Decision Support System For Crop Growth Management

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Abstract- *currently, greenhouse management mostly uses a traditional mode of management which is developed on the experience to manually adjust the light, temperature, humidity also irrigation, fertilization. This method leads to higher management costs, and also brings a chain of problems, such as low production efficiency, waste of resources and environmental pollution. Here presenting a state of art survey on agricultural greenhouse management system. The system mostly used utilizes the fuzzy logic, wireless sensor networks, Bluetooth or internet of thing, a fruitful solution can be the deployment of (DSS) Decision Support Systems to solve such difficulties, as they include expert's understanding and composite mathematical calculations on environmental input, thus serving managers in taking more productive decisions. Multi sensor decision fusion is the technique proposed which constitutes an inventive grant to the literature and simple to use, economical solution to lessen the misuse of pesticides and plant food in protected crops.*

Keywords- Fuzzy logic, wireless sensor networks (WSN), The Internet of Thing (IOT), Cloud Computing, Decision Support System (DSS), Multi sensor decision fusion.

I. INTRODUCTION

The usage of natural wealth is nowadays an important challenge for considering the expected increase of the population. Over decades, the impulsive misuse of natural capital has induced global consequences on the world ecosystem like the greenhouse reactions and the consequent global warming occurrences, which have raised serious trouble about the utility of resources for the next generations. The increasing population is an additional emergent threat to the global ecosystem.

To respond to this the notion of green saving has been introduced to earn a good balance linking the feasibility and the productivity of crops by expanding the ability of farming performance.

For productive use of greenhouse automation there are diverse techniques present which give the solution. In most general system the regular problem is related to the database collection and limited space for storage owing to its centralized hardware system. Hence to safeguard these natural resources and make their utility possible for the upcoming generations the implementation of decision support system could be a fruitful solution.

The decision-making is an electronic climate-control systems rather than simplifying and supervising data enrolled in précised agriculture and this DSS system can easily generate large data with composite relations. To organize all the factors and their interactions, suitable data handling procedures and decision tools must be implemented. Considering the need for further improvements in existing system and this improvement can be achieved by one of the most promising techniques i.e. Decision Support System (DSS).

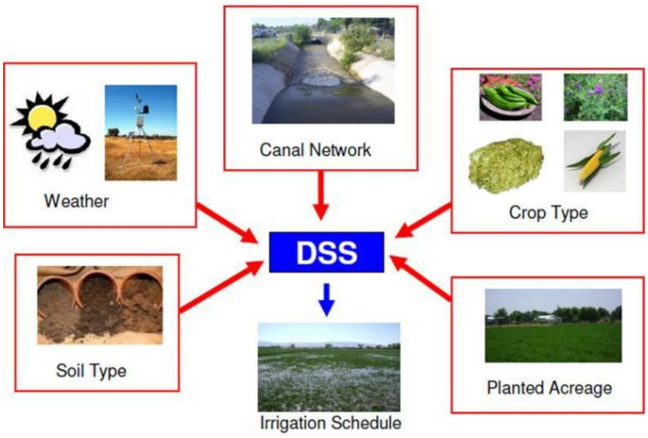

Figure 1. DSS Framework

Three basic components of DSS architecture are:

1. The database (or knowledge base).
2. The model (i.e., the user criteria).
3. The user interface.
4. The users are very important parameter of the architecture.

A DSS system involves a structured approach. This framework includes human, technology, and the development outlook:

The initial Framework of Decision Support System consists of four phases:

1. Intelligence – enquiring for situations that call for decision.
2. Design – Evolving and analyzing possible alternate actions of solution.
3. Choice – Selecting a path of action among those.
4. Implementation – using the selected course of action in decision situation.

II. COMPARATIVE STUDY OF CURRENT SYSTEMS

The equivalent work of greenhouse automation is explained in this section. There are adverse types of techniques which gives the solution for fruitful use of greenhouse automation. The most accurate state for the vegetation of crops and to prevent from the obstruction of pest development can be attained properly through analysis the conditions surrounding the system in greenhouse. On such conditions, several inventive control methods for greenhouse automation have been lately proposed. The bulk of the procedures are developed.

