Introduction:

Hydroponics (from the Greek words hydro water and ponos labor) means cultivation of plants in nutrient solution rather than in soil. Hydroponics is the science of growing healthy plants in a medium, other than soil, using mixtures of the essential plant nutrient elements, dissolved in water, as plant food. Utilizing this technology, the roots absorb a balanced nutrient solution dissolved in water that meets all the plants developmental requirements. Terrestrial plants may be grown with their roots in the mineral nutrient solution only or in an inert medium, such as perlite, gravel, mineral wool etc., that plants absorb essential mineral nutrients as inorganic ions in water. This technology can be used to grow healthy indoor plants and premium grade vegetables, fruits and herbs.

Figure 1 shows the set up to grow the plants. Hydroponics may also be called ‘controlled environmental agriculture’. Hydroponics can be adapted to many situations from outdoor farming to greenhouse and now in-home gardening. The main objective of hydroponics is to supply the ideal nutritional environment for optimum plant performance. Plant performance may be further optimized by controlling the climate and lighting. Advanced technology in lighting, nutrient delivery, and environmental control, will further improve plant productivity and performance. Since hydroponic systems reduce water and nutrient stress to the plants, they grow faster and can be grown together without starving each other. Healthier plants also produce higher yields.
Objective:
The main objective of the project is to completely automate the process of growing plants in a system designed to fit within one’s home. Useful feedback is given to the user about the condition of the plants via an Android application, which also helps the user learn about gardening. It utilizes hydroponics, a more efficient method for growing plants than traditional potted soil.

Methodology:
Drip irrigation system pumps the nutrient solution through the tube and drops onto plant roots via a network of drip lines. The action is often made automatic by a moisture sensor. Drip irrigation systems can be active recovery or non-recovery type system. In a recovery drip system, the nutrient solution is sent back to the reservoir via the drip tray. Meanwhile, the non-recovery system doesn’t collect the leach-out, which is not efficient, and this is only often used in the early days of hydroponics. In our project recovery type of system is used.

Figure-2 shows the circuit connection with the sensors. All the sensors and actuators are interfaced and integrated together. Moisture sensor and temperature sensors are kept near the plant system. Ultrasonic sensor is kept at the top of the nutrient solution container. pH solution is dipped inside the solution. DC pump is kept in the nutrient solution and a pipe is connected to it. Solenoid valve is connected to the container.

Nutrient solution will be present in the Reservoir which is mixed in proper proportions to meet the pH requirements of the crop. pH and NPK ratios are used during initial mixing procedure to meet the crop requirement. The nutrient solution level is recorded using ultrasonic sensor. A fresh nutrient solution is replaced once the nutrient solution level goes beyond the threshold level and this is intimated to the user through android application.
The crop is planted into a substrate like coco peat which is placed inside a casing. The pipes consisting of holes are laid above the substrate to wash the roots with nutrient solution thus forming a Drip Irrigation System. As the plant absorbs the nutrients from the solution, the pH value of the solution goes high. In order to bring down the pH value to the optimum level, pH down buffer solution (like dilute phosphoric or nitric acid) is used. The flow of such a buffer solution is controlled by Opening and Closing of the solenoid valve. The smart greenhouse is connected to an android application through a ubi-dots clouds hosting a web server. The sensor information is provided to the user so that the plants can be monitored from anywhere.

Ultrasonic sensor gives the level of the nutrient solution in the container. If the level of the nutrient solution reaches the threshold level, a fresh nutrient solution is prepared and added to the container. Moisture sensor gives the moisture of the hydroponics environment. If the moisture goes above the threshold level which indicates the dryness, motor pumps the solution to the plant. pH sensor gives the pH of the nutrient solution. Different plants need different pH for their growth. If the pH of the solution goes high, to bring it down to the required level pH down buffer is added using solenoid valve. All the above readings are then sent to the ubidots cloud.

Temperature sensor is used to record the temperature of the hydroponics environment to protect the system from germs attack. Sensor readings were displayed on dashboard in the ubidots cloud platform.

Result:

Our system maintains pH at optimum level and hence no nutritional problem observed in plants cultivated in our re-circulating system. Hydroponics growth and productivity are considerably affected by prolonged recycling of nutrient solutions where adjustments are based solely on pH measurements. This system can play an important role to conserve water and electricity and yet derive yields of higher magnitudes. Initial Investment stands as one time investment and same system setup can be used to grow variety of crops.

Future Scope:

1. This system can be extended by introducing cooling fans and Infrared lights which can be used to maintain required temperature for Indoor Hydroponics, which can be achieved by using Temperature Sensor.
2. Develop Android application to control actuators.
3. Ubidots cloud charges money for cloud storage, which is relatively high. Hence configure the cloud.
4. Design solar panel for the power supply instead of DC battery to conserve energy.