

IoT based Water Surface Vehicle

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Abstract : The paper proposed a structure for monitoring the ecological and environmental parameters based on multi-channel sensing module like water sampling, air quality index, temperature humidity and heat index. The entire sensing module is associated with Arduino mega microcontroller. The data received from the sensors are directly stored in the cloud using NodeMCU chip. The cloud service is provided by thingspeak which is free of cost and smart phone compatible.

IndexTerms - USVs, IoT, Arduino, Sensors

I. INTRODUCTION

There are various transmission or communication technologies available in technology index. Now days, IoT is leading on the chart of communication and technology. It is somewhere extension of wireless sensor network. Inter-Device communication through communication network with or without Gateway is the lifeline of Internet of Things. In last four decade, Internet has acquired all communication method as well as interaction methods with others, from mail writing to video streaming. IoT is a network of items which are embedded with actuators and sensors to send or receive data or instruction over the internet. [1] The devices introduced in IoT have been increasing day by day from luxury automobile to smart home appliances to ease up the life of human beings.

Various IT companies has initiated the new wing of development in IoT, while other companies are also planning for the initiation. In India, IoT is very popular in governmental schemes and projects. Smart-city is one of the prime concerns of the government. The devices which are connected to the internet, are many more than the population of the world. In a survey, 23.14 billion devices are connected to the internet in 2018. It is predicted that around 2020, 30 billion devices will be connected to the internet [2]. As the technology is becoming cheaper the number of IoT devices will be increased. Technology providers are concern to provide better protocols and enhanced security of an integrated IoT system for smart home. The robotics and artificial intelligence field of computer science is transforming and moving toward the IoT technology because it provides ease of operating the devices due to better interface.

India is the geographically rich country. It has many small and large river networks. The rivers and lakes are the source of fresh water which contains the nutrients, oxygen and food for the ecological system. But the administration is concerned about the pollution of the water due to industrial growth.[3] The monitoring of the rivers and the water is not possible because of the flexible course and typically dependency of the flow of water on the weather.

As technology is shifting towards the automation, the advancement in sensors provides the environment to tackle the problem of monitoring and accessibility to any system. This paper is also providing the accessibility and monitoring to such type of situation. A general model is explained in this paper that provides better connectivity to the devices at lowest possible cost and monitoring the aquatic environment very quickly. This work is designed to provide accessibility of the monitoring environment on the portable device like smart-phone or PDA. The hull of the ship represents its strength. Same way, the hull of the aquatic drone is designed very efficiently and effectively to provide durability and support to the entire structure. The system can perform maritime task such as monitoring and vigilance. Maritime aquatic drones are capable of cleaning oil spill from the surface, transceiver the data signals, 3 D bathymetric survey using LIDAR etc

This paper provides an aquatic monitoring system based on Arduino MEGA chipset and combination of temperature, underwater temperature and humidity sensors. The sound sensor and ultrasonic sensors are also associated with the proposed system to recognize the behavior of sound on water bodies and hassle-free movement of the drone on the surface of water. Wi-Fi wireless transceiver module will provide the IoT enabled compatibility.[4]

Water bodies are the part of human life. The life without water is not possible. So, the monitoring of water quality is the big area of concern. In India, Namami Gange is the largest scheme to clean the river Ganga. Micro aquatic bodies are equally important to the environment.[5]

Lots of human effort is required to monitor the river and taking water sample for laboratory process. This paper provide the mechanism of partial human free water collection model. Water transparency is also the key factor for measuring the water quality. Good health of water bodies is reflected as good health of human beings. Multi-drone swarms is the ultimate solution for getting the human free water monitoring system. We can address large number of the problems using the innovations in the technology.

There are various application specific purpose aquatic drones are available like oil spilling, cinematography, fish health monitoring. This paper present an Arduino mega based water surface vehicle used for monitoring the air quality, humidity, temperature and heat index. During the implementation of this aquatic drone several modules are covered. There are various micro-controller based devices available. But Arduino mega and NodeMCU is the low-cost and powerful devices to implement this proposed system.

