AN ADVANCED GREENHOUSE

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ABSTRACT

In today's world one of the prevalent problem is water paucity and agriculture is water intensive. Advanced Irrigation System evaluates the prevalent moisture of the soil and start operating. This system refers to the operation with no or just a minimum of manual involvement making irrigation less labour intensive.

In this project, we are trying to minimise the human effort required for irrigation, but not at the cost of decrease in Total Annual Productivity. We are trying to automate the irrigation process through which currently Advanced Farmer can look after his farm without even physically present at his field. This system has been programmed with the help of microcontroller in a way such that when the system goes ON, it gives the output information to the controller, and the information can be store in a database and it can be send to the owner with the help of internet. The useful information can be access by the owner for making decision related to his field no matter in which part of world he would be in.

Almost every electronic component can be programmed and work independent of the human intervention. By putting our knowledge in controller we gave it ability to take decision on our behalf. One of the important thing that should be kept in mind during working with such controller is that they are hypersensitive because they work on 5 volt and our household supply is 240 volts. Large voltage can burn the controller shut down the system. So an efficient interfacing required between controller and the water motor. This system makes crop production much easier and this project uses a microcontroller, which commands the water pump and there are also soil-moisture sensors, which sense the moisture in the field. A rain sensor is been employed to spot rain and make the decision accordingly. If the farmer is at distant from his agricultural field he will be having a notion of current conditions. Thus, it saves farmer's effort, water, time and his Agriculture.

BODY

HARDWARE AND SOFTWARE REQUIREMENTS:

- Moisture sensor
- Rain sensor
- Servo motor
- Arduino™ and Arduino IDE
- Ultrasonic sensor
- Pump with pipe
- A container acting as tank
- NodeMCU™
- 5v Relay Module
- Thermoelectric Peltier Module
- Water heater coil
- 5v relays

DESCRIPTION OF SOME HARDWARE EQUIPMENTS:

1. **NodeMCU™:** NodeMCU Development board is featured with Wi-Fi capability, analog pin, digital pins and serial communication protocols. The NodeMCU™ (Node microcontroller Unit) is an open source software and hardware development environment that is built around a very inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, contains all crucial elements of the modern computer: CPU, RAM, networking Wi-Fi, and even a modern operating system with SDK.
2. **Thermoelectric Peltier Module:** A Peltier cooler, heater, or thermoelectric heat pump is a solid-state active heat pump which transfers heat from one side of the device to the other, with consumption of electrical energy, depending on the direction of the current. It can also be used as a temperature controller that either heats or cools. A 65° delta-T means that if the 'hot side' is at 50 degrees (with a heatsink), then the absolute minimum temperature achievable on the 'cold side' is -15 degrees. Thus the cooler you can keep the 'hot side' at, the colder the 'cold side' will be.
3. **Relays:** Relays are generally used to switch smaller currents in a control circuit and do not usually control power consuming devices except for small motors and Solenoids that draw low amps. Nonetheless, relays can "control" larger voltages and amperes by having an amplifying effect because a small voltage applied to a relays coil can result in a large voltage being switched by the contacts.
4. **Moisture sensor:** The soil moisture sensor consists of two probes which are used to measure the volumetric content of water. The two probes allow the current to pass through the soil and then it gets the resistance value to measure the moisture value. When there is more water, the soil will conduct more electricity which means that there will be less resistance. Therefore, the moisture level will be higher. Dry soil conducts electricity poorly, so when there will be less water, then the soil will conduct less electricity which means that there will be more resistance. Therefore, the moisture level will be lower. This sensor can be connected in two modes; Analog mode and digital mode. When

taking the analog output from the soil moisture sensor, the sensor gives us the value from 0-1023, with more the moisture content, more the value, which can be converted to percentage.

5. **Rain sensor:** Rain Sensor module allows to measure moisture via analog output pins and it provides a digital output when a threshold of moisture exceeds. The module is based on the LM393 op amp. It includes the electronics module and a printed circuit board that “collects” the rain drops. As rain drops are collected on the circuit board, they create paths of parallel resistance that are measured via the op amp. The sensor is a resistive dipole that shows less resistance when wet and more resistance when dry. When there is no rain drop on board it increases the Resistance so we gets high voltage according to V=IR. When rain drop present it reduces the resistance because water is a conductor of electricity and presence of water connects nickel lines in parallel so reduces resistance and reduces voltage drop across it.

