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Cultivation of Cash Crops under Automated Greenhouse Using Internet of Things (IOT)

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ABSTRACT: Greenhouse Environment, used to grow plants under controlled climatic conditions for efficient production, forms an important part of the agriculture and horticulture sector .To create an optimal environment the main parameters such as temperature, humidity, light intensity ,ground water ,etc. needs to be controlled. The main objective of this project work is to design an automated greenhouse which is purely sensor based system .The system inputs from various sensors and displays output .The developed system is simple, cost efficient and easily installable. The results show that the system could be more efficient in man power saving and raising the economic value of products. This asset allows the farmer to improve the cultivation in a way the plants need. It leads to higher crop yield, prolonged production period, better quality, and less use of protective chemicals. For continuous monitoring and controlling, we are using wireless sensor network. Here the greenhouse parameters are send through the internet to the open source cloud server. The parameters can be controlled by another web-server hosted locally. This project mainly focused on user friendly UI design and automatic system.

KEYWORDS: internet of things, web server, greenhouse, agriculture, control systems, remote monitoring, user interface, wireless communication, wireless sensor network, arduino.

I. INTRODUCTION

A greenhouse is a structure with walls and roof made chiefly of transparent material, such as glass, in which plants requiring regulated climatic conditions are grown. A more scientific definition is a covered structure that protects the plants from extensive external climate conditions and diseases, creates optimal growth microenvironment, and offers a flexible solution for sustainable and efficient year-round cultivation. A modern greenhouse operates as a system; therefore, it is also referred to as controlled environment agriculture [1], controlled environment plant production system. Many commercial glass greenhouses or hothouses are high tech production facilities for vegetables or flowers. The glass greenhouses are filled with equipment including screening installations, heating, cooling, lighting, and may be controlled by a computer to optimize conditions for plant growth [2]. Different techniques are then used to evaluate optimality-degrees [3] and comfort ratio of greenhouse micro-climate (i.e., air temperature, relative humidity and vapor pressure deficit) in order to reduce production risk prior to cultivation of a specific crop [4]. From large freestanding buildings to small window-mounted structures, a greenhouse is possible for almost any property. Although working in an outdoor garden allows you to soak in the sun, many prefer the controlled indoor environment greenhouses provide you are still productive in the garden on a surprise rainy day. And, plants tend to grow better in greenhouses compared to outdoors. There are some important atmospheric parameters [5] that plays a major role in plants growth.

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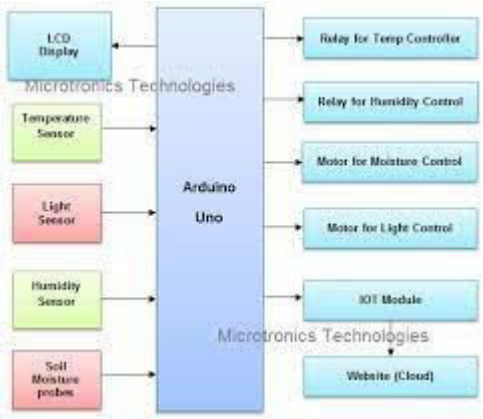

Fig1: Block Diagram

TEMPERATURE CONTROL

Outdoor temperature swings range widely between day and night. Plants subjected to extreme cold and heat across a 24-hour period do not grow as well as greenhouse plants and stressed plants become stunted over time [6]. The enclosed indoor space greenhouses provide is typically temperature-controlled with heaters and air ventilation for specific plant species, such as food crops. Timers connected to the heaters allow you to alter the temperature settings depending on the time of day. By following each plant species' temperature preferences, foliage, flowers and fruit flourish throughout the controlled space

CARBON DIOXIDE FACTOR

Controlling indoor air movement provides the greenhouse plants with a constant supply of carbon dioxide, which they need for sugar production [7]. Although outdoor plants have sufficient carbon dioxide levels, strategically placed horizontal fans throughout a greenhouse allows air to press closer to the foliage for peak photosynthesis action. The concentrated carbon dioxide results in larger leaves, stronger plant stems and possible early flowering and fruiting. However, air movement must be coupled with proper ventilation. Closing off the greenhouse to outside air circulation lowers indoor carbon dioxide levels because the plants use the gas quickly while transferring oxygen to the air in exchange.

