

# IoT Enabled Aquaponics-Monitoring, Game-play and Automatic Fish Feeder System

A.Saravanan<sup>1</sup>, Srushti Chakki<sup>2</sup>Electronics Engineer, Coéo Labs Pvt. Ltd, Bangalore, India<sup>1</sup>Product Development Engineer, Coéo Labs Pvt. Ltd, Bangalore, India<sup>2</sup>

**ABSTRACT:** The urban farming which is rising steadily over the years in terms of popularity trying to foster healthier residents and sustainable communities with the help of technique such as Aquaponics is slowly creating waves globally by changing the way the food is grown. This technique fuses a harmonious link between aquaculture (growing and breeding fish) and hydroponics (growing plants without using soil), with one system working to benefit the other in a cyclical fashion creating a symbiotic relationship. In order to maintain this relationship intact the Internet of things helps in constantly monitoring, analyzing environmental parameters and by means of MCU takes automated corrective actions such as the feeder actuation thus maximizing the yield henceforth reducing manual intervention. The Solution gives a complete real-time overview of essential sensory data and stores it on a cloud database thus making it available for the user to access it from any part of the world. In addition, the user can have a game-play interaction with fishes using web interface thus adding intelligence to the overall system.

**KEYWORDS:** Aquaponics, hydroponics, aquaculture.

## I. INTRODUCTION

Aquaponics is a technique which integrates conventional aquaculture with hydroponics creating a symbiotic environment where plants and fishes help each other thrive. In this system water from aquarium is fed to a hydroponic system where the by-products are broken down by nitrification bacteria into nitrates and nitrites, which are utilized by the plants as nutrients, and water is then recirculated back to the aquaculture system. Aquatic effluents, resulting from surplus feed or raising animals like fish, accumulate in water due to the closed-system recirculation of most aquaculture systems. The effluent-rich water becomes toxic to the aquatic animals when high in concentrations, but these nutrients helps in the growth of plants. Aquaponics systems are generally grouped into several other components or subsystems responsible for the effective removal of solid wastes, for adding bases to neutralize acids, or for maintaining and balancing water oxygenation.

**IoT enabled aquaponics** assists to constantly monitor and analyze the conditions of fish and plants. The system installed takes automated corrective actions to balance the variations based on data from the internet. The learning's from the collected data helps in maximizing the yield, reduces risks and eliminates manual intervention on regular basis. The Solution proposed is completely real time which monitors essential parameters collected from system like Temperature, Light Intensity etc. All the collected Data can be analyzed to obtain insights on growth and Energy/systems utilizations. Combining aquaculture and hydroponics, Aquaponics provides a sustainable food production option right in your own backyard. There is, of course, a science behind ensuring a healthy, balanced build-up of bacteria along with achieving the right water quality which is why it is always recommended to arm you with as much knowledge as possible. But done the right way and the results speak for themselves.

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## II. EXISTING SYSTEM

Recent technological research which is been carried out in this field in on the “Aquaponics system for commercial and urban farming”. The target here is for a field area of 500sq ft to 2500sq ft primarily focussed on commercial farming rather than for homes. The system developed monitors parameters governed for that respective system and provides online information and web based to the user anywhere. The only drawback derived from it is the target end users as it does not encourage its application in homes and public places. This is overcome by the proposed system which targets not only the urban farming but the end user requirement as well making the entire system automated and ensuring a user-system interaction.

## III. PROPOSED SYSTEM AND IMPLEMENTATION

The functionality of proposed system is subdivided into 3 modules i.e. acquiring sensor data, Monitoring essential parameters and displaying on a cloud platform followed by actuation system for feeder mechanism with a game-play interaction.

