Automated Environment monitoring and control system For agro-based industries using Wireless Sensor Networks

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Abstract— the aim of this paper is to develop a automation system agro-based industries using Wireless Sensor Network and also analyses and compare data using fuzzy logic. To design automated Monitoring and Controlling system which will monitor the analog parameters and transmit these values to the other side where they can be read and control with the set points. If these values exceed their corresponding set points, the system will start the controlling devices and set back the exceeded values back to normal. The Communicate uses ZigBee to implement this application. The analog parameters like PH, Temperature and Humidity are read by the respective sensors and these values are transmitted by the transmitter node. The receiver section; host computer, The ARM based computer named Raspberry-Pi receives these values and compares these values with the fixed values and if they exceed the set points, the ARM controller will send commands to controlling devices which will lower the exceeded values to normal.

Index Terms - WSN, Raspberry-Pi, ZigBee, Sensors.

1. INTRODUCTION

Advances in computer technology and in wireless sensor networks have made owning and operating agro-based industries like Greenhouse, Floriculture, Horticulture, Residential Gardening, and Landscape etc. easier than ever before. Innovations environmental control options can aid the home gardener or professional horticulturists by automatically adjusting temperature, humidity, and light intensity from within the greenhouse or from a remote location. An environmental control system will improve plant life within greenhouse by providing a constantly monitored atmosphere, producing a more uniform product.

1.1. *Environmental Control Systems can:*

- Adjust Temperature
- Adjust Humidity
- Control Light Intensity
- Monitor Atmosphere

1.2. *Greenhouse Accessories Controlled by Environmental Control Systems:*

- Fans
- Vents
- Misting Systems
- Fogging Systems
- Heating Systems
- Cooling Systems

The first stage of implementation can be as simple as an on/off switch to control circulation fans. By semi-automating a control system with a humidistat, a thermostat, or a timing device, the accessories will run only when necessary, lowering operating costs and saving energy. Fully automated systems have the option of being controlled by a semaphore or remote programming system on a PC or even through a cell phone, saving a substantial amount of time. These fully automated systems can be designed to maintain a specific set of criteria for constant plant comfort, taking into account the conditions outside the structure that may affect the plants growing atmosphere.

In addition to common greenhouse accessories, Solar Innovations, Inc. environmental control systems can be designed to accommodate advanced features like evaporation coolers and foggers, drip systems, semaphores, remote programming, photo and light sensors, and soil sensors. The horticulturists' time can now be spent tending to plants rather than tinkering with their growing environment. Beyond the cost and time efficiency of the greenhouse control system, Mother Nature will benefit. Control systems reduce the need for chemicals to aid plant growth as the environment is more closely adjusted to create the ideal conditions and reduce energy costs and waste.

2. ANALYSIS AND COMPARISON OF DATA USING FUZZY LOGIC:

The growth of a crop depends on many factors such as water given to crops, soil, temperature, humidity and fertilizer etc. The Proposed study evaluates crops growth by considering above factors. The major aim of presenting paper is to analyze, how the above factors are effective to improve crops growth using fuzzy logic and how our automated system will make difference in it.

