Robotic Merit Badge Session #1

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- July 6, 2015
- http://bsatroop675.org

Agenda

- Class Overview
  - Schedule
  - Materials for the Class
  - Robotics Merit Badge Requirements
  - Competition
- Safety Working in Robotics
- Introduction to Your Robot Brain (Dagu Micromagician)
- Programming
  - Development Tips
  - Exercises
- Assignment to work on before Session #2

Schedule

Class Dates	Topics
7/6	Introduction, Material Distribution, Programming
7/20	Programming, Electronics, Competition Specifications, Design
8/3	Design Review, Electronics
8/17	Pre-competition Preparation, Advanced Topics
8/31	Robotics Showcase/Competition

Computer Setup

- Review Class Reference Guide.
  - Arduino IDE Installation
  - USB Driver Installation
  - Github account
    - Fork https://github.com/mcli/RoboticsMB
    - Clone your RoboticsMB project
    - Launch Git Shell or Terminal
    - Setup upstream project:

```
git remote add upstream https://github.com/mcli/RoboticsMB.git
```

    - Synchronize upstream project (when needed)

```
git fetch upstream
git checkout master
git merge upstream/master
```

GitHub

- GitHub is a source code control service, based on the “git” utility
- I will use it to look at your programs to monitor your progress
- Commit and synchronize your code to make it available in your GitHub repository.
- Commit your code when you reach a stable point in development to checkpoint your changes.
- You can also synchronize with my project to get any class examples or utilities.
- Fork https://github.com/mcli/RoboticsMB and make it your upstream project (See Preparing for the First Session).

Material Inventory

- Carrying Case
- Tadpole Robot Kit
  - The Tadpole is only the starting point for your robot design.
  - You will be modifying it to achieve your own design goals.
- 4 AAA NiMH batteries
- Engineering notebook
- Merit Badge Booklet
- Merit Badge Workbook

Scout-Provided Materials

- Blue Card signed by Scoutmaster
- Computer with Arduino development environment installed
- USB-A to mini-USB Cable
- AAA NiMH battery charger
- Small phillips screw driver
- Pen/Pencil for taking notes

Other Useful Items

- Sony/Universal Remote Control
- Electric Multimeter to measure Voltage and Resistance
- Solder and Soldering Iron

Merit Badge Requirements

All Requirements are listed in the Workbook and Merit Badge Booklet and cover:

- Safety
- Robotics in industry
- General Knowledge
- Demonstration
- Competitions
- Careers

Complete the workbook on your own for Merit Badge Counselor review/check-off

Robotics Showcase Competition

- Gives you objectives for your robot design.
- You may optionally work together with one other scout as a team.
- Have fun.
- More details will be announced at the 2nd Session

