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Aquaponics: A Comparative Analysis of Approaches Taken for the System.

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Abstract: Currently, agriculture contributes to 20.19% of India's total GDP, yet this sector is most looked down upon when it comes to advancements, technologies, and providing benefits. As India is still a developing country, farming is done with traditional methods which are dependent upon the soil, climate, land condition, water facility, fertilizers, etc. It comes with its pitfalls like degrading soil quality, crop destruction due to unforeseen climatic conditions, and not enough/proper water supply. To prevail over these pitfalls of traditional farming, one such technique comes forward called Aquaponics. The term Aquaponics is coined from two words - Aquaculture (meaning raising aquatic animals such as fish, crayfish, snails, or prawns in tanks) + Hydroponics (cultivating plants crops in water was with no requirement of soil). Aquaponics is, therefore, a food production system that conjoins these two systems whereby the nutrient-rich aquaculture water bolsters the hydroponically grown plants using nitrifying bacteria to convert ammonia into nitrates.
Thus, this technique will provide us with crops as well as fish and is soil-less and uses less water, and less space. In this era of technology, this system can make use of IoT (Internet of Things) for its management and control with the help of various sensors to keep in check the different parameters of the system like PTT level, water level, temperature, etc.

Keywords: Aquaponics, Aquaculture, Hydroponics, IoT

I. INTRODUCTION

Indian farmers mostly rely on traditional farming methods to provide the population with food. But over the years agriculture is plagued by several natural as well as man-made problems. Soils quality could spell the success of the yield but overuse of fertilizers has, in turn, degraded our soils causing runoff and erosion, contamination of water supplies, and released greenhouse gases, thereby being a health hazard to humans. Again, India has uncertain rainfall and a lack of mechanization to add to the hurdles to traditional farming. Taking into consideration all of these factors, we need to come up with some different ideas which will help rule out some of these complications. This is where aquaponics comes into play.

It is a system of soilless farming which uses hydroponics and aquaculture. Hydroponics is basically supplying nutrients to the plants without soil, just through water. Aquaculture is fish farming and the fish extract is provided to the hydroponics system, providing nutrients to the plants together forming the Aquaponics system. The use of IoT will help enhance the monitoring system for aquaponics. Using various sensors, to evaluate various parameters of the system and surrounding like the PH factor, temperature, turbidity, etc. and user will be notified about all the data and operate the pump, feeder, lights, etc. with their smartphone.

II. PROBLEM STATEMENT

Our world has come to a point where there is a need for sustainable alternatives to almost everything – be it fuel, food, energy, fashion, or technology! Our water bodies have been polluted leading to a decrease in aquatic life and overuse of chemical fertilizers in traditional farming is putting a toll on soil quality. Studies suggest that we have less than 100 harvests left, after which the soil would be devoid of the nutrients to grow crops and plants. To counter this global issue and keep up with the food stock for the ever-increasing population, we need to forge some sustainable yet technologically advanced farming techniques that will prevail in the future and also go hand in hand with the modern world. An Aquaponics System (combination of Hydroponics and Aquaculture) checkmarks all these points and with the touch of IoT, it can change the face of Agriculture.

Following are some of the hurdles in previously existing systems:

Manual Monitoring: The Aquaponics System needs a particular environment and the range of parameters is sensitive to the growth of plants and fish which needs constant monitoring.

Manual Fish Feeding: The fishes are to be fed multiple times in a day which consumes a lot of time.

Unavailability of the Internet: Even if the system is being monitored by an IoT system, there are times when the app can't show the readings or alert the user due to a lack of internet facilities.

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III. Differences in Existing Systems and Proposed System

