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Intelligent system for multiple Greenhouses

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Abstract: ***The effectiveness of greenhouse can be improved by the application of model based intelligent system. Proposed system is an intelligent embedded system to control various parameters of greenhouse like temperature, humidity and light for effective decision making. The intelligent system will store knowledge of greenhouse practices for major issues related to agricultural practices, environment controlling, pest/diseases detection, consultation diagnosis for assisting decision–making for monitoring of greenhouse which will optimize crop production, uniform growth, quality of the crop.***

Wireless sensor network (WSN) framework is used of greenhouses for automation. Wireless communication is used to collect the measurements of input parameters and to communicate between the centralized control and the actuators located to the different parts of the greenhouse. Here, the structure of the control system, hardware, and software design and system control strategy has been designed.

For Decision making and providing expertise a web enabled application is developed comprised of modules that provide: (1) information about the cultivation process/agricultural of the supported crops ie water and soil (2) environment control by helping in taking decisions on external parameters and internal parameters (3) consultation for pesticides and diseases of plants (4) Diagnosis of diseases of plants.

The article focuses on the structure of the control system, hardware, software design and system control strategy. The control system has a simple hardware structure, cost-effective, easy to use and provides advantages of good stability.

I. INTRODUCTION

Greenhouses are built in various sizes and types all around the world to house plants needing special environmental conditions. Greenhouses are widely used both for vegetable and ornamental plant production.

The basic operation of a greenhouse is as follows: The transparent walls and roofs allow the solar radiation to pass through, but the warmed up air is kept inside. To prevent extreme high or low temperatures inside the house several actuators can be utilized. Shading curtains, automatic windows and active cooling systems can slow down the temperature rise in the summer while heating appliances are used in the cold season.

A greenhouse allows producing crop in places where the climate or geographic area or time would not feasible. As production s plant grows it goes many developmental changes which affected by surrounding and environment in which plant grows. The environment consist of temperature, humidity, moisture of soil, light intensity etc. Automated Greenhouse provides shelter as well as optimum condition for the development of crop. The quality and productivity of crop dependent on the information gathered from the greenhouse environment, so we do require optimum sensors for this process and jointly by analyzing the sensor out put the internal atmosphere of the greenhouse.

II. Objectives and General Description

Main objective of the system is making a greenhouse intelligent so as to create appropriate environment for corps to grow. For this first step is to design and develop an embedded system and the system will be divided in two stations control station and sensor station. The communication between two units control and sensor will be done by zigBee.

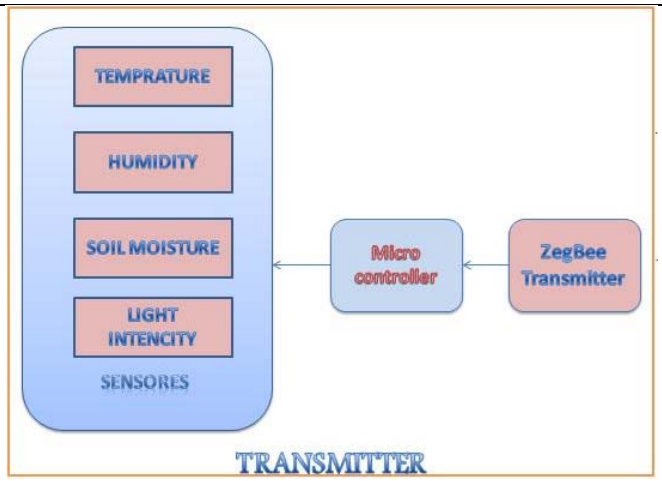
The greenhouse sensor station is basically a data acquisition unit it is responsible to collect data like temperature, humidity, soil moisture and light and send it to control station through ZigBee wireless module.

Coordinate station controls the flow of data and instruction it process incoming data and provide easy and convenient way that allows the user to store display and access the data. It manages green house climate by controlling sprinkler, humidifier, heater and light etc.

Microcontroller is most important part of embedded control unit which is used to Handel input data coming from sensor unit and processes it to generate proper control action to various parts such as sprinkler, heater etc.

III. The System Hardware

We are having two stations sensor station and control station data and instruction transmission between these two stations will be done through Zig Bee transmitter and receiver. Block diagram of both modules is displayed here. Figure 1 : Embedded Framework of Greenhouse.



According to the functional and technical indicators Block diagram of system hardware design structure shown in Figure 1, as was the object of all motor control, Electromagnetic valve, Electromagnetic switches, etc.- electrical equipment, and the controller use of the environment and relatively poor, in order to improve the control system reliability, output controller interface photoelectric isolation and SCR, it has good effects of segregation, the strong and weak, for electrical isolation, a further SCR Can reduce the power of the weak-interference, improve system reliability.

