An Automated Process of Monitoring and Control on Multivariable Non-Linear Greenhouse Environment

Vinothkumar. C, Marshiana. D, Balasankar Karavadi

Abstract: Environmental Conditions Have A Noteworthy Result On Plant Advancement. Every Single Industrial Plant Has Need Of Specific Conditions For Their Legitimate Development. A Greenhouse Is A Spot For Development Which Is Protected From The Outer Condition. A Greenhouse Is Viewed As A Multivariable Process With Nonlinear Nature And Is Affected By Biological Processes. The Five Most Vital Parameters To Think About While Making A Perfect Greenhouse Environment Are Temperature, Relative Humidity, Ground Water, Light Power And Co2 Focus. The Completely Computerized Greenhouse Framework Has Been Structured And Simulated Utilizing Labview. For Better Outcomes, The Whole Five Noteworthy Interrelated Condition Factors In A Temperature, Humidity, Ground Water, Light And Co2 – Were Viewed As Together [9]. The Automated Framework Is Planned So That The Framework Could Be Effectively Controlled And Observed By An Amateurish Client Who May Have No Or Minimal Specialized Foundation Regarding The Subject. The Fundamental Preferences Of This Framework Are Greater Adaptability, Better Execution And Access To More Facilities In The Whole System. When The Proposed Model Is Planned, Institutionalized And Actualized, It Gives Automated And Effectively Available Methods For A Better And Suitable Control Over The Greenhouse Management So As To Increment Required Proficiency As Well As Crop Cultivation. Moreover This Process Is Very Cheap As Compared To Existing System As It Is Not Based On The Conventional Ni Daq, Which Is Very Costly. The Present Model Can Be Implemented For Improvement In Crop Cultivation. It Is Well Suited For The People Residing In The Indian Villages As It Is A Low Cost System.

Index terms: greenhouse environment, labview, ldr, co_2 sensor, humidity sensor, temperature sensor, crop cultivation.

I. INTRODUCTION

By increasing human population the demand for basic things such as food, water is increasing day by day. Due to this ever increasing demand there is much pressure on the available resources. Numerous territories on the planet have a restricted measure of water accessible and the problem is bound to get worse due to population growth and climate change [1]. With the image as portrayed in the above as a main priority, clearly some productive advances should be actualized in order to improve the ebb and flow water circumstance in numerous pieces of the world and to lessen future dangers of water deficiency. Along these lines farming is one of the real water buyers; much is to be broadened when water use effectiveness is enhanced. A greenhouse is a place for cultivation [1] which is shielded from the external environment. Greenhouses have various points of interest over open-field vegetable creation:

- Protection from inordinate solid precipitation, high all inclusive radiation and wind,
- Collection and putting away of water,
- Rainwater spared by trickle water system,
- Water sparing because of lower radiation and wind levels,
- Yield improvement; clean harvests,
- Erosion is decreased by protecting the dirt from solid downpour,
- Plant security is simpler as pesticides are not washed off by solid downpour
- Work with the harvest is (for the most part) free from climate impacts.

Moreover in dry and arid regions, other merits are:

- Increased moistness inside the greenhouse reduces water utilization,
- Protection from dust storms,
- Water accumulation and capacity reduces water lack in dry periods,
- Large temperature varieties among day and night are leveled out.

The significant burden of utilizing nurseries in warm, semi-dry districts is the temperature inside that effectively surpasses the outside temperature. This framework is an activity to improve water use proficiency in cultivation just as expanding the developing season by applying nursery cooling. It monitors all the necessary parameters affecting plant growth. Moreover on the practical implementation side it is easy as well as cheap to build and repair. The five most imperative parameters to think about while making a perfect greenhouse are temperature, relative humidity, ground water, light and CO2 focus. So as to plan a fruitful control system, it is critical to understand that the five parameters referenced above are nonlinear and amazingly free. The PC control framework [1] for the greenhouse incorporates the accompanying parts:

- Acquisition of information through sensors
- Processing of information, contrasting it and wanted states lastly choosing what must be done to change the condition of the system.

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- Actuation part conveying the important activities.
- This automated system [7] being very simple could be easily modified as it is based on LabVIEW which is quite user friendly. Moreover it's feasible to implement it as it is a low cost application.

II. SCOPE OF THE INVESTIGATION

The aim of this system is to design a fully automated low cost system greenhouse control with LabVIEW. For better results, the entire five major interrelated environment variables in a greenhouse-Temperature, Humidity, Ground water, Light and CO2 –were considered altogether. By means of simulation, the optimal level of environment and growth factors inside the greenhouse can be achieved. The present automated control system uses LabVIEW, which is very modular & user friendly, to automate the climate control system for Greenhouse [3]. At present there are numerous systems available which serve the purpose but the basic demerit of these existing systems is high cost and complexity. Thus the most special feature of this system is that it is very inexpensive and simple as compared to the other existing systems based on electronic controllers and NI DAQ [2] and its maintenance is negligible. In future it can be used for automating the process related applications. This proposed system being very simple could be easily modified as it is based on LabVIEW which is quite user friendly.

