REAL TIME MONITORING OF AQUACULTURE AND SURVEILLANCE USING RASPBERRY PI

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Abstract: Aquaculture is one of the generally stretching out ventures inferable from the quick interest for fish everywhere throughout the world. While aquaculture and Internet of things (IoT) have exponentially grown in the world in the last years, the combination of both domains still remains at its early stage. We believe that developing user-friendly Internet of things (IoT) tools for fish farming will lead to a new era of connected, responsible and efficient aquaculture. Internet of things (IoT) for aquaculture needs to be smart, affordable, easy to deploy, reliable and highly efficient. This undertaking proposes an ongoing monitoring answer for estimating the physiochemical parameters of water and a choice emotionally supportive network for information stockpiling, monitoring, breaking down and sending the data to the users required at the ideal time and furthermore our proposed model uses raspberry pi to underpin remote real time monitoring of aqua-culture. In this undertaking, we utilize different sensors like pH esteem, temperature sensors and computerized surveillance with a remote pi camera module v2/v3 to empower live monitoring of the aqua-culture refined locales and their environment.

In this work we present the prototype and proof of concept of a distributed monitoring system of the aquaculture is totally dependent on the physical parameters of water to most of the extent. Water quality is determined by variables like temperature, transparency, turbidity, water colour, carbon dioxide, pH, alkalinity, hardness, unionized ammonia, nitrite, nitrate, primary productivity, BOD, plankton population etc. In our proposed model, real time monitoring of culture and the water quality management principles in fish culture have been reviewed to make aware farmers about the important parameters that influence health of a pond. The experimental results show that the system has great prospect and can be used to operate in real world environment in large scale for optimum control of aquaculture environment.

Keywords: Arduino, Aqua-Culture, Internet of Things, Raspberry pi, Sensors, Water quality parameters, Mobile & Cloud Computing.

INTRODUCTION

Aquaculture is one of the prospering segments in developing countries like India as it contributes 1.07 percent of the GDP. It is found that fish necessity of the country by 2025 would be in terms of 1.6 crores tones and due to the overfishing regular fisheries have been drained therefore commercial aquaculture has been appeared. Aquaculture comprises the arrangement of exercises, information and methods for the rearing of underwater plants and a few types of animals in the water. This action has incredible significance in monetary advancement and food development. Constant checking of the physical, synthetic and organic guideline of lake or pond water helps not only to identify and control the negative states of aquaculture yet additionally to maintain a distance from natural harm and the breakdown of the production process. The observing of physical and substance factors like pH, oxygen, and temperature in water is crucial to keep up sufficient conditions and avoid unfortunate circumstances that cause the failure of aquaculture. Aquaculture, known as aqua farming, is the farming of aquatic animals, for example, scavengers, fish, and crabs. The proposed work supports remote observing of the fish farming dependent on Internet of Things (IoT) for ongoing checking, control of a fish farming and the serious issue like wastage of water in aquaculture are controlled with aquaponics, also called the coordination of hydroponics with aquaculture, has developed to be a fruitful model of feasible natural and organic food production. The harmonious connection between fish, plants, and microscopic organisms, in a controlled domain, relies on ideal water quality conditions. This requires a need to create consistent water quality checking procedures that depend on keen information securing, communication, and handling. This work centres around utilizing the Internet of Things (IoT) technology to screen and control of water quality parameters utilizing sensors that give remote, persistent, and continuous data of pointers related to water quality, on a graphical user interface(GUI). A designed work containing a Raspberry Pi 3 and commercial sensor circuits and tests that measure pH, water temperature and turbidity was conveyed in an aquarium and the data gained from the sensors is transferred to Thing Speak, an IoT investigation stage service that gives continuous informationrepresentation and examination. Consistent observing of this information, and making vital modifications, will encourage the maintenance of a healthy environment that is conducive to the development of fish and plants while using around 90 percent less water than conventional farming.

OBJECTIVE

As of late commercial aquaculture is facing numerous challenges because of abrupt environmental condition variations that end up in changes in water quality parameters. As of now, aqua-farmers use manual check strategies for knowing the parameters of water. This will take longer and not correct since water quality parameters could change with respect to time. In order to avoid this downside, innovation should be involved in aquaculture that improves the potency and limits the losses by constant checking of water quality parameters. The goal of this project is to design and execute a distributed system for aquaculture water quality care through remote observing of turbidity, temperature and pH. This work will contribute remote monitoring framework through IoT to screen water quality in ponds. The system is portable, modular, low cost, versatile and permits sharing of data through the cloud that can be used for the advancement and improvement of aquaculture related activities.

