Hydroponics Farming

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***Abstract*—Agriculture is the heart of India's economic activity and our experience during the last 60 years has demonstrated the strong relationship between agricultural growth and economic wealth. The present agricultural system is a mix of outstanding achievements and missed opportunities in India. If India want to become powerful economically in the world, our agricultural productivity should be equal to those countries, which are currently rated as economic power of the world. We need a new and emerging technology which can improve continuously the productivity, profitability, quality of our major farming systems. One such technology used in India is the greenhouse technology. Although it is centuries old, it is new to India.**

In India, dependence on agricultural productivity and geographical conditions contribute majors to underdevelopment and poverty. These can be achieved by alternative new and latest technology of farming such as hydroponics. The goal of this project is to design and construct a hydroponic system which is fully automatic that can be integrated into the agricultural curriculum while introducing business skills.

Keywords—Hydroponics farming; Non-circulating method; Soil-less culture.

I. INTRODUCTION

Agriculture is considered as the vital piece of life for the human species as it is the fundamental wellspring of sustenance grains what's more, other crude materials required for person. It plays important part in the development of nation's economy and improvement. It additionally gives huge business openings to the general population. Development in agrarian segment is fundamental for the improvement of financial state of the nation. Tragically, numerous agriculturists still utilize the conventional strategies of cultivating which brings about low yielding of harvests and natural products. Be that as it may, wherever robotization had been actualized and human creatures had been supplanted via programmed apparatuses, the yield has been enhanced and less diligent work required. Consequently there is need to actualize and utilize present day innovation in the agribusiness part to increase the yield of harvest. The greater part of the papers means the utilization of remote sensor organize which gathers the information from various sorts of sensors and after that send it to principle server utilizing remote convention. The gathered information gives the data about various ecological elements which in swings screens the framework. Observing natural components are insufficient and finishes answer for enhance the yield of the harvests. Require robotization to make strides the yield of the harvests.

There are number of different components that influence the efficiency to awesome degree. These components incorporate assault of bugs when product is at the phase of gathering. Indeed, even after gathering, ranchers likewise confront issues away of collected trim and some more. In this way, so as to give answers for all such issues, it is important to create coordinated framework which will deal with all components influencing the efficiency in each stage.

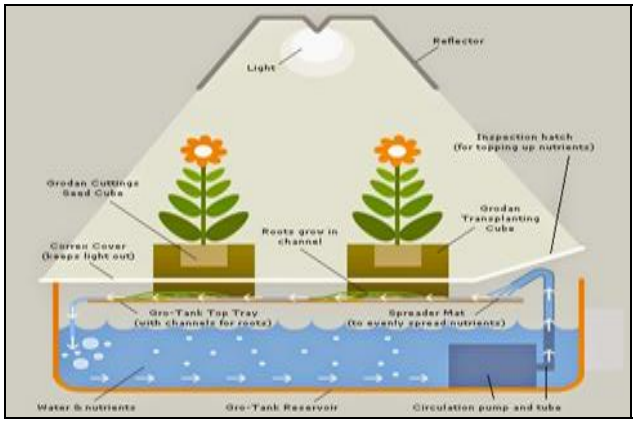

Fig.1. Basic idea about Hydroponics Farming

In this particular paper automation of hydroponics farming is to be done completely. In which, Automation of water supply, maintenance of farms temperature at required level, maintenance of nutrients pH level and EC (Electrical conductivity) at required level, automation in required sunlight for farm along with that alarms and indicators for unusual conditions for farms. Also related all information is to be displays on display panel and related info will be send to owner of that particular farm.

