Smart Agriculture using IoT

[1]Adarsh Rai ,[2]Dr. S.Mohideen Badhusha , [3]Mayur Shetty ,[4]Tushar Poojary

Dept. of Computer Science and Engineering
Alva's Institute of Engineering and Technology Mijar, Moodbidri, India.

Abstract

Smart Agriculture is an approach to re-orient the practice of Agriculture. The existing system has several gaps considering three parameters, a communication error in the Wi-Fi module, a need of rechargeable source of energy to the controllers controlling the sensors, and fault detection problem of sensors sensing faulty data from the fault sensors. In the proposed system, a GSM module has been implemented as an alternative for Wi-Fi communication. A solar panel and AAA batteries are used for rechargeable source of energy to the controllers. A fault detection algorithm is implemented to eliminate the fault sensors sending inaccurate data to the user. A Web portal has been developed for the end user.

Keywords—*Wireless Sensor Network, IoT, Web Application*

I. INTRODUCTION

Smart Agriculture is a revolution in the agriculture industry that helps to guide actions required to modify and reorient agricultural systems to effectively support the development and guarantee food security during an ever-changing climate. The main focus of approaching smart agriculture is to increase agricultural productivity and incomes. Climate-smart agriculture helps to reduce or remove greenhouse gas emissions. It also helps in monitoring and keeping track of all the conditions daily as like weather monitoring, moisture-level monitoring, rain prediction, etc.

The work in Smart Agriculture is booming day by day. IoT projects have been undertaken to minimize the efforts in re-orienting the traditional practices of Agriculture. Smart Agriculture based on IoT is a system to ease the operation of IoT system used in Agriculture. The system majorly covers three parameters. These three parameters were problems occurring in the current Smart Agriculture. The three parameters are communication error, battery drainage problem and fault sensors. The project system works in a single operation and isn't divided in parts. Open-source tools have been used in the system. The communication error can be occurred due to Internet connectivity loss as the system initiates with Wi-Fi connection. Hence, GSM is switched when there is a Wi-Fi module error and thus results in the continuous ongoing of the system. The GSM is a connection between the Arduino system and user mobile. The text message is sent to the user depicting the DHT and moisture level values in the text message.

The second parameter covers the battery drainage problem of the sensors. The sensors when tend to start losing energy is been charged with the battery that is powered with a solar panel. The charge is ultimately stored when the sensors are working fine. As soon as the charge decreases, the charge is retrieved and the sensors are continuous in process. Four power batteries have been used in this system. The batteries are connected to the Arduino controller and is triggered when the charge is depleted. The third parameter in this project is detecting the fault sensors that are giving inaccurate data as like the temperature sensor used in the system. Two sensors has been placed in the field and one of the sensors has been made faulty to return the error. In this case, the error node is being ignored and the correct value is shown in the Web Portal. The Web portal consists of registeration system where the user gets accessed to the portal and can view the readings of the sensors.

II. RELATED WORK

The literature on faulty sensors and recovery methods depicts several challenges and impose several rooms for improvement. Based on the literature survey it is difficult to get the exact correct information during to malfunctioning of the sensors.

Localization can be achieved by detecting the orphaned node in harsh conditions i a field. Detecting dangerous areas of toxic gases to prevent petrochemical accidents by detecting node failure in WSNs is been proposed. A use of planarization method is carried out to localize the orphaned node [1]

"Drip Irrigation System using Wireless Sensor Networks" the Model includes soil moisture, temperature and pressure sensors to monitor the irrigation operations. Specifically, taking into account the case where a system malfunction occurs, as when the pipes burst or the emitters block[2]

Joaquín Gutiérrez et al. the System has a distributed wireless network of soil-moisture & temperature sensors placed in root zone of plants. Gateway unit handles sensor information, triggers actuators, and transmits data to a web application. [3]

By removing the cable infrastructure, the wireless architecture enables the possibility for nodes in a network to dynamically and autonomously group into clusters according to the communication features and the data they collect. When localization of orphaned node is need to be achieved clusters need to be formed first. Overlapping is a problem in WSNs which in the journal. Three clustering criteria are proposed, that take into account both communication network topology and the measurements gathered by the sensor nodes.[4]

