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TAB TO MONITOR AND CONTROL CES USING RUNTIME TCP-IP PROTOCOL

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Abstract- The Indian economy mostly depends on agriculture. But the farmers in leading state like Maharashtra are committing suicides because of environmental parameters which strongly affect the crops. This forced us to think in the direction of farming and we mood to the topic mentioned below inspired by Eden project in UK and BIOS-3 project in Russia.
Greenhouse provided up to present era is not completely automatic and there are many errors and limitations in its working and are unaffordable, large, difficult to maintain and less accepted by the technologically unskilled workers. So we are trying to provide completely automised CES (Closed Ecological System) using runtime TCP-IP protocol to monitor and control the parameters which governs the plant growth. The architecture of a green house monitoring system comprises of a set of sensor nodes and a control unit that communicate with each sensor node and collects local information to make necessary decisions about the physical environment. The user is updated with the run time information of his field.
Keywords- AVR Microcontrollers, BIOS-3, CES, controlling equipments, Eden Project, Greenhouse, sensors, TAB or PC, TCP-IP Protocol, Vertical Farming, WSN

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Introduction - We live in world where everything can be controlled and operated on its own, but still there are some important sectors in our country where automation has not been adopted, because of several reasons such as cost. One such field is that of agriculture, it is the primary occupations of man since beginning. Greenhouses form an important part of the agriculture and horticulture sectors in our country since greenhouses can be used to grow plants under controlled climatic conditions for maximising the crop yield.
Automating a greenhouse includes monitoring and controlling of the climatic parameters which directly or indirectly govern the plant growth and hence their produce. A continuous interfacing of route hardware provides proper time to time info about the system. This can be achieved by TCP-IP runtime protocol to get a minute to minute proper info. TAB / PC help to get such a proper data to be analysed and processed further to obtain better result.
Wireless sensor network (WSN) forms a vital part of the automation system architecture in modern greenhouses. Wireless communication is used to collect the measurements and to communicate between the centralized control and the controlling equipments (actuators) located to the different parts of the greenhouse. Compared to the cabled systems, the WSN installation is easy, time and money saving.
The micro-controller AVR Atmega 16 [3] which works on 9V is provided with Hybrid power supply means AC line and solar power supply [Fig-1].

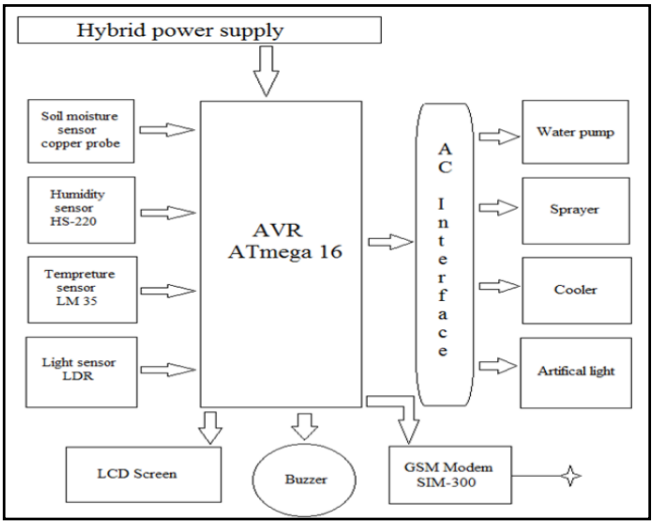

Fig.1- Greenhouse monitor and control system.

The micro-controller AVR Atmega 16[3] can support 8 parameters; here we are sensing and controlling 4 parameters-soil moisture, temperature, humidity and light intensity.
The measured values of parameters are displayed on LCD screen and at the same time sent to PC/TAB with the help of SIM-300 GSM modem [7].

Methodology

Atmega 16 accepts one of the four interrupts from sensor. The system is checked if ON or failed. If there is error in system, the signal is send to buzzer. The value of measured parameter is stored to EEPROM after conversion by ADC. That value is sent to TAB. If any of the parameter value is not within the threshold range then controlling equipment switch is ON or OFF to bring it within threshold range [Fig-2].