II. LITERATURE REVIEW

IoT based Smart Agriculture identified with remote sensor organize, scientists measured soil related parameters, for example, temperature and stickiness. Sensors were set underneath the dirt which speaks with hand-off hubs by the utilization of compelling correspondence convention giving low obligation cycle and henceforth expanding the life time of soil observing framework. The framework was created utilizing microcontroller, widespread no concurrent beneficiary transmitter (UART) interface and sensors while the transmission was finished by hourly testing also, buffering the information, transmit it and after that checking the status

messages. The downsides of the framework were its cost and organization of sensor under the dirt which causes weakening of radio recurrence (RF) signals. [1]

Field Monitoring and Automation utilizing IOT in Agriculture Area proposes the upsides of having Information and Correspondence Technology (ICT) in Indian agrarian area, which demonstrates the way for provincial ranchers to supplant a portion of the ordinary systems. Observing modules are exhibited utilizing different sensors for which the data sources are nourished from Knowledge base. A model of the system is done utilizing TI CC3200 Launchpad interconnected sensors modules with other vital electronic devices. The framework conquers confinements of customary farming strategies by using water asset productively and furthermore diminishing work cost. [2]

Hydroponics or soil-less culture is an innovation for developing plants in supplement arrangements that supply every supplement component required for ideal plant development with or without the utilization of an dormant medium, for example, rock, vermiculite, Rockwool, peat greenery, saw clean, coir tidy, coconut fiber, and so forth to give mechanical support. [3]

In this particular paper how one can do automation of hydroponics farming is explain completely. In which, Automation of water supply, maintenance of farms temperature at required level, maintenance of nutrients pH level and EC (Electrical conductivity) at required level, automation in required sunlight for farm along with that alarms and indicators for unusual conditions for farms. Also related all information is to be displays on display panel and related info will be send to owner of that particular farm.

III. HYDROPONICS

3.1 Why Hydroponics?

Soil is generally the most accessible developing medium and plants ordinarily develop in it. It gives dock, supplements, air, water, and so forth for fruitful plant development. Change of a soil another developing medium has a tendency to be costly. Notwithstanding, soils do posture genuine constraints for plant development, at times. Nearness of sickness bringing on life forms and nematodes, inadmissible soil response, ominous soil compaction, poor seepage, debasement because of disintegration, and so forth are some of them.

Further, ceaseless development of harvests has brought about poor soil fruitfulness, which thus has diminished the open doors for normal soil ripeness develops by organisms. This circumstance has prompted poor yield and quality. Also, traditional yield developing in soil (Open Field Agriculture) is troublesome as it includes expansive space, parcel of work and extensive volume of water. Furthermore, in a few spots like metropolitan regions, soil is most certainly not accessible for yield developing. Another significant issue experienced since generally is the trouble to contract work for ordinary open field agriculture.

Hydroponics or soil-less culture is an arrangement of developing plants which decreases a portion of the previously mentioned issues experienced in ordinary harvest development.

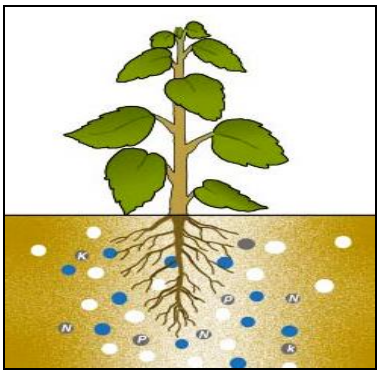

Fig.2. Soil based culture

Hydroponics offers chances to give ideal conditions for plant development and along these lines; higher yields can be acquired contrasted with open field farming. Hydroponics or soil less culture offers methods for control over soil-borne maladies and nuisances, which is particularly alluring in the tropics where the life cycles of these living beings proceeds continuous thus does the danger of invasion.

In this way the expensive and tedious undertakings of soil cleansing, soil improvement, and so on can be maintained a strategic distance from with hydroponics arrangement of development. It offers a perfect working condition and in this way enlisting work is simple.

3.2 What is Hydroponics?

Hydroponics or soil-less culture is an innovation for developing plants in supplement arrangements that supply every supplement component required for ideal plant development with or without the utilization of an latent medium, for example, rock, vermiculite, shake fleece, peat greenery, saw tidy, coir clean, coconut fiber, and so on to give mechanical support.

Fig.3. Hydroponics/Soil less culture

Initially, the creation framework is disconnected from the dirt. Planting happens at a helpful stature, where soil contamination has no effect. It takes into account vegetables to be delivered "without land" and in little physical spaces.