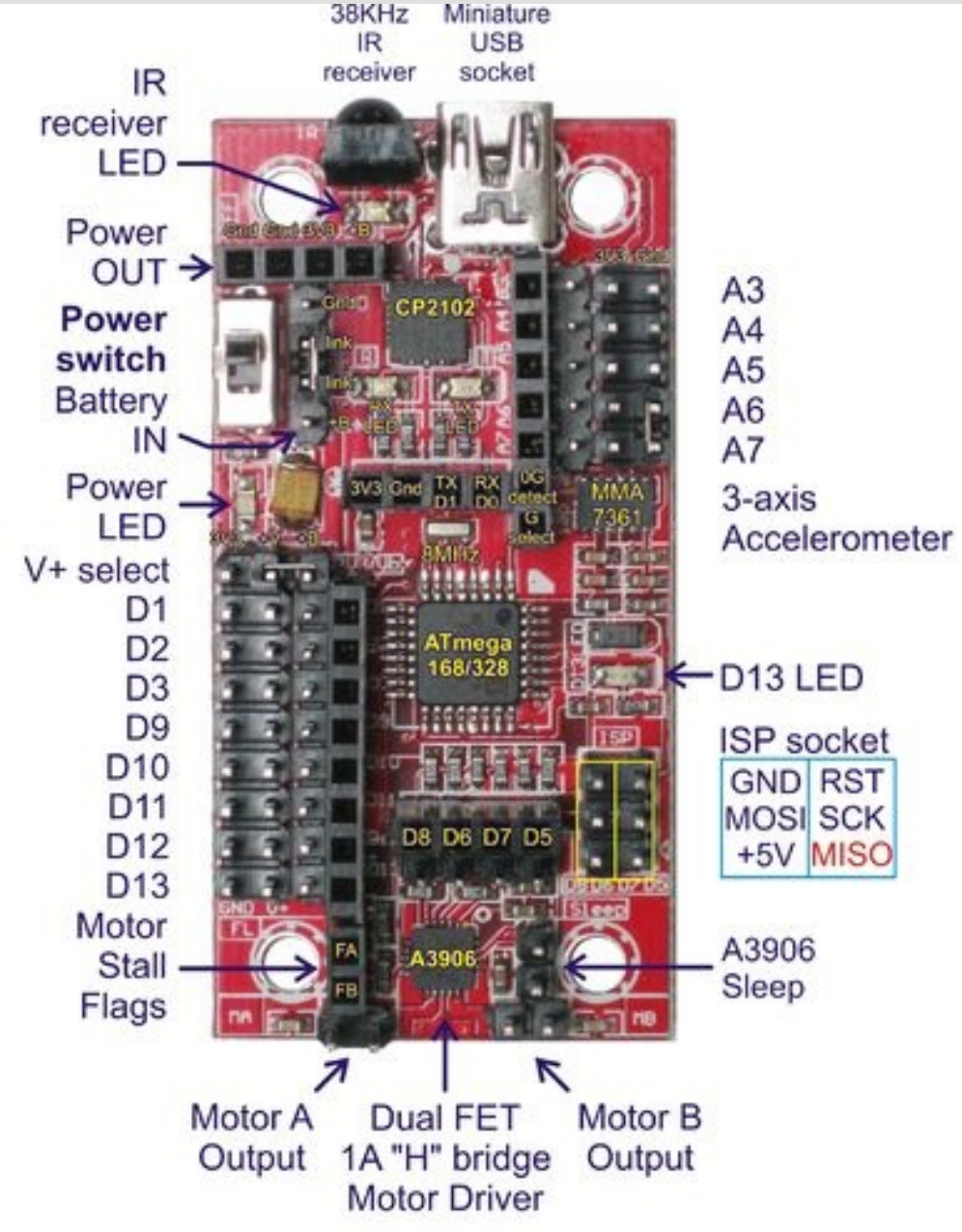
Safety Working with Robotics

Safety Working with Robotics

- Have a clean work area
- Electrical Circuits
  - Always disconnect power when modifying circuits.
- Electro-static discharge
- Precautions when cutting material

Introduction to Your Robot Brain

- The MicroMagician Controller
  - Atmega 328 microprocessor
  - Digital and Analog pins (I/O)
  - Power in/out -3.3V vs 5V
  - Motor driver and connections
  - Accelerometer
  - IR receiver



Analog Vs Digital Signals

- Analog signals are continuous with many values between minimum and maximum. e.g. a sine wave. Typically used for sensor processing.
- Digital signals are discrete. e.g. 0 or 1. Typically used to turn something on or off.

Analog Signal

Digital Signal

Arduino IDE Setup

- Board Configuration
  - Arduino Pro or Pro Mini
  - Atmega 328 (3.3V, 8MHz)
- Serial Port
  - Windows – COM3
  - Mac – /dev/cu.SLAB_USBtoUART
    - If you do not see this port, make sure you have installed the USB Driver correctly.