Since WSNs are installed in harsh environments, the sensors and sensor nodes used in the WSN-based agricultural CMSs are easily subject to faults, leading to corruption of the signals used for condition monitoring, which decreases the reliability of the CMS. This paper proposes a three-stage method for detection and isolation of three most common sensor faults, i.e., SHORT fault, CONSTANT fault, and NOISE fault, in WSN-based wind turbine CMS. [5]

Prediction algorithm uses information from past experiences to anticipate future events. These algorithms can be used I situations where data from a specific sample space can be collected over a period. This makes prediction algorithms ideal for use within smart environments. The term smart environment can be referred to homes, fields, power grids,etc. In this paper, the home context is used to implement the prediction algorithm. [9]

A. Challenges

Failed nodes decrease the quality of service of the entire Wireless Sensor Network. Massive low-cost sensor nodes are often deployed in uncontrollable and hostile environments. Therefore, failure in sensor nodes can occur more easily than in other systems. The applications of Wireless Sensor Networks are being widened entirely. Wireless Sensor Networks are also deployed in some occasions such as monitoring of nuclear reactor where high security is required. Fault detection for sensor nodes in this specified application is of great importance. It is troublesome and not practical to manually examine whether the nodes are functioning normally or any physical damage is there. Correct information cannot be obtained by the control center because failed nodes would produce incorrect data or some random data. Moreover, it may result in collapse of the whole network in some serious cases. Nodes are usually battery-powered and the energy is limited, so it is common for faults to occur due to battery depletion. In agriculture, continuous, monitoring and information about various modules is important to be retrieved

B. Need for the Study

Several implementation of the system in Smart Agriculture has shown that the demand for an essential system is increasing with time. Authors have stated the use of GPRS module. This receiver unit also has a duplex communication link based on a cellular-Internet interface, using general packet radio service (GPRS) protocol GSM has been implemented as a substitute module but its not efficient as per the study. An alternative module is required for the substitution [2]

III. CURRENT WORK IN THE DOMAIN

A. Wireless Sensor Unit

A WSU is comprised of a RF transceiver, sensors, a microcontroller, and power sources. Several WSUs can be deployed in-field to configure a distributed sensor network. The microcontroller, radio modem, rechargeable batteries, and electronic components are a part of the unit.

The wireless sensors are deployed ranging from 2-3 nodes to more than 1000 nodes in large area fields. It is responsible to sense the area and send the information.

B. Deployment strategy

Deploying the sensor nodes to monitor a farmland is crucial issue. In fact, many parameters must be considered to choose the most beneficial deployment, as the crops characteristics, the micro meteorological parameters, the sensors and nodes specification and obviously the farmer’s budget.

According to a generic guide proposed in [1] the coverage of the sensor nodes in agricultural WSN must be dense. By this way, all the required measurements can be gathered to have reliable knowledge of the monitored area. Network for a field with 100 m2 size, at least 80- 90 nodes are needed. They consider roughly 1 sensor node per 1 m2. Of course, with such density we can reduce the sensors transmission power to the lowest level to save energy. In addition to have an adequate number of nodes, the topology formation must be determined.

C. Use of Traditional System

- The referred paper implementation methods are based on traditional systems that has low potential when compared to new technology.
- At some extent the sensor data in multiple channels start to send fault information to the backend.
- They mostly rely on continuos maintenance for being accurate to the host and generally lose energy in the process.[3]

D. SHORT Fault Detection, Isolation, and Restoration

A SHORT fault causes an abrupt change (i.e., spike) in the signal. When the amplitude of the spike is much higher than the amplitude of the signal, the spike can be easily detected by comparing the maximum of the signal with a threshold. The purpose of the proposed method is to detect the SHORT fault where the magnitude(s) of the spike(s) are comparable to the signal amplitude and, therefore, are difficult to detect from the signal. To solve this problem, arduino can act as a controller for switch the signal.

