Hydroponics
Project

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1. Abstract

The IoT based hydroponics project in Dubai aims to introduce a new, technologically advanced method of growing crops in controlled environments. The project utilizes the Internet of Things (IoT) to create a smart hydroponic system that can monitor and control various factors such as temperature, humidity, light, and water levels in real-time.

The main goal of the project is to optimize crop growth and productivity in a sustainable and efficient manner. By leveraging IoT technology, the system can automatically adjust these factors to ensure optimal growing conditions for the plants, reducing the risk of crop failure and increasing yields. Additionally, the system can provide real-time data and analytics to help farmers make informed decisions about their crops.

In Dubai, where water resources are limited, the IoT based hydroponic system provides a sustainable solution for growing crops that requires less water compared to traditional agriculture methods. Furthermore, the controlled environment of the hydroponic system can reduce the impact of weather-related crop losses, ensuring a consistent and reliable source of fresh produce.

Overall, the IoT based hydroponic project in Dubai has the potential to revolutionize the way crops are grown and help address food security challenges in the region. By combining the latest technology with traditional agricultural practices, the project aims to create a more sustainable, efficient, and productive way of growing crops.

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2. Introduction

2.1. Motivation

The motivation behind the IoT based hydroponics project in Dubai is driven by a number of factors.

First, the increasing demand for fresh, locally sourced produce presents a challenge for traditional agriculture methods, particularly in regions with limited water resources such as Dubai. By utilizing hydroponic technology, the project provides a more efficient and sustainable solution for growing crops that reduces water usage and minimizes the impact of weather-related crop losses.

Second, the integration of IoT technology allows for real-time monitoring and control of the growing environment, ensuring optimal conditions for crop growth and reducing the risk of crop failure. This can lead to increased yields and improved productivity for farmers, helping to address the growing demand for fresh produce.

Third, the project addresses the important issue of food security in Dubai and other regions. By providing a reliable source of fresh, locally grown produce, the project can help to reduce the dependence on imported goods and promote self-sufficiency in the food supply chain.

Finally, the IoT based hydroponics project aligns with Dubai's efforts to embrace technology and innovation in all sectors, including agriculture. By leveraging the latest technology and combining it with traditional agricultural practices, the project helps to create a more sustainable, efficient, and productive way of growing crops, which can serve as a model for other regions.

In summary, the IoT based hydroponics project in Dubai is motivated by a combination of the need for sustainable, efficient agriculture practices, the increasing demand for fresh produce, the importance of food security, and the desire to embrace technology and innovation in the agriculture sector.

2.2. Literature Review

In spite of the fact that a typical individual consumes approximately 2 liters of water each day, it takes over 3,200 liters to produce adequate food for one person each day [3]. More than 70% of the freshwater that is extracted is used for agricultural purposes. A projection of population increases through 2050 is depicted in figure 1.
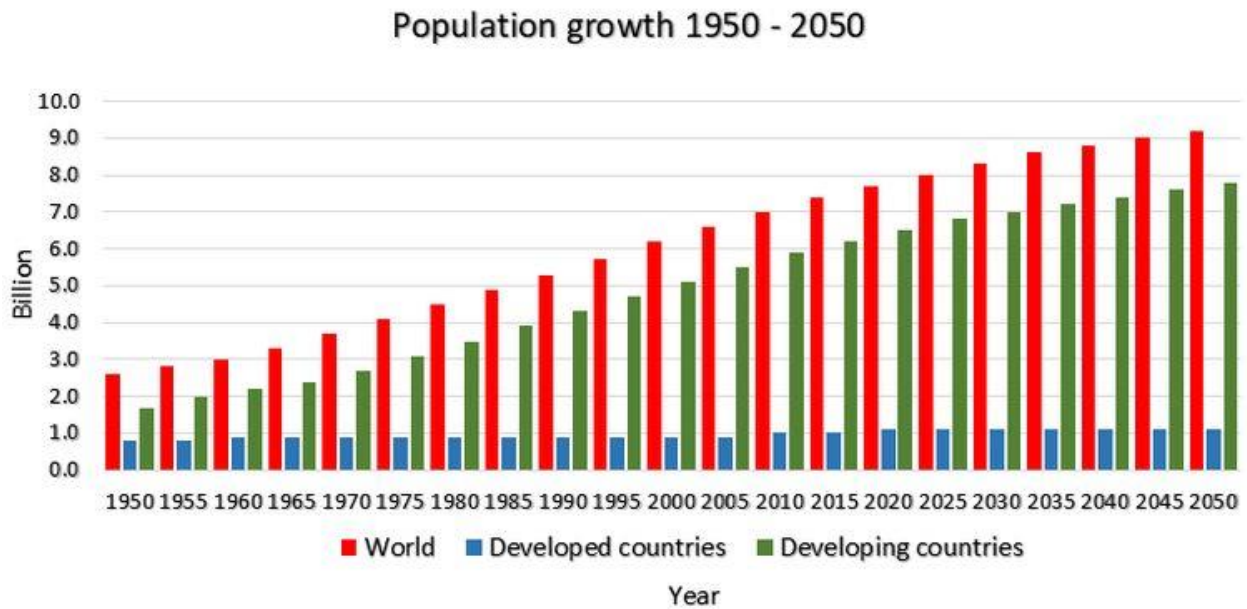
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Population growth 1950 - 2050