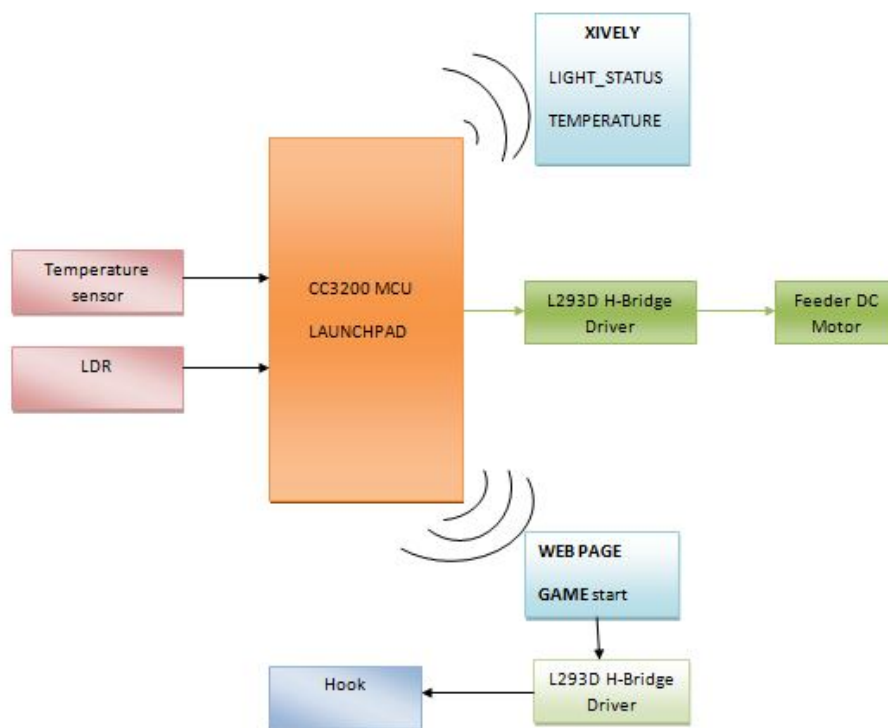


Fig. 1 System Block Diagram

Fig. 1 depicts the entire workflow. The sensor data measured here is the light intensity level and temperature using light dependent resistor and DHT-11. The entire operation is been controlled by CC3200 Texas MCU which has an on chip Wi-Fi that enables us to know the status of various operations carried out from any part of the world. This sensory data is then made available on a cloud platform Xively where a real time graph is been plotted based upon the live feeds obtained.

A software routine is coded into microcontroller for enabling auto feed on timely basis. There is a mechanical setup constructed wherein feeder is attached to a DC motor which is driven by L293D H-Bridge driver. The coding for

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CC3200 is done using energia which is an open source platform. In addition an HTML webpage is developed to actuate a hook for catching the fish on click of a button tab providing a game-play interface.

## IV. RESULTS

The live feeds are plotted on Xively – cloud platform as shown in the Fig. 2. This data is remotely accessible thus keeping user aware about the current status at any instants of time. In order to make this data available a software routine is written in energia and flashed on to the MCU. This software routine enables CC3200 to first establish a Wi-Fi connection followed by initializing the xively key to send the DataStream.

Once the feed is been obtained on xively a real time graph is plotted for the data versus time allowing us to perform analytics.