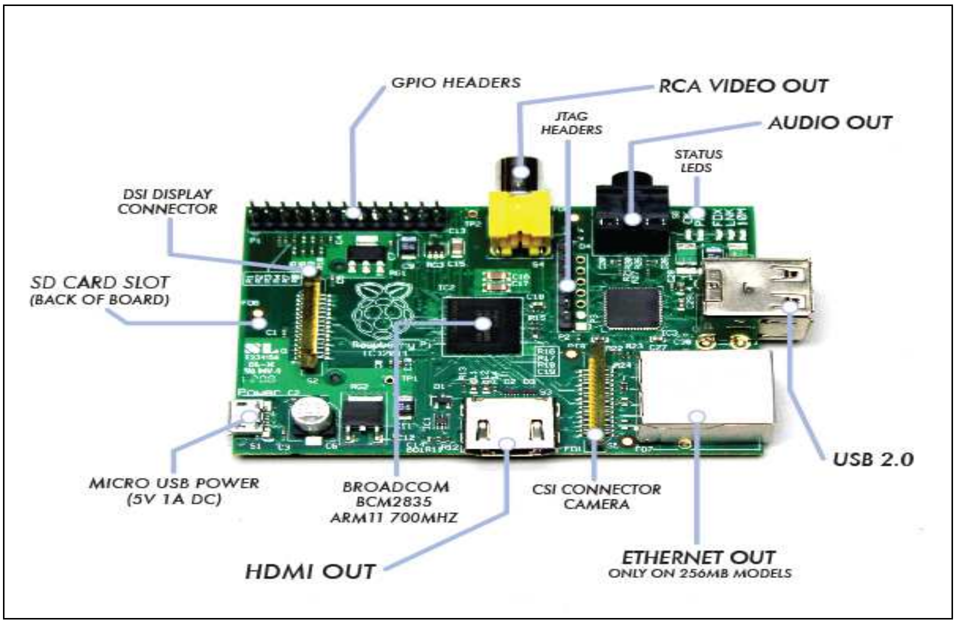
3. ORIGIN OF RESEARCH PROBLEM:

Crop growth is mainly influenced by the surrounding environmental climatic variables and by the amount of water and fertilizers supplied by irrigation. This is the main reason why a greenhouse is ideal for cultivation, since it constitutes a closed environment in which climatic and fertirrigation variables can be controlled to allow an optimal growth and development of the crop. The climate and the fertirrigation are two independent systems with different control problems. Empirically, the requirements of water and nutrients of different crop species are known and, in fact, the first automated systems were those that controlled these variables. As the problem of greenhouse crop production is a complex issue, an extended simplification consists of supposing that plants receive the amount of water and fertilizers that they require at every moment. In this way, the problem is reduced to the control of crop growth as a function of climate environmental conditions and analysis using FIS approach.

4. WSN FOR GREENHOUSE CLIMATE CONTROL

Wireless Sensor Networks are communication systems comprising a high number of nodes (sensors) typically distributed over large geographical areas and employed in several applications. There are many applications based on wireless sensor networks for environmental monitoring: it is worthy in this context to recall some leading applications that highlight the intriguingly vast scope of the subject and allows us to bring into focus some of the main issues to be tackled. This project aims at the development of an automated application that will be able to sense the environment and communicate with a base-station transceiver while being self powered, which is one of the main concern when implementing a sensor network. According to the application needs, sensor nodes could be randomly dispersed over a wide area or disposed accurately at locations of interest to collect sensor information when necessary. In [9] and [10] two canonical applications of WSNs for environmental monitoring are presented, namely forest fire detection and habitat monitoring: they aim at instrumenting natural spaces, but show completely different requirements in terms of data acquisition rates and timings, since fire detection require real–time and constant surveillance, while habitat monitoring calls for long term data collection at lower frequency or sporadically. Also, entering the field of building monitoring and indoor environment [11], the management of network services and of the network itself (e.g. communication routing) are of great interest. Finally, in the white-paper [12] there is a detailed discussion of the featuring characteristics of the monitoring action through the exploitation of wireless networks are stressed, with emphasis on the distributed aspects of sensing and processing: collaboration among nodes, redundancy, network adaptation, are some of the keywords to focus onto when designing WSNs architectures and algorithms.

5. RASPBERRY-PI:



The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.
The Raspberry Pi has the ability to interact with the outside world, and has been used in a wide array of digital maker projects, from music machines and parent detectors to weather stations and tweeting birdhouses with infra-red cameras.