TABLE 1. COMPARATIVE ANALYSIS OF TECHNIQUES

Author	Techniques	Advantages	Drawback
Zhaochan Li [1]	Networking technology, Agricultural IoT	Highly efficient and intelligent, possible to widely implement.	Hard designing and overall realization of system needs human intervention.
Prof. Giuseppe Aiello [2]	Multi sensor fusion method	Easy usage and cheap solution requires cautious and complete organization	By implementing a suitable cost models the economically benefits could be properly quantified
G. Sahitya [3]	Precision Agriculture by implementing ZigBee	Low power usage of multifunctioning sensor nodes	For efficient transmission of data, the nodes should be placed properly.
Ashraf Abdul Halim [4]	Scheduling	individual intervention. Flexible	multi-hop network inside the greenhous e
Migdat Hodzic [5]	Binary Algorithm	energy efficient, efficient networking and scalability	Energy reduction is most severe issues
Yifeng Cao [6]	Routing Protocol	energy-efficient routing protocol overall optimization work is built on the residual energy and transmission power	A trade-off Between time delay and energy Harvesting. A more Sufficient algorithm required
Sonam Maurya [7]	Threshold Sensitive Region-Based Hybrid Routing Protocol	minimizes the energy consumption Of nodes. Has a significant increase in network lifetime due to reduction in frequent data transmission	If the values of sensed parameter are not crossing any threshold i.e. T1 and T2 for a long time then BS may not receive any data
Marwa Mekki2 [8]	Wireless Sensor Networks	allows the farmer to upgrade the cultivation in a way the plants need, actuator is responsible for controlling the parameters	False alarming possible, One node fails whole system collapse.
Vo Que Son [9]	Context-aware system using Fuzzy Logic for Sensor Networks	Flexible and can be able to maximize the lifespan of networks	Collaboration between nodes can be complicate. vagueness

In the entire study, it has been observed that the old technologies could be taken over by the smarter use of DSS system. The previous technologies also have its merits and demerits as mentioned in the detail.

III. PROPOSED SYSTEM

DSS approach aims to propose a low fund and inclusive mechanized irrigation set-up constructed on wireless sensors for system controlling and remote monitoring. The systems constitute the understanding about the application and implement techniques that direct users to take the most favorable decisions. Among the various techniques to represent the knowledge, two standards proceed towards "case based" and "rules based". A manageable rule based system is utilized, to recommend the solution of the problem on the procedure of assembling of data from the sensor network. Eventually this technique known as multi sensor data fusion enables taking a general conclusion on the complete system. This segment constitutes an inventive offering to the present state of the art.

A rule-based system could be a successful solution to conquer difficulties, because they involve expert's knowledge and precise detailing on contextual data, hence helping managers in taking more precise decisions in the complete greenhouse production, and observational validation build on real data. The decision system here proposed contains specific domain knowledge through a set of rules. A particular rule has an if-then format: If <conditions> then <conclusion>, where "conditions" represent facts, and "conclusion" represents related actions.

This sensor unit installed in the greenhouse estimates humidity, light, temperature, soil, moisture etc. with their relative standards. By comparing the differences between positional points of sensors, profound segments in greenhouse are being conditioned. According to such configuration, by surveying the atmosphere in the greenhouse and creating proper alert thresholds, it is feasible to trigger control actions. The producers make suitable technical choices, with corrective actions when values exceed certain critical thresholds which are highly precise, accurate and demands less power by proposing Decisions Support System

Figure 2 displays structural diagram of proposed node section of DSS system. It uses the nodes N1, N2, N3 for gathering the greenhouse related parameters at separate locations inside greenhouse. Sensing node units calculate parameters with several sensor segments including light, soil moisture, humidity, and temperature. The nodes are self-reliant embedded system units. The method is applicable to the content gathered by sensor networks is rule-based which is established on mathematical models. It is a good procedure to avoid that unreliable data emerging from faulty sensors which could lead to invalid decisions. To make a more valid opinion of the environment towards sensor based decision making which marks the issue of how to fuse data from various sensors.

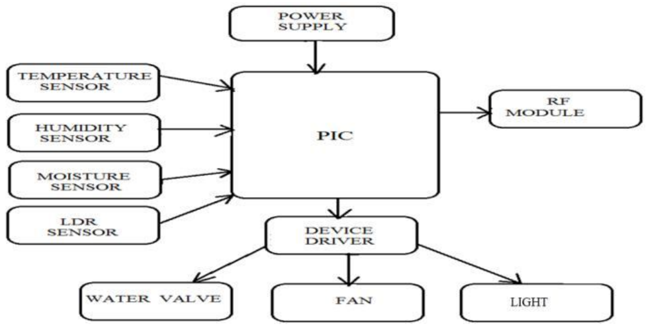

Figure 2. DSS Node Section

Hence the outlook could be adapting multi sensor data fusion. The monitoring system installed is constituted by PIC micro controller for temperature/humidity sensors communicating with the fundamental station through RF Trans receiver. To obtain more reliable judgment the proposed system includes a data fusion algorithm to process the information from the complete sensor network. For such motive, each node section carries its own information to a decision fusion center, which makes the final choice. The same information could be further communicated through internet using cloud computing as shown in figure 3.