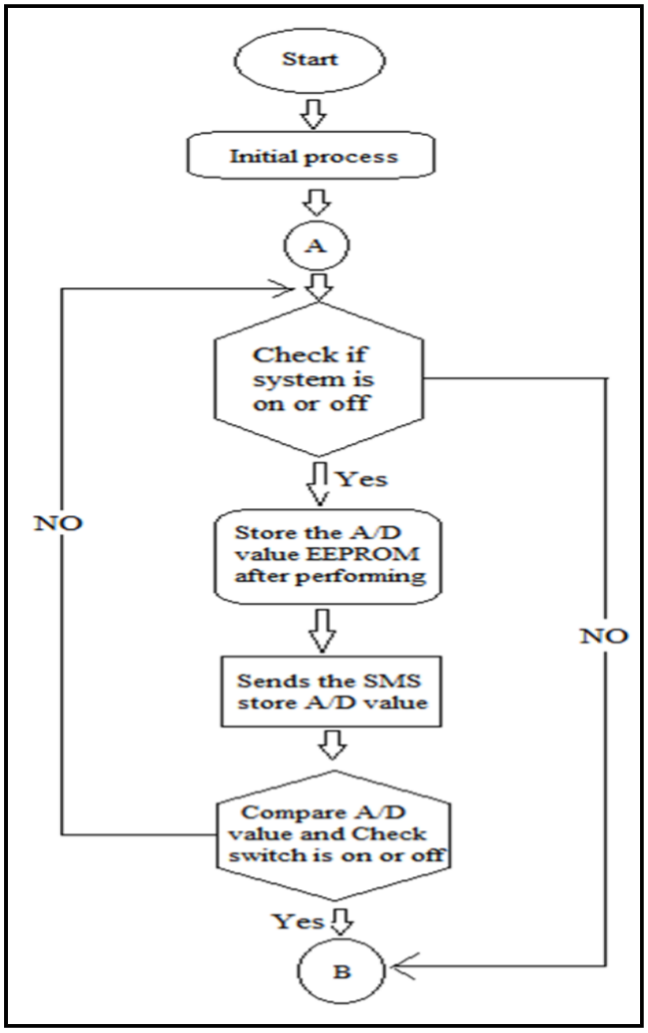

Fig. 2- Working of Atmega 16[8]

Temperature Sensor LM35

Various types of temperature sensors are available in the market. The LM35 [1] series are precision integrated-circuit LM35 temperature sensors, whose output voltage is directly proportional to the Celsius (Centigrade) temperature. It can be used with single power supplies, or with positive and negative supplies. The LM35 sensor [2] does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°Cover a full -55 to +150°C temperature range [Fig-3].

The LM35 output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 [5] thus has an advantage over linear temperature sensors labelled in °Kelvin, as the user is not required to subtract a large constant voltage from its output to get convenient Centigrade scaling. The LM35's low output resistance, linear output.