Development Tips

- Using the IDE to compile and upload programs (“sketches”)
- Using the Reference: Help → Reference
  - setup() - Runs once
  - loop() - Gets called continuously
  - ; (semicolon)
  - Data Types
  - = (assignment) vs == (equal to)
- All code must be within a function
- Utilizing libraries (microM Library)

Programming Exercises - Blink

- Load the Blink program from Examples → 01.Basics
- Save it in your sketchbook
- Compile it and upload it to the MicroMagician Board

```
void setup() {
  // initialize digital pin 13 as an output.
  pinMode(13, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(13, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(1000);              // wait for a second
  digitalWrite(13, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);              // wait for a second
}
```

Programming Exercises – Modifying Blink

- Save the pin number (13) in an “int” variable and replace all instances of “13” with the variable. e.g. int ledPin=13;
- Modify the program to generate the SOS signal – 3 short, 3 long, 3 short, pause, then repeat.
- Save as BlinkSOS and github commit.
- Revise the program to add 2 function, shortBlinks() and longBlinks(), to generate the SOS signal to make the program shorter and more readable.
- Save and github commit.
- Revise the program to use one function instead of two (combine shortBlinks() and longBlinks() into one)
- Save and github commit and sync.

Programming Exercises – Blink SOS – 2 functions

```
void setup()
{
 // same setup as before
}
void shortBlinks()
{
  for (int i = 0; i < 3; i++)
  {
    // call digitalWrite/delay here
  }
}

// define void longBlinks() here, similar to shortBlinks()

void loop()
{
   shortBlinks();
   longBlinks();
   shortBlinks();
   delay(1000);
}
```

Programming Exercises – Blink SOS in 1 function

```
void setup()
{
 // same setup as before
}
void blinks(int length)
{
      // have an if/then statement  to check if length is negative,
      // delay with the absolute value of length and don't blink

      // call digitalWrite and delay(length) here
}

// define void longBlinks() here, similar to shortBlinks()

void loop()
{
  // call blinks here with different parameters
}
```

Programming Exercises – Accelerometer

- Load the MicroM example “impact”: Files → libraries → microM → impact
- Open the Serial Monitor: Tools → Serial Monitor
- Run program, then tap the board lightly from different directions to see the delta values change
- Save the program into your sketches
- Modify the program to print the x, y, and z axis readings (not the delta readings)
- Turn the board in different directions and observe the readings.

Programming Exercises – Accelerometer

```
#include <microM.h>

void setup()
{
  microM.Setup();                  // this must be called first in your setup function
  microM.sensitivity=50;           // if your robot vibrates or moves over a rough surface
                                   // then increase this value to prevent false triggering
  microM.devibrate=50;             // depends on the construction of your robot. Increase
                                   // the value if you get additional readings after initial impact


  Serial.begin(9600);              // initialize serial monitor
  Serial.println("Ready");
}
```

Programming Exercises – Accelerometer

```
void loop()
{
  microM.Impact();                    // function must be called at least once every 2mS to
                                      //work accurately
  If (microM.magnitude>0)             // display results of impact
  {
    Serial.println("");
    Serial.print("\tMagnitude:");
    Serial.print(microM.magnitude);
    Serial.print("\tDelta X:");
    Serial.print(microM.deltx);
    Serial.print("\tDelta Y:");
    Serial.print(microM.delty);
    Serial.print("\tDelta Z:");
    Serial.println(microM.deltz);
    Serial.println("");
    microM.magnitude=0;               // prevents display repeating the same values
  }
```

Assignment

- Finish Class Exercises
- Commit and sync your programming exercises to your GitHub RoboticsMB project.
- Put together your tadpole robot following the instructions at instructables.com. Note that our Tadpole kit does not contain the bumper switches.
- Follow the tutorials at RocketBrandStudios to program and calibrate the motors.
- If you have Sony or universal remote control, use the microM → IR Receiver project to determine what codes correspond to which buttons on your remote. Write the button names/functions and the corresponding codes in a table in your engineering notebook. See if you can control your robot using the IR remote control.