelated units are proposed.

In the existing work they have proposed a application based Agricultural Crop Predictor and Advisor using ANN for Smartphone's. This system uses artificial neural network to predict crop. In this system we have to give various parameters such as pH, phosphate, potassium, nitrogen, depth, temperature and rainfall as input then by using ANN it will predict the output [3].

1.1 Related Work

Sinung Suakanto et al. have proposed a system design for decision support of smart farming with sensor network data acquisition and task management using IoT approach. The main problems addressed in this work are tasks management and planning, environment factors measurements, and information distribution [4].

Piyush K. Surkar et al. have proposed a arduino based Automatic Testing of Soil Samples Using Ion Selective Electrodes (ISEs). In this work they have used three different sensors that are pH Sensor, Electro conductivity Sensor and Potassium ISE to measure various soil properties. They used arduino uno as control unit which converts analog information and gives suitable data to output unit consisting of LCD and printer [5].

Giritharan Ravichandran et al. have proposed a application based Agricultural Crop Predictor and Advisor using ANN for Smartphones. This system uses artificial neural network to predict crop. In this system we have to give various parameters such as pH, phosphate, potassium, nitrogen, depth, temperature and rainfall as input then by using ANN it will predict the output [3].

Aakash G Ratkal et al. have proposed a Farmer's Analytical Assistant system based on sliding window non-linear regression technique to predict crop yield and price by analysing patterns in past data. For this they have analyze and collect past data of several districts of the state of Karnataka, India. In this system we have to give area, district, previous crop and sowing date as input then it will predict crop, price of crop, yield, water requirement and soil requirements as output [6].

1.2 Proposed System

- The proposed work helps farmers to update the agricultural parameters and cultivation information regularly.
- Using "Embedded Decision Support System for Smart Farming" farmers are guided to improve their agricultural production by predicting current crop and also we can analyze agricultural parameters on ThingSpeak through internet.
- The system provides information to the farmers in their regional language automatically through voice recorder.

2. METHODOLOGY

➢ Sensing Unit

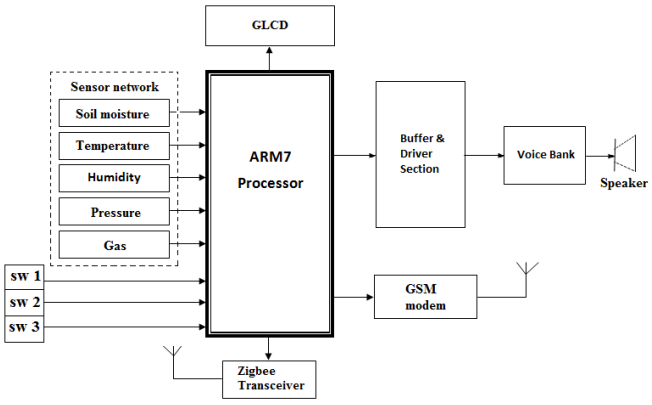

Fig -1: block diagram of the sensing unit

➢ Technical Database Monitoring Station

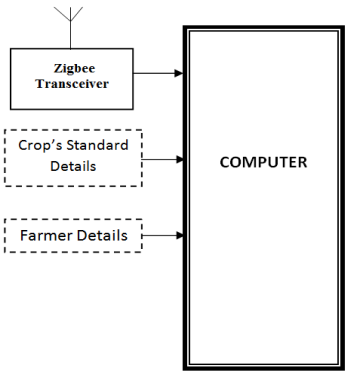

Fig -2: Block diagram of the Technical Database Station

The Embedded Decision Support System for Smart Farming uses simple components like sensors, display units, ZigBee Tx & Rx, ARM7 processors, Voice Bank and speaker etc, which are easily available in market and smaller in size which makes it portable. The sensor section used in this system gives accurate values of all the parameters necessary to test the soil fertility. When the user presses the button on the sensing section, the respective responses are obtained quickly and display the result on GLCD. The necessary assistance information stored in voice bank is triggered by RF unit as a voice output. Then the necessary parameter values are obtained at Technical Base Station via ZigBee Modems and those values are display on moniter for database purpose. Also the data is send to IoT site ThingSpeak through GSM modem.

