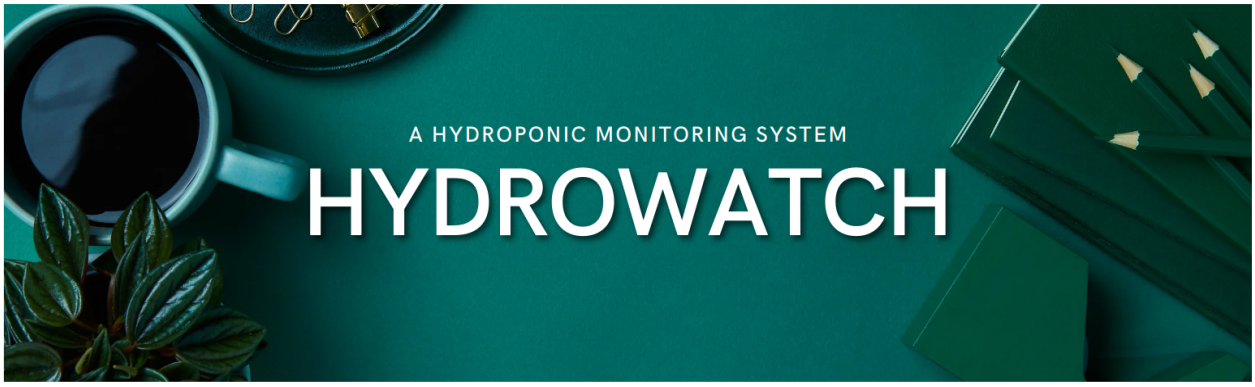


PROBLEM STATEMENT

Hydroponics is never the first option when it comes to farming and growing on a somewhat commercial scale due to the challenges faced in monitoring and setting up the entire system.

SOLUTION

Thought process
The initial design should address two major problems

- UI to get information about the farming setup at a glance
- Monitoring circuit

RESEARCH

Hydroponics is a method of growing plants without soil. Instead, plants are grown in a nutrient-rich water solution that provides everything they need to grow, including water, oxygen, and essential nutrients.

The word "hydroponics" comes from the Greek words "hydro," meaning water, and "ponos," meaning labor. The technique has been used for centuries, but has gained popularity in recent years due to its potential for increased crop yields, reduced water usage, and greater control over growing conditions.

Hydroponics can be used to grow a wide variety of plants, including vegetables, fruits, and herbs, and can be used in a variety of settings, including home gardens, commercial farms, and urban agriculture. Some of the benefits of hydroponic gardening include faster growth rates, higher yields, and the ability to grow plants in areas where traditional soil-based agriculture is not feasible.

Hydroponics can help solve many of the problems faced by farmers today, such as excessive use of fertilizers and harmful pesticides, poor crop quality, weather-related damage, lack of agronomy guidance, and inadequate market access. By using precision farming techniques, protected cultivation, and soilless farming, hydroponics can provide a reliable source of high-quality produce while reducing the need for harmful chemicals and minimizing the impact of adverse weather conditions. Additionally, hydroponics can provide greater control over the supply chain, ensuring that food is traceable and stored properly, and can help farmers operate their businesses more efficiently and profitably. By providing consumers with a healthier choice of food and helping farmers earn a fair price for their produce, hydroponics can help transform agriculture into a more sustainable and profitable industry.

Certain limitations and challenges faced in a hydroponic system are that despite of the numerous benefits of hydroponics, it has some limitations that need to be considered. Firstly, it requires technical knowledge to set up and operate, especially on a large scale. Additionally, the setup cost is high and constant supervision is needed. There is also a risk of water-based diseases due to poor handling during the process. It's important to note that not all crops can be grown using hydroponics, with examples being carrots and potatoes. Furthermore, factors such as temperature, humidity, and pH can also limit the effectiveness of hydroponics. In India, the high cost of setting up hydroponics systems makes it difficult for poor farmers to afford. Moreover, it requires specialized skills and practical knowledge to grow crops using this method, and many farmers lack awareness and training. As a result, the agricultural sector's focus on hydroponics is not well-defined. Educating and training farmers of all levels of expertise is a challenging task, requiring commitment and investment to achieve better outcomes and higher yields. Inexperienced farmers who want to work in this area may need to hire a horticulturist or skilled staff, which can be expensive and presents an additional challenge.

UI - WEBSITE

The website is designed to monitor and display the TDS (Total Dissolved Solids), pH, and water temperature of a hydroponics system. The website is hosted on Google Cloud using AMD instances, ensuring a reliable and fast service. The website is user-friendly and easy to navigate, allowing users to access real-time data of the three parameters. Users can set up alerts and notifications for when the parameters fall outside of the desired range. The website provides insights into the health of the hydroponic system and helps users make informed decisions to maintain optimal growing conditions for their plants.