LITERATURE SURVEY

As our framework depends on monitoring water quality parameters and taking preventive measures, we explored on sensors used to screen water parameters[6]. In 2012, teacher of K.L University outlined monitoring framework with the assistance of Zigbee Module and ARM7 controller to control constant aquaculture ecological factors and achieve the issues raised. Daudi S. Simbeye and Shi Feng Yang gave the outline of water quality monitoring and control framework for aquaculture in view of remote sensor systems and single chip PC innovation as a base in the genuine activity. It understands monitoring of the water natural parameters for escalated aquaculture and caution ,Zhu Wang Qi Wang, Xiao QiangHao examined the issue of the manual explanatory technique received in waterquality location with awful ongoing character and presented a novel sort of remote water quality estimating and monitoring framework in view of WSN. ShrutiSridharan et al. tended to in their venture about building up a productive remote sensor organize (WSN) based water quality monitoring framework, which looks at water quality.

Fish is considered a food with a high nutritional value, providing an important source of protein and a wide variety of vitamins (such as D and B2-riboflavin), minerals (iron, zinc, iodine, magnesium, and potassium) and poly-unsaturated omega-3 fatty acids. According to the report of Food and Agriculture Organization from 2014, in the year 2010 fish accounted 16.7% of the global population's intake of animal protein and 6.5% of all protein consumed. Taking into consideration that world's population keeps growing during next decades and global life standards, respectively animal protein need rises, fish demand will certainly growth. Because the wild fish captures are already exploited at maximum level, a large part of those new demands must be satisfied through aquaculture activity. As a result, aquaculture has generated a great interest from the international scientific community, supplying the concerns regarding the increase of sustainability and profitability by different methods.