III. MATERIALS AND METHODS

Materials that are involved in this automated system [5] are Microcontroller-Atmega8535, Light Sensor, Gas sensor, Humidity Sensor, Temperature Sensor, Relay, Solenoid valve and Fan.

The overall block diagram of the automated control of green house environment is shown in figure 1. In case of a real- time Greenhouse there may be slight variations based upon the specific plants being grown in it and the environmental conditions prevailing [4]. Now let us discuss all the physical components in detail.

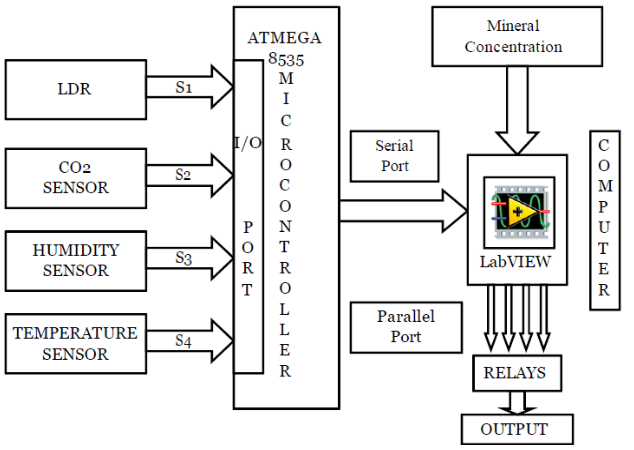

Fig 1: Overall Block Diagram of Control of Green House Environment

Light Sensor:

A photograph resistor (Light Dependent Resistor) is a resistor whose opposition diminishes with expanding occurrence light power. It can even be noted as a photo-conductor.

Fig 2: LDR and Circuit Symbol of LDR

Light Sensor Circuit

At the point when the light dimension is low then the resistance of the LDR is high. This anticipates current which is streaming to the base of the transistors. Accordingly the LED does not light. Be that as it may, when light-weight twinkles on the LDR its Resistance falls and current streams into the essential semiconductor unit base thus the second transistor is an LED light. The preset resistor can be turned up or down to increment or abatement obstruction; in this procedure it can make the circuit pretty much delicate.

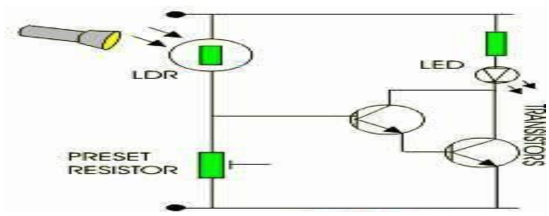

Fig. 3: LDR Circuit

There are 2 simple methods for developing the voltage divider, with the LDR at the best, or with the LDR at the base (fig 4).

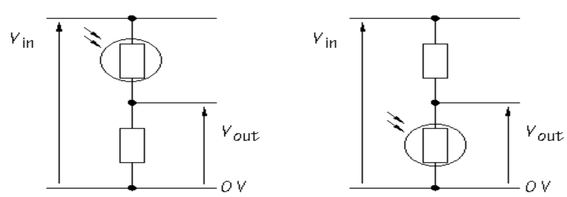

Fig. 4: Two possible LDR Circuits

Gas Sensor:

Carbon dioxide concentration assumes an essential job in the development of plants. The normal CO2 concentration in the environment is about 313ppm. This concentration is perfect for the photosynthesis procedure. An issue emerges when a greenhouse is kept shut in harvest time or amid winter season so as to hold the warmth. So as to improve the development of plants inside the greenhouse [6], it is important to expand CO2 fixation alongside favorable temperature and light.

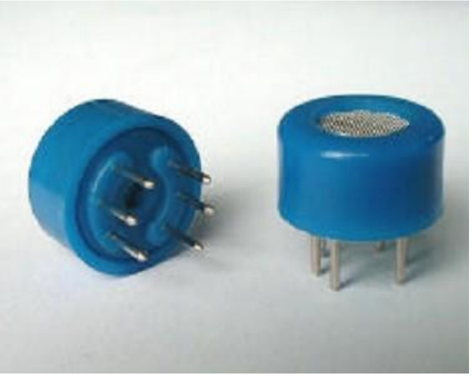

Fig. 5: CO_2 Gas Sensor

Humidity Sensor:

Humidity is that the quantity of water vapours within the air. In daily language the term "humidity" is generally taken to mean ratio. Humidity may be expressed as absolute humidness and specific humidness. Relative humidity is a very important metric employed in foretelling weather. Humidity indicates the likelihood of precipitation, condensation, or vapor. High humidness makes the individuals feel hotter outside within the summer as a result of it reduces the effectiveness of sweating to chill the body by preventing the evaporation of perspiration from the skin.