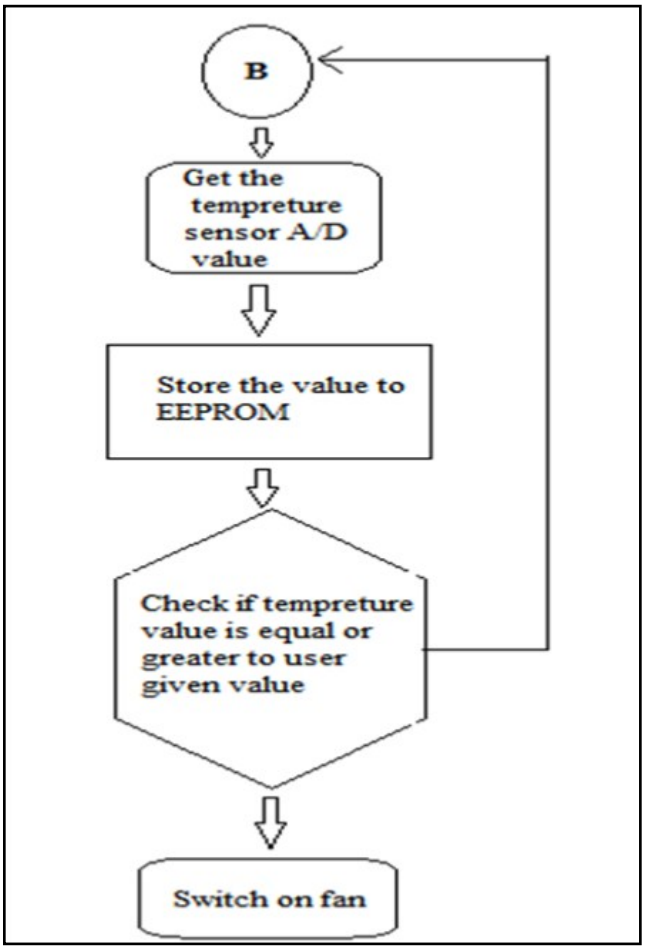

Fig. 3- Temperature Algorithm[8]

Humidity Sensor (HS-220)

We are using HS-220 [5,6] for sensing the humidity of our green-house. Absolute Humidity is the exact measure of the amount of water vapour in the air. It is normally expressed in terms of relative humidity.

Features of Humidity Sensor

1. Direct input to a controller due to sensor's linear voltage output.
2. Typical current drawn is only 200 mA.
3. Excellent resistance to wetting.
4. Excellent resistance to dust & dirt.
5. Excellent resistance to oils, and common environmental chemicals.

Soil Moisture Sensor

The measured value of moisture is sent to port of Atmega 16. It is stored in EEPROM after converted by ADC. If value of the moisture is not within the threshold range then sprayer is switched ON or OFF to bring it within threshold range [Fig-4].

Light Sensor

Light Dependent Resistor (LDR) [7] also known as photoconductor or photocell, is a device which has impedance that changes according to the amount of light falling on its surface. Since LDR is very sensitive in visible light range, it is well suited for the proposed application.

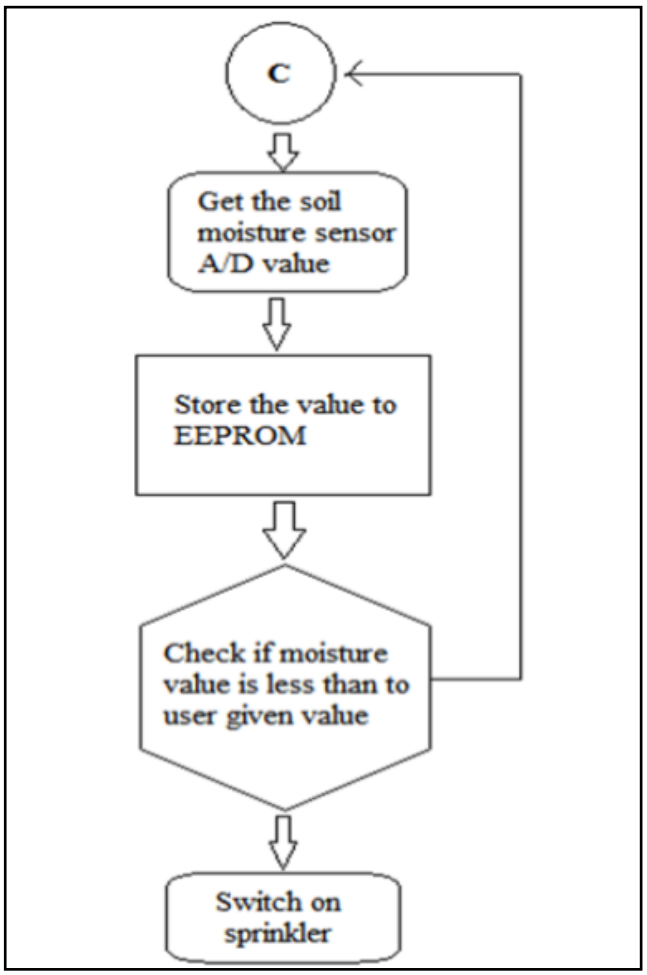

Fig. 4- Algorithm for moisture sensor [8]

Features of the Light Sensor

1. Light Dependent Resistor (LDR) [7] is made using semiconductor Cadmium Sulphide (CdS).
2. The light falling on the brown zigzag lines on the sensor cause the resistance of the device to fall. This is known as negative co-efficient. There are some LDRs that work in the inversely i.e. their impedance increases with light (called positive co-efficient).
3. The resistance of the LDR decreases as the intensity of the light falling on it increases. Incident photos drive electrons from the valence band into the conduction band.

