Review Paper on Smart Agriculture

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***Abstract*- Smart Agriculture is an approach to re-orient the practice of Agriculture. According to the survey made, the existing system of Smart Agriculture has gaps on the communication side such as communication error due to unavoidable disconnections of Wi-Fi module. The existing systems get the power supply from external sockets. Existence of faulty sensors deployed sensors aggregating faulty data is another problem that needs to be solved. Several works have been carried out in this domain.**

Index Terms- IoT, Web Application, WSN

INTRODUCTION

The work in Smart Agriculture is booming day by day. IoT projects have undertaken to minimize the efforts in reorienting 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 mainly addresses three issues existing in the current Smart Agriculture domain. The three issues are communication error, battery drainage problem and faulty sensor problem. The GSM module mentioned in the survey can be implemented in Wi-Fi system to prevent the communication problem.

The second issue is 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. Solar panels needs to be implemented as a renewable source of energy. The third aspect in this project is detecting the fault sensors that are aggregating inaccurate data. Fault sensors elimination hasn't been carried out in Smart Agriculture.

LITERATURE SURVEY

Mithun Mukherjeey et.al [1] proposed that research on Smart Agriculture has generally centered around the techniques to enhance the use of Wireless Sensor Networks in Agriculture. Localization can be achieved by detecting the orphaned node in harsh conditions in an agricultural field. Most of the applications of WSNs till date have been concentrated in industrial sectors. Bringing the WSN Technology in agriculture is beneficial for the agricultural society. For eg. 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. The connectivity of the network is used in detecting the gas diffusion by the deployment of a sufficient number of sensor nodes. In this network, the nodes were fully connected with each other to detect the dangerous area of the gas diffusion. The dangerous area consists of the inner area and outer boundary area of the leaking gases. In the proposed detection scheme, 5 planarization algorithms were used to planarize a monitoring network. Such planarization allows us to obtain different topologies. The size of the detected dangerous area was large in the scheme that took the node failure into consideration compared to the scheme that did not. This work influences the localization problem in agriculture.

Bennis, Fouchal, O. Zytoune, et al [2] "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. Also, differentiating two main traffic levels for the information transmitted by the WSAN, and using an adequate priority-based routing protocol to achieve high QoS performance. Simulations conducted over the NS-2 simulator show promising results in terms of delay and Packet Delivery Ratio (PDR), mainly for priority traffic.

Joaquín Gutiérrez, Juan Francisco Villa-Medina, Alejandra Nieto-Garibay, et al [3] "Automated

Irrigation System Using a Wireless Sensor Network and GPRS Module", in this paper 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. An algorithm was developed with threshold values of sensors that were programmed into a microcontroller-based gateway.

Gajjala Ashok, Gogada Rajasekar, et al [4] "Smart Drip Irrigation System using Raspberry Pi and Arduino", this paper proposes a design for home automation system using ready-to use, cost effective and energy efficient devices including raspberry pi, Arduino microcontrollers, xbee modules and relay boards. Use of these components results in overall cost effective, scalable and robust implementation of system. The sensor data were uploaded in to cloud by raspberry pi using python programming language. Arduino microcontrollers used to transmit the sensor data to the raspberry pi using ZigBee protocol. Star ZigBee topology serves as backbone for the communication between raspberry pi and end devices. Raspberry pi acts a central coordinator and end devices act as various routers.

Angelo Cenedese et.al [5] proposed that clustering is the task of grouping a set of objects in such a way that objects in the same group are more similar to each other than to those in other groups. In one of the papers of Industrial Wireless Sensor Networks. 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. The proposed procedure in the journal is then tested both in numerical simulations and on a real–world dataset, to provide an assessment of its performance in environmental monitoring and fault detection applications employed in building and process automation.

