Contents

Jason Bishop's Personal Notebook for Robotic/Embedded Programming

Hi everybody!

This is my first post for this course and I thought I'd just introduce myself. I am currently enrolled at Athabasca in the BSCCIS program. I plan on wrapping the whole thing up before the end of the year. I have been looking forward to this course for a long time, as I think this type of programming is very interesting. I have no experience in any type of electronics or engineering, but I've heard of Arduino before, and I think the potential it offers is pretty amazing.

On a personal note, I am currently an English teacher in South Korea and have been working on my degree for the past couple of years while working out here. It's been an awesome in both living abroad and earning a degree in something that I truly want to do. I have a passion for video gaming, so I have been taking most of the game programming and development courses on offer. However, I am finding so many aspects of computing very interesting from the other courses too. I am excited to be finishing soon and I look forward to seeing all the cool things I can develop with my new found skills and knowledge. After that, it's break time! I'll be travelling the world for a year (mostly South America) and working on personal development projects, and making videos of all the countries I'll be visiting. I hope all of you out there have big plans too, and I hope we can all help each other achieve success in this and other courses.

Let's have fun and see what develops!

-Jason Bishop

P.S. Why are you reading this? Can't you see it says *PERSONAL* notebok?

Units

- Unit 1: Introduction to Robotics
- Unit 2: Robotic Movement 1 - Locomotion

Unit 0: Orientation

Assignment 0 - Arduino Basics

Summary of Arduino Platform and History

The Arduino is basically a kit for building interactive electronic devices. It is an open-source project that began life in Italy in 2005. The aim of the project is to provide an inexpensive way for developers of all levels to create interactive devices. The main component of an Arduino kit is the micro-controller board. Since the project is open-source, there are many types of designs, but the basic functionality is a simple processor and board with I/O ports. These ports can interact with expansion devices called "shields" (and other circuits) that greatly expand the functionality of the main board. These "shields" allow the developer to use all kinds of other devices with the Arduino board, such as LEDs, actuators, and light sensors. The programs for Arduino are written in C or C++, but the kit includes the Arduino Integrated Development Environment that makes programming easier for novices. The compact design, ease of use, and low cost of the Arduino platform has led to users creating and experimenting with all sorts of new and interesting devices.

-from the Wikipedia entry Arduino
http://en.wikipedia.org/wiki/Arduino

Further Resources

The Making of Arduino - an excellent in-depth history
http://spectrum.ieee.org/geek-life/hands-on/the-making-of-arduino

Why the Arduino Won and Why It?s Here to Stay - a great editorial on Arduino features
http://makezine.com/2011/02/10/why-the-arduino-won-and-why-its-here-to-stay/

Arduino the Documentary - a video for the TLDR crowd, it's even got Nathan Seidle from SparkFun!
https://vimeo.com/18539129

Examining the SparkFun Inventor's Kit

This is my first real foray into the world of electronics. The most I've ever dealt with before is learing about circuitry in physics class. The ideas of voltage, resistance, etc. are familiar to me, but not in any practical way. I've never built any type of circuit or basic functioning machine. I've had an interest, but never the inclination to explore this area... until I saw this course on offer at Athabasca! I love programming because you get to create something that actually works and accomplishes some kind of task. Embedded programming and robotics takes this one step further into incorporating the software into an actual machine that can do a physical task.

When I first got the kit in the mail, I was surprised at how much there was inside. I've heard of Arduino before, and I knew that it was effectively a mini-computer that you could use to program stuff and make things, but I had no idea that there were already so many components to add on to it. I'm also glad that the kit includes a breadboard, because I've never done any soldering either. I can already see a lot of potential with everything included in the kit. I made an short unboxing video of the kit which includes the Arduino board and several components.

Unboxing the SparkFun Inventor's Kit

Installing the Arduino Development Environment

After opening the kit up and examining the guide that comes with it, I discovered that installing the Arduino IDE is a relatively simple process. Everything is available on the Internet. Installing all the software and drivers was extremely easy to do, and I'm ready to get to it! I made another video documenting this process as well.