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Plant foliage transpiration relies on a constant supply of moisture from both the roots and surrounding atmosphere for peak growth. Dry, outdoor conditions force plants to rely solely on soil moisture, which can cause water stress, especially if the roots are in drought conditions. Stunted growth and reduced resistance to pests and diseases occur when dry conditions stay constant for an outdoor plant. But greenhouses with humidity controls keep the air moist for peak plant growth [8]. Reducing water stress by watering the roots and providing a humid environment allows each plant to concentrate its energy on fruiting and flowering. The Internet of things (IoT) is the network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors, actuators, and connectivity which enables these objects to connect and exchange data [9]. Each thing is uniquely identifiable through its embedded computing system but is able to inter-operate within the existing Internet infrastructure. The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, [10] creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and

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economic benefit in addition to reduced human intervention. When IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, virtual power plants, smart homes, intelligent transportation and smart cities. "Things," in the IoT sense, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, cameras streaming live feeds of wild animals in coastal water, automobiles with built-in sensors, DNA analysis devices for environmental/food/pathogen monitoring, or field operation devices that assist firefighters in search and rescue operations. Legal scholars suggest regarding "things" as an "inextricable mixture of hardware, software, data and service".

BACKGROUND WORK

In recent years improvements in sensor manufacturing technologies have occurred driven by post-process high-speed, low-power and low-cost microelectronic hybrid circuits [1-3]. The requirement for commercial competiveness is sequential enhancement of quality and product reliability. Furthermore, it is important to know the degree of efficiency of each sensor related to its calibration circumstances and sensing mechanism [4]. We live in the world where every thing can be controlled and operated automatically, but there are still few sectors in our country where automation has not been adopted or not being put to a full-fledged use, perhaps because of several reason one such reason is cost and one such field is ‘agriculture’. Agriculture has been one of the primary occupations of man since early civilization and even today manual interventions in farming are inevitable. Greenhouse form an important part of the agriculture and horticulture sectors in our country as they can be used to grow plants under controlled climatic conditions for optimal growth[5]. Greenhouse technology is the technique of providing favorable environmental conditions for plants [6]. It replaces the direct supervision. Now a day, due to urbanization and lack of land availability there is a great need to construct the greenhouse, which will be revered mainly for growing crops[7]. Greenhouse monitoring and controlling projects is used to measure the various parameters like temperature ,humidity, light, water content,ph level,moisture,etc. and to display them on LED. Continuous monitoring of these environmental factors gives relevant information pertaining to the individual effects of the various factors towards obtaining effects of the various factorstowards obtaining maximum crop production.Unlike open farming where natures control takes the upper hand, green house prevents a closed environment that can be strictly controlled by humans in order to provide optimal conditions for the growth of plants [8].

The effectiveness in greenhouse crop production depends significantly on the modification of optimal growth conditions to achieve high yield at lower costs, good quality and low environmental load. To achieve these goals several parameters must be optimally controlled as per certain criteria through heating and ventilation, etc [9][10]. Over the years the greenhouse systems became more reliable but with increased complexity. Earlier automated control systems considering thermostats and timers provided major advances in efficiency and product quality making growers lives simpler.

However, many of these control devices and methods cannot deliver the level of automation and efficiency needed in today’s dynamic and competitive environment. Several models have been developed to represent greenhouse environments over the years varying in complexity and details. As operating cost increased and greenhouse systems became increasingly complex, the demands for increased control capability grew. The computer revolution of early 80s created the opportunity to meet the needs for improved control. In the last decade, there has been tremendous rise in the use of computers for green houses. In order to design successful control system it is important to realize that these parameters are interdependent [11][12].This project presents the systems that collects and automatically controls condition of greenhouse environment and crops by using different sensors. The existing control system monitors temperature, humidity, light intensity, soil moisture. To make up for this week point, this project proposes and collects the information regarding these parameters so that the change of condition of crops depending on internal environment factors of greenhouse can be estimated[13].