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PROPOSED SYSTEM

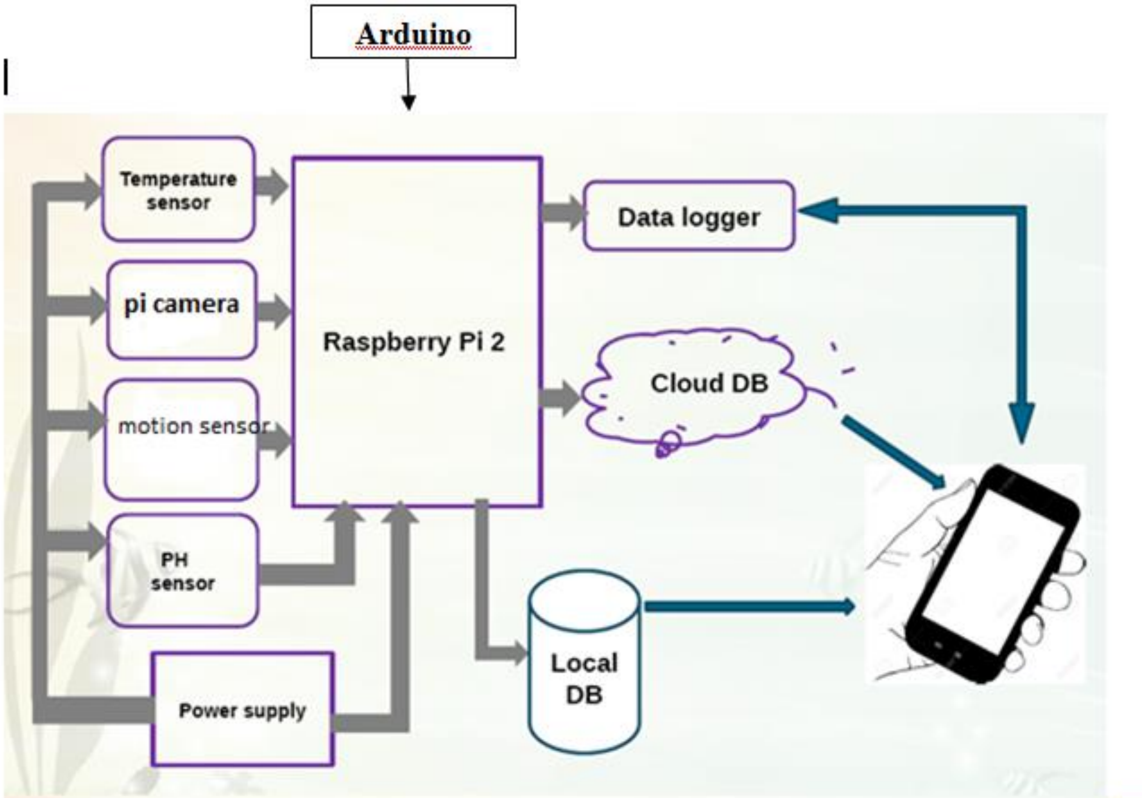

FIG. 1(A): BLOCK DIAGRAM

BLOCK DIAGRAM DESCRIPTION

Power module: The power module has a DC-DC converter, charge controller, battery. The battery is predominantly used to supply control in the night as water quality parameters for the most part changes at night. A DC-DC converter is there to give the capacity to scale controller module which will work at 5V. A DC-DC converter is mainly used to provide an invariable voltage.

Sensor module: The sensor module consists of certain sensors, for example, pH, turbidity, nitrate sensor, dissolved oxygen sensor. These sensors are connected with Raspberry Pi and are used for detecting the water parameters from time to time.

Controller module: It is treated as the most important part of this project. Raspberry Pi-3 model B is used as a controller. Raspberry Pi is a low budget, small computer board with Linux as a working framework. It has a large number of favorable circumstances when contrasted with other small scale controllers, for example, inbuilt Wi-Fi module. The Program for getting the sensor information is written in the python language and send that information to the cloud. The server-side program constantly onlookers the sensor esteems whether they are inside the edge extend. In the event that the qualities go amiss from the edge extend, telling message with the arrangement is sent to the mobile app that is an output module.

Output module: Aqua farmer mobile is treated as an output section. An app has been developed in the mobile phone which has several widgets to display the sensor data and other buttons to control the flow of water through the motor and if the sensed data exceed the threshold ranges alert Message will be sent to the farmer with necessary steps to be taken.

IMPLEMENTATION

Raspberry Pi

The Raspberry Pi- a credit card sized single board computer developed by Raspberry Pi Foundation, United Kingdom. The board is a miniature marvel, packs extreme computing power and capable to develop amazing projects. The computer costs ranging from $5 to $35 and is perfect to perform all sort of computing tasks and interfacing various sorts of devices via GPIO. The Raspberry Pi board contains Broadcom based ARM Processor, Graphics Chip, RAM, GPIO and other connectors for external devices. The operating procedure of Raspberry Pi is very similar as compared to PC and requires additional hardware like Keyboard, Mouse, Display Unit, Power Supply, SD Card with OS Installed (Acting like Hard Disk) for operation. Raspberry Pi also facilitates USB ports, Ethernet for Internet/Network-Peer to Peer Connectivity. Like any other computer, where Operating system acts as backbone for operation. Raspberry Pi, facilitates open source operating system's based on Linux. Till date more than 30 operating systems based on different flavors of Linux is being launched. Raspberry Pi foundation has also launched various accessories like Camera, Gertboard and Compute Model Kit for deploying add-on hardware modules.