Figure 1 Population growth [6]

In order to fulfil increased food demand (mostly for foods that need a large amount of water) by 2050, agricultural output must generate more than 70% of the total [4]. Figure 2 depicts the availability of arable land.
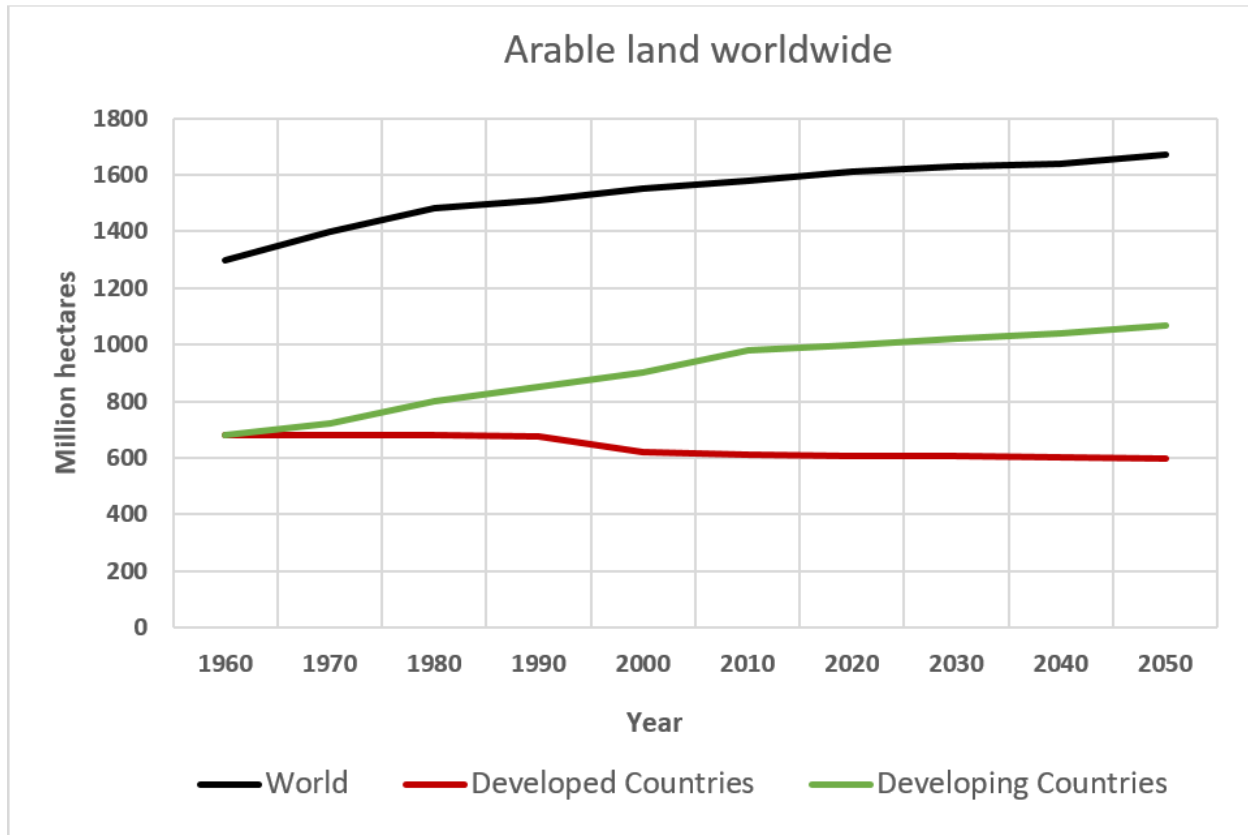
Figure 2 Availability of land for agriculture

