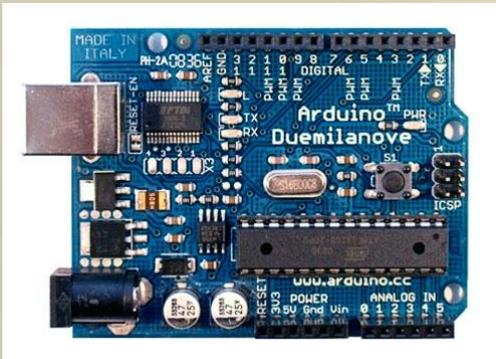


## An Introduction to the Arduino

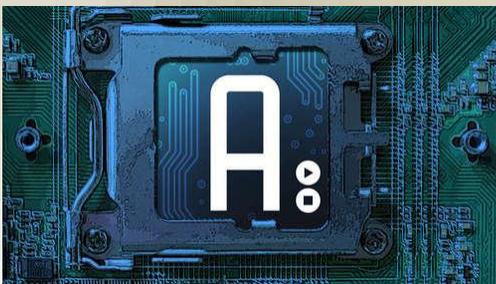
“Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments”

<http://www.arduino.cc/>

The Arduino Project started in Ivrea, Italy in 2005 as a project intended for students. All official Arduino hardware and software is open source. Arduino microcontrollers are easy to program and are fairly inexpensive.



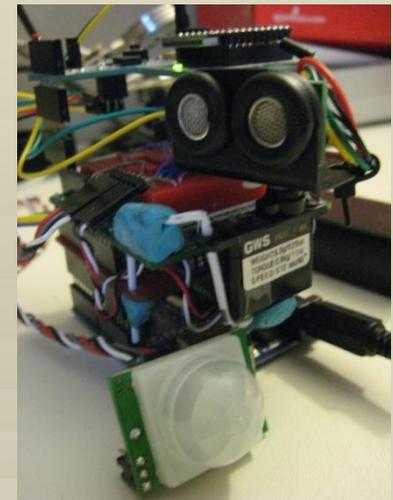
The basic, but capable Arduino IDE is free and runs on Windows, Linux, and Mac. Firmata, a microcontroller interface specification, can be used to write code for Arduinos using most high-level languages.



[www.arduino.cc](http://www.arduino.cc)

## The George Washington University School of Engineering and Applied Science (SEAS)

*Embedded Systems Final Project Information*

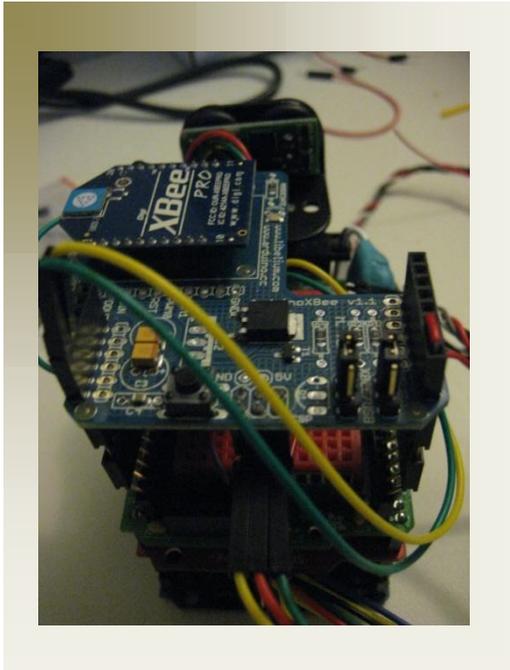


**Arduino-based Object Detection System**

CSCI 297 - Spring 2010

Frank Ervin

xxxxxxx@gwu.edu



## Project Abstract

The goal of this project was to develop an object detection system which could be retrofitted to a semi-autonomous robot up the road.

The system leverages an ultrasonic range finder to detect obstacles located in proximity to the apparatus. The ultrasonic sensor is mounted on a sub micro servo in order to have a sweeping perspective. A Passive Infrared (PIR) sensor is also used to activate the SONAR when motion is detected.

The apparatus sends sensor readings and distance measurements over 802.15.4 to a computer for graphical display. Code running on the microcontroller generates audible alerts using a serial-driven voice synthesizer chip attached to a small speaker.

## Hardware

I built this apparatus around the Arduino Duemilanove microcontroller, namely because I had already purchased one and had some experience interfacing with it and wanted to learn more. The Arduino is an open microcontroller platform that uses an AVR-C derivative known as Wiring. The availability of shields for prototyping, SpeakJet, and XBee made for a fairly tidy package for this project.

For the SONAR device, I used a Devantech SRF10 ultrasonic sensor mounted on a Grand Wing Servo (GWS) sub micro servo. The SRF10 is mounted using two screws and the SRF10 mounting kit.

The SRF10 uses an I2C interface, which means that communications with the device leverage analog pins in alternate function I2C mode. When connected in this way, the Wire library can be used to communicate with the sensor on the Arduino's I2C bus.

The project also uses the Arduino's digital output capabilities for moving the servo on which the ultrasonic sensor is mounted. The Servo library does a good job of abstracting the Pulse Width Modulation (PWM) which happens behind the scenes to command the servo.

I also used a digital input for reading the state on a Parallax Passive Infrared Sensor (PIR). This simple device takes the input pin high when it senses motion within its range.

To enable speech, my Arduino code communicates with a Magnevation SpeakJet synthesizer chip via a software serial connection.

The XBee interface to the computer is simply a serial port replacement for taking sensor data off of the microcontroller. I used two Digi XBee Series 1 Pro chips for this application.

## Software

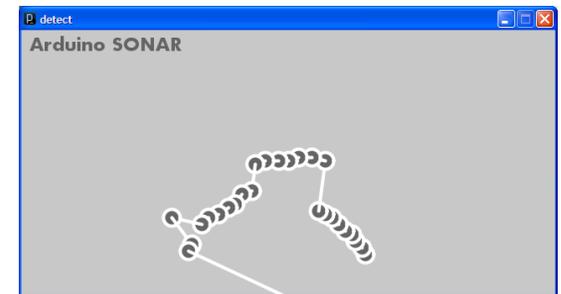
In order to make all this work hardware work together on the Arduino, I wrote four libraries.

The `pir_controller` is used to initialize the PIR and wait for a motion detection event

The `servo_controller` is used to initialize the servo and move it as needed.

The `sonar_controller` is used to initialize the ultrasonic sensor, get range values, and coordinate sweep rotation by calling the `servo_controller`.

The `speakjet_controller` is used to initialize the SpeakJet and say various messages which are stored in the library.



In order to better debug and demonstrate the apparatus, I wrote a very simple Processing sketch for visualization. The sketch simply plots the Cartesian coordinates of the ultrasonic sensor information and connects these data points with lines.

Learn More...

Visit the following sites:

<http://www.atomicrhubarb.com/>

<http://www.arduino.cc/>

<http://processing.org/>