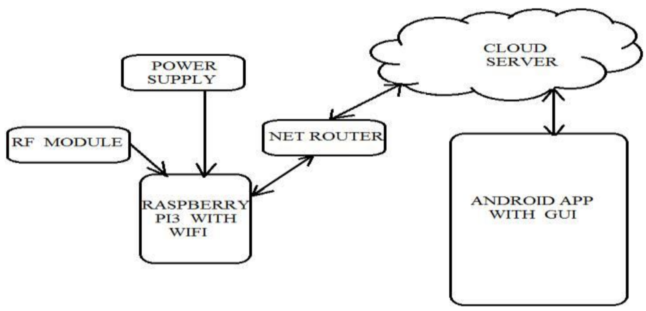

Figure 3. DSS Base Station

This system approaches an execution of the decision binding algorithm which allows taking the decisions regarding the possible risk of pest disease established on the data gathered through all the sensors of the network. In particular, every node provides a prior alert to the decision center by a threshold built decision rule. Lastly, the overall decision is estimated by combining the inputs from all sensors by considering a majority rule. Further, through mobile android app which gives a pleasant experience to user, a path for the greenhouse supervision and ruling across the globe

IV. RESULTS AND DISCUSSION

Proposed system utilizes the express PCB software for the feature like converting from hand-drawn schematic into a PCB. By linking the schematic into the layout editor reducing the probability of error. Figure 4 shows power supply and circuit implementation of proposed system in express PCB software. Proposed system consists of raspberry pi 3 module, ULN IC 2803, limit switches, SPDT relays.

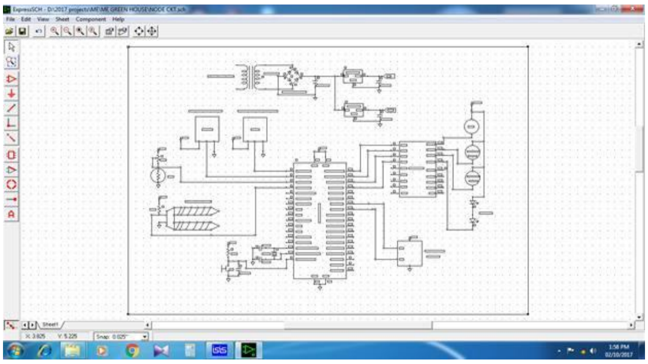

Figure 4. Simulation of Node section

We use the Raspberry Pi 3 model which is having the more beneficial features than the other controllers. Raspberry Pi 3 is a single board computer which is uses Linux based OS and that can be for different numbers of applications because it has general purpose input/output (GPIO) pins right on the board. This controller having the inbuilt Wi-Fi model, BCM 2837,Quad Cortex A53, 1.2Ghz, 1GB SDRAM, 802.11n/Blue tooth 4.0. We monitor the green house on Mobile Android App using Cloud Technology. Android Studio Development Kit is use to create high quality android apps for every android device is to compile and run it. Android applications are develop in the Java language using the Android Studio Development Kit.

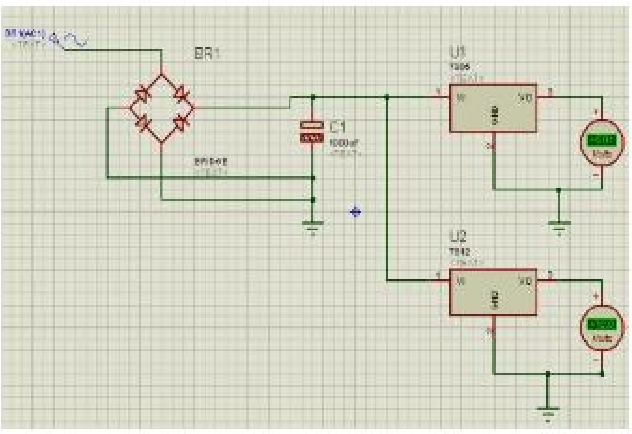

Figure 5. Power supply simulation

The user perform the proper operation on actual time environment & and gets the results as per user requirements. Thus, need to overcome the old technologies through the mobile android app and also using a cloud technology in real world is the scope of future work.

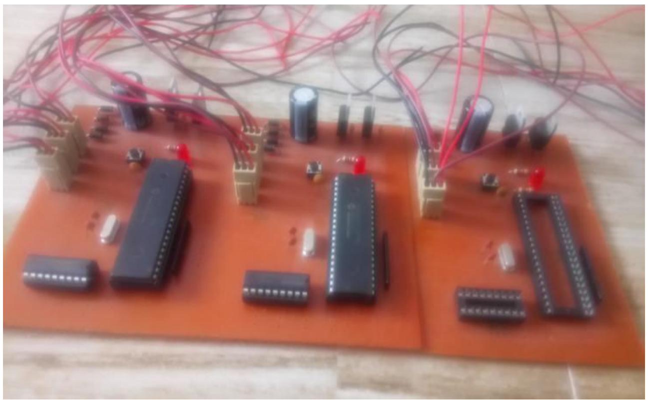

Figure 6. Hardware setup

Figure 7. Android application

V. CONCLUSION

As there is necessity for upgrading the greenhouse automation in all regards. And the traditional techniques have limitations like collaboration between nodes can be complicated besides false alarming, lack in making decision and are not a proper solution for the greenhouse supervising and controlling. Thus there is a demand to work on a system which may be used to expand the hours of time to market, produce good quality of product and increase the productivity.

