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Automating and Analysing Greenhouse Hydroponic Farms using IOT

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Abstract: ***Hydroponics is a subset of hydro culture and is a method of growing plants using mineral nutrient solutions, in water, without soil. This paper presents Intelligent Plant Care Hydroponic that exercises environment driven control methods through an Internet-of-Things (IOT) management tool called IOT talk. IOT talk provides a scalable and configurable software for users to easily and quickly add/remove/exchange the sensors and actuators and program their interactions. From the experimental measurement results, the developed environment driven control methods include sensors, LED lighting, water spray and water pump which can effectively lower the CO2 concentration, the temperature and increases the water level respectively.***
Keywords: Hydroponics, IOT, nutrients, sensors.

I. INTRODUCTION

The scarcity of water resources and cultivable lands has forced farmers to look for modern techniques in farming. Such farms generally require very less water consumption when compared to the conventional farms. Usually, hydroponic farming in a greenhouse or indoor farming environment since the surrounding conditions can be controlled better. The implantation of IOT in hydroponics would help the farmers to automate the whole farming process thereby ensuring better yield and the quality of the produce.

Figure 1: Real image of hydroponic set up.

In hydroponics, liquid mineral solutions infused with nutrients are directly fed to the plants during its growth, blooming and pre-harvesting stages. According to studies, plants grow 20-80% faster in hydroponic farming systems and are absolutely free of weed infestations. The seeds which can be planted in hydroponic farms are 2-3 times greater than in normal farming, hence more yields are assured. Once growing quality on a smaller scale is achieved expansion can be easier. Designing and testing smaller systems will also allow you to test different techniques and decide which works the best. The
embedded technology in hydroponics helps the cultivators to interact with the external environment. IOT systems have applications across industries through their unique flexibility and ability to be suitable in any environment. They enhance data collection, automation, operations and much more through smart devices and enabling technology. IOT utilizes existing and emerging technology for sensing and networking. The new and advanced elements in embedded and IOT brings major changes in the delivery of plants, vegetables, fruits and many other products through the process of greenhouse hydroponic farming.

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II. LITERATURE REVIEW

The hydroponic growing has been shown from the hanging gardens of Babylon, the floating gardens of Aztecs of Mexico, and in older Chinese cultures. In 1929 William Gericke of the University of California at Berkeley began promoting the growing of plants in a soil less medium and coined the term hydroponics. Gericke created a sensation by growing tomatoes 25 feet high in his backyard in mineral nutrient solutions rather than soil. One of the earliest success of hydroponics occurred on Wake Island, a rocky atoll in the Pacific Ocean used as a refuelling stop for Pan American Airlines. Hydroponics was used
there in the 1930's to grow vegetables for the passengers because there was no soil and it was expensive to airlift in fresh vegetables. The roots of the plants have constant access to oxygen and that the plants have access to as much or as little water as they need. The one of most common errors when growing is over- and under- watering and hydroponics prevents this from occurring as large amounts of water can be made available to the plant. By 2050, the earth's population increases up to 9.6 billion leads to a decrease in land available for food and production. NASA has already begun experimentation and research with hydroponic because we have to find the soil suitable for supporting life in space. The plants would also supply oxygen and remove CO2 from the astronaut's environment.

A. Implementation

The implementation of hydroponic farming is the fastest growing sector of agriculture and it could very well dominate the food production in the future. Hydroponic farms require 90-95% less water than the conventional farms and the farm can be placed anywhere as no soil is required. The main aim of our project is to make a compact system to automate nutrient dose, PH, water supply and temperature of a greenhouse hydroponic farm.

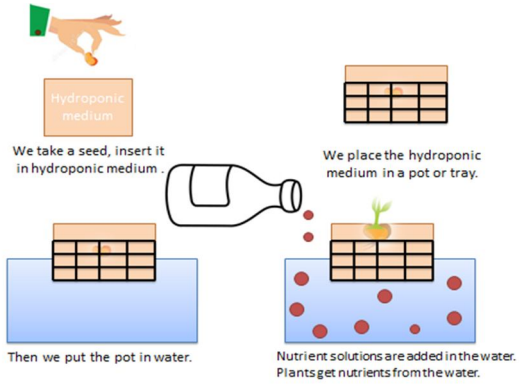

Figure 2: Process of growing a hydroponic plant.

In this technique, we ensure that plant gets all nutrients from the water solution. Hydroponic systems can accomplish this by allowing crop production in urban environments not available for conventional farming. In our project, the parameters are controlled automatically. Also, the cultivators can know the conditions of the plant growth and control the parameters remotely by using IOT technology. Here we have considered the arduino micro controller with three types of sensors such as temperature sensor, PH sensor and LDR for both plant 1 and plant2. ESP8266 is a wi-fi module to communicate by using internet of things with the server. The GSM module is to communicate and relay is used to automatically turn on/off the water supply from the pumping motor.