WORKING:

We have created an artificial greenhouse using glass walls which will let only useful sunrays to enter into the farms. The greenhouse is temperature maintained by the thermoelectric Peltier, which will act as a temperature control device. When the temperature sensor module senses an increase in temperature, the temperature control module orders the microcontroller, to start the Peltier module and decrease the temperature of the Greenhouse room. The user can also manually control the Peltier module through the server cause all the temperature details will be shared with the user using NodeMCU™. After the required temperature is being attained, the system starts and the humidity sensor starts sensing the moisture content of the soil and transfers the data to the microcontroller, on which the microcontroller decides what has to be done with the humidity level. If the humidity content of the particular soil is more than required, it doesn’t does anything and if it senses less humidity content, it takes a note of the humidity content and decodes the plot number from the Algorithm and orders the servo motor to turn to the particular angle of the plot and starts the pump which will start watering. Now, it such happens that a particular plot of land has such plants which requires slightly cool temperature than the rest of the plots, so, the microcontroller orders the Peltier module to cool the separate tank and water is being fed to the particular plot using pump connected with the second pump. Such can also be done if a particular plant requires some amount of warm water to grow, so the microcontroller orders the Water heater circuit to warm the secondary tank and water is being distributed to the particular plant using pump connected to the secondary tank.

As for example, we have 3 plots of land, in which all the 3 plots are having moisture sensors dipped in them. All the 3 moisture sensors are in turn connected to a microcontroller, which receives data from those sensors, processes them according to the algorithm and orders the pump to switch ON/OFF if water is required in the particular plot. To minimise the use of pumps and decrease the number of hose-pipes or sprinklers connected to each plots, we have connected the whole setup to a servo motor, which will be connected to a microcontroller, which will rotate to the angle at which the plot is located and water that plot if water is required according to humidity content. Our system also has a rain sensor attached with it, so when it is raining, the microcontroller goes to sleep mode, and all the processes goes to sleep. Now, when rain sensor senses no rain, the microcontroller awakens and checks the water content of the tank though the ultrasonic sensor. When it has the minimum required water content, it starts the process of watering the soil, according to the needs of soil.

Our greenhouse also has a laser mesh protecting the whole farm from insects which acts in such a way the laser is placed in one side of the farm and photoelectric receivers on the other side, when any insect crosses the laser mesh, the connection between the laser and the receiver breaks due to the passing of the insect and it is being fed to the microcontroller to process the data and the greenhouse being partitioned into many parts, the microcontroller processes through its algorithm that which part of the room the insect is detected and sprays pesticides to the that particular part of the room thus decreasing the mass usage of pesticides which can be dangerous to human health. The greenhouse atmosphere is also air controlled such that unwanted organisms can’t enter through air.

Now, let’s come to the IoT part:

The whole system is automated and since we know that all kinds of plants doesn’t require the same amount of water, some loves dry soil and some moist soil. So, through IoT, we have provided the potentially “advanced farmer” with 2 choices:

- Automatic watering(as described above)
- Manual watering

In manual watering method, the farmer can manually water the plots of land without being physically present at the location. So, we made the algorithm in such a way, that the moisture content of the plots will be sent through NodeMCU™ to a webpage, which has columns that will show the real time moisture content of each plot of land and real time water level of the tank. Now, the person connected to the NodeMCU™ can manually access each plots of land, suppose, he wants to water plot-1, so, he clicks on plot-1 and servo rotates to the plot-1 direction and the water is being transferred to the plot using sprinkler or the hose-pipe, provided that sufficient amount of water is present in the tank, otherwise the microcontroller will order all the processes to halt unless sufficient amount of water is not being sensed by the ultrasonic sensor connected to the tank.

Since the whole greenhouse is temperature protected using the thermoelectric Peltier module, the current temperature data is collected using the temperature collection module and fed to the microcontroller which in turn sends it to the NodeMCU™ to be sent to server. Now algorithm is programmed in such a way that all the processes is automatically controlled, but if the user wants, he can manually start the Peltier module any time he wants to use it to decrease the temperature of the greenhouse. The Peltier module can deliver a maximum temperature of -15 degrees from the cold side to 65 degrees from the hot side with a maximum error of -5 degree.

