An Automated Fish Farming System

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Abstract— **Automation has become a modern necessity to render high quality and effectiveness. The report discusses on automation on fisheries sector. A prototype has been built to fully automate fish feeding and a smart system has been developed to observe the necessary condition for fishes to grow to its potential (e.g., Water level, Water temperature, Turbidity). The project has been modeled into two parts. One part is controlled via a Node MCU, and another module has been integrated with an Arduino Uno. With the help of two microcontrollers the following smart system is developed.**

Keywords—Aquaculture, Automated Fish Farming, IoT, Arduino Uno, Motor, Sensors, Mobile application

I. INTRODUCTION

The idea of connecting any gadget to the Internet and other linked devices is known as the "Internet of Things." The Internet of Things is a vast network of interconnected devices and people, all of which gather and exchange information about their environments. IOT is now needed in all aspects of life. As smart technologies simplify our lives and make them more pleasant so the demand of automated or smart systems are rapidly increasing day by day.

Bangladesh is a river-rich country. Approximately 1.2 million people work in inland water fishing, while 0.3 million works in sea fishing. Currently, the fishing industry contributes 3.8% of the GDP. In Bangladesh, 55 percent of the protein consumed comes from fish. Although Bangladesh tends to excel in producing aquaculture and inland water capture fish, its achievement and performance in marine capture fish production is rather weak and time-consuming. The people working in the sector of fisheries are not updated and depends more on the men-power which is also costly, and the outcome is barely effective. As a result, lack of control has caused a huge misspend in the fisheries market from the start which caused limitless losses and delay in this sector.

Now every industry is adopting modern technologies to accelerate their productivity. In fish farming modern tech has extended their capabilities which involves operations, management, production and service. A hybrid strategy, which combines human and technical intervention to make sure that farmers are aware of the best practices widely used in farming, is a smart way to close these gaps in the aquaculture ecosystem. The secret to increased productivity and disease control is smart technology.

A variety of cutting-edge technology may significantly boost the industry's overall sustainability while also helping them increase production and profitability. This automated technology can sense the ponds and river water if the temperature is normal or not and set the desired temperature for the fishes just by using the smart phones. Also, it can control the fish farming necessities like automatic feeding, turbidity control and pH scaling system with help of micro-controllers. As micro-controllers are cheap and available this can minimize the cost and accelerate the productivity in this sector.

II. LITERATURE REVIEW

Wen-Tsai Sung (2016),[1] found that the amount of dissolved oxygen in water increases/decreases based on seasons. When the amount of dissolved oxygen in water is reduced below certain limit then fish growth will be hindered. When amount of dissolved oxygen becomes lower than the fish survival conditions the fish will die. [2] Nocheski, S., and A. Naumoski. (2018), developed a WSN based Traceability System for fish farming ponds. The system enables rapid deployment and can acquire water temperature, salinity, dissolved oxygen and pH and achieve real-time data transmission. [3] K.Raghu Sita Rama Raju and G.Harish kumar Varma (2017), performed a work entitled as “Knowledge Based Real Time Monitoring System for Aquaculture Using IoT” which uses several sensors such as Dissolved Oxygen, Temperature, Ammonia, Salt, pH, Nitrate and Carbonates. But maintaining lots of sensors is costly. So, a system is needed which is not much costly and can determine the overall quality of the water effectively. [4] Wang, Xin, Ma, Longquan, Yang, Huizhong, (2011), developed an online water monitoring system based on ZigBee and GPRS. The sensor data were collected and transmitted via ZigBee and GPRS. The Data Process Procedure was implemented by LabVIEW software. [5]

Haijiang, Tai, Shuangyin, Liu, Daoliang, Li, Qisheng, Ding, Daokun, Ma, (2012), developed a distributed measurement system based on networked smart sensors to monitor aquaculture factors in multi-environment. The system consists of four parts: data collection nodes, routing nodes, on-site monitoring center and remote monitoring center; and can bring-out real-time monitoring water quality parameters and meteorological parameters. [6] Epinosa-Faller, Francisco J., Rendon-Rodriguez, Guillermo E., (2012), developed a ZigBee wireless sensor network for monitoring an experimental aquaculture recirculating system. Temperature, dissolved oxygen, water and air pressure as well as electric current sensors were included in the setup. The modules were installed in an aquaculture recirculating system to transmit sensor values to the network coordinator. A remote wireless system for water quality online monitoring in intensive fish culture, which combined web-server-embedded technology with mobile telecommunication technology was also developed. [7]

