Smart Aquarium using Internet of Things (IOT) and Digital Image processing (DIP)

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Abstract -This project presents the design and implementation of a universal intelligent control system that automates the operation of an aquarium system called Aqua-tronics. In our approach, the water temperature control, lighting of aquarium environment, feeding of fish, draining and infilling of the aquarium tank are all automatically controlled by a software embedded in an intelligent controller. The aquarist through the keypad interfaced to the controller can select the range of temperature and the feeding time, thus the system is universal and user-friendly. Essentially, the cloudiness of the water is detected automatically using dirty water detector enabling the controller to drain and refill the tank as at when due. The prototype aquarium was simulated using Proteus development tool before the building of the physical system. Summary tests are also outlined in this work.

Key Words:Raspberry pi, Gsm module, gps system

1.INTRODUCTION

Aquarium is a man-made ecosystem designed to grow and preserve aquatic life. The popularity of the aquatic hobby has grown steadily over the years as people look to bring a little piece of nature into their homes. Aquariums offer an amazing way to appreciate the beauty and diversity of aquatic life.

Fish keeping is a popular trend nowadays. People from all the age groups like to keep fish at their homes, offices etc. for decoration purpose or as a hobby. Commercial fish farming and ornamental fish farming has become very popular. Therefore it's important to automate aquarium/pond. As it is difficult to check the conditions of an aquarium manually. Here, we present a IOT connected system which monitor and control the whole aquarium using electronics and will communicate or transmitting real time status to user Smartphone. The project is an automated system to take care of fishes. It will monitor the physical changes in the water and will maintain it to the ideal conditions, with required changes. The aquarium will perform all the operations automatically like temperature control, pH control, monitor lighting, feeding, water renewal etc. It will reduce the manual effort required in maintenance of aquariums by automating the aquarium management process.

A. AIM

Main aim of this project is to make a simple, easily controllable and cheap device which helps to make aquarium owner's life easier. This project is to designand construct an aquarium controller that manages manyaspects of theaquarium such as lighting, temperature, water flow and feeding.

2. SYSTEM DESIGN

Detailed design starts after the system design phase is completed and the system design has been certified through the review. The goal of this phase is to develop the internal logic of each of the modules identified during system design.

A. Data Flow Diagram

DFD graphically representing the functions, or processes, which capture, manipulate, store, and distribute data between a system and its environment and between components of a system. The visual representation makes it a good communication tool between User and System designer. Structure of DFD allows starting from a broad overview and expand it to a hierarchy of detailed diagrams.

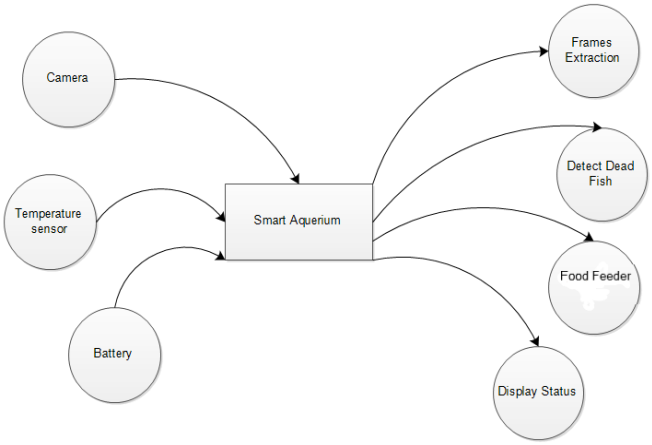

Fig -1: Data Flow diagram

B. Use case diagram

Use case diagram is a graph of actors, a set of use cases enclosed by a system boundary, communication associations between the actor and the use case. The use case diagram describes how a system interacts with outside actors; each use case represents a piece of functionality that a system provides to its users. A use case is known as an ellipse containing the name of the use case and an actor is shown as a stick figure with the name of the actor below the figure.

The use cases are used during the analysis phase of a project to identify and partition system functionality. They separate the system into actors and use case. Actors represent roles thatare played by user of the system. Those users can be humans, other computers, pieces of hardware, or even other software systems.