A stator phase current signal with a SHORT fault and the one layer decomposition of the corrupted current signal by the DWT, where the SHORT fault appears clearly as an abrupt change in the detail coefficient of the signal and, therefore, can be easily detected by the proposed method; and the corrupted data sample can be easily isolated. Each corrupted data sample is restored by replacing it with the average value of the data samples before and after it. Compared with the traditional method using a low-pass filter to filter out the spikes from the signal, the proposed method does not filter out useful information from the signal, but only remedies the corrupted data samples [5]

Some clustering algorithms are implemented for clustering in sensor fault detection system to generate the fault node.

E. Accuracy

The fault node sending inaccurate data is only known by the system but not been fixed automatically or without human intervention. This is mainly needed as it might mislead to improper operations.

The traditional accuracy system fails to localize the node and depict the problem. A graph within a graph is an “inset”, not an “insert”. The word alternatively is preferred to the word “alternately” (unless you really mean something that alternates).A prediction based algorithm can be used to find the the faulty node and the misleading information based on the previously generated data records.

The systems as referred doesn’t show any such approach to find the accuracy.The prediction system will predict the actual information generated when a node is faulty. Several parameters needs to be considered withe module which will be implemented in smart agriculture.

IV. PROPOSED METHODOLOGY

A. Major concerns

1) *Data Storage: MySQL database is used in the proposed system*
2) *Selection:* At a particular time which parameter needs to be considered.
3) *Maintenance:* Overall processing of the system time to time.
4) *Deletion:* Deleting or removing unwanted stuff from the information generated.

A scaling factor needs to considered as per the review this factor hasn’t been considered. It generally boils down to the parameters considering the temperature, soil moisture level, etc to scale up to a certain level to relate to each other or not on basis In this system we have used a total of three sensors i.e two DHT sensors and one soil moisture sensor. The sensors are connected to the Arduino controller. The sensors are used to sense the temperature, humidity and the soil moisture sensor. The sensors values are aggregated and displayed on the Web portal to the user.

A threshold value of 40 is set in the program for the temperature, 120 for the humidity and 300 for the moisture level sensor, any readings exceeding the value pings a message to the user and eliminates the readings of that sensor and returns the correct aggregated value to the user. The values are depicted in the form of a visualization in the Web portal. Hence, this elimination of sensor readings alerts the user regarding an uncertain incident in the location where the sensor has been placed returning the inaccurate values.. The storage of data if too voluminous might need better management which isn’t quite discussed in the references.

A rechargeable source of energy for the sensors placed in a remote areas which do not have an external source of energy was needed. In this third parameter considered, a 0.5W solar panel is used to retrieve solar energy and recharge AAA batteries which are used as an energy sorce for the controller and sensors. Thus, the process works in a loop and continuous energy is supplied to the controller to keep the operation of sensor aggregating values intact without any stoppage due to energy loss.

b. Implementation

As the system initiates with the Wi-Fi connection, due to certain causes the Wi-Fi connection tend to lose the connection, hence a GSM module is placed as an alternative for the communication between two ends. As soon as the connection is lost, the user is pinged up with a message of his/her registered mobile number and the last readings from the sensor is sent by a message.

Fault Detection Algorithm

Input: Values from DHT and Soil moisture sensors.

Output: Error message of Sensor crossing the threshold value.

Step 1: Start

Step 2: Initialize Wi-Fi communication and sensors.

Step 3: Set up interval time for sensor values.

Step 4: if Wi-Fi communication disconnected:

switch(GSM connection)

if else

Return DHT_i

Else

Return moisture $level_i$ values

Step 5: Send message:

print(Wi-Fi has been disconnected)

Step 6: Print DHT_i values.

Step 7: Print moisture $level_i$ value.

Step 8: Set a threshold value for a DHT sensor.

Step 9: Set a threshold value for moisture sensor.