3.1 Input Module

This module's major function is passes to the greenhouse in temperature and humidity data to the computer. The traditional load module is by temperature, the humidity sensor, the special-purpose amplifier and ADC is composed.

3.2 Data Storage Module

For data storage we are using microcontrollers internal FLASH memory, enables the controller both online to revise in 1 year the random number of days 1 hour temperature and humidity ideal setting value, and can in the record greenhouse each hour average temperature and the average humidity value, moreover the request power failure data does not lose. The controller must record the data are many (in for 1 year, daily 24 hours, each hour has a temperature and humidity setting value, but must record in 1 year each hour greenhouse temperature and humidity mean value). If uses each data 1 byte (i.e. 1B), altogether needs 3652422=35040B. The data automatic input storage modules, completes the data test result saves according to the specific form in the corresponding precision and the reliability is not high. Adopt the advanced integrated transducer of digital temperature and humidity in the input subsystem of this system. Its most major characteristic is the direct output digit quantity, does not need the signal amplifying circuit and ADC. Moreover it uses "a main line" the system, may receive, the transmission data in a data line, and may hang meets many sensors, the microcontrollers distinguishes through the difference different sensor serial number measures the temperature and humidity spot one by one.

3.3 Control Output Module

Controller controls objects mainly sensors and transmit instruction through Zigbee module. Transmitted measurement result are based on the control strategy, so that the temperature and humidity of the greenhouse is in the for the eight output solid state relays (A backup, in order to expand the new control object), solid state relay by 5V. In order to improve the reliability of in control output modules include Electro-optical coupler, with the former level after level of contact between no electricity. A transistor array drive relay, the circuit more tidy. LCD display module is mainly used to show the system to control and monitor the state.

Control module chooses state according to the measurement result and control strategy, so that the Temperature and humidity light intensity etc. can be modulated with respect to environment and type of crop.

3.1.4 Wireless Sensor Module

Many wireless technologies have emerged and are now available on the market for both personal and industrial uses.ZigBee is one of these emergin wireless technologies. ZigBee wireless technology is capable of providing larger scale low power wireless network with inexpensive batteries which can run devices for years. It is applicable in any type of application because of low cost and low network characteristics. ZigBee provides reliable data transmission up to 100 meters or more while consuming a very small amount of power.

Receiver station consist ZigBee receiver module which is attached with a microcontroller which takes data from ZigBee receiver and controls the relay.

IV. THE EXPORT SYSTEM FOR GREEN HOUSE

The proposed system will be implemented as a web-based application using web technologies and subsystems comprised of modules that provide: (1) information about the cultivation process/agricultural of the supported crops ie water and soil (2) environment control by helping in taking decisions on external parameters and internal parameters (3) consultation for pesticides and diseases of plants (4) Diagnosis of diseases of plants.

The major parameters that determine the irrigation process are: Type of growth, Status of the growth (height, depth of roots), Leaf coverage, Kind of soil and saltiness, Water budget (economy or normal irrigation). Therefore, the input parameters that are used by the system are: Soil (ground) humidity, Temperature, Radiation, Wind speed, Air humidity, Salinity (amount of salt in the ground).

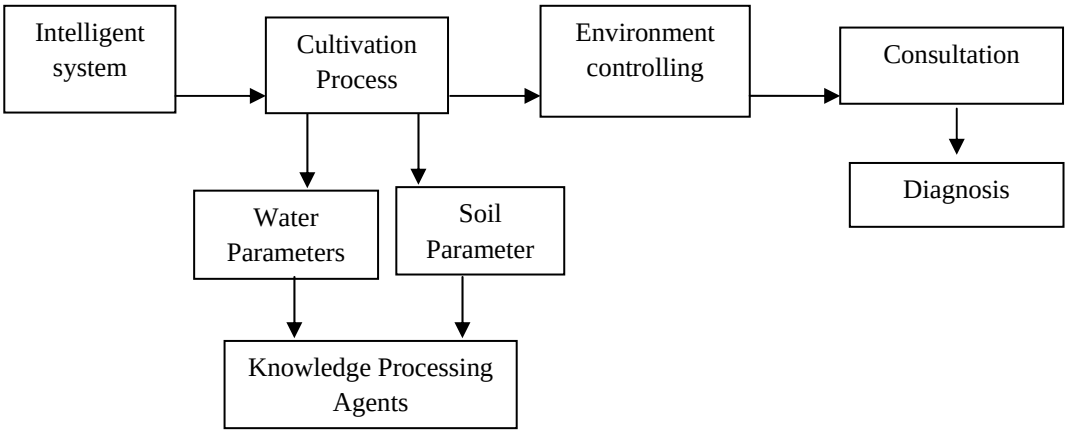


Figure 2: Intelligent Architecture of Greenhouse (I)

The output parameters are:

- Opening/closing the valves for water and/or fertilizer and adjusting their amounts in combination;
- Turning energy systems on/off (lights, heating, ventilation);
- Opening/closing walls and roofs of hothouses.
- Desired soil moisture properly.