The literature review with respect to the UAE and hydroponic technology reveals a growing interest in this area in recent years. The UAE has a strong focus on agriculture as a key component of its overall economic development strategy, and there has been a growing recognition of the need for innovative and sustainable agriculture solutions.

Several studies have investigated the potential of hydroponic technology for agriculture in the UAE, highlighting the benefits of this approach for water conservation, food security, and improved crop yields. These studies have shown that hydroponic technology can reduce water usage by up to 90% compared to traditional agriculture methods, making it an attractive solution for regions with limited water resources like the UAE.

In addition to these benefits, the UAE has also been exploring the use of smart technologies, such as IoT, in hydroponic systems to enhance the efficiency and productivity of these systems. For example, studies have shown that the integration of IoT technology in hydroponic systems can

improve the monitoring and control of environmental factors such as temperature, humidity, light, and water levels, leading to improved crop growth and increased yields.

Overall, the literature review suggests that hydroponic technology has significant potential for agriculture in the UAE, particularly in terms of water conservation and food security. The integration of IoT technology in these systems is seen as a way to enhance the efficiency and productivity of hydroponic systems, and to ensure their success in the long term.

In conclusion, the literature review highlights the growing interest in hydroponic technology and its potential for agriculture in the UAE, and highlights the importance of continued research and development in this area to ensure its success in the future.

2.3. Project benefits

The benefits of an IoT based hydroponics project in the UAE are numerous and significant. Some of the key benefits include:

1. Water Conservation: Hydroponic technology significantly reduces the amount of water used in agriculture compared to traditional methods, making it an ideal solution for regions with limited water resources such as the UAE.
2. Increased Yields and Productivity: The integration of IoT technology in hydroponic systems allows for real-time monitoring and control of the growing environment, leading to improved crop growth and increased yields.
3. Food Security: By providing a reliable source of fresh, locally grown produce, the project can help to reduce the dependence on imported goods and promote self-sufficiency in the food supply chain.
4. Sustainability: Hydroponic technology is a more sustainable solution for agriculture as it reduces water usage and minimizes the impact of weather-related crop losses.

5. Technological Innovation: The project aligns with the UAE's efforts to embrace technology and innovation in all sectors, including agriculture. By leveraging the latest technology, the project can serve as a model for other regions.

6. Job Creation: The project can create new jobs in areas such as agriculture, technology, and engineering, contributing to the local economy.

7. Environmental Benefits: Hydroponic systems can reduce the need for pesticides and other chemicals, leading to a more environmentally friendly solution for agriculture.

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2.4. Final prototype

The final prototype operates on distributed wireless sensor technology and it is able to monitor and measure the different environmental elements like temperature, and soil moisture. Moreover, the system collects UAE's weather information to minimize environmental impact and help managing water resources through the function of machine learning algorithm. All the data will be presented on a mobile app for the users to track their farm activity, however, the main purpose of the app is to allow users to monitor and control the water level in the soil remotely through turning on/off the water pumps. The overall system should allow users to manage their farms or garden smoothly and with less effort.

3. Problem Statement and Objective

3.1. Problem Statement

The problem statement for an IoT based hydroponic project in the UAE can be stated as follows:

In the UAE, agriculture is a crucial sector for the economy, but it faces several challenges, including limited water resources, weather-related crop losses, and dependence on imported goods for food security. This results in a need for innovative and sustainable solutions to address these challenges.