Simbeye, D. S., J. Zhao, and S. Yang (2014), developed and deployed low-cost short-range modules of wireless sensor network based on ZigBee standard and virtual instruments technology in order to monitor and control an aquaculture system in real time. The system consists of smart sensor nodes, coordinator/gateway node and personal computer (PC). The smart sensor nodes monitor environmental parameters such as dissolved oxygen, water temperature, pH and water level using relevant sensors, transmit this information to the coordinator/gateway node through ZigBee network and receive control signals for actuator control. [8] Maulana, Y.Y., G. Wiranto, D. Kurniawan, I. Syamsu, and D. Mahmudin In this paper, they described the design and realization of online water quality monitoring system based on wireless sensor network.

The new system has been implemented specifically to monitor parameters Dissolved Oxygen (DO), pH and temperature in one spot shrimp aquaculture in Bangka Island. Their aim was to create a suitable water condition for shrimp aquaculture and save the cost of energy consumption using an automated aeration system, by maintaining the value of the DO above 5 mg/L. On the other hand, water quality data collected from sensor measurements are sent to a data logger using WSN, and then the data is sent to a data center using cellular network (GPRS) such that this data can be viewed using the website. [9] Acar, U., F. Kane, P. Vlacheas, V. Foteinos, P. Demestichas, G. Yücetürk, I. Drigkopoulou, and A. Vargün. (2019). In this paper, they presented a use case with an IoT cloud solution after summarizing the potential technologies and tools to use in accordance with the use case problem as identified in the Horizon2020 Project, the intelligent management system for integrated multi-trophic aquaculture (IMPAQT) in which they have been participating in. Islam, M., Uddin, J., Kashem, M. A., Rabbi, F., & Hasnat, M. (2021) [10]. In this paper, they presented an Internet of Things (IoT) system using K Nearest Neighbors Machine Learning Model for selection fish species by analyzing a fish data set. For storing real time data from used sensors, they used a cloud server. They made a dynamic website for giving information of various fish species living in an aquatic environment. This website is connected with cloud server; anyone can easily watch it on a web application. Therefore, they can easily decide what should follow the next step, which kinds of fish are surviving in the water. For constructing the proposed IoT system, they utilized 5 sensors including mq7, ph, temperature, ultrasonic and turbidity. These sensors are connected with an Arduino Uno. The real time data of water environment using sensor is obtained in the cloud server as a csv format file. In this study, they have utilized a server of thing speak. The end user of fish farming can monitor easily remotely using the proposed IoT system.

III. Methodology and Modeling

The Following Project will handle into two modules. One is to integrate Node MCU based feature and other will be to integrate Arduino Based Feature. Both modules will integrate further to be developed a full-fledged smart fish farming system.

Component Description:

1. Arduino UNO R3

Arduino UNO is a microcontroller board based on the ATmega328P. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

a. Memory:
   1) AVR CPU at up to 16 MHz
   2) 32KB Flash
   3) 2KB SRAM
   4) 1KB EEPROM

b. Power: 2.7-5.5 volt

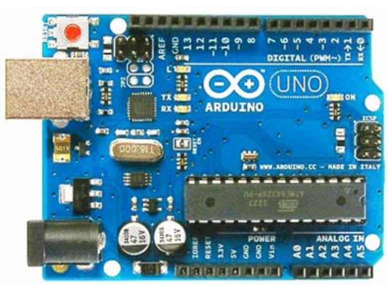


Fig 1: Arduino UNO

2. NodeMCU ESP8266MOD

NodeMCU is an open-source Lua based firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module.