Plants are developed in water compartments or in low–cost normal substrates (sand, rice husk, pumice, and so on.). With this framework, it is conceivable to grow a limitless scope of vegetables. For instance: lettuce, tomatoes, carrots, celery, watercress, eggplants, beans, parsley, wild radish, leeks, strawberries, melons, fragrant and restorative plants, and so forth.

3.3 Basic requirements of Hydroponics:

i. An answer upkeep of corrosiveness or alkalinity (pH) and electrical conductivity (EC) in reasonable reaches for plant root framework.

ii. Water

iii. The supplement arrangement or the manure blend utilized must contain all smaller scale and large scale components important for plant

iv. The temperature and air circulation of the supplement arrangement is appropriate for plant root framework.

TABLE 1. BASIC NEED OF HYDROPONICS FARMING

pH requirement	5.8-6.5
Temperature requirement	20-30 degree Celsius
Light requirements	14-16 hours per day
EC requirement	1.5-2.5 dS/m

3.4 Solution regarding problem fluctuation in pH & EC range of nutrient solution:

At the point when pH strays outside the perfect. It can be brought down by including weaken centralizations of phosphoric or nitric acids and raised by including a weaken centralization of potassium hydroxide.

At the point when plants take up supplements and water from the arrangement, the aggregate salt focus, i.e., the EC of the arrangement changes. On the off chance that the EC is higher than the prescribed range, new water must be added to diminish it. In the event that it is lower, add supplements to raise it.

3.5 Classification of Hydroponics/ Soil-less Culture:

The term hydroponics initially implied supplement arrangement culture with no supporting medium. Nonetheless, plant developing in strong media for safe haven utilizing supplement arrangement is too incorporated into hydroponics. This method is called total framework.

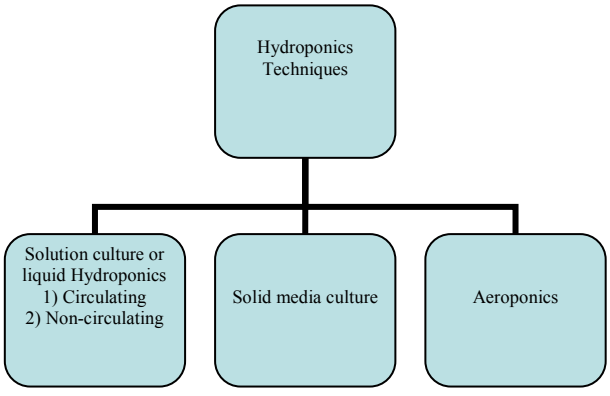

Fig.4. Classification of Hydroponics

Hydroponics frameworks are additionally arranged as open (i.e., once the supplement arrangement is conveyed to the plant roots, it is not reused) or shut (i.e., surplus arrangement is recuperated, renewed and reused). Current hydroponics frameworks of development can be ordered by the strategies utilized. A hydroponic strategy alludes to the technique for applying supplement answer for the plant roots.

IV. METHODOLOGY USED FOR HYDROPONICS

4.1 Non Circulating method:

The supplement arrangement is not coursed but rather utilized just once. At the point when its supplement focus abatements or pH or EC transforms, it is supplanted.

Fig.5. Non Circulating method

4.1.1 Root Dipping Technique:

In this method, plants are developed in little pots loaded with small developing medium. The pots are put such that bring down 2 – 3 cm of the pots is submerged in the supplement arrangement shown in Fig.6. A few roots are dunked in the arrangement while others linger palpably over the answer for supplement and air assimilation, separately. This method is simple and can be created utilizing effortlessly accessible materials. This 'low tech' developing strategy is modest to build and needs little upkeep. Essentially, this procedure does not require costly things, for example, power, water pump, channels, and so on. For root edits be that as it may, a dormant medium must be utilized.

