International Conference on Recent Trends in Mechanical Engineering
International Journal of Scientific Research inScience,
Engineering and Technology
Print ISSN: 2395-1990 | Online ISSN : 2394-4099 (www.ijsrset.com)

WSN Framework for Rose Greenhouse Monitoring

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ABSTRACT

Current world is rapidly forward towards smart systems to incarnate easy and versatile in all actions of development using Wireless sensor network (WSN) technologies. WSN is applied in smart farming to assist in monitoring and controlling as advances in technology. The applications based on WSN are similar to those components used in industries, control applications, automation and security systems. WSN can be designed and implemented for commercial crop rose in a greenhouse to provide best growing conditions. In this paper a new device namely Smart panel, a system helps person with inferior knowledge of technology to understand and maintain rose green house will be considered. The system allows agricultural environment data collection from each sensor such as temperature, humidity, and light in rose greenhouse a smart panel will be designed. The data mining techniques will be used to identify behavioral patterns according to environmental conditions captured by sensor network. The monitoring includes functions like crops management, harvesting, water supply control, animal control, pesticide distribution, humidity and temperature. The actuators to automate farming and provide precision farming experience. The smart panel assists in e-governance by setting simple data exchange between farmers and government. Farmers will be benefitted by system as to keep them up to date agricultural related announcements.

Keywords: WSN, data mining, smart agriculture, precision farming, smart panel, e governance, Crop yield, pest control, green house

I. INTRODUCTION

The collection of large set of mobile or static sensor nodes featured with self-organization and self-location assisted single or multi-hop network is known as Wireless Sensor Network (WSN). The sensors will be embedded with capability to interact with each other in network environment be processing information and communication to each other wirelessly. Mainly WSN is deployed with purpose to detect, process and to communicate sensed information in remote areas. Hence it has greater impacts in seismic, low sampling magnetic, thermal, visual, infrared, acoustic and radar real time applications (1). The typical WSN network is shown in figure 1.

The WSN has been employed in precision agriculture with an aim to prevent to manage routine to a crop regardless of site circumstances to improve in several circumstances such as minimize the water requirement, wastage of pesticides, control pests and diseases, supply of required nutrients to soil and others(2). The tradition farming varies from PA sense that this process accurately identifies variations and relates the spatial data to management activities. PA involves five stages, namely, (i) data collection, (ii) diagnosis, (iii) data analysis, (iv) precision field operation, and (v) evaluation [4].

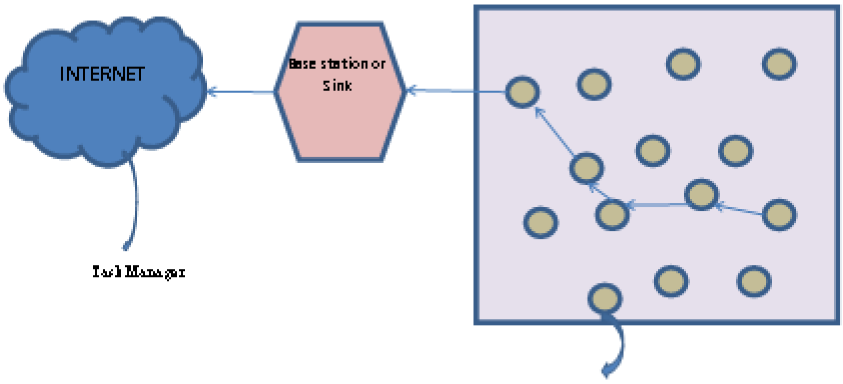

Figure 1: Typical WSN architecture

A. Motivation

One of the primary basic needs of human beings is food due to increase in population throughout world is facing shortage of food. Though according to world statistics India being in 27th position in production of food face problem to feed everyone in the country. The changes in climate and scarcity of water alarm adaptation of new improvement methods (Mueller et al., 2012). So, agricultural sector must increase yield by adopting modern technologies in order to meet gap ((Chen et al., 2015;). the most favorable facilities for Agriculture can be considered as one of WSNs to improve food crop yields and minimize the burden of farmers[3]. Hence, out main objective of proposed work is to assist a farmer with very less or absolute technical knowledge by introducing smart panel concept.

The main contributions of this paper are summarized as follows:

- Automatic watering and pesticide supply system for rose greenhouse
- The identification of smart sensor potentials in terms of best power consumption and communication distance for PA application.
- The taxonomy of energy-efficient and energy harvesting techniques to resolve problems of communication
- To develop an environmental conditions identification system to high precision agriculture within controlled environment by applying to rose green house
- The smart panel will be provided interface to sensor and actuators
- The existing solutions, applicability, and limitations of applying WSNs in agriculture will be reviewed and compared
- The applicability of data mining techniques to obtain prediction model will be dealt.