2.1 System Diagram

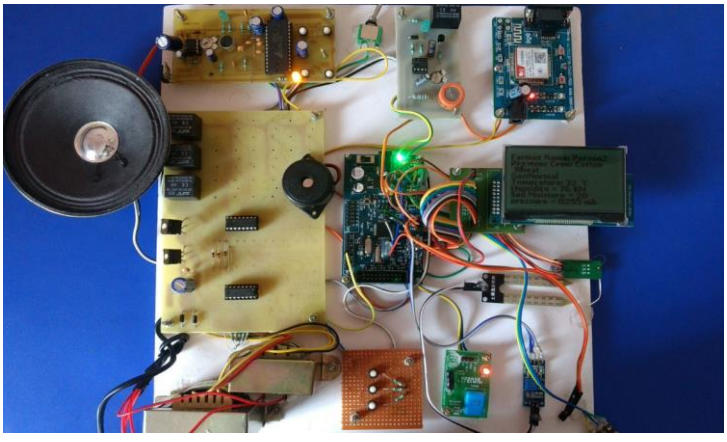

Fig -3: Implemented board (Sensing unit)

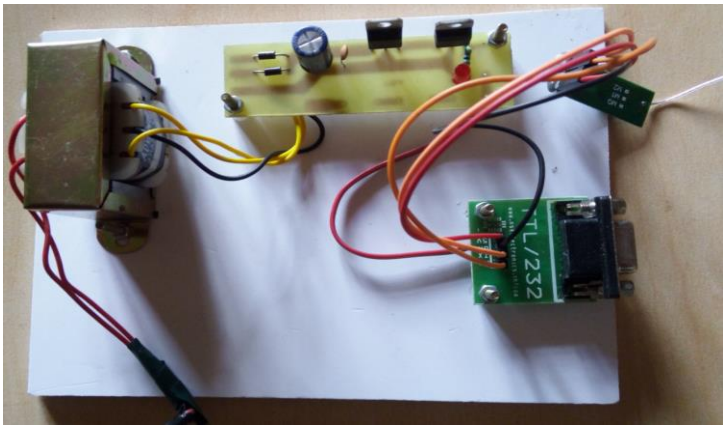

Fig -4: Implemented board (Technical database monitoring station)

2.2 ThingSpeak

It is an IoT application which stores and receives the data using Hypertext Transfer Protocol (HTTP) via internet. This is the website where it can upload the information and also can locate the tracking applications [2]. ThingSpeak support numerical computing software. The data which is uploaded on the website can be analyze and visualize.

In this work, information about the weather in terms of temperature, humidity, pressure, and soil moisture will be displayed in the website. Hence every user can check the information any where globally. Initially every user needs to do register on the website. Some of the Steps are involved to do create the website is as follows:

- First step is needed to create an account by providing user name and password.
- Every user having the unique channel id on which the information can be seen. Once the account is created need to do the channel settings.

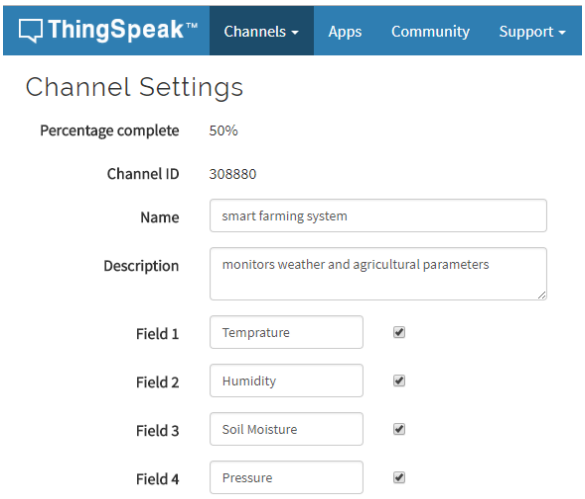

Fig -5: Channel settings of ThingSpeak website

The fig-5 shows the steps for channel settings where it containing the channel ID which will be unique for every user. Need to do the channel naming and giving short description about it. There are four fields are named field1 for temperature, field2 for humidity, field3 for soil moisture and field4 for pressure. In this project displayed the information about the farming of fields on the ThingSpeak website.