6. ZIGBEE:

ZigBee is a specification for a suite of high level communication protocols. Zigbee is a typical wireless communication technology. ZigBee uses low rate, low-power digital radios based on an IEEE 802 standard for personal area networks. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other WPANs (Wireless personal area network), such as Bluetooth. ZigBee is targeted at radio-frequency (RF) applications that require a low data rate, long battery life, and secure networking. ZigBee has a defined rate of 250 kbps best suited for periodic or intermittent data or a single signal transmission from a sensor or input device. It is Open standard protocol with no or negligible licensing fees, chipsets available from multiple sources, remotely upgraded firmware, fully wireless and low power, mesh networking to operate on batteries, low maintenance and larger network size with standard based high security.

7. SIGNIFICANCE OF THE STUDY

7.1. *A Dynamic Environment:* Greenhouse environments present unique challenges to good control. Temperature changes occur rapidly and vary widely depending on solar radiation levels, outside temperatures and humidity levels, wind speed and direction, the amount of plant material in the greenhouse, watering routines, etc. Proper control of this dynamic environment is indeed challenging, but the benefits of good control far exceed the costs. Ultimately, the objective of any greenhouse system is to reduce the input cost per unit of production and maintain or increase the quality of production. While some investments affect the input cost and/or quality of one or two specific tasks (i.e. transplanters, soil handling equipment, etc.), a well-integrated environment system will have a positive effect on virtually every function in a facility. Even a small percentage of improvement in several areas will yield substantial improvements overall. Growers that own Integrated Control Systems report experiencing many real benefits resulting from improved control.

7.2. *Higher Energy Efficiency:* Better equipment coordination and more accurate control can reduce heating fuel and electrical costs. Savings vary depending on how well you already manage your environment and the controls you purchase.

7.3. *Better Labor Efficiency:* Automated controls increase the productivity of workers by enabling them to attend to more valuable tasks. Increased output reduces the pressure for more labor.

7.4. *Improved Management Effectiveness:* Perhaps the most important function of good control systems is the additional information available to managers and growers, enabling them to make better management decisions and spend more time managing the process instead of being or doing the process.

7.5. *Reduced Water Use:* With the modern irrigation control capabilities in many systems water application is more precise, and timelier. Growers report reduced overall water use and runoff of as much as 70% with the most effective irrigation controls.

7.6. *Reduced Fertilizer Use:* Constant monitoring and control provides higher accuracy that, when combined with efficient water use, can substantially reduce fertilizer application and improve its effectiveness.

7.7. *Reduced Chemical Use:* More precise control of temperatures and more effective use of DIF and other growth regulating temperature regimens reduce the need for growth regulators. Better management of humidity, irrigation, and temperature also helps reduce plant stress and diseases and, consequently, the need for fungicides and other chemicals.