II. METHODS

LIGHT SENSOR:

A light dependant resistor also know as a LDR, photo resistor, photoconductor or photocell, is a resistor whose resistance increases or decreases depending on the amount of light intensity. LDRs (Light Dependant Resistors) are a very useful tool in a light/dark circuits. LDRs can have a variety of resistance and functions. For example it can be used to turn on a light when the LDR is in darkness or to turn off a light when the LDR is in light. It can also work the other way around so when the LDR is in light it turns on the circuit and when it’s in darkness the resistance increases and

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disrupts the circuit. The way an LDR works is that they are made of many semi-conductive materials with high resistance. When light falls on the semi conductive material it absorbs the light photons and the energy is transferred to the electrons, which allow them to break free from the crystal lattice and conduct electricity and Lower the resistance of the LDR.

SOIL MOISTURE SENSER:

Irrigation water management requires timely application of the right amount of water. Competition for water, high pumping costs, and concerns for the environment are making good water management more important. Managing irrigation water needs to combine a method of measuring soil moisture with some method of irrigation scheduling. Measuring soil moisture detects if there is a water shortage that can reduce yields or if there is excessive water application that can result in water logging or leaching of nitrates below the root zone. Measuring soil moisture also can build an awareness and knowledge of each irrigated field that is invaluable for planning and management. Monitoring soil moisture levels is required for effective irrigation water management. Many tried and proven methods of estimating or measuring soil moisture are available. The methods elected depends on a variety of factors such as accuracy, cost and ease of use [25]. The Soil Moisture Sensor is used to measure the volumetric water content of soil. This makes it for performing experiments in courses such as soil science, agricultural science, environmental science, horticulture, botany, and biology.

ADC:

Many of us consider the ADC to be a mysterious device. It can, however, be considered very simply to be the instrument that it is: a device that provides an output that digitally represents the input voltage or current level. Because the Analog-to-Digital Converter (A/D Converter or ADC) has both analog and digital functions, it is a mixed-signal device. Most ADCs convert an input voltage to a digital word, but the true definition of an ADC does include the possibility of an input current. An ADC has an analog reference voltage or current against which the analog input is compared. The digital output word tells us what fraction of the reference voltage or current is the input voltage or current. So, basically, the ADC is a divider circuit [27]. ADC converters are used for the reverse process of changing analog signals to equivalent binary signals.ADC might be used to change analog output signals from transducers (measuring temperature, pressure, vibration, etc.) into equivalent digital signals. An ADC is often referred to as an encoding device [28].The designed system uses IC 741.

III. RESULTS

An experiment is done to record the temperature, humidity, light intensity and soil moisture readings in greenhouse. The reason for this experiment is to make sure that the system that was designed is functioning well and the data can be recorded correctly. Advantages of this system are: it is relatively simple to design and install. This is very useful to all-climatic conditions .It is economic friendly. This makes increase in productivity and reduces water consumption. This is safest and no manpower is required. Reduces soil erosion and nutrients leaching. May be concealed to maintain the beauty of the landscape, and to reduce vandalism and liability when installed in public.

Fig2: Greenhouse monitoring

An Arduino based “Automated Monitoring and Controlling of Greenhouse” is designed using the DHT11 sensor, Soil Moisture Sensor, LDR sensor and flame sensor are the main sensors used in this project which give the exact value of

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temperature, humidity, moisture content, light intensity respectively. This system found to be feasible and cost-effective for optimizing water resources for agricultural production. Implementation of this system proves that the use of water can be diminished for a given amount of fresh biomass production. This system can change by the variety of the crop and there needs so it requires minimum maintenance of crop. The modular configuration of this system allows it to be scaled up for larger greenhouses or open fields.

IV. CONCLUSION

Green house prevents the plants from the effects of climate; inspect and so on, which makes great sense for agricultural production. The automation and high efficiency on greenhouse environment monitoring and control are crucial. Applying new technologies to greenhouse is a revolution for protected agriculture which overcomes the limits of wire connection systems. Such a system can be easily installed and maintained. This paper emphasizes on the monitoring and controlling the greenhouse, low cost data acquisition of a greenhouse processes. The agricultural areas are f prime importance for computer control processes. The greenhouse processes parameters which are under consideration here whose processes data temperature, humidity, soil moisture and light intensity should be acquired from the field, logged in a data base and the data is further used for supervisory control. The GUI is made in virtual instrumentation domain lab view. The system has successfully overcome quite a few short coming of the existing system by reducing the power consumption, maintenance and complexity, at the same time providing a flexible and precise form of maintaining the environment.