1) Memory: 128kBytes
2) Storage: 4Mbytes
3) Power: Micro-USB, 3.3V, GND, Vin

Fig 2: NodeMCU ESP8266

3. DS 18B20 Temperature Sensor

The DS18B20 is one type of temperature sensor and it supplies 9-bit to 12-bit readings of temperature. These values show the temperature of a particular device. The communication of this sensor can be done through a one-wire bus protocol which uses one data line to communicate with an inner microprocessor.

Fig 3: Temperature Sensor

4. Turbidity Sensor

The turbidity of water refers to the degree of turbidity caused by suspended substances such as silt, clay, organic matter, plankton and microorganisms contained in the water.

Fig 4: Turbidity Sensor

5. Water Level Sensor

The water level sensor is a device that measures the liquid level in a fixed container that is too high or too low.

Fig 5: Water Level Sensor

6. **Micro Servo Motor SG90**

A servo motor is a type of motor that can rotate with great precision. Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors to rotate with great precision.

Fig 6: Servo Motor

7. **LCD Display**

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers.

Fig 7: LCD Display

8. **16×2 i2c**

I2C is short for Inter-IC. And it is a type of BUS. I2C is a synchronous, multi slave, multi master packet switched, single-ended serial bus. Multiple chips can be connected to the same bus. I2C uses only two bidirectional open collector or open drain lines, Serial Data Line (SDA) and Serial Clock Line (SCL), pulled up with resistors.

Fig 8: i2c

9. **Other Components:**
    1) Breadboard
    2) 9v Battery
    3) LED Lights
    4) Resistors
    5) Jumper Wires
    6) Plastic Pots

IV. IMPLEMENTATION

The project has been implemented with two parts and a total of 4 features. 2 of the features will be controlled by the node mcu ESP-8288 remotely with the help of Blynk app and remaning feature will be controlled by the micro controller Arduino Uno. Sensors of 4 features are connected as mentioned below:

Sensor Name	Sensor Task	Connected To	Type of Output
Water Temperature Sensor	Measure the temperature of the environment	NodeMCU (ESP8266MOD)	Float Values Unit: Celsius
Turbidity Sensor	Measure water turbidity	Arduino Uno and LCD1	String and Integer
Water Level Sensor	Measure water level	Arduino Uno and LCD1	String

Working flow-chart of Arduino Uno:

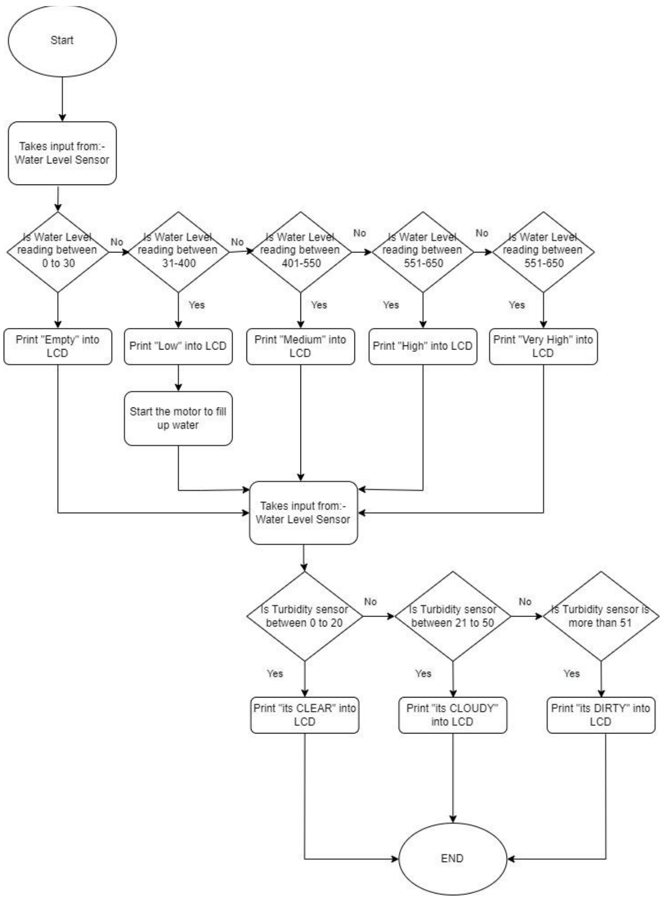
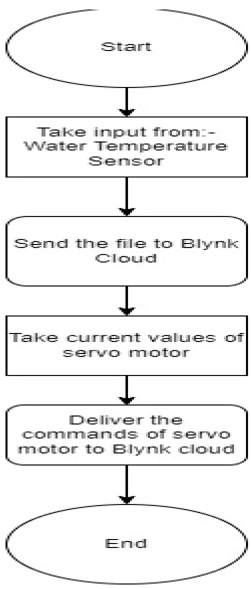