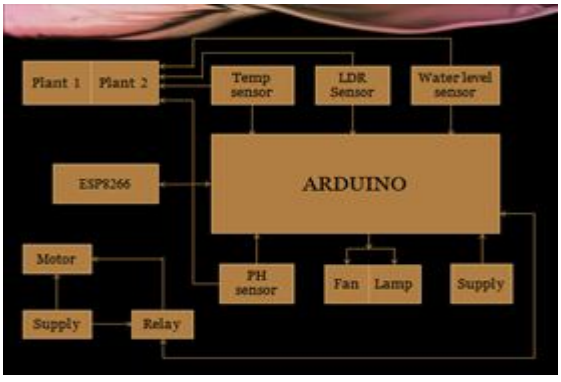

Figure 3: Block diagram of automated hydroponic farm.

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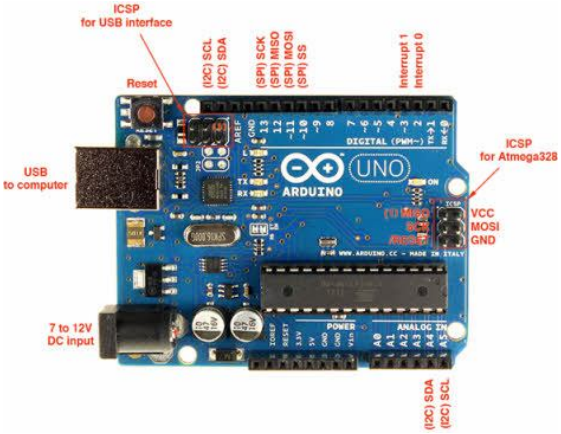
B. Arduino Microcontroller

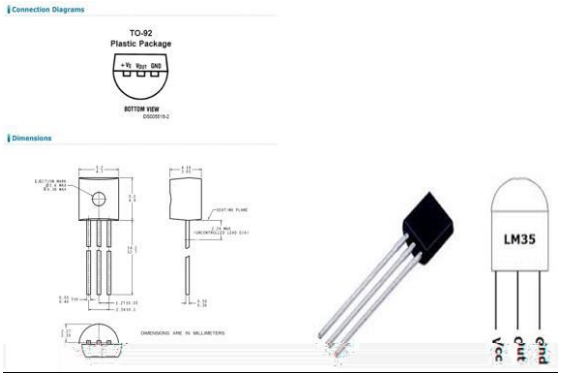
Arduino is a single-board microcontroller meant to make the application more accessible which are interactive objects and its surroundings. The hardware features with an open-source hardware board designed around an 8-bit Atmel AVR microcontroller or a 32-bit Atmel ARM.

Current models consist of USB interface, 6 analog input pins and 14 digital I/O pins that allow the user to attach various extension boards.



C. Temperature Senso

LM35 is an integrated analog temperature sensor whose electrical output is proportional to the Degree Centigrade. They are used in your daily household devices from Microwave, fridges, AC to all fields of engineering.



D. PH Senso

The most common PH sensor is the glass electrode. It's used in many industry applications and in a wide variety of fields. The glass-electrode method has high reproducibility, and it can measure PH of various solutions. A PH electrode is a potentiometric or electrochemical sensor that has a voltage output

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E. LDR

A light-dependent resistor alternatively called an LDR, photo resistor, photoconductor, or photocell, is a variable resistor whose value decreases with increasing incident light intensity. An LDR is made of a high-resistance semiconductor. The resulting free electron conducts electricity, thereby lowering resistance.

F. ESP8266

ESP8266 offers a complete and self-contained Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor .When ESP8266 hosts the application, and when it is the only application processor in the device

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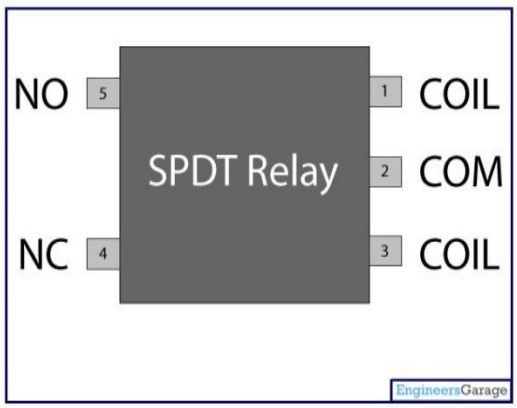
G. RELAYS

Relays are simple switches which are operated both electrically and mechanically. Relays consist of an electromagnet and also a set of contacts. The switching mechanism is carried with the help of the electromagnet.



H. DC MOTOR

The direct current motor is represented by the circle in the center, on which is mounted the brushes, where we connect the external terminals, from where supply voltage is given. The generated Emf Eb is directed opposite to the supplied voltage and is known as the back Emf, as it counters the forward voltage. Electric current which flows through the rotor armature via brushes, in presence of the magnetic field, produces a torque.