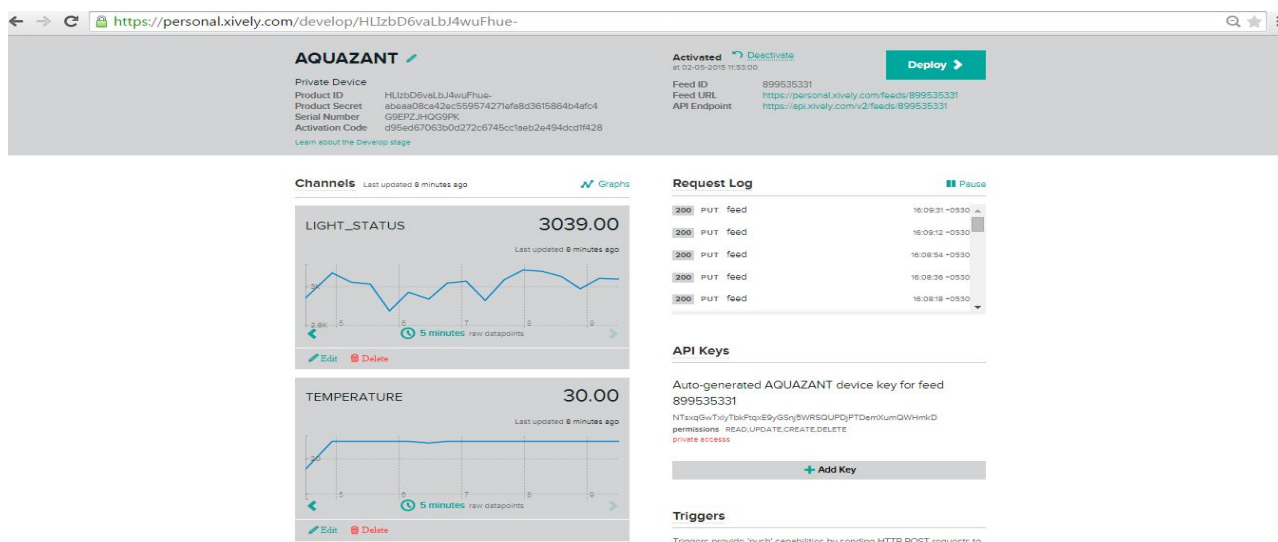


Fig. 2 Xively Data for Light Intensity and Temperature

Webpage for game-play interface between user and system is as shown in Fig. 3.

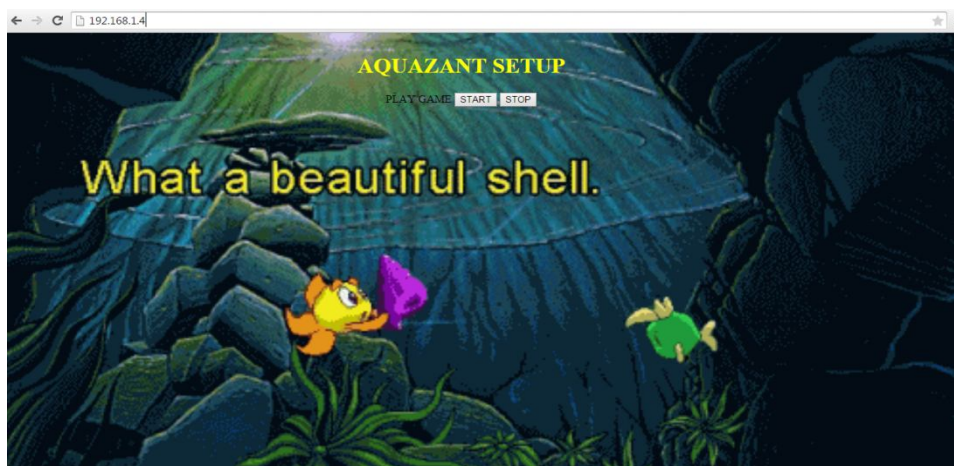


Fig. 3 Game-play Interface

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The software routine for establishing a webpage starts with an attempt to connect to the existing wifi network. Once the connection is established the ip address is been obtained and webserver starts on port 80. Once the server is available it waits for the incoming clients and once the client is connected, the webpage is ready to open. It is coded with initial header file named AQUAZANT SETUP followed by start and stop button for controlling hook. Based upon the client request the start button initiates the DC motor controlling the hook via L293D H-Bridge driver and the stop button brings hook back to the original position thus establishing a gamer interface.

## V. CONCLUSION

The implemented system cleverly combines both hardware and software disciplines resulting into one successful system. The internet of things platform effectively plays an important role in making the data available on the cloud at any given time. With the help of TI's CC3200 Launch pad, the overall power consumption and the additional wireless circuitry is been reduced making the entire system cost-effective. In near future this technology can be extended to next level wherein we have the measure of nitrate content to check for the ammonia waste by different fishes and to ensure a direct relationship with the growth of plants. Considering this proposed system as a basis this platform can be used to yield better growth rates than conventional methods thus promoting urban farming to a greater extent.

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