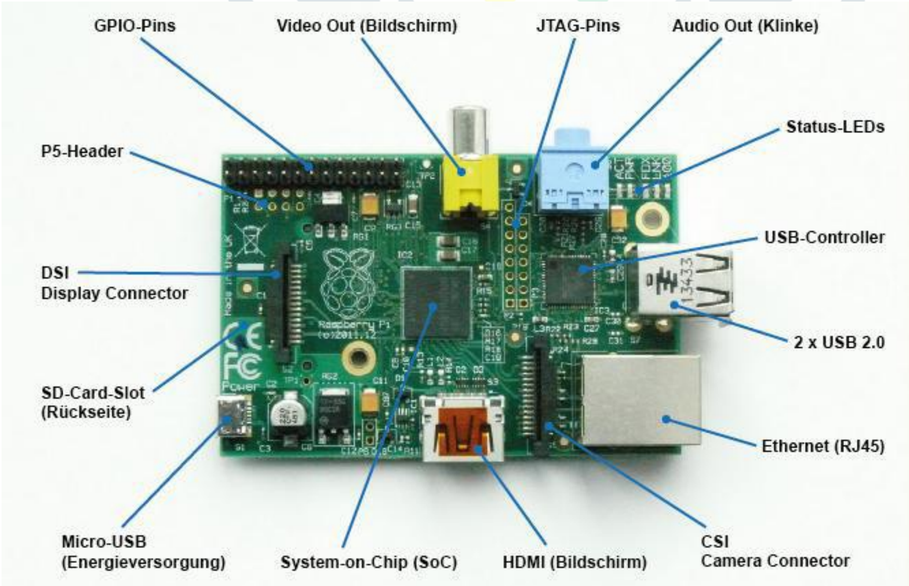

FIG 1 (B).BLOCK DIAGRAM OF RASPBERRY PI

Connecting an Arduino to Raspberry Pi

After pricing a multitude of combinations of microcontroller boards and Wifi adapters, I found that the Raspberry Pi + USB Wifi + Arduino is the absolute best value for money if you need both wireless internet access and easy sensor data handling.

FIG. 1(C): ARDUINO CONNECTION WITH RASPBERRY PI

The Arduino using the IDE running on the Raspberry pi this running headless by connecting to the RPi across the network using the Windows Remote Desktop Connection tool. The connection of the Raspberry Pi and Arduino is by connecting the GPIO on the Raspberry Pi and the Serial Pins on the Arduino.

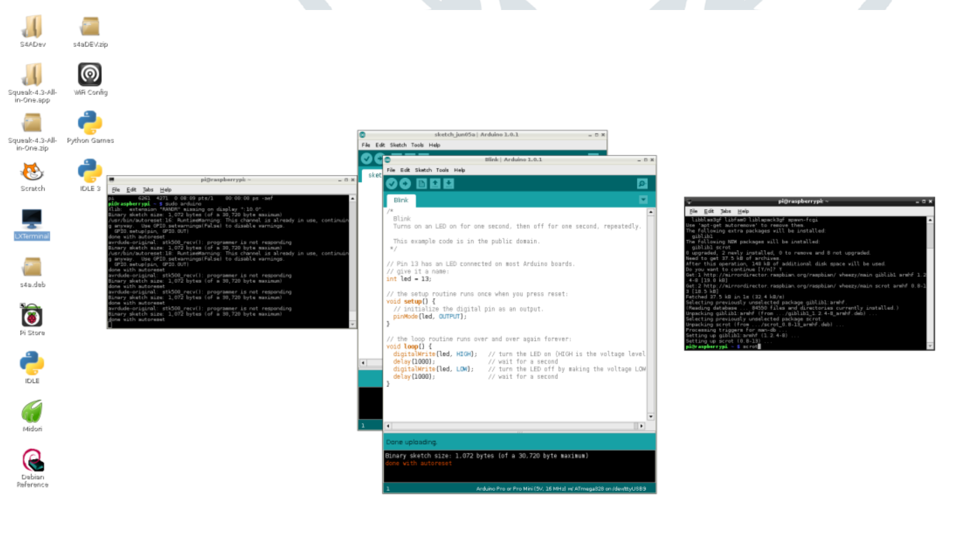

FIG. 1(D):ARDUINO IDLE AND ITS BOOT TERMINALS

The implementation of the entire system is categorized in terms of Hardware and Software. Once the hardware part is assembled that is sensor nodes with Raspberry Pi, comes the software part. Implementation is done mainly three differentdomains - Python, Cloud and Android. Thing Speak is used for implementing cloud operations. Android App is developed using Android Studio. Raspberry Pi uses Raspbian as an Operating System (OS) and Python IDLE is used for writing Python codes. In addition to these, Putty and vncserver are also used for accessing the Raspberry Pi terminal from a laptop without connecting Raspberry Pi to monitor and separate keyboard and mouse. The communication mechanism between different nodes is based on I2C or SPI protocol. SPI (Serial peripheral interface) is a connectivity protocol for the machine- to - machine (M2M) communication. It was designed as transportation of extremely lightweight messaging and publishing. It is beneficial for remote location interconnections where a small code footprint is required and there is limited network bandwidth. The System uses ThingSpeak API as a key with URL to send the data from python IDLE. It can post messages after a ThingSpeak client is connected to a broker. ThingSpeak has a topic - based clarification of the broker's messages, so each message needs to contain a particular subject that the broker will use to send the message to active clients. Normally, each message has a payload containing the actual data to be transmitted in byte format. ThingSpeak is data-agnostic and the structure of the payload depends entirely on the use case. If you want to send binary data, textual data or even full-fledged XML or JSON or CSV, it is completely up to the sender. The Sensor hub, Cloud and end User Device all comes into picture while acknowledging in a consecutive way. Most importantly, information caught by the sensor hub is sent to the cloud and furthermore the end User. In the cloud, getting information is controlled and diverse errand is performed which are altogether clarified as the flowchart.