II. RELATED WORK

This section briefs some compiled works which aligns with proposed by highlighting key focus and progress. Since from time of PA adaptation around 1994 have gone through various modifications with the advancement in technologies. Few researchers have also incorporated IOT and cloud computing to assist in PA functionalities [4]. For processing and to get accurate results at faster rate machine learning techniques are being introduced [5]. The key concern of PA is smart irrigation system. The automatic watering system based on Arduino UNO design in [8] detecting level of moisture in the soil using soil moisture sensors. A similar project developed in [9] by applying increased technology ATmega32 microcontroller, where an automatic watering of plants from tank is developed. IOT based automated irrigation system was developed in (10). Decision support system based on PH levels for watering of plants adopted in (11). The Raspberry Pi, humidity and temperature sensors based automatic system irrigation system developed to increase crop production [2]. Wi-Fi enabled ploy house implemented in [3], low power Bluetooth and Low Power Wide Area Networks (LPWAN) communication modules and MQ Telemetry Transport (MQTT) communication method is used in monitoring and control systems of PA in [4]

The crop estimation has been another major research concern in PA, the image based crop estimation was implemented in [12], satellite image based prediction adopted in [13], machine learning model based prediction in [5], prediction based on data mining knowing soil quality designed in [6]

In [1] an IoT based monitoring and controlling system designed using moisture sensors. For pest control initially manual techniques were applied by trapping those in pheromone trap [6] later moved on to image based pest fine grained optimization [7].the crop suggestion system based on soil fertility was developed in [7].

A zigbee based WSN drip watering system designed measuring soil moisture, temperature, light intensity and electric conductivity for making decisions in (Xinjian Xiang14). A monitoring system to monitor agricultural environment using System on Chip to reduce cost and physical size was constructed in (Jzau-Sheng Lin et al.15). A decision system for producer using WSN is implemented in (Zhao Liang et al). the knowledge base and diffuse inference rules providing intelligent watering mechanisms implemented in this system.

Initially smart board concept was adopted for teaching purpose [14], and mainly to teach math [15], later similar concept was adopted in (16) identifying benefits of smart board.

The prediction system for apple plagues constructed based on WSN in (Bharava, 13). The system is used to identify temperature and foliar humidity measurements. The watering for cherry plant by detecting specific area and implementing drip watering system with Bluetooth build in (Dursen and Ozden16). An automated agriculture system to monitor and control the growth process of melon in green house was implemented in (Yoo S. et al.17). Most of the works presented systems are only proposals, few works are implemented and very few works are specific to applications. So, forward trending actions are required for better productivity.

TABLE 1 SUMMARY OF RELATED WORK

Author	Title	Year	Domain	Application of interest
Jonathan Jao, Bo Sun Kui Wu	A Prototype wireless Sensor Network for Precision Agriculture	2013	WSN in agriculture	Utilizes solar panels and rechargeable battery to address the problem of limited battery supply
Ravi Kishore Kodali, Nisheeth Rawat, Lakshmi Boppana	WSN Sensors for Precision Agriculture	2015	WSN In Precision Agriculture	Different Sensors used in Agriculture and mathematics behind them
Santoshkumar, Udaykumar R.Y	Development of WSN system for precision agriculture	2015	Precision Agriculture	Smart low cost WSN is used for monitoring and control in Precision Agriculture
G.Sahitya,Dr.N.Balaji,Dr. C.D Naidu	Wireless Sensor Network for Smart Agriculture	2016	Agriculture	To give real input according to the environment, Sensor network designing and transferring sensed values to zigbee

III. PROPOSED WSN SYSTEM CONSTRUCTION

Agriculture includes growing, maintaining and yielding of crops. Our aim is to construct smart panel to assist in monitoring all such actions remotely in a green house. Also, this paper tries to reduce problems of farmer. The modules included to assist are, automated calculation of crop yield, automatic watering of field, timely reporting of disorder and automatic pesticide application.