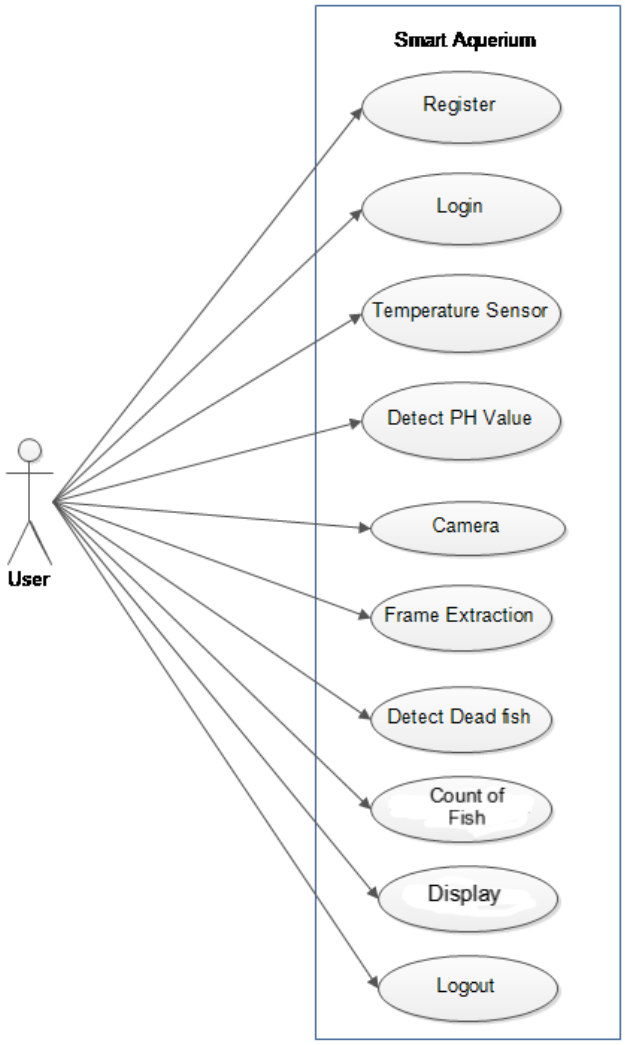

Fig -2: Use Case Diagram

A. Sequence Diagram

A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario. Sequence diagrams are sometimes called event diagrams, event scenarios.

UML sequence diagrams are used to represent or model the flow of messages, events and actions between the objects orcomponents of a system. Time is represented in the vertical direction showing the sequence of interactions of the header elements, which are displayed horizontally at the top of the diagram Sequence Diagrams are used primarily to design, document and validate the architecture, interfaces and logic of the system by describing the sequence of actions that need to be performed to complete a task or scenario. UML sequence diagrams are useful design tools because they provide a dynamic view of the system behavior.

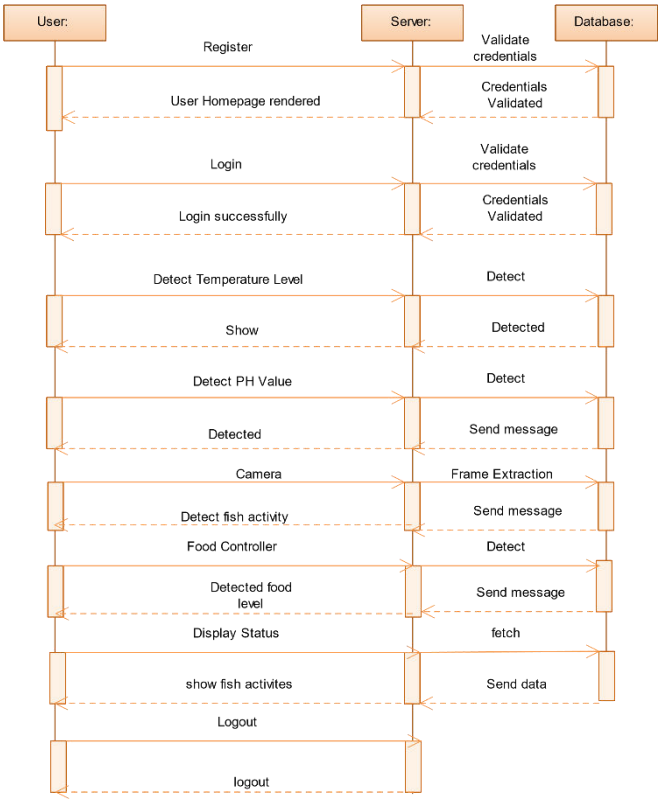

Fig -3: Sequence Diagram

D. Activity Diagrams

Activity diagrams represent the business and operational workflows of a system. An Activity diagram is a dynamic diagram that shows the activity and the event that causes the object to be in the particular state. It is simple and intuitive illustration of what happens in a workflow, what activities can be done in parallel, and whether there are alternative paths through workflow.

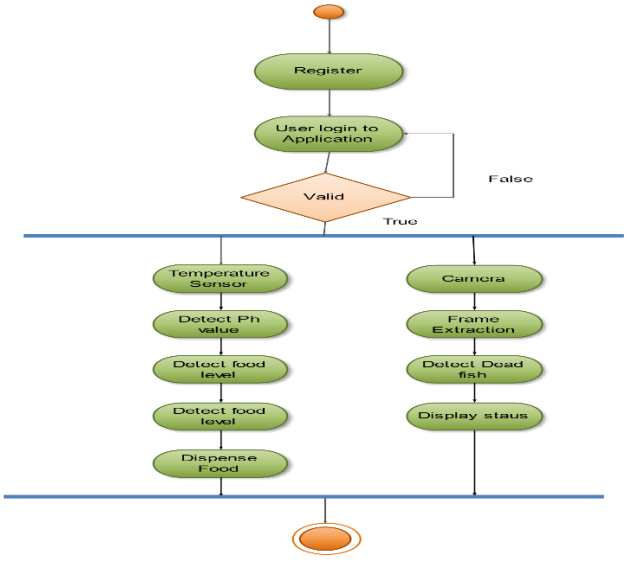

Fig -4: Activity Diagram.

