Automatic Fish Monitoring System using MSP430

An IOT based automation system

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***Abstract*: An automatic fish feeder is a device that automatically feed the fish at a predetermined time. In a way, it is to control the fish feeding activity by using a fish feeder that combined the mechanical system and electrical system to form a device instead of manually feeding the fish by hand. Fish owners who are away for a long time will have trouble knowing the situation of the pond or aquarium. Thus such device is very convenient. Additionally, there is a feedback system that sense the level of water and the amount of food left in the container and notify the update to the user. With this, the user or the owner can be away with the android device monitoring the aquarium condition.**

Keywords—MSP430, Servo, Bluetooth, Force sensor, LDR , LED, USB to UART.

I. INTRODUCTION

Food and feeding are the important elements for growth and production, their management being one of the main challenges for aquaculture development, survivability and maintenance. The adjustment of food delivery to ensure the survival of the fish is important for fish owners, whether as pet or aquaculture. However for this paper, I will focus on the fish reared by home owners. In order to solve this problem, several direct and indirect techniques have been developed. Self-feeders may be used for direct adjustment, whereas indirect methods have also been used based on using automated device to deliver the feed to the fish. Therefore, the aim of the present study is the development of a feeder that can handle good control of fish food feedings.

A. Background

Recently, there has been increase of number of people who kept fish as a pet at their own home. Be it a hobby or for business purposes. One parameter that involve in a feeder is time management controller that act as main part of a feeder. Many industrialists in aqua field and also fish owner seem to have trouble with this timely operation. Traditional method of feeding fish either for fish in pond, cage or even small lake is by use of man power. For the worker, they sometime face difficulties to do the feedings at the same exact time during some unexpected event especially when raining. If the they continue the job, the only result are not just the pellet ending at the bottom of the pond as waste faster or lead water to pollute, but the main critical problem is the unfed fish. This matter will even grow bigger during raining season and will cost a lot of trouble to the industrialist. [1]

Moreover, the running period for each feeding also determine by this timer that is also programmed by the user. Plus, there is also a need for warning for user if the storage reach a low level of fish feed, such as sending notifications to user phone. At the same time, monitoring the environment of the aquarium is also important in some part of the country. Moreover, there should be a level of water such that the fish can survive. Sometimes the water level goes down and sometimes goes up. Such cases will definite carry huge risk towards the fish. If such cases occur, the fish will probably die. Thus, there is also need to update such situation via notifications. Same as previously mention situation.

B. Research Objectives

The aim for this research is to develop fish feeder to automatically dispense flakes twice a day or more according to user interest every day. The system should be able to send notification to the owner if the water level goes below than preset minimum amount. The system should also monitor the overall environment of the aquarium using different sensors and update the user by Bluetooth communications. The objectives of this paper are:

1. To design and develop automatic fish feeder for indoor aquarium.

2. To monitor the environment of the aquarium and update the user by sending notifications.

3. To evaluate the performance of the developed mechanism

II. Literature Review

Basically, there is a lot of inventions had been made and been classified as “automatic fish feeder”. From those previous designs, a few are chosen due to their criterions which are quite interesting and also useful. The first design is by David C. Smeltzer [3] which is patented in 4th April 1985. His design is capable of dispensing feed having various sizes of grains over a wide range of dispensing volumes with a high degree of accuracy. The device was able to do this by utilizing an adjustable counterbalance weight which the amount of water required are changeable to produce a dispensing action and simultaneously adjusts the vibration movement made by the fish feeder to differentiate the amount of food given out. [4] Consequently, both the frequency of feeding and amount can be controlled by the counterbalancing the weight.

However, as stated by Mohapatra [5], Sarkar, Sharma and Majhi (2009) and Noor, Hussian, Saaid, Ali and Zolkapli (2012), for most automatic fish feeder, it is not easy to control the amount feed released. Plus, the constant speed to deliver the food pallet limited its usage. [6] At the same time, it is also a waste of food. The size of the device will depend on the location it will be used or install, whether the device is used for normal aquarium or pond. For indoor aquarium, a small device will work well and the outer pond will require a bigger device with a big storage. The size of the storage will determine the number of trips the user needs to do to replenish the feed.[7] Not to mentioned, for most of the time, the cost are proportional the size of the device.