Wei Qiao et.al [6] proposed that to improve the reliability in agriculture, various condition monitoring systems (CMSs) have been developed and most of them transmit data using wired communication channels. Recently, wireless sensor networks (WSNs) have been used to transmit data in agricultural CMS due to the low cost and easy deployment feature of WSNs. 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. The proposed sensor fault detection and isolation (SFDI) greatly increases the accuracy and reliability of agricultural CMSs. Data collected from the field are used to validate the effectiveness of the proposed method. This paper proposes a sensor fault detection and isolation (SFDI) method for the agriculture condition monitoring data received from the WSN. After the SFDI, only the data from healthy sensors will be used for health condition monitoring; while the data from faulty sensors will be restored or discarded depending on the fault types. The framework of the proposed SFDI consists three stages. The first stage uses a wavelet transform-based method to decompose the signal into detail coefficients and approximation coefficients for the detection of SHORT faults. Once a SHORT fault is detected, the corrupted data is restored by an interpolation method. The second stage is the detection of CONSTANT faults using a cross correlation-based method. When there is no fault in the three-phase current signals, they are highly correlated with each other. However, when a CONSTANT fault occurs, the correlation between the corrupted signal and the healthy signal will become weaker. This information will be used for CONSTANT fault detection and isolation and only the healthy signal(s) will be used for condition monitoring. The third stage uses a DTW-based method to detect NOISE faults. The DTW-based method measures the similarity of the signals. If a signal is corrupted by a NOISE fault and the others do not, the similarity between the corrupted and healthy signals will decrease. This information will also be used for NOISE fault isolation. By detecting and isolating the corrupted signal(s), only the healthy signal(s) are used for condition monitoring and fault diagnosis. Therefore, the reliability and accuracy of the CMS is improved.

Guozhi Li et.al [7] proposed that the emerging software defined networking (SDN) enables the separation of control plane and data plane and saves the resource consumption of the network. The limited routing strategy in software defined wireless sensor networks (SDWSNs) imposes a great challenge in achieving the minimum traffic load. In this paper, a flow splitting optimization (FSO) algorithm for solving the problem of traffic load minimization (TLM) in SDWSNs by considering the selection of optimal relay sensor node and the transmission of optimal splitting flow is proposed. A typical software defined wireless sensor networks (SDWSNs) consists of logically-centralized controllers and a set of sensor nodes. Different sensor nodes may gather the same data in an adjacent environment, therefore, we only need to send as less data as possible in source nodes, and other data can be supplemented from relay nodes. Based on the consideration, in the following, the types of packets are modelled. The algorithm aims to find an optimal routing path from the source sensor node to the sink node, and ensure the traffic load of SDWSNs is minimum. Therefore, the algorithm can guarantee that the SDWSNs consumes as little physical resources as possible. The first step of the FSO algorithm is to establish the forwarding areas. The second step is to choose the appropriate relay sensor nodes which have minimal value of function in the set. The third step is to determine the forwarding packets at each appropriate relay sensor node. The main challenge of traffic load minimization (TLM) in software defined wireless sensor networks lies in the selection of optimal paths and the transmission of less redundant packets. The concept of similarity to identify various types of packets in different sensor nodes is introduced. Afterwards, the TLM problem as the optimization problem which is constrained by the load of sensor nodes and the similarity of different packets is formulated. And then the flow splitting optimization (FSO) algorithm is proposed by solving the TLM problem in SDWSNs, which aims to find an optimal routing path from the source sensor node to the sink node, and ensure the traffic load of SDWSNs is minimized.

Shih-Chun Lin et.al [8] proposed that Wireless underground sensor networks is used in the areas of earthquake detection, oil upstream monitoring, etc. These applications which are location-dependent, so they require precise sensor positions. There are two propagation properties of localization which are electromagnetic waves and magnetic induction. However, classical localization solutions based on the propagation properties of electromagnetic waves do not function well in underground environments, which is one of the issues in Wireless Sensor Networks. Hence this journal proposes a magnetic induction (MI)-based localization that accurately and efficiently locates randomly-deployed sensors in underground environments. Specifically, the MI-based localization framework is first proposed based on underground MI channel modeling with additive white Gaussian noise. Next, the paper proposes a two-step positioning mechanism for obtaining fast and accurate localization results by: first, developing the fast-initial positioning through an alternating direction augmented method for rough sensor locations within a short processing time, and then proposing finegrained positioning for performing powerful search for optimal location estimations via the conjugate gradient algorithm. Simulations confirm that the solution yields accurate sensor locations with both low and high noise and reveals the fundamental impact of underground environments on the localization performance.