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III. CONCLUSION

Hydroponically grown plants do not come in contact with soil borne pests and diseases thus saves costs of soil preparation, insecticides and fungicides. Since the amount of nutrients is fed directly to the plants, there is no wastage of water due to run off or evaporation. Today, hydroponics is an established branch of farming. Progress has been on large scale and results obtained in various countries in the world have proved that this technology is thoroughly practical and has very definite advantages over conventional methods of crop production.

IV. FUTURE SCOPE

Many IOT enabled hydroponic farms such as rooftop farms, vertical farms and green buildings can be placed near the city areas which will directly cut transportation costs & using IOT plants can be transported safely. A standard website can be made which will take sensor data place correct graphs and help farmers to attain information. This way every farm will be used for research purposes. Government, big co-operations will jump into hydroponics because of low arable land, availability of water, costs, climate change and increasing population.

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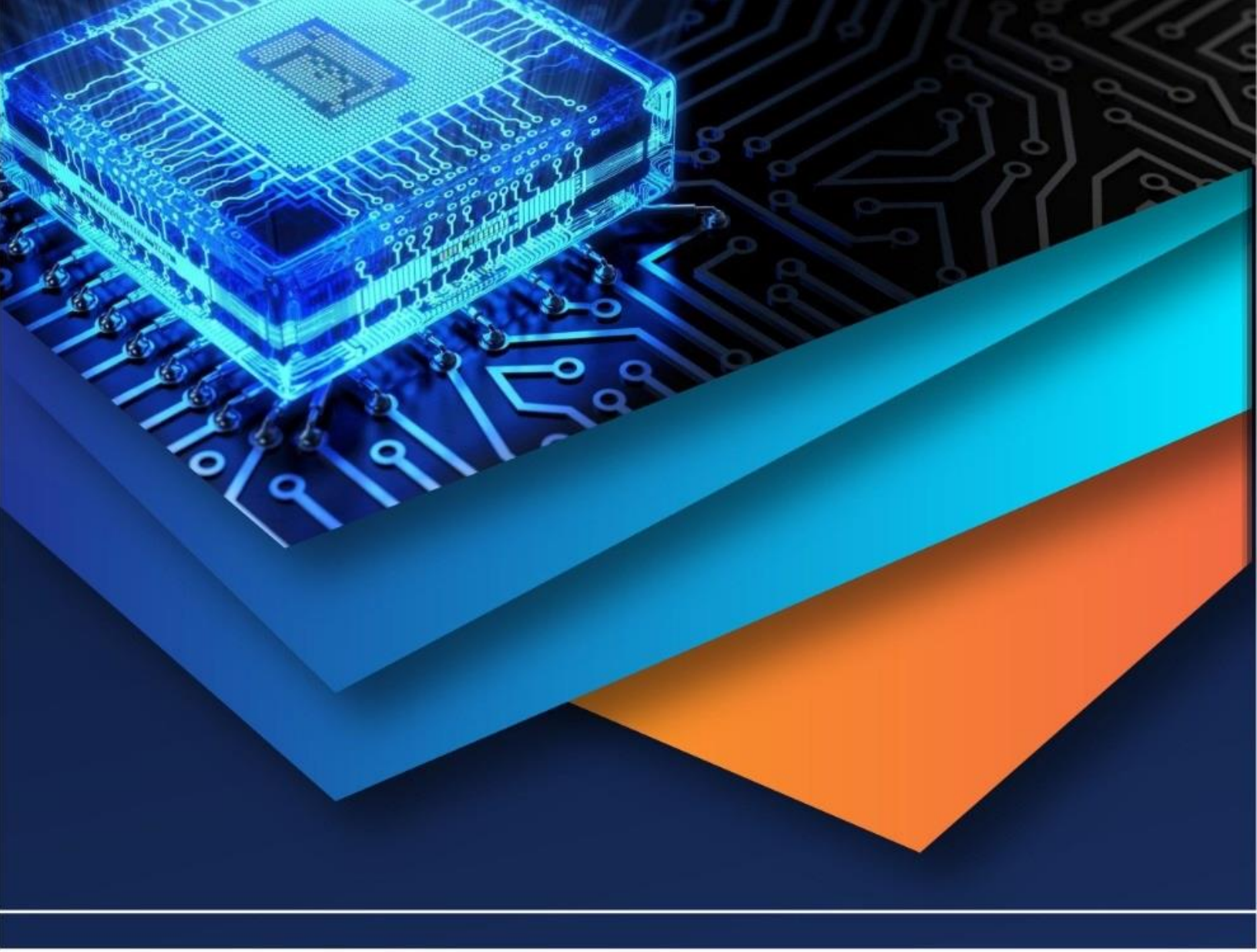

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