Proposed method shows the integrating relays to Raspberry Pi unit for controlling greenhouse from a remote location in a physical scenario. To develop the IoT framework and use cloud computing infrastructure for connecting and also store sensor data. Using IoT it allows cellular devices and computers to smoothly direct all the functions and features of greenhouse from anywhere via internet connection.

REFERENCES

[1] Zhaochan Li1, Jinlong Wang, Russell Higgs, Li Zhou, Wenbin Yuan4,"Design of an Intelligent Management System for Agricultural Greenhouses based on the Internet of Things", IEEE International Conference on Computational Science and Engineering (CSE) and Embedded and Ubiquitous Computing(EUC), 2017.

[2] Prof. Giuseppe Aiello, Dott. Irene Giovino, Prof. mariangela vallone, prof. pietro Catania, Ing.Antonella Argento, "A Decision Support System based on multi sensor data fusion for sustainable greenhouse management" Journal of Cleaner Production 2017.

[3] G. Sahitya, Dr.N.Balaj, Dr.C.DNaidu, S.Abinaya, "Designing a Wireless Sensor Network For Precision Agriculture Using Zigbee", IEEE 7th International Advance Computing Conference 2017.

[4] Ahmad Ashraf Abdul Halim , Najmuddin Mohd Hassan , Ammar Zakaria Latifah Munirah Kamaruddin, Asyraf Hakimi Abu Bakar , "Automated Scheduling Based on Plant Growth For Greenhouse Management System Ahmad", 3rd IEEE International Conference on Electronic Design (ICED) 2016.

[5] Migdat Hodzic, Indira Muhic, "Binary Algorithm for Energy Saving in Low Power Wireless Sensor Networks" IEEE 2016.

[6] Yifeng Cao, Xiao-Yang Liu, Linghe Kong, Min-You Wu, Muhammad Khurram Khan, "Routing Protocol for Energy Harvesting Wireless Sensor Networks " IEEE 22nd International Conference on Parallel and Distributed Systems 2016.

[7] Sonam Maurya and Vinod Kumar Jain, "Threshold Sensitive Region-Based Hybrid Routing Protocol for Precision Agriculture" Workshop on International Workshop on Mobile Edge Computing and IoT (MEIoT 2016).

[8] Marwa Mekki2 ,Osman Abdallah1 , Magdi B.M.Amin, "Greenhouse monitoring and control system based on wireless Sensor Network ", International Conference on Computing, Control systems 2015.

[9] Vo Que Son, Ta Tri Nghia, Tu Luong Phan Nguyen, "Context-aware Monitoring Model using Fuzzy Logic for Wireless Sensor Networks in Logistics" The International Conference on Advanced Technologies for Communications (ATC'14) 2014

[10] A. Moon and S. Lee, "Design of the farmer's experience based greenhouse operating systems," Proc. - 12th IEEE Int. Conf. Trust. Secur. Priv. Computer.Communication. Trust. 2013, pp. 1407–1411, 2013

[11] Reading, Shao Jun. Zigbee Low power consumption design of monitoring system for greenhouse. The computer measurement and control, 2012,20 (7): 356-361

[12] Jignesh B Patel et al. "Field Irrigation Management System using Wireless Sensor Network" Institute of Technology, Nirma University, Ahmedabad. 2011 IEEE, pp.1-4

[13] Aiello, G., Cannizzaro, L., La Scalia, G., Muriana, "An expert system for vineyard management based upon ubiquitous network technologies". International Journal of Services Operations and Informatics 2011

[14] Sun Qibo. Liu Jie. The Internet of things: Summary of the research on concept, architecture and key technologies University of posts and telecommunications journal, 2010 (3): 1-16.

[15] Langton, F.A., Horridge, J. S., Holdsworth, M.D. Hamer "Control and optimization of the greenhouse environment using infra-red sensors". Acta Agriculture 2004.

[16] Tian Min, Fei XW, Zhao DZ. "Facility agriculture monitoring system based on Internet of things" [J]. Wireless Int Technol, 2016, (6): 28

[17] Bahrenburg, A.W.T., 1974.Psychometric and Psychometric Charts, 3rd ed., Cape and Transvaal Printers Ltd., Cape Town.

[18] Internet information Internet encyclopedia [EB/OL]. http://baike.baidu.com.

[19] "Humidity Sensor," IST USA. [Online]. Available: usadivision.com/sensors/humidity/.

[20] :http://www.soilsensor.com/soilsensors.aspx.