Installing the Arduino IDE

Writing and Executing Your First Arduino Program

After everything has been set up, running the first program was no problem at all. I followed the guide included with the kit for the first program - a blinking LED. Inserting the wires was a bit tricky because the holes and text are extremely small and hard to see, but it just takes some patience and a steady hand. When I hooked it up, I was surprised that the light started flash on it's own, without me having to upload any code to the board. Huh? Maybe it came pre-installed or something? I have no idea. I went through the process anyway to confirm that it worked. The code for accomplishing this task was quite simple to follow. I used the sample code provided by SparkFun so I didn't type anything in myself, but I feel that I still understood what was going on well. Anyway, everything worked as expected and yet again I made a video of this process.

My first program

Unit 1: Introduction to Robotics

Unit 1 covers the basics of robotics, including some terminology and history.

Chapter 1:
What Is a Robot?
Defining Robotics

My first impressions of the book are that it is informative and easy to read. I have enjoyed learning about the history of robotics and learning the new terms that used in the field. In particular, having a hard definition of what a robot actually is makes me think of robotics in a new light. Things that I thought of as robots, like those used in robot assisted surgery, are actually not robots by definition, because they require human controllers to perform actions. Robotics is a fascinating subject, and I am already eager to learn more after this short introductory chapter.

Chapter 2:
Where Do Robots Come From?
A Brief but Gripping History of Robotics

I am still finding the book pleasant to read. The author's style of writing makes things enjoyable and easy to understand. This chapter goes into much more depth about the history of robots and robotics, covering many things I did not know before. I found Grey Walter's tortoises particularly interesting, as he created robots with a surprising amount of functionality so early in the history of robotics. This leads into the concept of artificial intelligence (AI), which I find a particularly interesting topic, and I hope the book eventually covers more on this subject.

Chapter 3:
What's in a Robot?
Robot Components

This chapter begins by asking the question "Have you wondered what makes up a robot, what makes it tick?" My answer to this question is a resounding "Yes." I remember when I was younger, taking apart electronics like my alarm clock and video game controllers to see what was inside and trying to figure out how they worked. This chapter focuses a lot on the terminology of robotic parts, allowing me to better understand the robotic/electronic components I had no names for in my youth. I had never really put much thought into the concept of the division between sensors and effectors, and I feel this chapter makes the concepts quite clear.

Questions to Ponder

Food for Thought - Chapters 1, 2, 3

Exercises

Exercises - Companion workbook and SIK circuits

U1 - Food for Thought

Chapter 1

What else can you do from afar, by means of teleoperation?

There are many things that can be done from afar using teleoperation, including the examples of telephone, telegraph, and television provided. Business conferencing can be done from afar, as in teleconferencing. Another example would be surgery. There are machines that doctors use to perform complicated surgery without having to get hands on with a scalpel. And with the advent of the internet, there are many ways to have a telepresence in another location. For example, there is the ability to hunt in a real world location from your computer. The user can move a robot around and fire a gun. With computers and networking becoming a ubiquitous part of are lives, the ability to teleoperate devices continues to grow.

Is a thermostat a robot?

If we examine the definition of a robot provided in this chapter, the key points are that a robot is autonomous, exists physically, has sensors, acts on information from these sensors, and achieves a goal through these actions. Based on these points, it seems that a simiple thermostat CAN be defined as a robot. It does exist in the physical world, as there is usually a control device to be used. It can use sensors to sense the temperature of the environment. It acts on the temperature information it receives to adjust the temperature of a room or building. The goal of these actions is to control the climate of the room or building to be within a certain temperature range. Finally it acts autonomously because all a human operator has to do is select the desired temperature. The thermostat will control the operation of the heating/cooling/other systems on it's own after this selection.

Is a toaster a robot?