The prediction of crop yield requires temperature, humidity, moisture and nutrient sensors. The counter sensors will be installed to figure out ripe crops with in green house area. The sensors will be communicating one to another to get live details regarding temperature or moisture detector will collect information within detection range(13). PH, temperature and moisture sensors will be installed in fields to function in automatic watering. PH level i.e nutrient index from PH sensors, dielectric constant index of the soil from moisture sensor and temperature of field from temperature sensors will be collected to make decision on movement of motor and amount of watering to rose plant. The water supply will be automatically made to start when sensors data shows information more than 800ohm, 700ohm and 7for temperature, moisture and PH respectively which is considered as non-ideal situation for rose plant (11). -Suitable mechanism will be installed such as ultrasonic pest detector with range between 20-50 kHz band and transducers to recognize pest through sound. The scale from 1-5 will be designed to identify level of disorder based on portion area being infected. Through the information collected farmer will be able to supply suitable amount of pesticide via pump. Pesticide can be automatically supplied using motor as in water distribution or supplied manually. To establish communication between sensors wireless sensor network will be construct assisted with 802.15.4 technical standard and Zigbee Full Function Device to transmit data and GSM remote network distribution for storage and processing of information or federator-network technology like WLAN and WWAN can also be equipped or if all functions are to be carried in a system without Internet connection then WiMAx technology setup will be done (19,20). The data storage and result analysis can be suitably made to compute in smart panel so that smart panel will be able to communicate back to required sensor through commands. The proposed smart panel architecture to equip fro rose greenhouse is shown in figure 3 to assist in remote greenhouse monitoring.

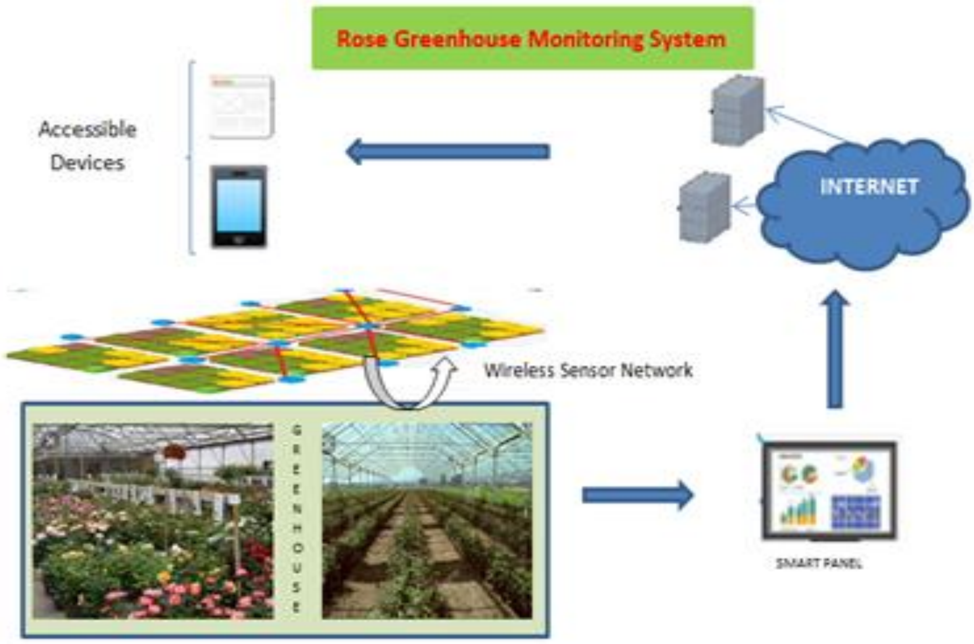

Figure 3: The Architecture of Rose Greenhouse Monitoring System

The major advantage of introduction of smart panel will be to help farmer with very less technical knowledge. It is observed from many precision farming systems that embedding and collaborating functionalities between modules to make it operative will be an issue. In such cases smart panel concept will be useful where it can be handled with minimum knowledge as person need not to interact directly with sensors or actuators. Further, the green house will be divided into small areas. It avoids overuse of water or pesticides by supplying only to required areas in correct proportions. If portion on is not having ideal values only sensors in that location will be active and rest portions sensors and actuators will be in sleep.