SIM 300

A GSM modem is a specialized type of modem that accepts a SIM card, and operates on subscription to a mobile operator. It is a dedicated modem device with a serial, USB or Bluetooth connection. We have used SIMCOM'S SIM300 [9] GSM Module. SIM300 is a Tri-band GSM/GPRS engine that works on frequencies EGSM 900 MHz, DCS 1800 MHz and PCS 1900 MHz SIM300 also provides GPRS multi-slot capability. SIM300 has a configuration such that it can fit almost everywhere. The SIM300 is designed with power saving technique, the electricity consumption to as low as 2.5mA in SLEEP mode. The SIM300 [9] is integrated with the TCP/IP protocol. Extended TCP/IP "AT commands" are developed which are useful for data transfer applications.

TCP-IP Protocol

The Internet protocols are the world's most popular open-system (non proprietary) protocol suite because they can be used to communicate across any set of interconnected networks and are equally well suited for LAN and WAN communications. The Internet protocols composed of a suite of communication protocols, of which the two best known are the Transmission Control Protocol (TCP) and the Internet Protocol (IP). The Internet protocol suite not only includes lower-layer protocols (such as TCP-IP), but it also species common applications such as e-mail, terminal emulation and file transfer.

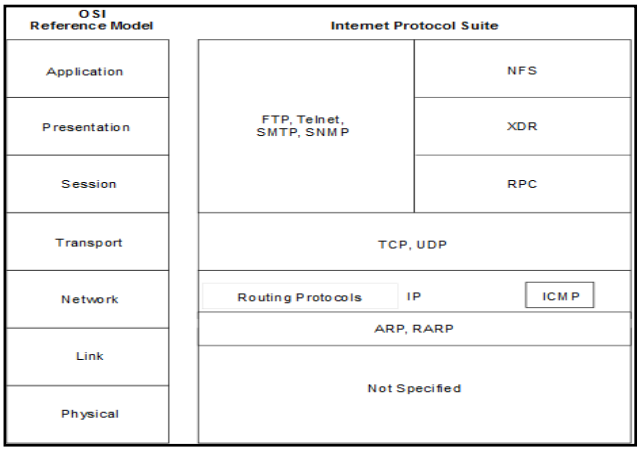

Fig. 5- Internet protocols span the complete range of OSI model layers

As with all other communications protocol, TCP/IP is composed of layers:

IP- is responsible for moving packet of data from node to node. IP forwards each packet based on a four byte destination address. The internet authorities distribute ranges of numbers to different organizations. The organizations appoint groups of numbers to departments. IP works on gateway machines that transfer information from department to organization to region and then around the world.

TCP- is responsible for verifying the correct delivery of data from client to server. Data may lost in the intermediate network. TCP adds support to detect errors or lost data and to trigger retransmission until the data is correctly and completely received.

Sockets- is a name given to the package of subroutines that provide access to TCP/IP on most systems.

Applications

1. Global info about greenhouse environment for particular sector.
2. Helps to get various measures about plant statistics.
3. Helps in agriculture to increase crop production
4. Proper controlling & monitoring of plants.
5. Helps to get guidelines for farmers.

Conclusion

A step-by-step approach in designing the microcontroller based system for measurement and control of the four essential plant growth parameters, such as humidity, temperature, soil moisture and light intensity, has been followed. The output of the measurement has shown that the system performance is quite reliable and accurate.

The system has successfully get over quite a few shortcomings of the existing systems 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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