The sensors are mounted on NodeMCU chip. The ultrasonic sensors are used to provide the direction to the aquatic vehicle. Thingspeak is the open source cloud service used to send the captured data.

II. RELATED WORK

Lisbon based Bio-Machine Lab is designing the swarm of drones model, based on WiFi to perform Sea-based tasks. These drones are equipped with Raspberry Pi 2 (another powerful micro-controller) , GPS and Compass. This is the application of distributed computing Network. [6]

In 2015, ICCPCT which stand for International Conference on Circuit Power and Computing Technology reported a research that used Raspberry Pi with IoT module and temperature sensor. The data received by micro-controller is uploaded to the cloud service.[7]

The robust and the grand research in this field is WOW. WOW is USA based Water on Web project. It is the latest development in the field of water sampling and environmental monitoring. It collects the data from lakes and rivers and upload the collected data to the web servers. It is a floating station that uses underwater sampling system. It is equipped with turbidity sensors , pH sensor, temperature sensor and GSM network.[8]

The prime concern of latest development and research in this field is to reduce the size of aquatic vehicle and enlarging the number of sensors mounted on it.

III. SYSTEM DESCRIPTION

The proposed system consists of two modules. First, For the motion of the vehicle associated with four motors ultrasonic sensors mounted over Arduino Mega. Second, NodeMCU chip embedded with IEEE 802.11 Wi-Fi facility. The NodeMCU device is associated with two sensors. One is DHT11 Temperature sensor , working on the principle of voltage-temperature relation. Another is Gas sensor MQ-135, which is used to detect the surrounding hazardous gas. Both sensors are connected to 3.3 Volt power supply. [9]

The data pin in DHT11 is attached with GPIO-0 Pin or D3 pin of NodeMCU. There are four pin in hazardous gas detection sensor. Two out of four pins are used as ground and Vcc. Remaining two are digital and analog pin. Digital pin is linked with D4 and analog pin is linked with A0 pin of NodeMCU. To run the entire module successfully , a hotspot service will comes under prerequisite.

$$RH\% = [(V_{out} / V_{supply}) - 0.16] / 0.0062$$

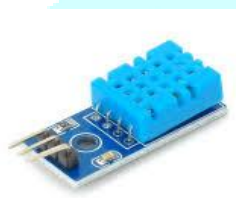


Fig 1.0- DHT11 Sensor for Temperature

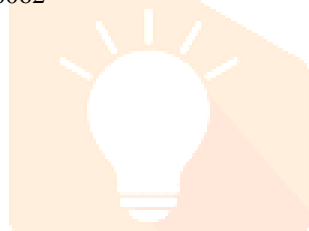


Fig 1.1- MQ135 Sensor for Air Quality Detection

The data received from the sensors is directly uploaded to the THINGSPEAK cloud service, The program of slave Wi-Fi, with hotspot credentials like name and password is passed Into the code to get- connected with internet. Prerequisite of using the THINGSPEAK server is get registered on the web portal with the cloud services. The API keys are provided to share the data. But before sharing the API key, new project has to be formed. One project shares Two API keys. One is to receive the data and another to send the stored data.

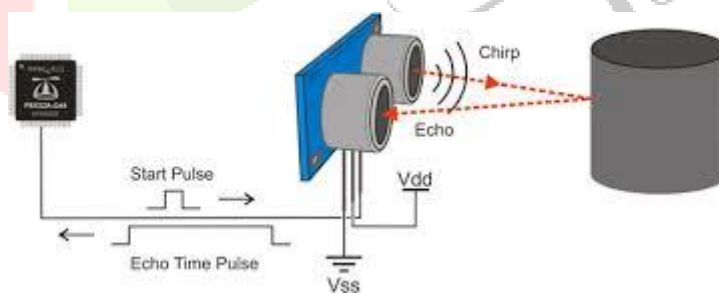


Fig 1.2 Working of Ultrasonic Sensor Module

By pushing box service, Google Spreadsheet is also used to transmit the data. But it is little complex as multichannel API is to be configured by the developer. But in thingspeak one API is enough to share the entire data.