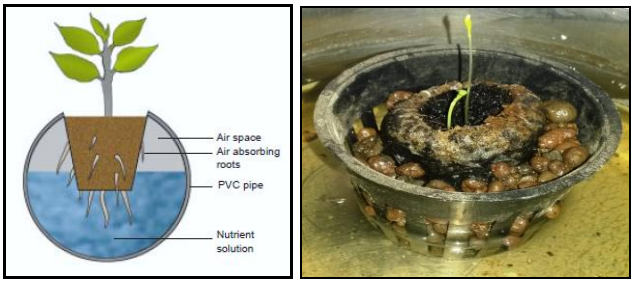

Fig.6. Concept, real photograph of Hydroponics farm

V. SYSTEM DESIGN AND REALIZATION

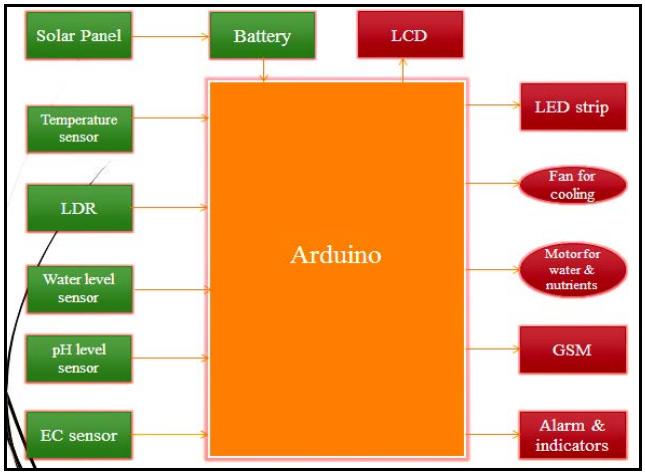

Fig.7. Architecture of the system

It consists of Arduino Uno board, Solar Panel, Battery, Temperature sensor, LDR, Water level sensor, pH level sensor for nutrients, EC(Electrical conductivity) sensor for nutrients solution, LED strip, LCD display, Fan for cooling, Motor for water & nutrients, GSM, Alarm & LED indications shown in Fig.7.

As in hydroponics farming, Plants are grows in soil-less culture means only water along with nutrients in PVC pipe environment. So it is a very important thing to maintain water level along with maintaining pH level and EC of nutrient solution. For sensing water level in PVC pipe which is to be maintain in such a way that roots of plant goes under water. When level of water not maintains as prescribe motor used to pump water inside PVC pipe.

The optimum pH range for hydroponic nutrient solution is between 5.8 and 6.5 maintain using pH level sensor and The ideal Ec range for hydroponics is between 1.5 and 2.5 dS/m maintain by EC sensor if values are not in prescribe range then nutrient solution along with water added to maintain that. In some cases complete water nutrient solutions are need to be replaced.

Temperature to be maintained healthy for plant by sensing temperature using sensor and cooling fan. LDR used to detect low light case for plant and maintaining healthy light condition for plant using LED strip. Solar panel to convert solar energy to electrical energy in battery.

LCD display to display information about Temperature, Water level, pH level & EC level of nutrients. Alarm & LED used for indication. Each & every information regarding hydroponics farming to Owners mobile via GSM.