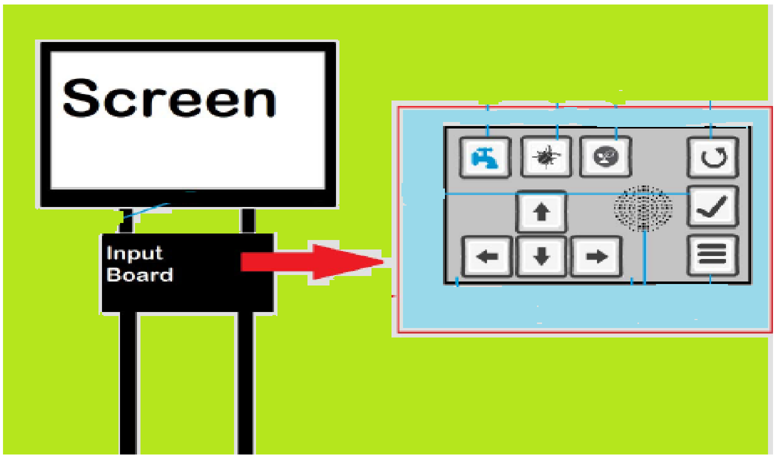

Figure 4: Smart panel

An interactive smart panel will be designed as in figure 4. It will consist of buttons to accept commands or made to accept input and output voice messages. Further the operating system with simple functions required to support interface in smart panel. The interactive dash board and farmers assistant tool box to alert regarding information of any warnings for farmers, any news alert for any coming cyclone of flood will be designed. The flow of operations in the proposed model is described in figure 5. Governmental services notifications or suggestions regarding current crop yield information are accessible via smart panel.

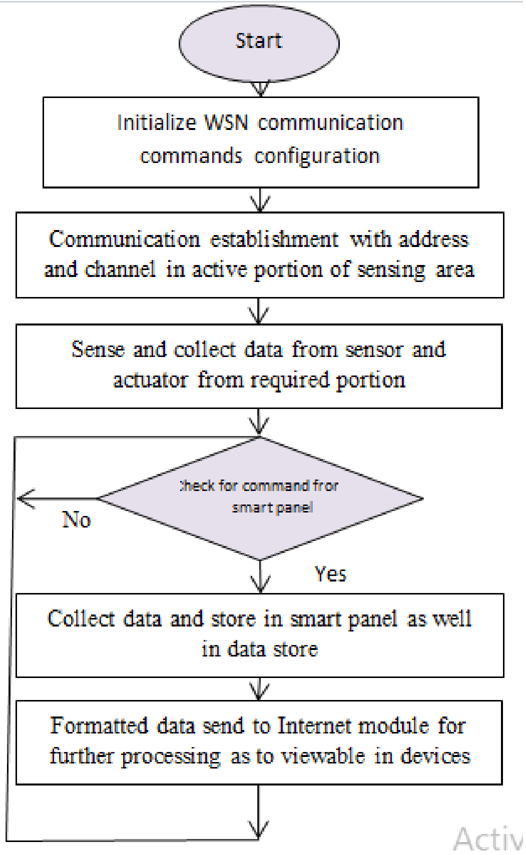

Figure 5 : Flow diagram of Rose Greenhouse Monitoring

IV. PREDICTIVE MODEL

The proposed rose greenhouse monitoring system model is a completely implementation model but still not yet instrumented practically. The rate of success of proposed model is estimated collecting economic data of components as in table 2(22,21). The price list of sensors and smart panel are estimated based on current market information.

TABLE 2: ESTIMATED COST OF ROSE GREENHOUSE MONITORING SYSTEM

Name of the Component	**Required Number of Units**	**Cost**
Temperature sensor	4	2000
Moisture sensor	10	5000
PH sensor	2	12000
UV sensor	2	1000
Servo motor	8	5000
Smart panel components	1	10000
Total cost		**35000**

A. Application Feature:

The smart panel will be interactive for farmer to know about field information and to operate remotely. The data will be stored for further decisions making or for instant data fetching in web interactive pages or in mobiles. The information is provided to only authenticate persons through a Log-invalidating via a confirmation email. The data collected will be scripted with suitable parameters for further mining and subsequently to generate prediction model through learning tool. The temporal and numerical data will adjust itself to the algorithm which gives the best results and can show a prediction with the least amount of deviation to the parameters that were taken for the study probably. The dataset will be designed to include both raw; data collected from sensors and normalized data between zero and on. The three predictive models will be used to perform test linear regression, neural networks and support vector machines.

V. CONCLUSION

Thus, smart farming helps farmers to make sure to earn more money thereby improving economy of our county considering in large scale. Technology applied in proposed model is fundamentally a support, monitor and management tool for agricultural domain which can be extended to other domain also. Generally monitoring and predictive system being developed influences much on decision making on parameters temperature, humidity, moisture, luminosity and others. Normally, the goal of recording such value is to characterize crop by size, duration, sanitary status and others which assist farmers to take earlier actions. The learning algorithms tuned up in order to enhance greenhouse environmental conditions forecasting and a comparison with other techniques will be put into effect. In the future, a complete solution using different hardware and software components designed during proposed work will be put in place. Further improvement for proposed work can be focused with automatic control of data regarding phonological status with introduction of cameras applying image processing concepts. Similarly nodes can be made to operate on solar energy minimizing energy requirement.

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