Fig 9: Arduino Uno work-process

Working Flowchart of NodeESP -8286:



Experimental Setup:

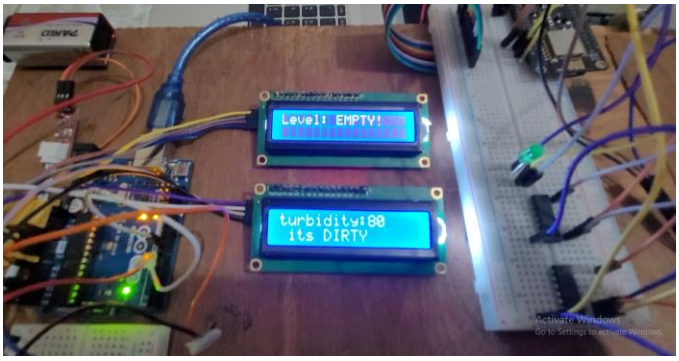


Fig 11: Initial Setup

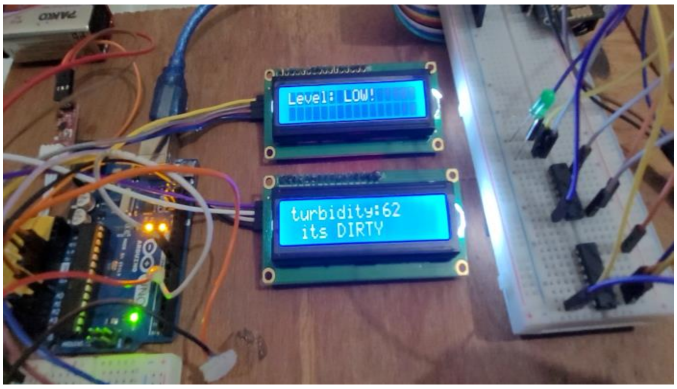


Fig 12: Low water

Fig 13: Water level Medium

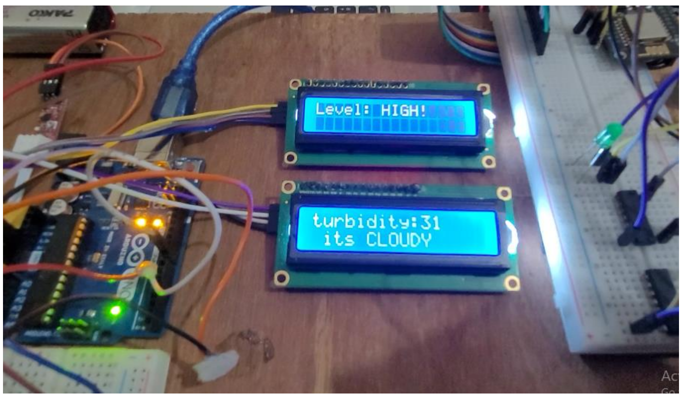


Fig 14: Water level High

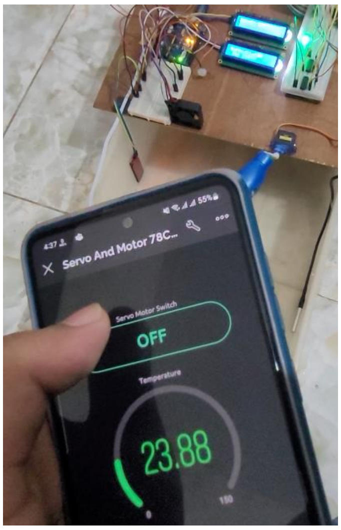


Fig 15: Initial Temperature

Fig 16: Temperature Drop at adding water

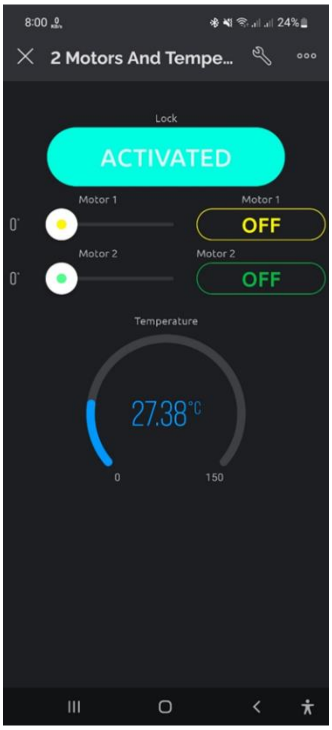


Fig 17: UI with 2 motor

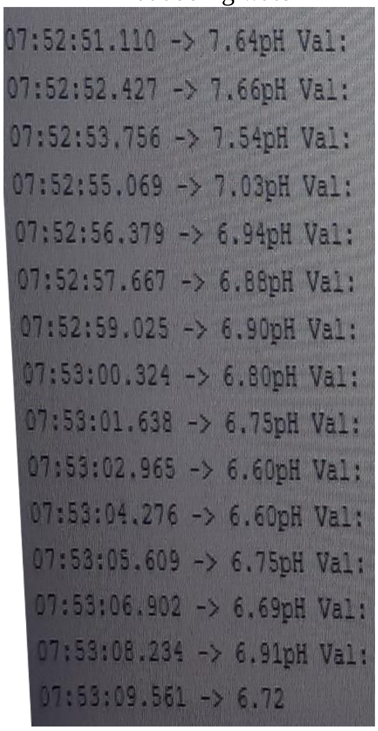


Fig 18: Output from PH sensor

Cost Analysis:

Serial	Component Name	Quantity	Price (in taka)
1	DS 18B20	1	120 tk
2	Turbidity Sensor	1	680 tk
3	Sonar Sensor	1	70 tk
4	Buzzer	1	10 tk
5	LCD Panel 1602	2	260 tk
6	I2C	2	170 tk
7	SG-90	2	220 tk
8	ESP 8266	1	240 tk
9	Jumper Wire	4	200 tk
10	9V Battery	1	150 tk
11	Breadboard	2	180 tk
12	Water Level Sensor	1	50 tk
13	Arduino UNO	2	3500 tk
14	IC -7408	1	16 tk
15	IC -7404	1	16 tk
		Total	5882 tk

V. RESULT AND DISCUSSION

Numerical Analysis

1. For water level Sensor

The water level sensor is connected to an LCD panel for display purposes. Here is some set of data taken to check the accredit ability of the system.

Estimated Water(cm)	*Expected Output*	*Actual Output (LCD)*	*Status Check*
00	*Empty*	*Empty*	***Working***
25	*Empty*	*Empty*	***Working***
40	*Low*	*Low*	***Working***
100	*Low*	*Low*	***Working***
450	*Medium*	*Medium*	***Working***
550	*High*	*High*	***Working***
1000	*High*	*High*	***Working***

2. For Turbidity Sensor

Estimated Turbidity	*Expected Result*	*Actual Result*	*Status*
Null	*Clear*	***Dirty***	***Sensor defect***
55	*Dirty*	*Dirty*	***Working***
20	*Clear*	*Clear*	***Working***

Experimental Results & Discussion

After implementing the project, it is widely apparent that most of the sensors are working perfectly fine and giving the expected results as the actual results. 2 motors used for convenient feeding. Both motors and temperature module can be controlled with the Blynk app. So, it could be said that the proposed project was implemented successfully and efficiently.

Limitation of the Project

- A PH sensor can deliver crucial information about the water quality and healthiness of the fish. But a working PH sensor was not implemented here.
- The turbidity module does not show accurate values when being used.

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