5.1 Hardware Requirements:

- Arduino: Arduino Uno Atmega 328 microcontroller used here which is nothing but the heart of system which collects sensor output data; process it and controlling functionality of system with 6 analog input pins and 14 digital input pins with TX, RX included.
- Solar Panel: To work this particular systems on solar energy Solar panel are used to convert solar energy into electrical energy with rating is 5W to operate system.
- Battery: To store electrical energy generated by Solar panel Battery is used which store dc charge into it. Battery rating is 12V DC with 1A.
- Temperature sensor: To sense the temperature of water & farm temperature sensors are used. After sensing temperature data given to Arduino.LM35 used here as an Air temperature sensor and DS18B20 Water temperature sensor shown in Fig.8.b).
- LDR: Light dependent resistor used here to sense light intensity of farm and gives out respective data to Arduino. This is a very small light sensor. A photocell changes (also called a photo detector, CdS or photoconductive cell) resistance depending on the amount of light it is exposed to. These little sensors make great ambient light triggers (when light in the room turns on, does something).Light resistance: ~1k Ohm. Dark resistance: ~10k Ohm
- Water/Nutrient solution level sensor: Used to sense the level of water/nutrient solution inside PVC pipe and gives out respective data to Arduino. For sensing water level in PVC pipe which is to be maintain in such a way that roots of plant goes under water. Float sensor used which detect required level of water/nutrient solution.
- pH sensor: Used to sense the pH level of nutrient solution inside PVC pipe and gives out respective data to Arduino shown in Fig. 8.a). The optimum pH range for hydroponic nutrient solution is between 5.8 and 6.5 maintain using pH level sensor.pH sensor have range of 3 to 10.
- EC sensor: Electrical conductivity sensor used to sense EC of nutrient solution inside PVC pipe and gives out respective data to Arduino. The ideal Ec range for hydroponics is between 1.5 and 2.5 dS/m maintain by EC sensor.
- LCD: To display pH level, Temperature of farm and water, EC level of nutrient solution LCD display is used.16x2 LCD display used here.
- LED strip: When light inside farm goes below required level sense by LDR in that case LED strip turns on under control of Arduino.12V operated LED strip used here.
- Fan for cooling: When the temperature of Farm goes above required level sense by temperature sensor then Fan turns on for cooling under control of Arduino.12V DC fan used here.
- Motor for Water and nutrients supply: When water/nutrient solution level in PVC pipe goes below required level and also when EC level of nutrient solution goes below or above required range then motor on to supply water and nutrients to plants under control of Arduino.12V DC operated pump used here for water and nutrients supply. 12V operated relay used here for isolation and switching.
- GSM: Used to send message to owner of farm regarding pH value, EC value, Temperature and unusual condition alerts.SIM800 GSM module used here for communication.
- Alarm and Indicators: Used to indicate unusual conditions of Farm by indication using LED and buzzer.

TABLE 2. HARDWARE SPECIFICATION

pH sensor range	1-14
Temperature sensor LM35	-55 – +150 degree Celsius
Temperature sensor-waterproof(DS18B20) measurement range	-55 – +125 degree Celsius
Operating voltage	3.3 – 12 volts
GSM module	Quad band 850/900/1800/1900MHz

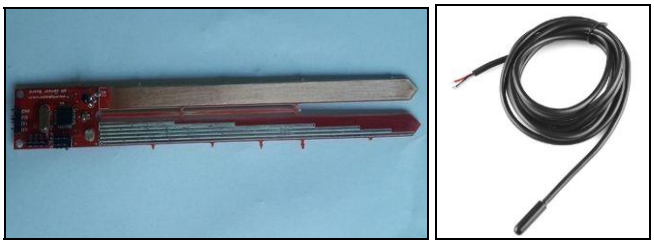

Fig. 8. a) pH sensor board b) Temperature sensor (DS18B20)

5.2 Software Requirements:

- 1.6.8, an Arduino programming environment is used for writing code in the Arduino programming language to instruct the Arduino, writes embedded c code, compile and execute them.
- Proteus 8.1 used here for circuit simulation and results verification.
- Eagle 5.7 used here for PCB layout preparation.

5.3 Advantages of system:

- Limitations of conventional manual method Hydroponics farming are solved using automation of hydroponics farm.
- pH and EC of nutrient maintain here using this system.
- Need not to be go to farm and measure pH & EC
- Measurement of pH and EC does automatically and inform to Farm owner about values through GSM.
- If pH & EC are not in required range then maintain automatically in required range by adding fresh water or nutrient solution.
- If temperatures of farm and solution rise above range that can be maintain using cooling Fan so limitation of manual hydroponics of yield decrease solved.
- Energy input problem solve using Solar panel technology.
- Aeration problem solved by using oxygen pump.
- In winter season and rainy season problem of low light is there that can be also solved using LED strip.

5.4 Limitations of system:

- Higher initial capital expenditure.

VI. RESULTS AND MEASUREMENTS

I got favorable results regarding my hydroponics farming which are shown below. This shows display of farms parameters and also shows result on owners mobile through SMS using GSM module.