The objective of this project is to develop an IoT based hydroponic system that leverages the latest technology to provide a reliable source of fresh, locally grown produce and to reduce the dependence on imported goods for food security. The system will also aim to conserve water and minimize the impact of weather-related crop losses, making it a sustainable solution for agriculture in the UAE. The project will provide a proof of concept for the potential of IoT based hydroponic systems and serve as a model for other regions.

3.2. Objectives

Objectives of the project are given below

- Get temperature data using dht 11
- Get the water level in tubes
- Send the data to the iot platform
- Get data for set temperature and set water level from the arduino cloud
- Turn the fan ON and relay ON according to the set levels

4. Methodology

4.1. Proposed solution

The hydroponics system is attached with iot to get better results and set the level of water as well as maintaining the temperature of area from anywhere in the world. The project is based on ESP32 microcontroller, having two water level measuring sensors in the hydroponics tubes. If the level gets down than the threshold, pump automatically start and fill the tubes with required level of water so plants nourish in the best way. A temperature sensor is also attached to check the temperature and microcontroller allow the fan to turn ON when the threshold reaches the level.
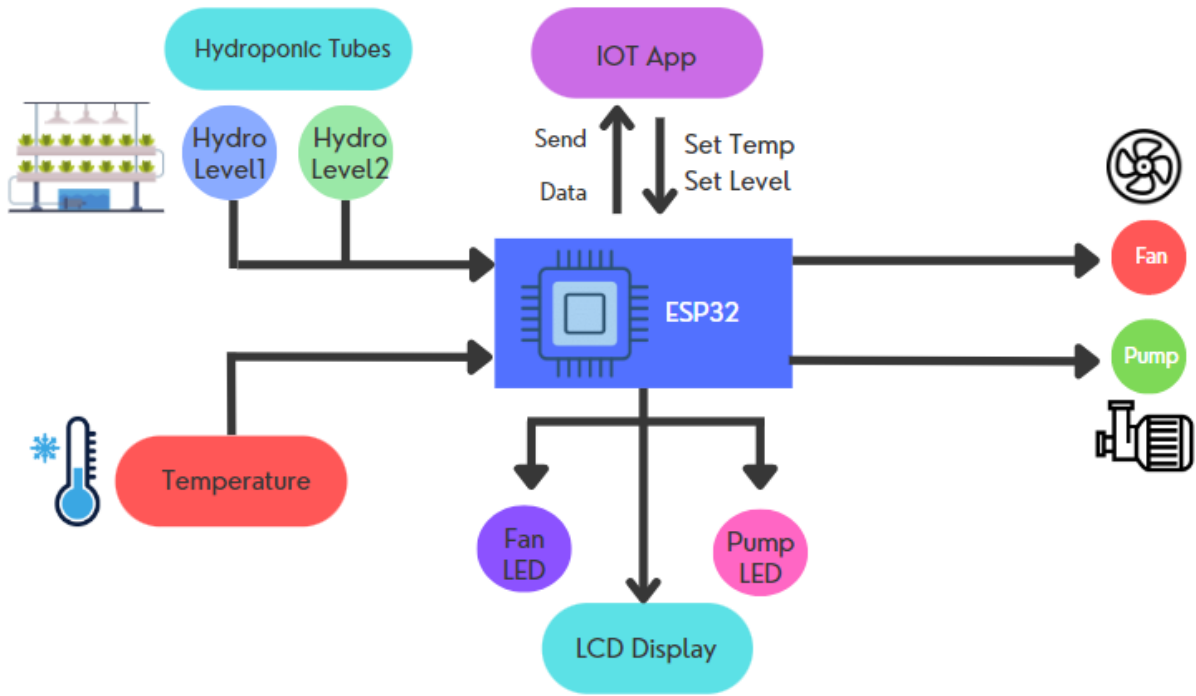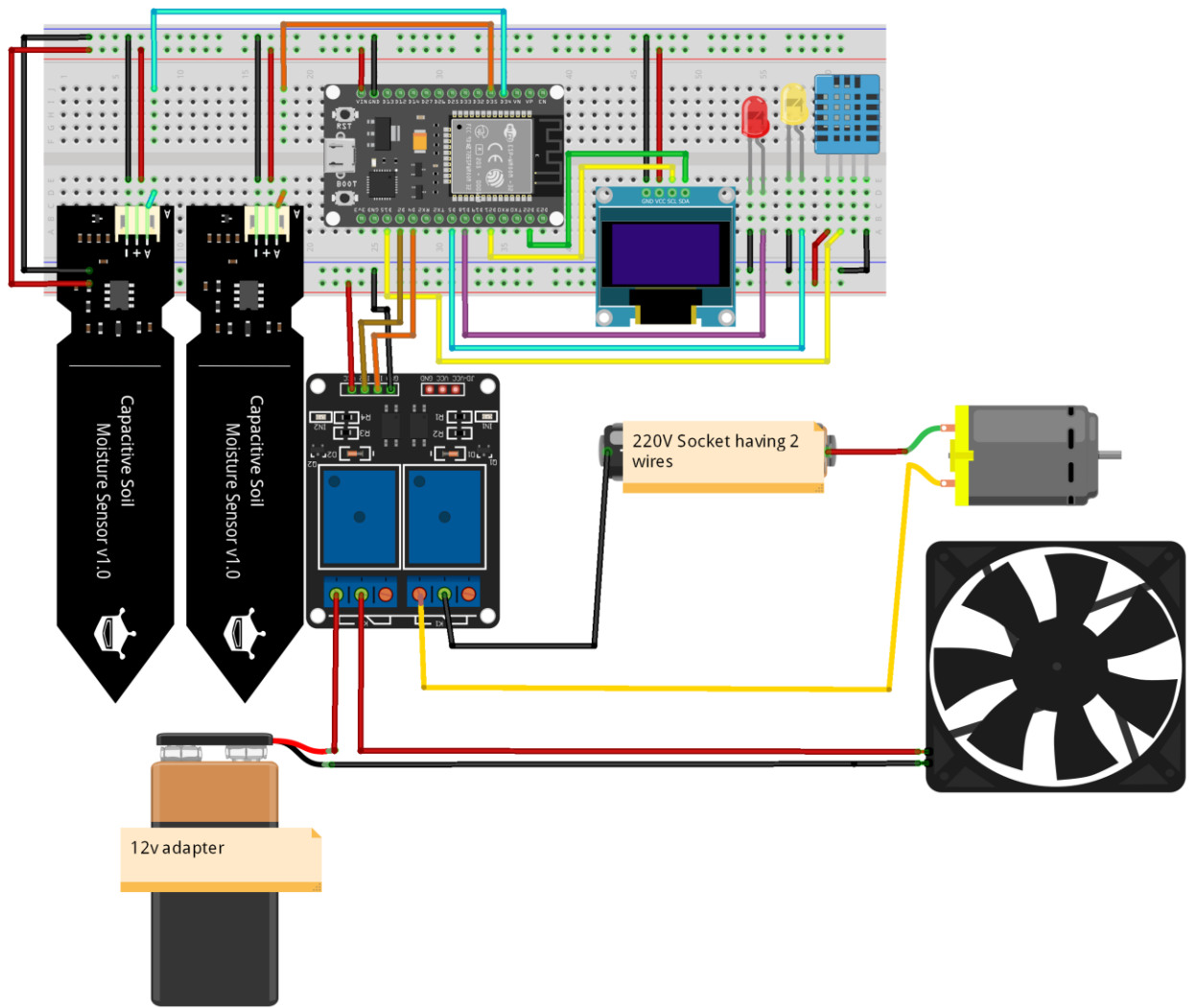
Figure 3 Flow Diagram