III. System Design

We have used several components including arm cortex, several sensors and module for this project. Here we are explaining which components we used for which reasons.

A. MSP430

We used EXP430G2 Launchpad as a microcontroller as its features are simpler and complex coding also can be done in such a way that is easy to understand. Furthermore, this microcontroller has its own USB connection, a power jack and a reset button. It is standard on microcontrollers, most pins connect to a more specialized peripheral, but if that peripheral is not needed, the pin may be used for general purpose I/O. The pins are divided into 8-bit groups called "ports", each of which is controlled by a number of 8-bit registers. [8] In some cases, the ports are arranged in pairs which can be accessed as 16-bit registers. This device is just needed to connect to the computer with a USB cable to begin uploading the necessary coding

B. Servo Motor

Different than normal motor, the servo circuitry is built right inside the motor unit and has a positional shaft, which usually is fitted with a gear (as shown below as shown Fig 3.2.). The motor is controlled with an electric signal which controls the shaft movement. Inside the servo is a simple set-up: a small DC motor, potentiometer and a control circuit. As the motor rotates, the potentiometer’s resistance changes, thus the control circuit can precisely regulate how much movement there is and in also which direction to turn. [9]This is possible due to the motor is attached by gears to the control wheel. When the shaft of the motor is at the desired position, power supplied to the motor is stopped. If not, the motor is turned in the appropriate direction. The desired position is sent via electrical pulses through the signal wire.

C. Light Dependent Resistor and Lighr Emitting Diode

A Light Dependent resister (LDR) is a component that has a (variable) resistance that changes with the light intensity that falls upon it. This allows them to be used in light sensing circuits. When the light level decreases, the resistance of the LDR increases. As this resistance increases in relation to the other Resistor, which has a fixed resistance, it causes the voltage dropped across the LDR to also increase.[10] We used LDR for detecting the amount of food, as it is a threat for the fish inside the water. We wanted to use the LDR covered with black paper so that the external light cannot affect its value and a led just before the LDR for detecting the addled water. But for the black cover, LDR was not able to detect any light and was giving the maximum value. So we uncovered it.

D. Force Sensor

Force Sensing Resistor (FSR) will vary its resistance depending on how much pressure is being applied to the sensing area. The harder the force, the lower the resistance. When no pressure is being applied to the FSR its resistance will be larger than 1MΩ. This FSR can sense applied force anywhere in the range of 100g-10kg. [11]
These sensors are simple to set up and great for sensing pressure, but they aren’t incredibly accurate. As we don’t need the exact value, we used it for measuring the level of water remaining in the aquarium so that we can send an alert message to the user when the water level is not comfortable for the fishes.

E. USB to Serial Converter

We used CP2102 Breakout Board which is a great tool for embedded systems that require a serial connection to a computer. The board attaches to the USB bus via a standard type B female connector, and appears as a standard COM port. This IC doesn’t require any external oscillator, has an on-board voltage regulator, and uses reprogrammable internal EEPROM for the device description. The full hardware UART has flow control for baud rates from 300bps to 921600bps. This breakout also allows you to connect the TX/RX pins of your favorite microcontroller or serial application to the RX/TX pins of the breakout, creating a simple serial cable replacement. As our microcontroller does not have the driver for displaying numbers in the serial port we have used this module to see the vales in the computer.

F. *Bluetooth Module*

Bluetooth is a wireless technology standard for exchanging data over short distances (using short-wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz) from fixed and mobile devices, and building personal area networks (PANs). Invented by telecom vendor Ericsson in 1994 [12], it was originally conceived as a wireless alternative to RS-232data cables. We are using HC-05 module which is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication we are using this module for connecting with the user via smartphone where the microcontroller will send notifications when needed.