- Step 3 is for displaying the fields information

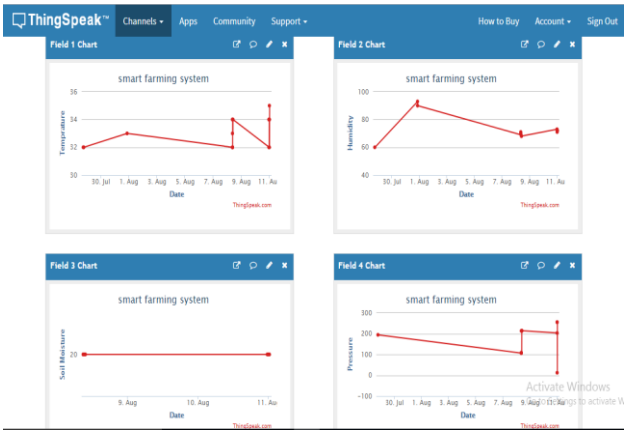

Fig -6: display of the field information

The fig-6 shows the monitored parameters information in terms of fields. Field1 shows the temperature in terms of degree Celsius. Field 2 shows humidity occurs. Field 3 and 4 are for the soil moisture and pressure.

3. RESULTS AND DISCUSSIONS

Fig -7: Display of person2 farm information on GLCD

Fig-7 shows predicted crop and agricultural information of person2 calculated in his farm.

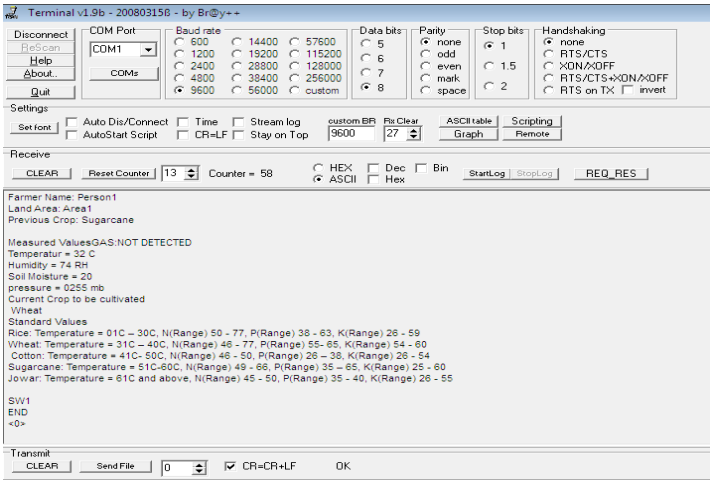

Fig -8: Terminal display farmer's details at technical database station through ZigBee.

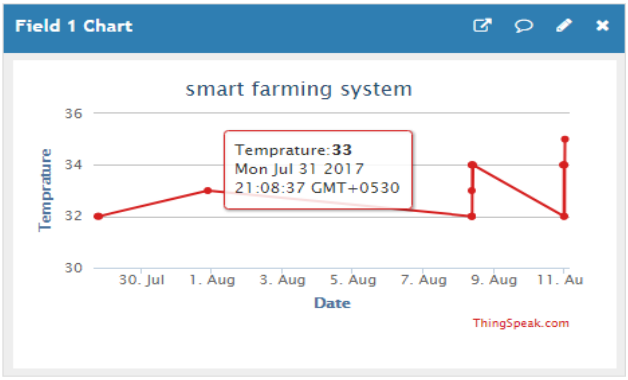

Fig -9: Display of temperature of various lands on the web server

Fig -8 shows agricultural parameters and crop to be cultivated of person1 in terminal software. We have used terminal software to display data received from ZigBee.