Figure 4 Circuit Diagram

5. Estimated budget and justification

NO.	Component Name	Justification	Price($)	Quantity	Purchase Link
1	ESP32	ESP32 provide multiple analog pins to get sensor data and it is faster than Arduino	10.99	1	https://www.amazon.com/HiLetgo-ESP-WROOM-32-Development-Microcontroller-Integrated/dp/B0718T232Z
2	Capacitive water level sensor	Measure the water level more accurately	12.52	2	https://www.amazon.com/Capacitive-Moisture-Magnetron-Corrosion-Resistant/dp/B09PZJN7GP/ref=sr_1_7?crid=OVQLCQG8TZCJ&keywords=capacitive+soil+moisture+sensor+v2.0&qid=1676012680&sprefix=capacitive+soil%2Caps%2C615&sr=8-7
3	Relay modules	Used to power pump and fan	11.46		https://www.amazon.com/SainSmart-101-70-100-2-Channel-Relay-Module/dp/B0057OC6D8/ref=sr_1_3?crid=1LLWZJ2864XQD&keywords=relay+module&qid=1676012957&sprefix=relay+modul%2Caps%2C368&sr=8-3
4	Dht11	Measure temperature	6.78		https://www.amazon.com/Taidacent-Sensor-Temperature-Humidity-Digital/dp/B07T6SDYJD/ref=sr_1_1?crid=1PSKPEJ9KKAUJ&keywords=dht11&qid=1676012892&sprefix=dht11%2Caps%2C403&sr=8-1
5	Water pump 12V	To supply water to plant	8.89		https://www.amazon.com/Q-BAIHE-Jt-180a-12-Brushless-Amphibious-Submersible/dp/B00NALTNAO/ref=sr_1_13?crid=5FSTJOSE04J5&keywords=water+pump+5v&qid=1653267174&sprefix=soil+moisture+sensor+arduino%2Caps%2C4241&sr=8-13
8	OLED i2c	Used to show the data live on the display	26.47		https://www.amazon.com/DIYmall-ESP32-WROOM-32-Development-Yellow-Display/dp/B09TGXT45J/ref=sr_1_8?crid=1ZD7IBBECI6TK&keywords=oled+i2c&qid=1653327313&sprefix=oled+i2%2Caps%2C444&sr=8-8
9	Jumpers MF	Pack	5	pack	https://www.amazon.com/Velleman-WJW009-VP-Jumper-Yellow-Orange/dp/B01NAU7CV1/ref=sr_1_19?crid=1N7ONKFUN7NJW&keywords=jumper+wires&

					qid=1647462636&sprefix=jumper+wir%2Caps%2C305&sr=8-19
1 0	Power supply 12v	Power the fan and Pump if required	7.74	1	https://www.amazon.com/PPJ-110V-240V-Adapter-Charger-Monitor/dp/B085XG1S6Z/ref=sr_1_4?crid=25OOH5MQ7X3VL&keywords=power+12v+dc+adapter&qid=1676012783&sprefix=power+12v+dc+adapt%2Caps%2C443&sr=8-4
Total Budget			89.85$		