TABLE I Summary of Differences

Sr. No.	Name of Reference Paper	Submitted By	Year	Distinct points presented in a paper	Our System
1	A Review on Plant Without Soil - Hydroponics	Ms. Mamta D. Sardare , Ms. Shraddha V. Admane	September 2016	This paper has given various points related to soilless farming, i.e. Hydroponics. They have discussed various methods for hydroponics as well as plants that can be grown using this technique.	Our aim has been to implement something that would have a sustainable impact on the agricultural sector as there hasn't been much progress in terms of technology, especially automation. We have taken into consideration, the aquaponics system which further leads to the study of hydroponics and agriculture. Using IoT technology, we have enhanced this sustainable farming by making an automated monitoring system.
2	Aquaculture: A Rapidly Growing and Significant Source of Sustainable Food? Status, Transitions, and Potential	D. C. Little, R. W. Newton, and M. C. M. Beveridge	July 2015	The major discussion of this paper is about aquaculture which in simpler terms means fish farming stating its advantages and challenges.	
3	Aquaponics: A Sustainable Food Production System	Maryam Shafahi, Daniel Woolston	November 2014	In this paper, they have discussed the integrated system of Hydroponics and Aquaculture which is coined Aquaponics. This paper discusses the advantages of the system and its stages.	
4	Towards automated aquaponics: a review on monitoring, IoT, and smart systems.	A. Reyes Yanes, P. Martinez , R. Ahmada	April 2020	This paper mainly focuses on the chemical and biological processes that are necessary for the aquaponics system. It shows a comparative study of parameter ranges and their possible effects on the system.	Our system primarily focuses on monitoring the system using various sensors and controlling some features remotely using IoT Technology.
5	HARMONY: A Smart Aquaponics System integrated with Conversational Interface and Internet of Things	Bibek Behera , Subhash Kunnath , Abinash Sahu, and Pallavi Khatri	2021	They created an interactive IoT Aquaponics system by deploying a chatbot in which you could ask about the condition or parameters of the system. They used a GPU board for data	We aimed to automate the system that will allow the user to be informed and alerted on its own if some threshold values are crossed.
6	Smart Aquaponics Farming Using IoT & Mobile Computing	Janavi Chavan , Sonali Patil , Kiran Jangam, Divya Chirayil	April 2020	In this paper, they used IC Atmega328P as their micro-controller, GSM module, and ESP8266 to accomplish the system. Also, they mentioned various ways of filtration using clay pebbles, Lava Rock, and Gravel.	We used Arduino and ESP8266 as the microcontroller and wi-fi module respectively. The mode of filtration medium that will be used is clay balls or pebbles.
7	Smart Aquaponics using IoT	Varsha R, Santhosh A C, Sowndharya	June 2019	They have worked on PIC 16F877 micro-controller which uses flash memory technology.	Compared to this we decided not to use the MQ-137 Ammonia sensor as the sensor is not submersible

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		S, Sri Saranish R, Prabha R			and is unable to give readings of the ammonia present in water.
8	IoT Based Aquaponics Monitoring System	Abhay Dutta, Prayukti Dahal, Rabina Prajapati, Pawan Tamang	September 2018	This paper showcases the use of PVC pipes to grow plants instead of grow-beds. The hardware environment they chose was Raspberry Pi but for converting analog signals to digital format, the use of Arduino Nano was seen along with a designed Printed Circuit Board.	Keeping in mind that to keep our project cost-effective, we have just used Arduino Uno as the microcontroller and used plastic containers for all the plants and fishes.
9.	Smart Aquaponic with Monitoring and Control System Based On IoT	Wanda Vernandhes, N.S Salahuddin , A. Kowanda, Sri Poernomo Sari	February 2018	They have given the information regarding growbox, growlight, etc. that they have used to implement the system. They also used a soil moisture sensor in this project and worked on Arduino Board as the hardware controller.	We have eliminated the use of soil moisture sensors as we have studied that Aquaponics is soil-less farming. Also, we are using led lights instead of grow-light to make them more accessible.
10.	Aquaponics for Agriculture using IoT	Maryam Jawadwala, Yogesh Pingle	2021	This paper has given the implementation of the Aquaponics system which is being automated using IoT Technology and Blynk Application.	Our system has overcome the drawback of manual fish feeding with an automated feeder which will automatically release food to fish.

IV. CONCLUSION

We have discussed the key point of differences in various research papers based on the topic of Aquaponics, Hydroponics, and Aquaculture along with the use of IoT in that particular area and proposed to build a system that attempts to vanquish the pitfalls in them. We aim to implement a system that will cater to the needs of a sustainable food production alternative in the future and also reduce the barricade of human involvement in feeding, filtering, and air pumping in domesticated fishery systems. The model will be capable of sending notifications of the current parameters in the Aquaponics system to the user anywhere, thereby enabling them to monitor the critical parameters and take action remotely.

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