Sana Ullah Jan et.al [9] proposed a solution which deals with the problem of fault detection and diagnosis in sensors considering erratic, drift, hard-over, spike, and stuck faults. The data set containing samples of the above mentioned fault signals was acquired as follows: normal data signals were obtained from a temperature-to-voltage converter by using an Arduino Uno microcontroller board and MATLAB. Then, faults were simulated in normal data to get 100 samples of each fault, in which one sample is composed of 1000 data elements. A support vector machine (SVM) was used for data classification in a one-versus-rest manner. The statistical time-domain features, extracted from a sample, were used as a single observation for training and testing SVM. The number of features varied from 5 to 10 to examine the effect on accuracy of SVM. Three different kernel functions used to train SVM include linear, polynomial, and radial-basis function kernels. The fault occurrence event in fault samples was chosen randomly in some cases to replicate a practical scenario in industrial systems. The results show that an increase in the number of features from 5 to 10 hardly increases the total accuracy of the classifier. However, using ten features gives the highest accuracy for fault classification in an SVM. An increase in the number of training samples from 40 to 60 caused an overfitting problem. The k-fold cross-validation technique was adopted to overcome this issue. The increase in number of data elements per sample to 2500 increases the efficiency of the classifier. However, an increase in the number of training samples to 400 reduces the capability of SVM to classify stuck fault. The receiver operating characteristics curve comparison shows the efficiency of SVM over a neural network.

Gajjala Ashok and Gogada Rajasekar, et al [10] “Smart Drip Irrigation System using Raspberry Pi and Arduino”, this paper proposes a design for home automation system using ready-to-use, cost effective and energy efficient devices including raspberry pi, Arduino microcontrollers, xbee modules and relay boards. Use of these components results in overall cost effective, scalable and robust implementation of system. The sensor data were uploaded in to cloud by raspberry pi using python programming language. The design can be used in big agriculture fields as well as in small gardens and water plants. The use of ultrasound sensors and solenoid valves make a smart drip irrigation system.

D Bhuvaneswari, [11] built an Android application which pushes the rancher to ON/OFF the engine without user physical vicinity in the field. System has continuous detecting and control of a watering system framework. GSM is used to educate the client about the definite state of the field. This data is passed onto the client demand as SMS.

Pavithra D S, et al [12] built an application that makes use of the GPRS feature of mobile phone as a solution for irrigation control system. Global System for Mobile Communication (GSM) is used to inform the user about the exact field condition. Information is passed onto the user request in the form of SMS.

Ahmed Imteaj, et al [13] designed an automatic water supplying system in farmland using Arduino, microcontrollers, WiFi module, relay boards and couple of sensors. Depending upon the moisture level of farmland and daylight intensity, the system can detect the appropriate time of water supply in the trees.

Krishna Kanthprabhu A V, et al [14] have used Raspberry Pi in the design of the prototype model in making the system compact and sustainable. The system has sensor which measures the moisture of the soil and switches relay which controls solenoid value according to the requirement. It also aids time saving, cost effectiveness, environmental protection, and low maintenance and operating cost and efficient irrigation service.

Diksha S Dasare, [15] invented a System suited for places where water is scares and has to be used in limited quantity. UART controller will be used in this project. A 16×2 LCD is connected to the microcontroller, which displays the various statuses. GSM modem to communicate farmer and his farm status using SMS. One relay is used to shut-off the main motor which is used to pump the water to the field.

Sebastian Bader and Bengt Oelmann [16] addressed the feasibility of battery using solar energy harvesting presenting two circuit architectures optimized for low energy leakage and evaluate their performance based on data gathered from a deployment. The proposed system is carried out in sensor networks. In smart agriculture the IoT system needed the same approach to operate in remote areas.

Tsang-Yi Wang and Li-Yuan Chang et al [17] propose a pre-designed fusion rule under the assumption of identical local decision rules in fault-free environments, this bound can then characterize the fusion error probability when local decisions are no longer identical due to sensor faults. Simulation results indicate that this less complex criterion provides even better fault-tolerance capability in some situations when sensor faults significantly deviate from normally operating sensors.

CONCLUSION

The literature survey carried out summarizes the work in Smart Agriculture using Wireless Sensor Networks, IoT, Web Application. The existing gaps needs to be fulfilled by to enhance the system. Over the past years, smart agriculture is proving to be a boom for agriculture production. The existing IoT system has three issues namely, communication problem, battery drainage problem and the need for elimination of faulty sensors. The researchers can focus on these areas to investigate further.

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