App Overview:
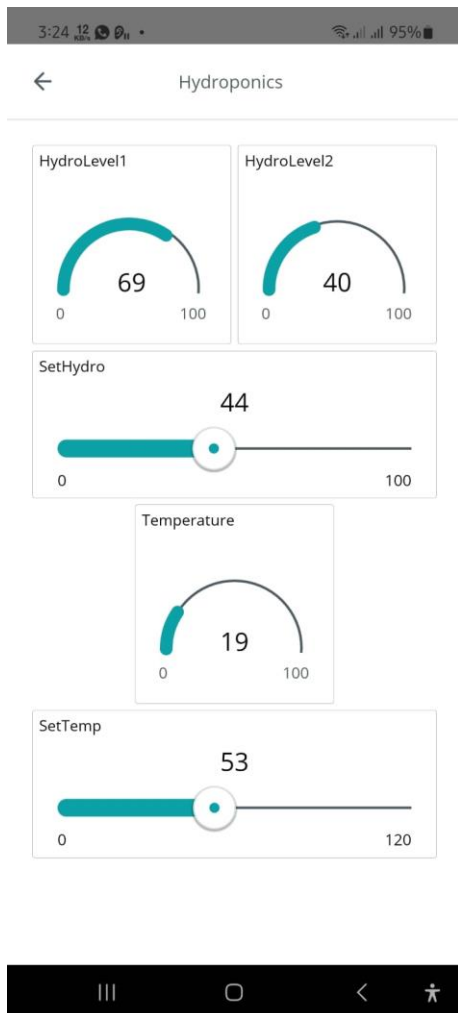
OLED result
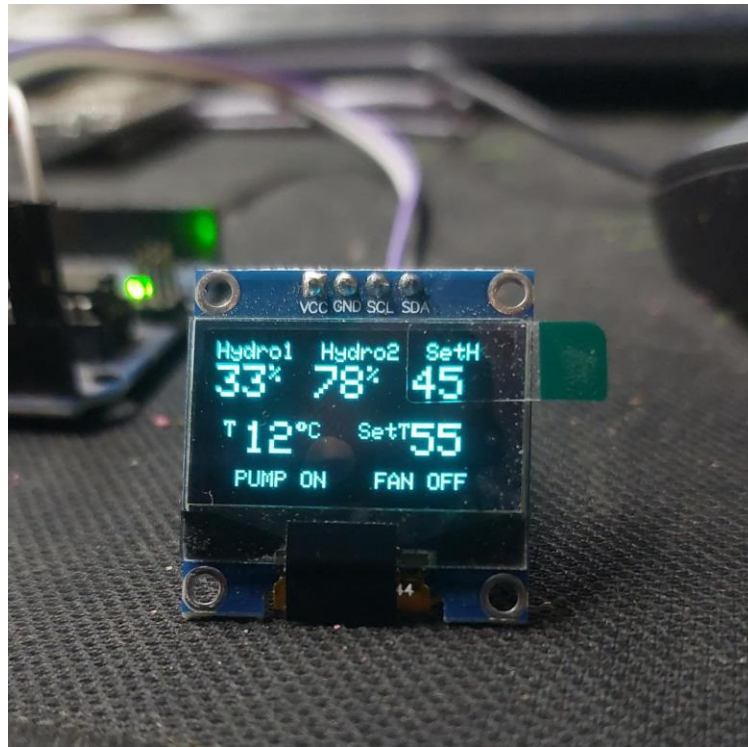
6. Conclusion

In conclusion, the implementation of an IoT based hydroponic project in the UAE has the potential to address several challenges faced by the agriculture sector, including water conservation, increased yields and productivity, food security, and sustainability. By leveraging the latest technology, the project can provide a reliable source of fresh, locally grown produce, reduce the dependence on imported goods, and contribute to the local economy through job creation. The success of this project could serve as a model for other regions facing similar challenges and demonstrate the potential of IoT based hydroponic systems as a sustainable solution for agriculture.

References

[1] https://en.wikipedia.org/wiki/Precision _agriculture.

[2] Zhao Liqiang, Yin Shouyi, Liu Leibo, Zhang Zhen, Wei Shaojun, A crop Monitoring System Based on Wireless Sensor Network ELSEVIER,Procedia Environmental Sciences-2011.

[3] Yingli Zhua*, Jingjiang Songa , Fuzhou Donga, Applications of Wireless sensor network in the agriculture environment monitoring ELSEVIER,Procedia Engineering Sciences-2011.

[4] Shruti A Jaishetty, Rekha Patil, ⯑IoT sensor network based approach for agricultural field monitoring and control. IJRET: International Journal of Research in Engineering and Technology, Volume: 05 Issue: 06 | Jun-2016.

[5] G. Parameswaran, K.Sivaprasath, ⯑ Arduino Based Smart Drip Irrigation System Using Internet of Things DOI 10.4010/2016.1348 ,ISSN 2321 3361 © 2016 IJESC.

[6] https://www.qf.org.qa/stories/approaches-building-smarter-cities-using-innovation-sustainability

[7] https://www.UAE-tribune.com/news-details/id/176625/-UAE-s-water-consumption-among-highest-in-the-world-

[8] https://www.gulf-times.com/story/698733/UAE-s-Water-Crisis

[9] https://www.instructables.com/GSM-SIM900A-With-Arduino/