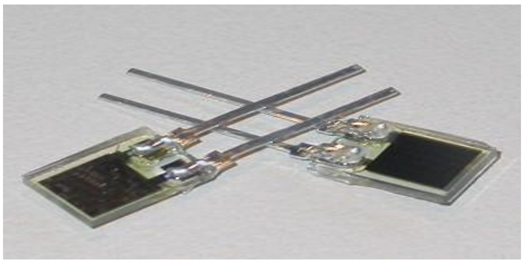

Fig. 6: Humidity Sensor HS07

Temperature Sensor:

Temperature the board is imperative for achieving high harvest development, yield and quality. Outrageous temperatures may actuate pressure and related harm to the plasmatic structures of the plant. In addition non perfect temperatures additionally meddle with the photosynthetic procedure. Less outrageous problematic temperatures might be postpone plant advancement and influence other plant qualities, for example, dry issue course. By and large, the security given by the greenhouse is adequate to permit the advancement of harvests amid winter without the utilization of warming systems. Be that as it may, a greenhouse with automated warming facilities presents favorable circumstances like expanded generation speed, plausibility of delivering items out of season and better control of ailments.

IV. RESULT ANALYSIS

When the prototype model of this system was tested to check its working, it worked very well and met the design specifications. The so designed prototype system was tested for various parameters based on real time basis. This automated system was tested for all the basic parameters namely light, gas, humidity and temperature [5].The prototype system [4] was able to act according to the set points fixed by operator. Whenever the real time field signals crossed over the set point the output relays were activated accordingly so as to control the parameter [2]. Moreover the value of the parameters namely, light, gas, humidity and temperature can be recorded by the operator from the custom designed panel.The system is so designed that it generates alarm under any of the following conditions:

1) When light intensity is less than the set point
2) When gas intensity is less than the set point
3) When humidity is more than the set point
4) When temperature is more than the set point

When the light intensity is less than the set point then the LED is switched 'ON' on the output side.

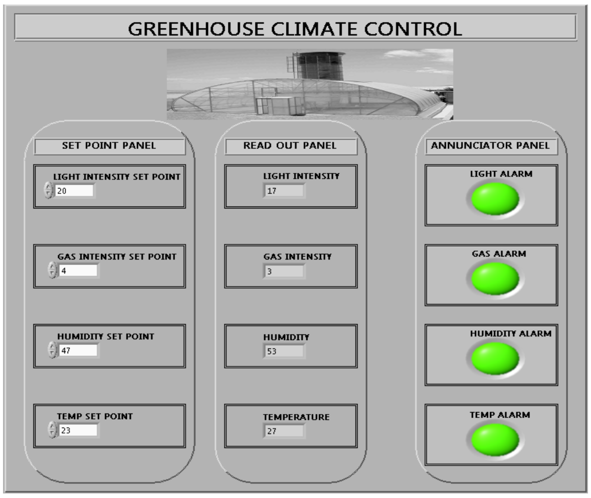

Fig. 7(a): Front Panel in case of No Alarm

This can be modified to lighting system for a real time application. When the gas intensity is less than the set point then the valve is opened. This can be made to allow the flow of gas inside the greenhouse system. When the humidity value increases above the set point then the de humidifier is switched 'ON'. In case the temperature value rises above the desired optimum set point the fan is witched 'ON'.

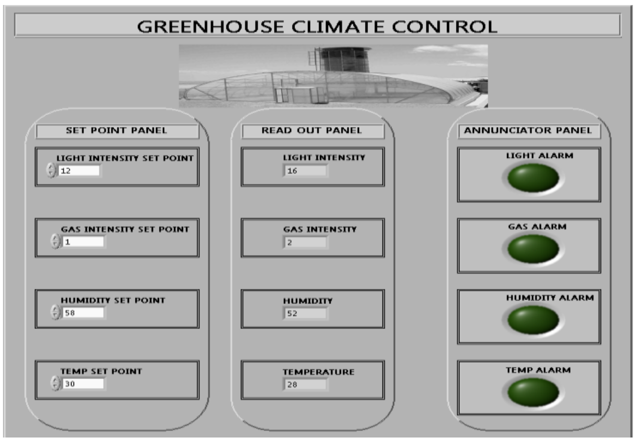

Fig. 7(b): Front Panel in case of Alarm

V. CONCLUSION

Multivariable automated system aims at improving the climatic conditions inside the greenhouse. Moreover it helps in improving the yield also. This system has been implemented on a very small scale. As the software being used in this process is LabVIEW, so the whole system is very modular. This automated system modeled using LabVIEW instead of other text based languages as C++ or Visual C, the coding is easy to understand, debug and modify. Even a person with little or no prior knowledge of LabVIEW could control the entire greenhouse climate control system without much hard work. Once this system is implemented on real time basis with very little or no modification, it provides an automated and accessible means for a superior and suitable control over the greenhouse environment in order to amplify effectiveness. This automated system can be used for data-logging of the various parameters which could be very useful in research applications with very little modification in the VI's. Moreover it's also possible to transmit the status of greenhouse to a distant PC by means of internet.

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