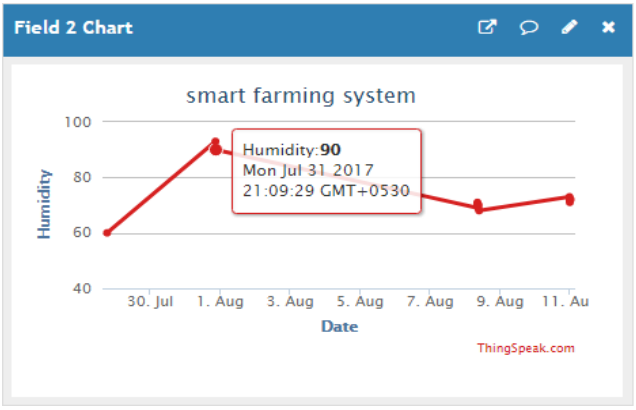

Fig -10: Display of humidity of various land on the web server

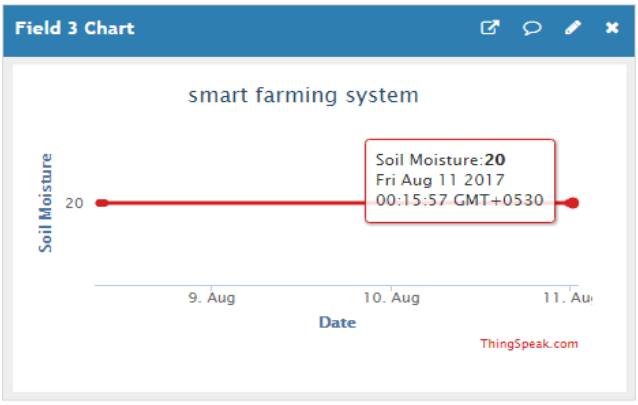

Fig -11: Display of soil moisture of various lands on the web server

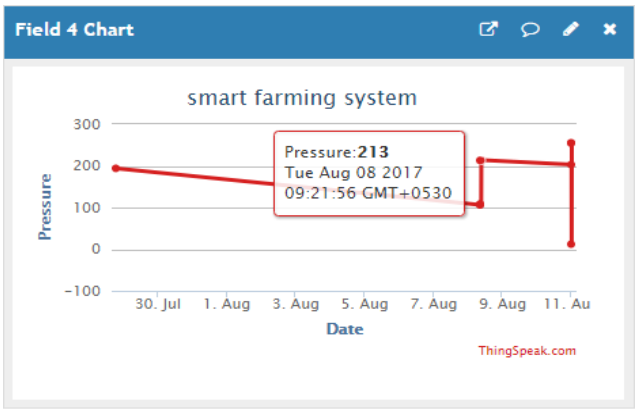

Fig -12: Display of pressure on the web server

Fig-9 and fig-10 shows the temperature and humidity calculated in various farm with date and time.

Table -1: Comparison between proposed and existing systems [3].

Criterion/issue	Proposed System	Existing System
Crop prediction	Done	Done
IoT application (ThingSpeak)	Used	Not used
Voice recorder	Used	Not used
Training	No	Yes
Temperature sensor	Used	Not used
Humidity sensor	Used	Not used
Soil moisture sensor	Used	Not used
Complexity	Less	High

From table -1 we can analyze that Artificial Neural Network (ANN) technique demands a complex prediction model and anonymous major data at different points on the field.

4. CONCLUSION

In this work the essential constituents of smart agricultural system are proposed. The data analysis of Wireless Sensor Network (WSN) based temperature, humidity, soil moisture on the fields are uploaded onto IoT site ThingSpeak. The IoT supports analysis and visualization of the uploaded data. Iot helps to visualize the data anywhere, anytime and by anyone. In the work IEEE 802.15.4 protocol has been used. This provides 2.4GHz ZigBee connectivity which supports connectivity around 100 meter.

In future it is possible to provide android application for embedded decision support system for smart farming. It is also possible to add authentic and privacy issues to see the particular farms agricultural parameters.

ACKNOWLEDGEMENT

The first author would like to thank i3Concepts, pune, India for providing internship on the IoT based project and also for strong support for motivation and my special thanks to my guide Dr. Udaykumar L Naik, Professor, Dept. of E&C for encouraging me for this work.

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