Robotic Fish

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Advanced Mechatronics Raspberry Pi Project
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Robotic fish

- Robotic fish, Commodore, has been exhibited at Washington DC, New Jersey, and New York.
- To enhance informal science learning and increase interest in biology and engineering.
- Currently, controlled by iPad applications.
Underwater Camera

- Everyone like to take pictures when they go on vacations. Interesting pictures are taken at hard to reach places.
- GoPros are a viable option for an underwater camera that can be viewed by an app. However, these are very programming constrained and have to be handheld.
- A controllable robotic fish may present a solution.
Look through the eyes of a robotic fish!

- Looking through the eyes of the robotic fish can give children a more interesting experience. Super fun!
- If we can do it in Xcode, why not try for Android too? Good practice in Android app development.
- Apply concepts in the classroom to practical knowledge and the development of an underwater camera system for a robotic fish. (Raspberry Pi, Android, Arduino and OpenCV)
Logitech Webcam

Python + mjpeg

Raspberry pi

UDP comm

UDP comm

Google Nexus 7

Netgear router

Radio via RF22+Arduino
Hardware

- One robotic fish named the Commodore. Multi-linked motorized tail with a waterproofed box housing an Arduino Pro mini as the processor.
- Android, Arduino, and RF22 to handle communications over the NETGEAR router using UDP protocol.
- A web camera and Raspberry Pi encased in a portable waterproofed container.
Raspberry Pi

• Uses a Rasbian build.

• Uses python script, UDP communication protocol and opencv.

• Uses MJPEG Streamer to stream the video feed to Android tablet and computer.

• Not powerful enough to stream and process the images at the same time.
Android

- Creates a one screen interface that lets users choose the direction to control the robotic fish and a stop button. Two buttons for on/off. Three buttons for steering.
- Located on IP address 192.168.1.100
- Collects the video stream from the mjpeg streamer from the router and displays it on the app.
Arduino (Commodore/Base station)

- A base station converts UDP commands from router to radio signals using the RF22 transmitter chip.
- Arduino is programmed to listen to the radio signals in the format “Mode:Manual”, “s0f1”, or “s0o10”
- Robotic fish responds by beating its tail following a carangiform motion based on the received message.

```cpp
#include <SPI.h>  // needed for Arduino versions later than 0018
#include <Ethernet.h>  // UDP library from kjoerns Son.stanford.edu 12/30/2008

// Enter a MAC address and IP address for your controller below.
// The IP address will be dependent on your local network:
const byte xmc[] = { 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 };  // IP Address 192.168.1.2

unsigned int localPort = 9999;  // local port to listen on

// buffers for receiving and sending data
char packetBuffer[UDP_MAX_PACKET_SIZE];  // buffer to hold incoming packet.
char replyBuffer[] = "acknowledged";  // a string to send back

// An Ethernet/UDP instance to let us send and receive packets over UDP
EthernetUDP udp;

void setup() {
  Serial.begin(9600);  // start the serial port
  Serial.println("try begin");
  Ethernet.begin(xmc);  // start the Ethernet and UDP:
  Serial.println("try udp");
  udp.begin(localPort);
  udp.flush();
  Serial.println("setup done");
}

void loop() {

```

by Michael Vergolis
Thank you for your attention!
We would be happy to answer any questions.