URL: http://35.228.160.214/index.php?temp=40&ph=6.3&tds=1140

MONITORING CIRCUIT

We decided to monitor these parameters as a baseline to keep track of the nutrient solution.

- Total Dissolved Salts
- pH
- Temperature

TOTAL DISSOLVED SALTS

It is the measure of dissolved combined content of all organic and inorganic solutes in a liquid. It is usually measured in ppm(parts per million).

Why we are measuring this

TDS gives us a measure of the dissolved nutrients in our nutrient fluid. Even though it doesn't specifically measure the nutrients required for plant growth, given we have a controlled environment with little to no contamination, this serves as an appropriate measurement tool. There are also indexes that give the required TDS for a particular plant, which is very helpful in setting up the borders for our nutrient measurement.

How we are measuring this
TDS sensor helps us convert this parameter into voltage range of 0-2.3V with low power consumption. We can then handle the input from the sensor and convert it to a range of 0-3000 ppm.

pH

It is the measure of the overall acidity/alkalinity of matter. The scale ranges from 0 to 14, 0 being the most acidic. It indicates the activity of hydrogen ions in the solution, which is an important factor in the availability of nutrients in water.

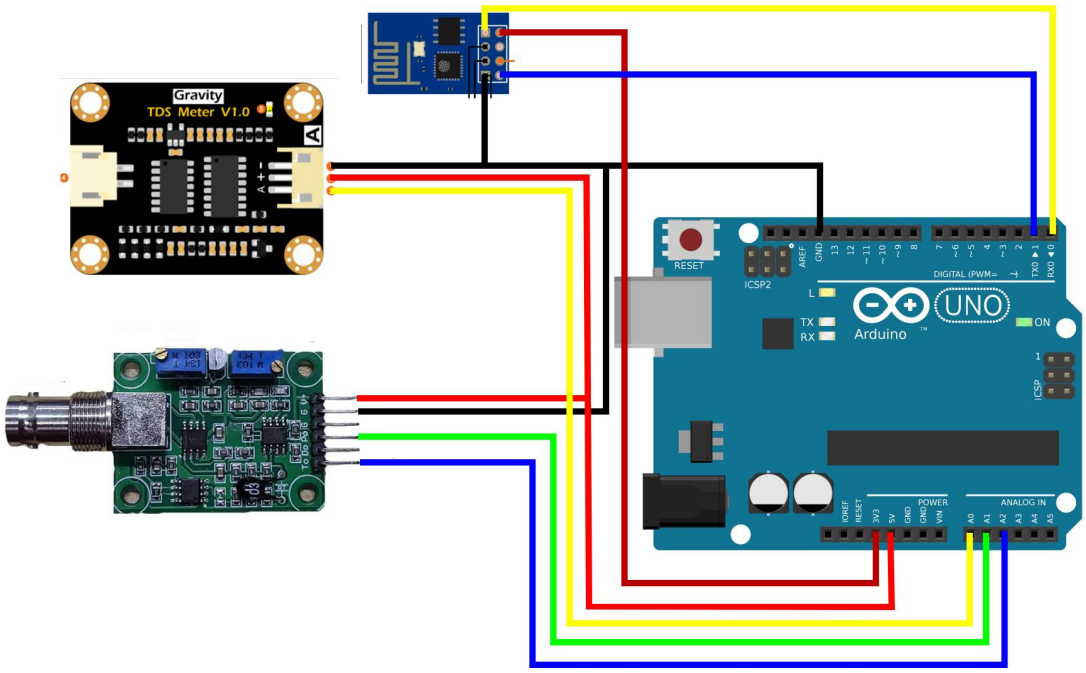
Why are we measuring this
pH content of water, or even soil is an important factor in determining the availability of nutrients required for plant growth. Hence it becomes very important to keep a track of pH in our nutrients solution for best yield