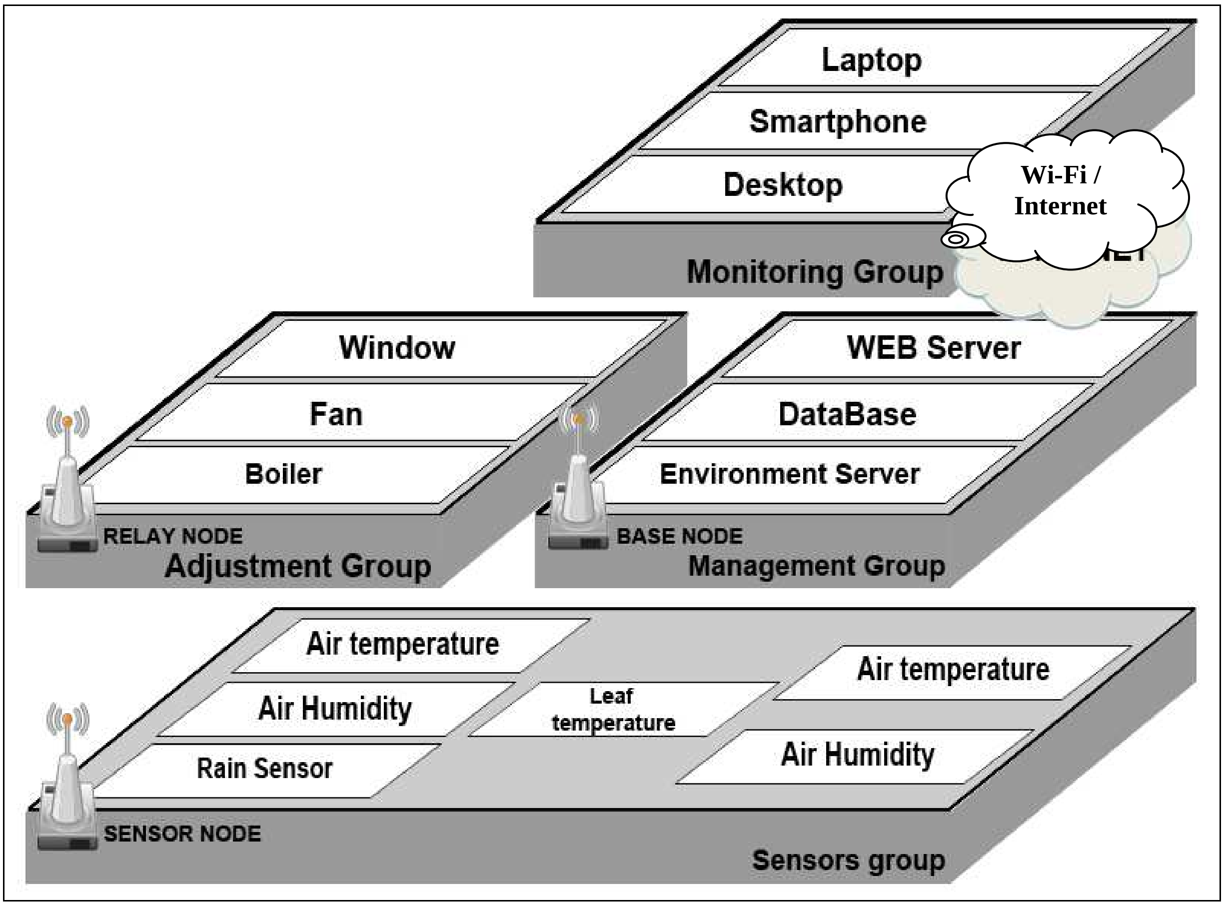
7.8. *Reduced Pesticide Use:* Greenhouses with better climate control and precise irrigation produce healthier plants. Healthier plants are less susceptible to disease and insect infestation. Growers report noticeable reductions in insect populations and pesticide use in well-controlled environments.

7.8. *Improved Plant Quality & Uniformity:* Less disease, more effective irrigation and fertilization, improved grower information and management all combine to increase the health and uniformity of plants. Uniform crops are easier to handle and market.

7.9. *Reduced Equipment Wear & Tear:* Poor control over-taxes equipment by over-cycling and increasing operation hours. Good control allows more precise management of the equipment. Continuous monitoring and alarms alert growers to pending breakdowns and other problems earlier, before more serious consequences occur.

7.10. ***Less Plant Loss from Failures:*** Good data logging and graphing of greenhouse conditions and sophisticated early warning alarm systems help reduce losses from catastrophic failures

8. METHODOLOGY:



9. CONCLUSION

India is an agriculture–oriented country. For the quality and Productivity improvement of greenhouse and open field crops, it is necessary to measure and control several interacting physical variables. These tasks can only be accomplished by 'control systems with built in software'. Erecting greenhouse is expensive. Automation machinery is imported in India hence it is expensive. Many farmers cannot adopt the greenhouse technology due to its high cost. Our system highlights about the approach to control the environment in Greenhouse. The greenhouse controller senses the changes in the temperatures (Dry temperature, Wet temperature), humidity, soil moisture etc. through input sensors and processes to take control action. Real time monitoring provides reliable, timely information of crop and soil status, important in taking decisions for crop production improvement. Evaluation of agricultural production systems is a time consuming and difficult process because it means performing visits to selected crop fields to be able to measure and register certain physical, chemical and biological characteristics of the cultivated areas and analysis of all input parameters using fuzzy approach.

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