ADVANTAGES:

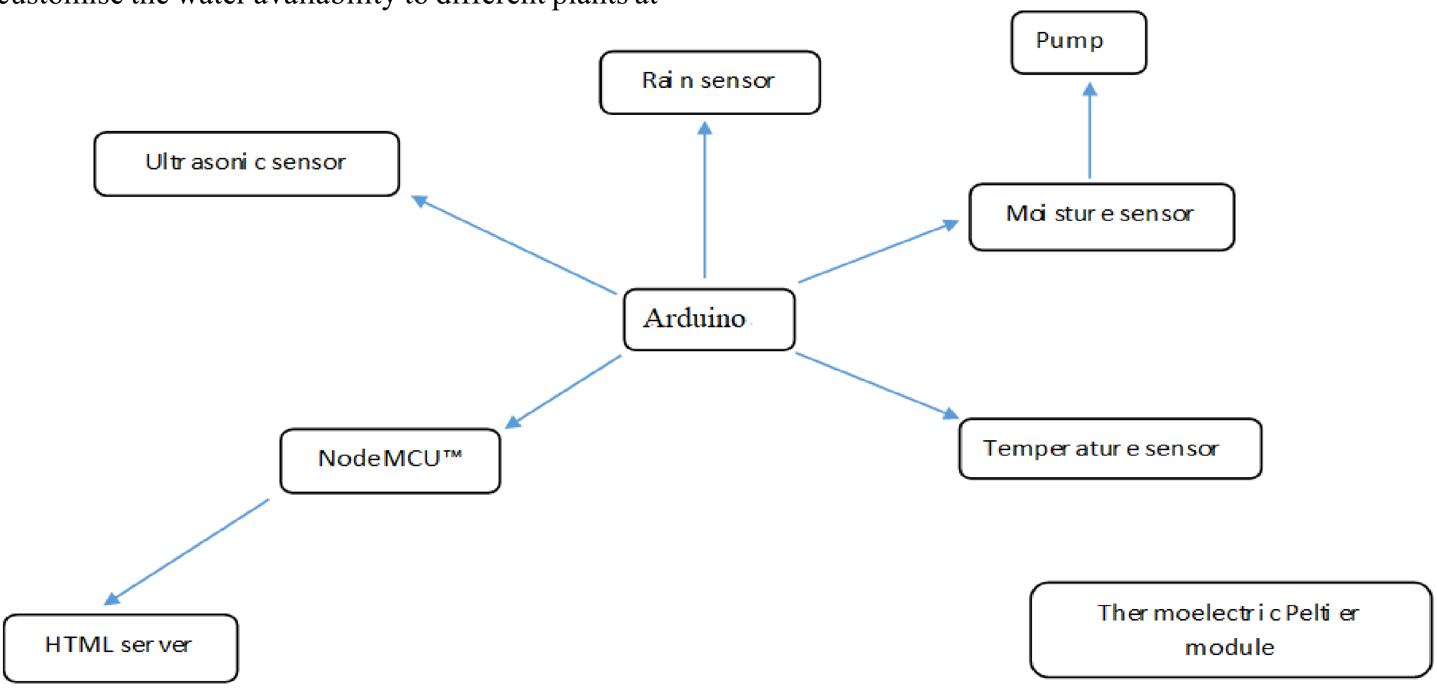
The main application of this project is to provide a less labour and less water intensive irrigation and saving time and money of the farmer or gardener. This system can be used create self-irrigating gardens and self-irrigated farmlands and the user can also keep an eye on his farm through real time data of his farm through different sensors and customise the water availability to different plants at different conditions. By using different water saving method like rain water harvesting or sprinkler irrigation million gallons of water can be saved. Parts of the world where rainfall is very low this system could be a boon for the irrigation there.

FUTURE SCOPE:

The capabilities of the project can be further boosted by boosting the microcontroller's operating speed, memory capacity, and instruction cycle. More number of sensors can be interfaced in order to get desired number of channels. Using industrial-grade microcontroller will also give better results due to their better ram management and more memory than Arduino™, which has only 32kb memory and can process only one information at a time, due to which users can face problems getting critical real-time data on their interfaces.

CONCLUSION:

There are some imperfections which need to improve in the upcoming time. A system needs to be implemented which can handle complexity easily and give precise results. As the cost of electronics software and hardware is decreasing continuously. It can be used to increase the quality and quantity of the Crop and saving a lot of water by efficiently using the system. Further improvements can be made as better sensor like gold-plating the moisture sensors which will in turn increase the conductivity and give better results to be processed which are specially made for irrigation purpose are employed in Crop production.



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