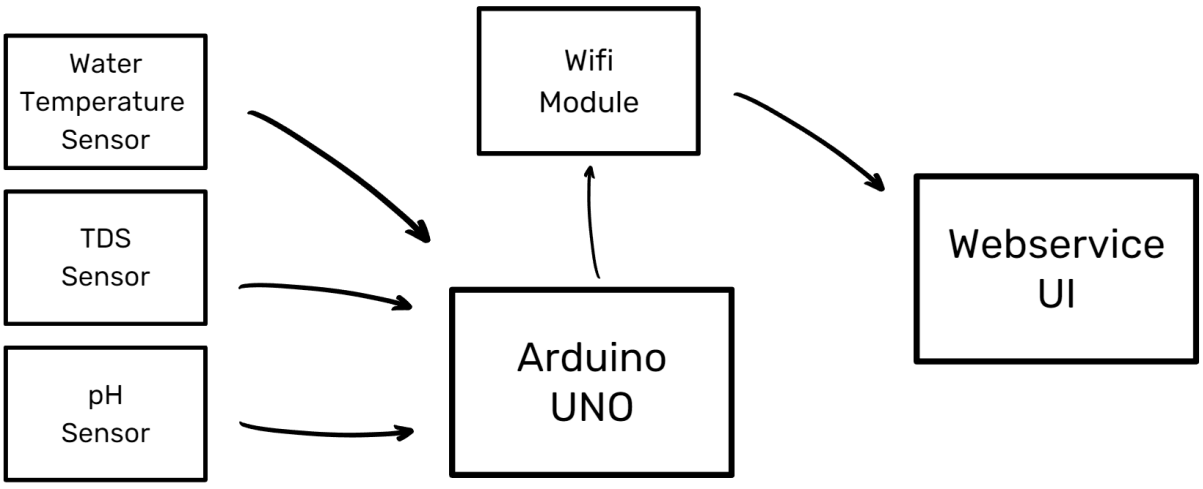
How are we measuring this
Gravity pH sensor helps us to measure pH for the complete range of 0-14 and has a working voltage of 3.3V/5V

TEMPERATURE

Temperature is an important factor in deciding dissolved oxygen and nutrient availability in water. Warm water has less oxygen and cold water makes it difficult for plants to absorb nutrients dissolved

CIRCUIT DESIGN





FUTURE PROSPECTS/FEATURES

Measuring Electrical Conductivity

Electrical conductivity(EC) is directly dependent on the concentration of nutrients in the solution and helps us track the nutrient consumption by the plants over a time period.

- If the EC measurement stays the same it shows that the plant is using as much water as it is nutrient, and is balanced. Keep the nutrient tank topped up with the solution of the same strength to keep this balance but check regularly to ensure everything is still working as it should.
- If the EC measurement goes down it indicates that the plant is using up more nutrient than water. You should top the nutrient solution back to what it was, and possibly even try a stronger nutrient solution feed. If you do increase the strength, watch the EC closely to see how your plant is reacting.
- If the EC measurement goes up your plant is using more water than a nutrient, and it isn't taking up what it should be. You need to add more water to dilute the solution down. Burned leaf tips and slowed growth can be signs of over-feeding and if so your nutrient solution may be too strong. Temperatures can also affect this, and on hotter days your plants may take up more water.

EC measures the number of nutrients available but doesn't tell you how much of each individual element is in there. You could have the perfect EC measurement but still have nutrient deficiencies. EC can be measured using a digital meter (Bluelab CF Truncheon) and dipping one of its end in the solution.

Growing Lights

Growing lights are artificial light sources designed to provide plants with the necessary light spectrum for photosynthesis and growth. They are commonly used in indoor gardening, including hydroponic systems, where natural light may be limited or insufficient.

Growing lights come in different types, including fluorescent, LED, and high-intensity discharge (HID) lights. LED lights are the most energy-efficient and popular choice for indoor gardening, as they produce less heat and consume less energy than other types of lights.

By adding growing lights to a hydroponic monitoring system, you can ensure that your plants receive the necessary light to grow and thrive. With the help of sensors and

automation, you can also control the timing, intensity, and duration of the light to optimize plant growth and yield.

Overall, integrating growing lights into your hydroponic monitoring system can improve your crop production, reduce energy consumption, and provide greater control over your indoor gardening environment.

Monitor dissolved oxygen

Dissolved oxygen is a crucial factor in hydroponic systems, as it plays a vital role in supporting plant growth and preventing root diseases. Oxygen is essential for the roots to absorb nutrients and grow, and without enough oxygen, roots can become waterlogged and suffocate, leading to stunted growth and root rot.

Maintaining proper levels of dissolved oxygen in hydroponic systems is critical to ensure healthy plant growth and prevent the buildup of harmful bacteria and pathogens. In a hydroponic system, oxygen is typically added to the water through air stones, diffusers, or other aeration devices.

As a future addition to a hydroponic monitoring system, measuring dissolved oxygen levels can help growers ensure that their plants are receiving adequate oxygen and prevent problems before they occur. By monitoring dissolved oxygen levels, growers can detect issues with their aeration system or nutrient solution, adjust oxygen levels as needed, and optimize plant growth and yield.

In summary, dissolved oxygen is a critical factor in hydroponic systems, and monitoring its levels is an important part of ensuring healthy plant growth. By adding dissolved oxygen monitoring to a hydroponic monitoring system, growers can optimize their growing conditions and maximize their harvest.