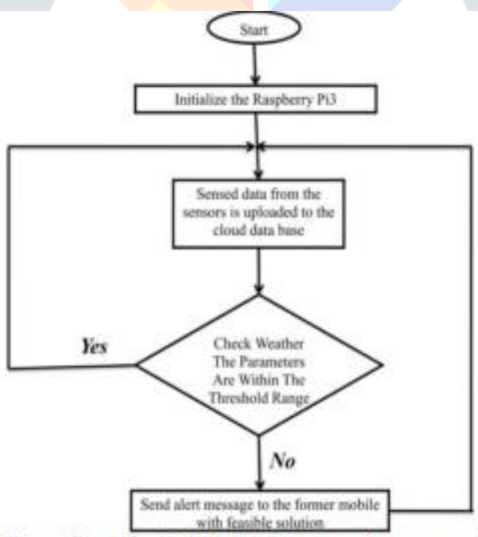

Fig. 2: Flowchart for IoT based aquaculture monitoring and control system

Figure 2, shows At the point when the web association is set up, it will begin perusing the parameters of various sensors. The edge levels for the required sensors are set. The sensor information is sent to the distributed storage just as the end client. The information can be examined down anyplace at any time. On the off chance that the sensor parameters are more than the limit level, at that point, the particular caution will be raised, and the end user is notified with an alert. The user is able to see values coming from the sensor node, and also remotely control the home appliances. Initially, Raspberry-pi has been powered on with 5V DC battery. Then all the sensors were interfaced and measure the respective values using the controller, then the measured values and threshold values are compared to provide a solution to the aqua farmers.

The real-time monitoring system is implemented in an open access mobile-web to obtain interoperability in various platforms such as mobile and PC. The current parameters is displayed on the user interface with the latestvales monitored by the sensor and updated automatically based on the latest values recorded. Also, the visualization is set by default, a day behind the current date and time. The data is then represented using a graphical curve visualization used to analyze the sensed data. Basically, the stakeholders used an application to browse the mobile-web through downloading the app at google playstore or using the URL.

FIG 3.CONNECTION BETWEEN SENSORS TO PI TO MOBILE

The mobile app is created from the code or directly downloaded from the google playstore which in turn connect the mobile to the PI which reads the sensor information or in some cases the threshold breach levels. Moreover the mobile application can be operated from anywhere and at anytime and read the sensor values.

RESULTS

There results will be the two way prototype as in which it comprises of the field(aquaculture) tested results and the ordinal test results.

CODE TERMINAL VIEW:

This terminal is to run the code which was written in python 3.7.3 version for accessing the sensors data in which all the sensing sensors to get run efficiently without error dialogs.

Working:

i) Open a new terminal window in python 3.1 idle.

ii)Write a code of all the sensors which were used in the hardware .

iii)After a code was written efficiently then run the code and it will redirect another window from the arduino idle to visualise all the sensors data on continuous manner.

iv)Then stop the code by clicking stop button in the window.

