Monitor and Control of Greenhouse Environment

Abstract:-

Appropriate environmental conditions are necessary for optimum plant growth, improved crop yields, and efficient use of water and other resources. Automating the data acquisition process of the soil conditions and various climatic parameters that govern plant growth allows information to be collected at high frequency with less labor requirements. The existing systems employ PC or SMS-based systems for keeping the user continuously informed of the conditions inside the greenhouse; but are unaffordable, bulky, difficult to maintain and less accepted by the technologically unskilled workers.

Objective:

The objective of this project is to design a simple, easy to install, microcontroller-based circuit to monitor and record the values of temperature, humidity, soil moisture and sunlight of the natural environment that are continuously modified and controlled in order optimize them to achieve maximum plant growth and yield. The controller used is a low power, cost efficient chip manufactured by ATMEL having 8K bytes of on-chip flash memory. It communicates with the various sensor modules in real-time in order to control the light, aeration and drainage process efficiently inside a greenhouse by actuating a cooler, fogger, dripper and lights respectively according to the necessary condition of the crops. An integrated Liquid crystal display (LCD) is also used for real time display of data acquired from the various sensors and the status of the various devices. Also, the use of easily available components reduces the manufacturing and maintenance costs.

The design is quite flexible as the software can be changed any time. It can thus be tailor-made to the specific requirements of the user.

This makes the proposed system to be an economical, portable and a low maintenance solution for greenhouse applications, especially in rural areas and for small scale agriculturists.

INTRODUCTION:-

Greenhouses in India are being deployed in the high-altitude regions where the sub- zero temperature up to -40° C makes any kind of plantation almost impossible and in arid regions where conditions for plant growth are hostile. The existing set-ups primarily are:

1.1.1 MANUAL SET-UP:

This set-up involves visual inspection of the plant growth, manual irrigation of plants, turning ON and OFF the temperature controllers, manual spraying of the fertilizers and pesticides. It is time consuming, vulnerable to human error and hence less accurate and unreliable.

1.1.2 PARTIALLY AUTOMATED SET-UP:

This set-up is a combination of manual supervision and partial automation and is similar to manual set-up in most respects but it reduces the labor involved in terms of irrigating the set-up.

1.1.3 FULLY- AUTOMATED:

This is a sophisticated set-up which is well equipped to react to most of the climatic changes occurring inside the greenhouse. It works on a feedback system which helps it to respond to the external stimuli efficiently. Although this set-up overcomes the problems caused due to human errors it is not completely automated and expensive.

1.2 PROBLEM DEFINITION

A number of problems associated with the above mentioned systems are enumerated as below:

1. Complexity involved in monitoring climatic parameters like humidity, soil moisture, illumination, soil pH, temperature, etc which directly or indirectly govern the plant growth.

2. Investment in the automation process are high, as today's greenhouse control systems are designed for only one parameter monitoring (as per GKVK research center); to control more than one parameter simultaneously there will be a need to buy more than one system.

3. High maintenance and need for skilled technical labor**.** The modern proposed systems use the mobile technology as the communication schemes and wireless data acquisition systems, providing global access to the information about one's farms. But it suffers from various limitations like design complexity, inconvenient repairing and high price. Also the reliability of the system is relatively low, and when there are malfunctions in local devices, all local and tele data will be lost and hence the whole system collapses. More over farmers in India do not work under such sophisticated environment and find no necessity of such an advanced system, and cannot afford the same.

Keeping these issues in view, a microcontroller based monitoring and control system is designed to find implementation in the near future that will help Indian farmers.

1.3 PROPOSED MODEL FOR AUTOMATION OF GREENHOUSE

The proposed system is an embedded system which will closely monitor and control the microclimatic parameters of a greenhouse on a regular basis round the clock for cultivation of crops or specific plant species which could maximize their production over the whole crop growth season and to eliminate the difficulties involved in the system by reducing human intervention to the best possible extent. The system comprises of sensors, Analog to Digital Converter, microcontroller and actuators.

When any of the above mentioned climatic parameters cross a safety threshold which has to be maintained to protect the crops, the sensors sense the change and the microcontroller reads this from the data at its input ports after being converted to a digital form by the ADC. The microcontroller then performs the needed actions by employing relays until the strayed-out parameter has been brought back to its optimum level. Since a microcontroller is used as the heart of the system, it makes the set-up low-cost and effective nevertheless. As the system also employs an LCD display for continuously alerting the user about the condition inside the greenhouse, the entire set-up becomes user friendly.

Thus, this system eliminates the drawbacks of the existing set-ups mentioned in the previous section and is designed as an easy to maintain, flexible and low cost solution.

SCHEMATIC DIAGRAM