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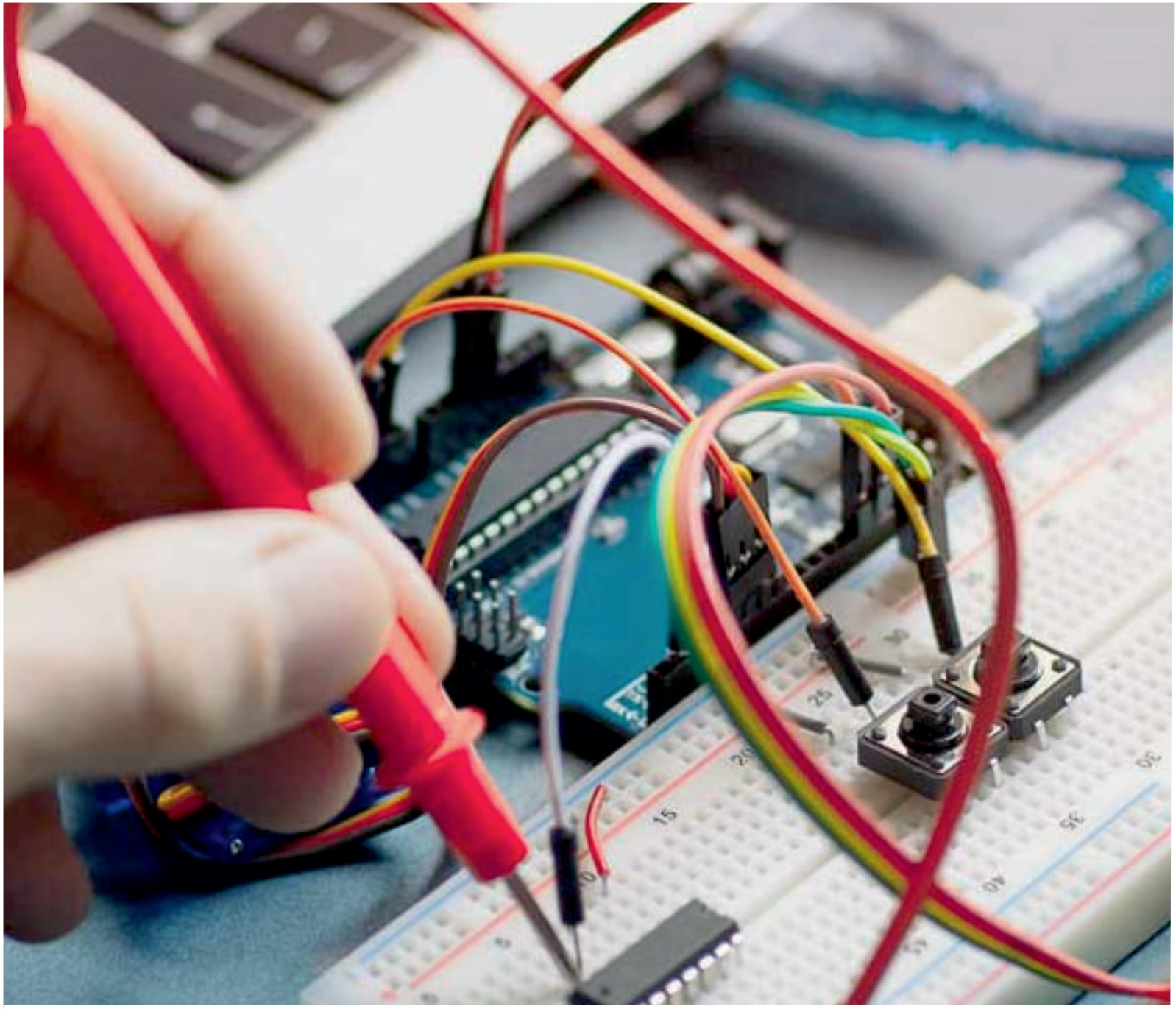

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