3. IMPLIMENTATION

Following are the Algorithms used for this project:

1. Parallel Conversion type of Implementation:

In this type of implementation both the current system and the proposed system run in parallel. This happens till the user gets the complete confidence on the proposed system and hence cuts of the current system.

2. Phase-in method of implementation:

In this type of implementation the proposed system is introduced phase-by-phase. This reduces the risk of uncertainty of proposed system. Each program is tested individually at the time of development using the data and has verified that this program linked together in the way specified in the programs specification, the computer system and its environment is tested to the satisfaction of the user. The system that has been developed is accepted and proved to be satisfactory for the user. And so the system is going to be implemented very soon. A simple operating procedure is included so that the user can understand the different functions clearly and quickly.

The project is implemented in modular approach. Each module is coded as per the requirements and tested and this process is iterated till the all the modules have been thoroughly implemented.

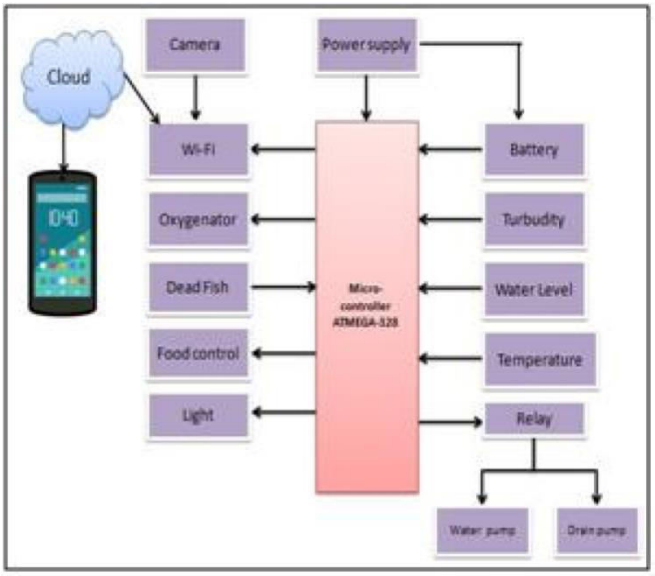

Fig -5: Block Diagram of Smart Aquarium System

In our system microcontroller ATMega328 is centralize unit of system. It is three port device each port having 8 input and output pins. It is interface with all other devices in our system such as,

a) Oxygenator- It is use to maintain proper oxygen level to whole aquarium.
b) Temperature sensor- It is a water proof temperature sensor and will use to sense the temperature of water.
c) Food controller- Will provide necessary amount of food to the fishes.
d) Battery- We will use in absence of main power supply. Water level sensor- is use to control water level while changing the water of aquarium.
e) Turbidity sensor- is use detect the impurity and PH value of the water.
f) Dead fish detector- Will detect dead fish by using IR sensor.
g) Camera- is also connected to our aquarium which will give real time status of the aquarium to the owner, with the help of Wi-Fi module.
h) Relay- It is use as ON/OFF switch for water pump.
i) Display- It will show the real time status of aquarium.
j) Food level detector- Will detect the level of food in food container.
k) In Digital Image processing
l) Frame Extraction- In this process, Extract the frames from the video and detect the object.
m) Object detection- In this process, Detect the object from the each frame, if found display the status of the object.

4.SCREENSHOTS

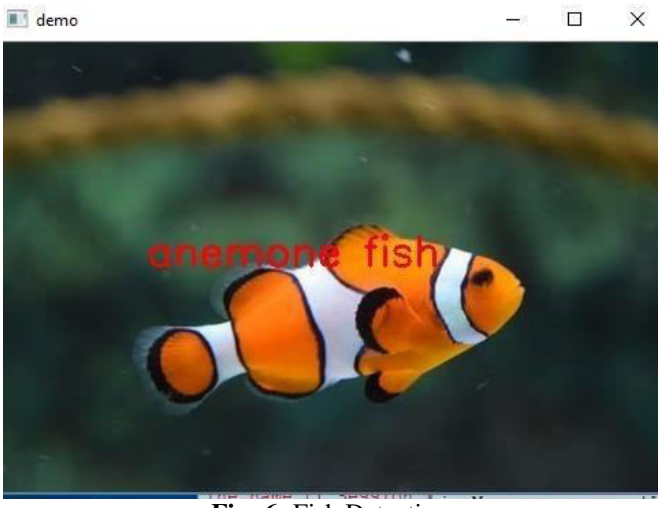

Fig -6: Fish Detection

Fig -7: Fish Category

Fig -8: Result

5. CONCLUSIONS

We started off the project with the aim to accomplish the simple looking task of designing an automatic aquarium. The basic idea proposed in this project works well and can be implemented on large scale industries like fish cultivation, commercial fisheries etc. Having a Smart Aquarium will save our time and we would not have to be worried for our fish and their aquariums for long time. Since PLC is used as the controller, many aquariums can be automated using a single PLC. Though we are able to achieve all the goals of our project but still we think that lots of advancement can be done on this project. For advancements, we need more time, money and hard work.

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