Fig.9. Actual system with healthy condition

Fig.9. shows actual system with healthy condition means proper water solution level, pH & EC value, Temperature of farm etc. & Fig.10 shows actual system with unhealthy condition means improper water solution level required for plant growth.

Fig.10. Actual system with unhealthy condition

Fig.11. shows LDR & Water level sensor simulation on Arduino 1.6.12 (Healthy condition) & Fig.12 shows LDR & Water level sensor simulation on Arduino 1.6.12 (Unhealthy condition)

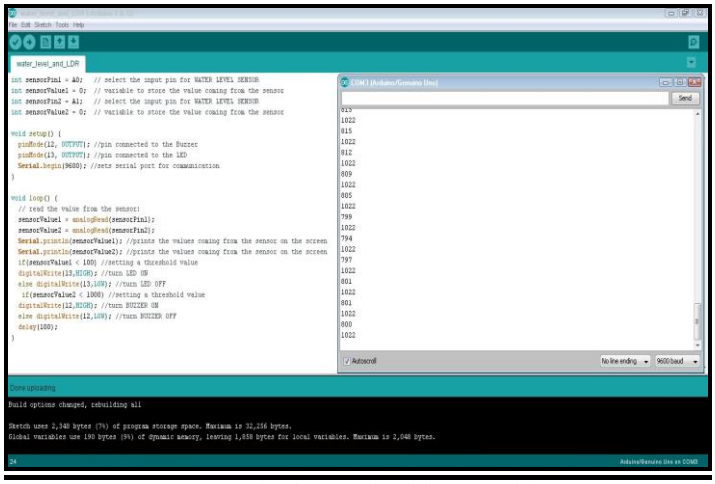

Fig.11. LDR & Water level sensor simulation on Arduino 1.6.12 (Healthy condition)

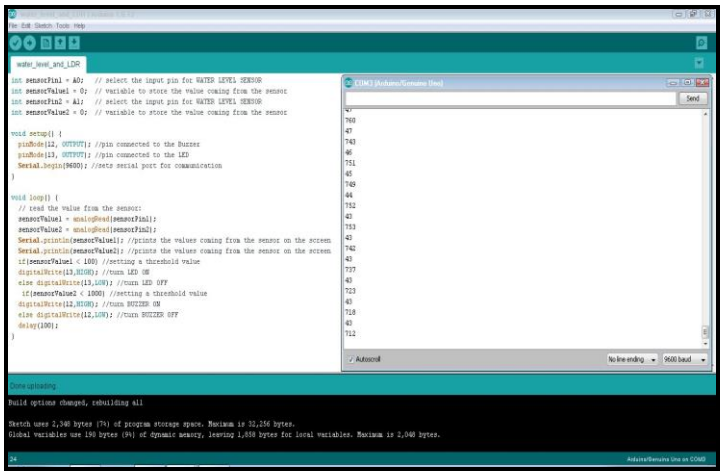

Fig.12. LDR & Water level sensor simulation on Arduino 1.6.12 (Unhealthy condition)

VII. CONCLUSION

Hydroponic cultivating offers many focal points when contrasted with regular cultivating. One of the principle points of interest is that products can be developed in spots with infertile or sullied arrive. Hydroponically developed plants are too more impervious to water with a high salt substance. Another advantage incorporates not having creepy crawlies, creatures, and infections for example, growths effectively exhibit in the developing medium. Work serious work, for example, working, developing, fumigation, and watering is not required for hydroponic cultivating. On the off chance that the framework is robotized utilizing pumps or even PCs, work expenses will diminish drastically. So automation in Hydroponic farming done to have many advantages for healthy growth of plants which leads to increase in yield of farm with proper amount of nutrient, light, water and in healthy temperature conditions. That can be done here using Arduino based automation of water and nutrient solution with proper management of temperature. It also shows indicators and alarm system in unusual conditions. Also inform to farm owner about happenings of hydroponics farm. In this way proposed system has many advantages over conventional manual hydroponics.

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