Step 10: if output > DHT_i threshold value

Send error message

Eliminate DHT_i sensor

else

Go to step 6

Step 11: if output > moisture $level_i$ threshold value

Send error message

Eliminate moisture $level_i$ sensor

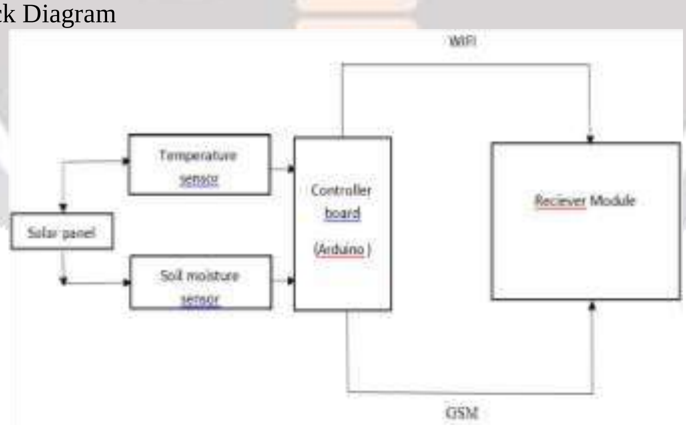
else

Go to step 7

Step 12: Stop

B. Figures and Tables

a) Proposed System Block Diagram



C. Conclusion

Considering the three parameters, on the disconnection of Wi-Fi communication, the system switches to GSM communication module, and an rechargeable source of energy is produced from solar panels and is supplied to the components in the system in a continuous loop which excludes the need of a connection of an external energy source supply. The fault sensors are detected when the readings of a particular sensors crosses the threshold value given to the sensors. When the sensors surpasses the threshold value, a message is sent to the user showing the faulty sensors. Thus, the issues in these parameters are resolved and can be implemented in field monitoring and applications.

REFERENCES

[1] Bennis, H. Fouchal, O. Zytoune, D. Aboutajdine, “Drip Irrigation System using Wireless Sensor Networks” Proceedings of the Federated Conference on Computer Science and Information Systems, ACSIS, Vol. 5, 2015.

[2] Joaquín Gutiérrez, Juan Francisco Villa-Medina, Alejandra NietoGaribay, and Miguel ÁngelPorta- Gándara, “Automated Irrigation System Using a Wireless Sensor Network and GPRS Module,” IEEE Transactions on Instrumentation and Measurement, vol. 63, no. 1, January 2014.

[3] Detecting the Dangerous Area of Toxic Gases with Wireless Sensor Networks. Lei Shuyz, YuanfangCheny, ZhihongSuny, FeiTongx, MithunMukherjeey, 2016

[4] Gajjala Ashok, GogadaRajasekar, “Smart Drip Irrigation System using Raspberry Pi and Arduino” International Journal of Scientific Engineering and Technology for Technology, 2016

[5] Distributed Clustering Strategies in Industrial Wireless Sensor Networks Angelo Cenedese, Member, IEEE, Michele Luvisotto, Student Member, IEEE, and Giulia Michieletto, 2016

[6] Sensor Fault Detection and Isolation for a Wireless Sensor NetworkBased Remote Wind Turbine Condition Monitoring System YayuPeng, Student Member, IEEE, Wei Qiao, Senior Member, IEEE, LiyanQu, Senio r Member, IEEE, and Jun Wang, Member, IEEE, 2017

[7] Traffic Load Minimization in Software Defined Wireless Sensor Networks Guozhi Li, SongtaoGuo, Member, IEEE, Yang Yang and Yuanyuan Yang, Fellow, IEEE, 2018

[8]Magnetic Induction-Based Localization in Randomly-Deployed Wireless Underground Sensor Networks Shih-Chun Lin, Member, IEEE, AbdallahAwadhAlshehri, Pu Wang, Member, IEEE, and Ian F. Akyildiz, Fellow, IEEE, 2017

[9] Survey on Prediction Algorithms in Smart Homes in Smart Homes, IEEEIoT Journal, Shoen Wu, Jacob B, Rendall Mathew, IEEE 2018