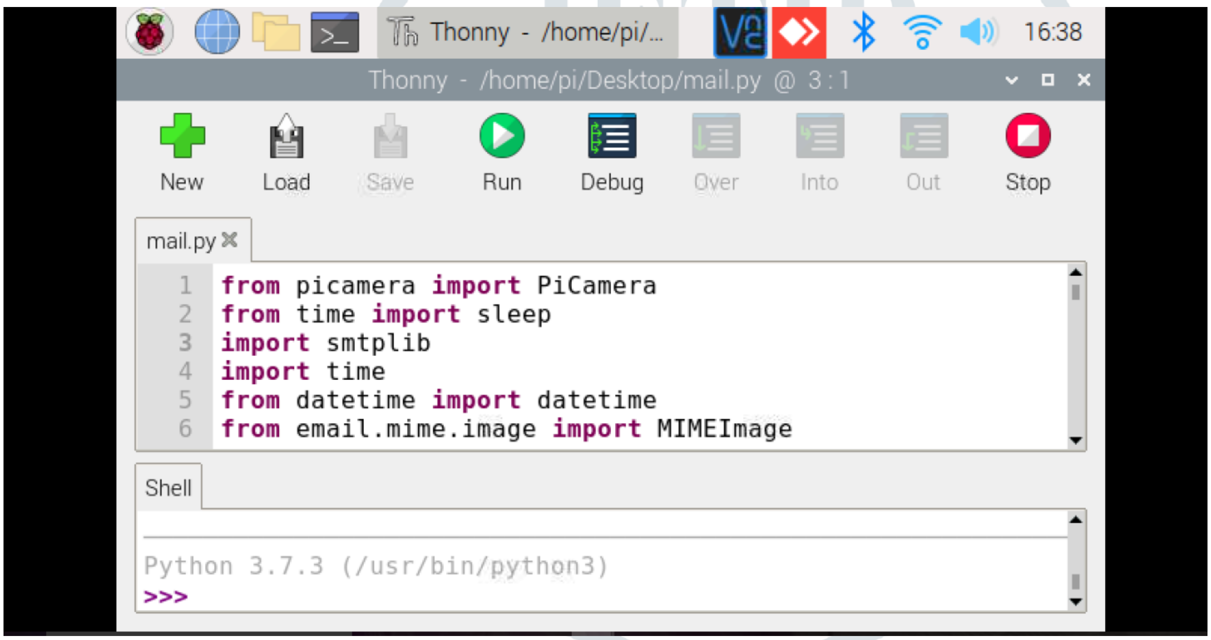

Fig3. Terminal window of sensors code data

As this code prevails that the temperature sensor, pH sensor , camera pi module which were written in highly efficient programming language i.e. python 3.1

DESKTOP TERMINAL VIEW:

This terminal view is a another window which will be opened after running a code by connecting arduino to our pc or system to get the sensors data if needed by instance. This window has a autoscroll option in which the data will be continuously recorded but when we stop running the code in python idle terminal then it stops recording the values. Alternatively this has timestamp option to configure the values in slotted time and date if needed and also shows the baud rate.

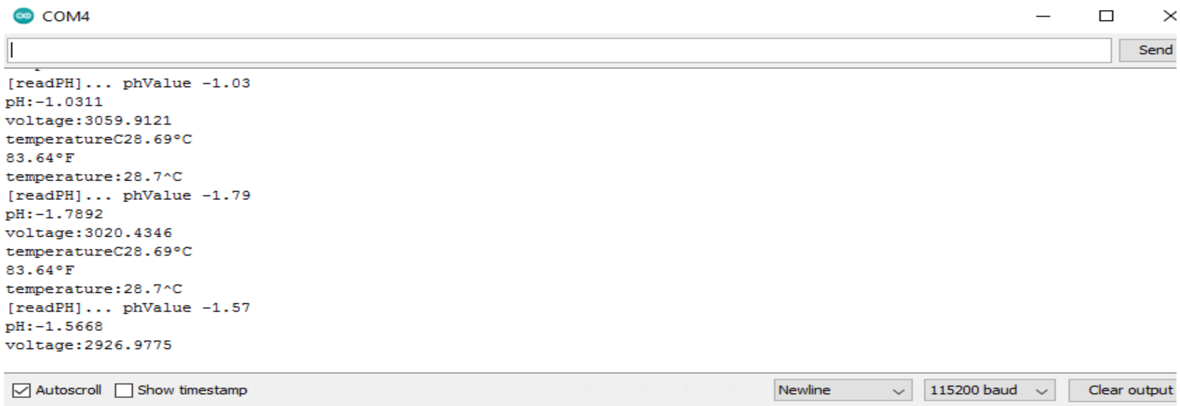

Fig4 .Monitored results in Desktop through com arduino idle window

This shows that the continuous monitoring of temperature and pH sensor values when the code gets run and initiliazes when the audruino idle gets ON and it will terminate when the code gets stopped running .Moreover this is a desktop view of output in continuous manner which initialises and terminates when the code gets run or stop.