IV. EXPERIMENTAL SETUP

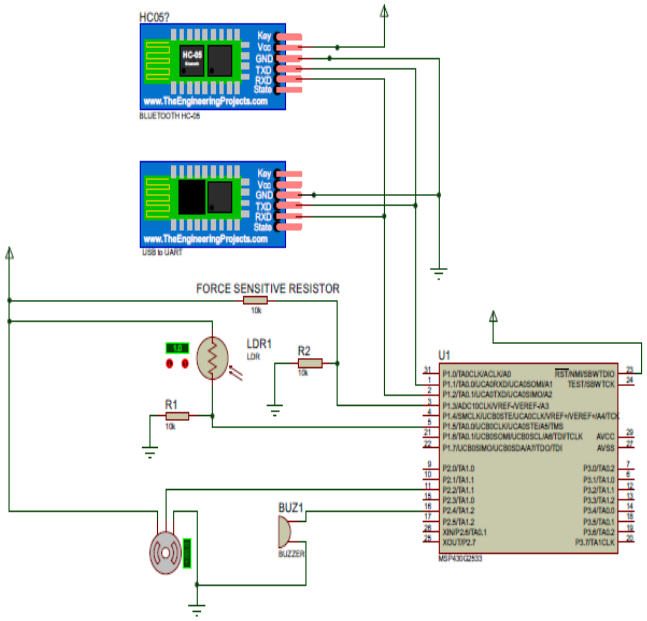

Fig-1 : Experimental Setup

Fig-1 shows the experimental setup of our fish monitoring sensor where we used EXP430G2 as a microcontroller, HC-05 as a Bluetooth Module, Force sensing resistor as a force sensor and also used Servo motor, Light Dependent resistor(LDR) for measuring amount of remaining food and CP2102 USB to UART module as serial converter. We have examined our project in a bowl (filled with water) to make sure that it is working. We noticed that the LDR sometimes gives different value as the light differs from place to places. So it was not that much acurate to detect the remaining. In addition, force sensor is a very sensiive sensor, it needs more pressure to determine the variation in force , we used a rubber to solve the problem and to create enough pressure which is working fine. We designed the project in a way that the food comes from the container doesnot fall in one place, we used more than one holes to make sure that the food can spread in the water and the fishes can find food easily. We used serial port to see the value of LDR and force sensor so that we can determine the amount of food left in the container and level of water for which we need to notify the user.

V. RESULT

As we are using these modules and some sensors for the first time, we could not do the whole project very efficiently. We struggled a lot. We examined the servo and it was working fine. Then we tried to use the force sensor for measuring the water level but unfortunately we could not work with that. Water licked the bag and the force sensor was damaged. As we used Energia as our IDE, it actually uses the serial port of msp430, so we needed to connect with USB to UART module for using Bluetooth module externally. We made an android app that was taking response from msp430 and updating the status of the app according to the values. However, using LDR for measuring food amount was a bad idea. LDR does not give constant value in different places. We tried to cover the LDR with the black straw but when we did that, it could not detect the light intensity at all. So we had to see the value in serial port in different place and write the code accordingly. Despite all difficulties, overall, the project was working fine.

VI. FUTURE PLAN

For shortage of time, we could not use many modules and sensors in our project to improve its performance despite our will. In future we will work on how to lessen the expense for the project and how to improve the efficiency and performance. We will study on how to program the servo motor at desired interval and desired opening angle, how to use the GMS900 and interface it with the MSP430, how to use the display connected to the keypad, how to connect GSM module with its coding for sending the user short messages and also learn how to create the overall algorithm. I will also need to prepare for trouble shooting as combining all the coding into one big program will usually cause a lot of error. We will use Exp8266 module so that user can get update about the fish when they will be out of their home. Moreover we are planning to use proximity sensor for determining whether the the remaining food is enough for the fish or not. We will work on this project in the large scale where the project will monitor the fish not only in aquarium but also in pond. At the same time, we also need to make sure the device is stable and somewhat robust.

VII. CONCLUSION

To create an automatic fish feeder device is not an easy task. Plus, adding the Bluetooth module for connecting with user is new to us as well as we never used force sensor so this was also a challenge for us. It requires a lot of research and reading. We also have to consider balancing the optimum cost with it practical usage as, in terms of marketing, no customer will want to buy an overpriced product. This will be a challenge to us, because with my limited knowledge, we do not know all the cheapest component that are available in the market that fulfill the requirement and achieved the desirable result. We already did some literature review to get the idea on

the component used to make this device. We also already have my design and also the initial idea on how everything will be put together. We already select the possible components to be used and, the project will continue with the creation of the devices.

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