On the other hand, four ultrasonic sensors are mounted on the aquatic vehicle in all four directions. These sensors are used to get the distance from the obstacle to the drone. The data received from ultra-sonic sensors are used in motion designing algorithm that is responsible for the motion of the vehicle. The algorithm is implemented on Arduino Mega Microcontroller board.



Fig 1.3 Arduino Mega Microcontroller

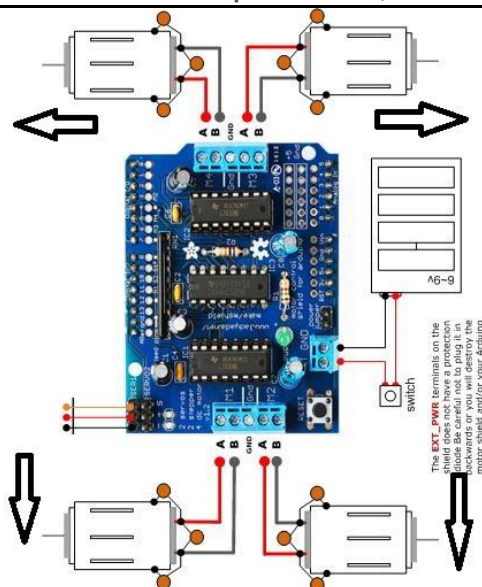


Fig 1.4- Motor Shield L293D

The hull or the base structure of the aquatic drone is made up of PVC pipe, which is quite stable and reliable model. The design is inspired from the safety tube used in swimming pools and marine ships.

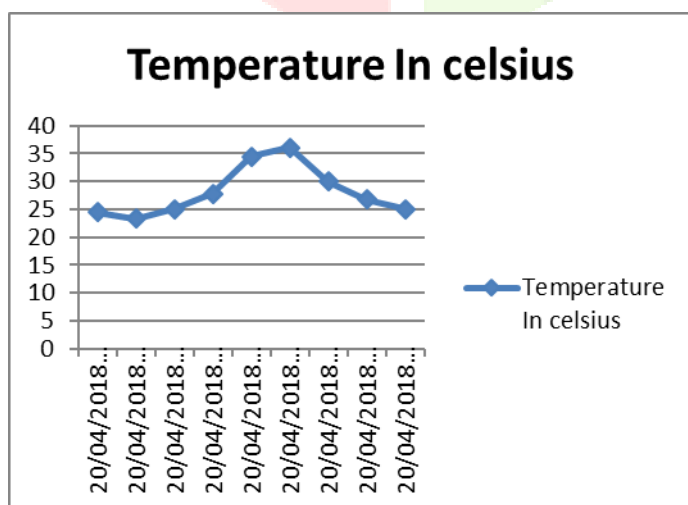
IV. RESULTS

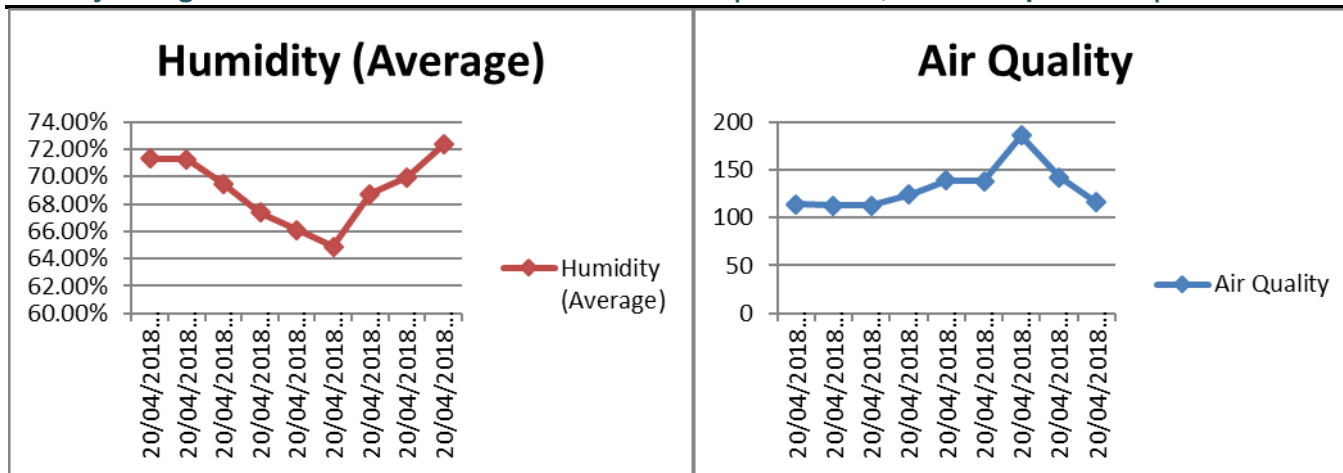
RESULTS- The data received from NodeMCU is given below. The data is captured during the observation on the pond of Ashoka Hostel of Babasaheb Bhemrao Ambedkar University, Lucknow. The data is stored using pushing box and Google spreadsheet.