BLYNK APP(MOBILE VIEW):

The blynk app is an faster result output exposure application in which all the sensing data will be available untill unless the hardware is on or off and when the minimal or maximal range exceed both the temperature and ph sensors then automatically the notification is displayed in our mobile shows that the threshold value of temperature and ph value is exceeded or decreased based on the pond environmental conditions.

This makes the farmer much alert with his basic smart phone always and can visible the data all the time from anywhere and anytime and also it efficiently decreases the effort by instead of continuous monitoring the pond.

Fig5.BLYNK app view of temperature and pH values

This blynk app shows both the temperature and ph values from anywhere and anytime without any delay factor. To maintain the aquaculture, we need to maintain the pond with the conditions required to yield better production so that the normal range of temperature to be maintained in the pond is 25 degrees to 37 degrees and similarly the Ph value to be maintained for the pond that the nominal range is 6.5 to 8.5 . If the climatic conditions or environmental conditions gets disrupted then the ranges will be abnormal so that the fish pond will be in danger. To make it reliable ,we made it simple as the values gets crosses the threshold values then automatically the notification will be alerted in the blynk app saying that ph is high or low and similarly the tempearature is high or low. This makes much simpler for the pond owner to get the pond safe by alert notification if the normal ranges crosses the threshold values.

CAMERA PI MODULE:

Raspberry Pi has a Mobile Industry Processor Interface (MIPI) Camera Serial Interface Type 2 (CSI-2). CSI-2 facilitates connection of small camera to Broadcom BCM 2835 processor. The function of this interface is to standardize the attachment of camera modules to the processors for the mobile phone industry. MIPI CSI-2 version 1.01 supports upto 4 data lanes, and each lane carries 1 Gbps bandwidth. The D-PHY specification defines the physical hardware layer interface between camera and processor to facilitate fast exchange of data. The camera pi module is also a sensor in which we are substantially using to monitor the pond to safeguard the pond as this cam pi is used when the motion is existed in the pond then it automatically snap a picture and sends to the corresponding mail in which we have already given by default in the code.

The pi camera is always streams the pond but in case any person or something in motion takes place then it triggers and click a snap to alert the pond owner .This is an efficient usage to safegaurd the pond from the thief's and it can be used from anywhere to anytime through the motion sensing device.

Fig6.PI camera is in surveillance mode

This pi camera has a motion sensing device additionally to which the camera is always in surveilling the pond but when the motion in the pond exists either by person or any living creature then automatically this motion sensing device gets active and takes pictures continuosly untill the motion in the pond disappear. The pictures which were clicked by pi camera will be sent from source mail to destination mail in which source mail and destination mails will be under his control. As this picture shows that someone who enters the pond by security breach so the motion sensing device takes a snap and sends it to the owner'smail. This reduces the strain ,effort ,workload to get always in our surveillance camera to safegaurd the pond.

Conclusion

This project help the farmers for accurate and reliablemonitoring of water quality parameters because manual testingcan consume time and water quality parameters may alter withtime being and it helps to take pro-active measures beforenecessary damage was done. Though the initial cost is highthere will be no additional cost and maintenance once it getsinstalled. Further there is no need for manual testingperiodically. Thus IOT has reachedthe farmers for reducing the risk from climatic fluctuationsand ensures growth and health for aquatic life. This increaseproductivity and helps for improving the foreign trade andincreases the GDP of the nation. Further the collected data canbe analyzed using big data analytics and preventive measurescan be taken before the water quality parameter crosses thethreshold range. The aqua system can be made automationusing internet of things which reduces the energy consumptionand labor cost. The results obtained in the design and development clearly suggests that with the proper selection of the appropriate instruments for the water temperature sensors, the water monitoring system can assess the fisher folks in real-time water temperature monitoring and the data is clouded for monitoring and an notification alarm has been sent when the threshold level crosses. The water analysis could also aid in preventing inevitable water environment occurrences, decision-making, proper planning and management of aquaculture industry.

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