The control stage: In this stage the desires soil moisture is compared with the measured soil moisture following the comparison, a dynamic decision is made regarding the amount of water to be added to the soil.

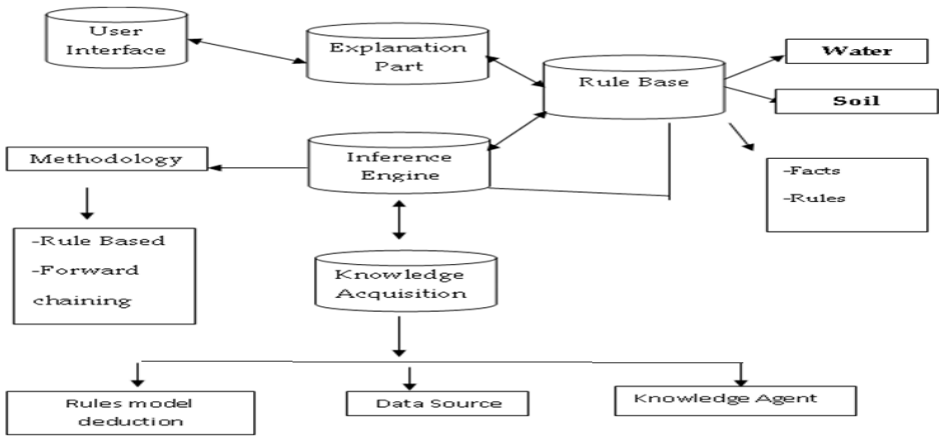


Figure 2: Intelligent Architecture of Greenhouse (II)

V. METHODOLOGY

To achieve above stated objectives following has to be carried out :

- Assessment of Water and soil quality parameters like pH, temperature, etc and standards of parameters and heavy metals etc to be applied. As information related to these is not compiled and not available at one source it has collected through various sources like journals, books, pollution control booklet, experts etc.
- The collected information is stored in appropriate ways using **predicate logic** so that it can be saved, inferred, and manipulated at the later as and when required.
- KBS development process will consists of different steps Problem Identification, Knowledge Acquisition, Knowledge Formulation, Knowledge Representation, KBS Implementation, Verification and Validation, Deployment and Maintenance.

- The architecture of KBS has to develop having main four components: User Interface, Inference Engines, Knowledge Base and Explanation Module.
- For intelligent Web based and Mobile based different layers like Presentation, Data, Information and Knowledge has to be developed.
- Inference Engine provides a methodology for reasoning about information through first order predicate calculus of rule-based in the knowledge base and for formulating conclusions. Forward chaining data driven approach will be used in the proposed architecture where various functions like Promptuser, Deduce, Stepforward, Matchthen, Usethen, Testif, and Remember, are included. Deductive reasoning and modus ponens are used to reason and solve domain problems.
- Knowledge base containing facts, knowledge and rules necessary for understanding and solving problem from human experts in addition to facts provided by user during interaction with the system to assists and guides farmers, planners etc. has to be collected and categorized into five main groups: domain knowledge, preference knowledge, probabilistic knowledge, user data and process knowledge.
- Thereafter, for maintaining consistency of this knowledge base ontology will be created and extraction of ontology using sample rule from Knowledge Base will be done.
- Intelligent agents will be used in each component of Web-based based has to designed and developed. .Primary concentration will be on agents like query agents, search agent, text agents etc.

To achieve a truly system independent and agent system architecture independent solution, researcher used XML-based mobile agent architecture. The mobile phone user interfaces are developed using Java as a developing tool. A mobile agent system design based on the use of XML-based agent code, the UDDI registry for agent registration and lookup/discovery and XML Web Service calls for mobile agent intercommunication and migration. Using the built-in Common Object Request Broker Architecture (CORBA), data and execution requests are passed through back-end Java class and the resulting Java Beans. Communicating with the three lower layers – Data, Information, and Knowledge in the proposed architecture, CORBA collects and sends the requested water data. To simplify calls, input and output parameters are converted into XML strings by a customized XML parser. After the XML parser reassembles the settings and information from the requested weather data, the knowledge discovery algorithms are executed. Because the knowledge discovery methods are written in JAVA, the KBS uses Java Native Interface (JNI) to execute the methods as shared libraries. Upon its return, a separate C++ XML parser formats the result data. Finally, the back-end updates the KBS online interface with results presented to the user web browser or mobile screen.

VI. CONCLUSION

This WSN based greenhouse automation proposed system consist transmitter and receiver station. Where Transmitter station act like a data acquisition unit that is capable of measuring different parameters. Compact, portable and low power consumption is the most important key elements in the design of a wireless system. Also, it has advisory system for cultivation and consultation of crops in greenhouse.

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