DATE and TIME	Temperature(in Celsius)	Average Humidity	Air Quality
20/04/2018 12:00 AM	24.50	71.30%	114
20/04/2018 03:00 AM	23.34	71.25%	113
20/04/2018 06:00 AM	25.04	69.46%	113
20/04/2018 09:00 AM	27.84	67.36%	124
20/04/2018 12:00 PM	34.44	66.08%	139
20/04/2018 03:00 PM	36.08	64.86%	138
20/04/2018 06:00 PM	29.94	68.75%	186
20/04/2018 09:00 PM	26.77	69.97%	142
20/04/2018 12:00 AM	25.09	72.35%	116

Table 1.0 – Data received by DHT11 and MQ135

The graph-view is represented below-





V. CONCLUSION AND FUTURE SCOPE

The goal of this paper to provides the data of environmental monitoring for research and development. This also helps to provide more specific details on the aquatic body. The data is fetched by cloud for a long time because it uses 3.3 Volt power supply, which is so minimal. As the vehicle is mobile, so it is very easy to get the point specific data, on the water body.

The future work will be focused on developing the specific mobile application which fetch the data from web or cloud services. It is semi IoT based module of aquatic drone, because the motion is not controlled over the internet. But in future work, the fully IoT based structure can be implemented.

Artificial intelligence, machine learning and MATLAB processing are the future scope of this paper. As AI requires more computations, fast processing device or microcontroller is required. MATLAB processing requires images to work on. So, a camera module should be the requirement of the next version.

There are also some limitations as the module is completely surf over the water surface, the sensor and computational chip is not 100% water proof. The impact of water and moisture may damage the circuit board and sensors.

References

- [1] Brown, Eric (13 September 2016). "Who Needs the Internet of Things?". Linux.com. Retrieved 23 October 2016.
- [2] Hsu, Chin-Lung; Lin, Judy Chuan-Chuan (2016). "An empirical examination of consumer adoption of Internet of Things services: Network externalities and concern for information privacy perspectives". *Computers in Human Behavior*. 62: 516–527.
- [3] Hassan, D. (2006). *Protecting the Marine Environment From Land-Based Sources of Pollution*. London: Routledge.
- [4] [online] Available : <https://store.arduino.cc/usa/arduino-mega-2560-rev3>
- [5] "About National Mission for Clean Ganga". NMCG. 2011-08-12. Retrieved 2016-10-13.
- [6] Duarte Miguel, Costa Vasco, Gomes Jorge, Rodrigues Tiago, Silva Fernando, Oliveira Sancho Moura, Christensen Anders Lyhne, "Evolution of Collective Behaviours for a Real Swarm of Aquatic Surface Robots", *PLOS ONE*. 2016, vol. 11, no. 3, pp. e0151834, 2016.
- [7] N Vijayakumar, R Ramya, "The real time monitoring of water quality in IoT environment", 2015 International Conference on Circuits Power and Computing Technologies [ICCPCT-2015], 2015
- [8] [online] Available: <http://www.waterontheweb.org/data/index.html>.
- [9] Chattoraj, S., 2015. Smart Home Automation based on different sensors and Arduino as the master controller. *International Journal of Scientific and Research Publications*, 5(10), pp.1-4.