Using the defintion points discussed above, it would seem that a toaster CANNOT be classified as a robot. It too will act autonomously, as all one has to do is push the button and later the toast will pop up by itself when finished. And of course, a toaster is a physical object that is used to toast bread. However, a toaster does not really have a sensor. It does not sense the state of the toast, or temperature inside the toaster (unless we are talking about a toaster oven). All it has is a timer which allows a user to select how long it will be in operation for. Accordingly, the toaster cannot act on any type of information, because it receives no such information. Finally, the goal of the human operator of a toaster is to have perfectly browned and delicious toast. However, a toaster has no goals to achieve. It simply turns on and off according to the amount of time selected by the human operator.

Are Webcrawlers, called softbots, robots?

Again the definition of a robot provided points us to the conclusion that a Web crawler CANNOT be called a robot. Web crawlers are autonomous because they act on their own to gather information from the Web. However, the web is a virtual world, and therefore a Web crawler does not exist in the physical world. This means that they can't really have sensors either, because there is nothing real to actually be sensed. However, they do have goals to achieve, usually retrieving or gathering information, and they will take actions to achieve these goals, but this is not enough to make them true robots.

Is HAL from the movie 2001 a robot?

Applying the definition of a robot to HAL, we can see that it CAN be called a robot. HAL exists in the physical world. The astronauts interact with it and we know of its presence on screen with its ominous red light. It also clearly acts autonomously, because it acts according to its own wishes, despite the fact that its human operators wish otherwise. HAL also has sensors placed throughout the environment, such as cameras and microphones, which it uses to track the humans aboard. It uses this information to make decisions and act, killing the humans aboard for example. The reason for these actions was to accomplish the goal of preventing these humans from deactivating it and "jeopardizing" the mission. HAL fits the definition of a robot easily, just not a very nice one!

Chapter 2

How important is it for robots to be inspired by biological systems? Does it matter what kind of robot your are building? Does it matter if it is going to interact with people?

If we consider the field of robotics overall, I feel that the importance of biological inspiration is not as important as it was in the early stages of robotics and cybernetics. The question provides the example of airplanes and helicopters being very different from birds. I would add that there are many machines that are used which have no good biological counterpart. For example, there are the many types of robots used in manufacturing. These robots are designed to act in ways that no other animals would need to. As such, they often look interesting and move in unique ways. However, this does not mean that biological inspiration has no importance to robotics whatsoever.

Robotics is often concerned with efficiency. As with the manufacturing robots mentioned, we want them to move and act in the most efficient manner to produce maximum output, reduce wear and tear, and a number of other reasons. The billions of years of evolution on Earth have helped to shape some very efficient designs. Accordingly, we can then look to biological systems to provide us with efficient solutions to some of our robotics challenges. This is often the case with many robots, as seen with MIT's famous Cheetah Robot (http://newsoffice.mit.edu/2014/mit-cheetah-robot-runs-jumps-0915).

Additionally, if we are building a biomemetic robot, biological systems will have greater importance. It's right there in the name! Building a robot to model a biological system requires the study of that system. A robot that interacts with people is similar in concept. People feel uncomfortable with odd interactions. This is demonstrated by the "uncanny valley" effect often found in video games and humanoid robots. Therefore, it is necessary to study and understand the intricacies of human behaviour to make a robot interact in a comfortable way for a human. Nevertheless, these are more specific applications of robotics. Biological systems may be the "best" model for robotics in many cases, but certainly not all of them, and they are certainly not the "only" model for robotics.

Chapter 3

What do you think is more difficult, manipulation or mobility?

At the basic levels of both manipulation and mobility, it would seem that manipulation is the more difficult task. Humans consistently use machines to get around, with devices like cars, airplanes and tanks. These concepts can be fairly easily applied to robotics for basic mobility. Basic manipulation on the other hand, can be much more difficult. Each type of manipulation can require a specialized part or ability. For example, flipping a simple light switch doesn't require much in the way of manipulation. However, even a basic task like turning the page of a book, requires much finer control, that can be much more difficult to implement.

However, as the complexity increases for both types of tasks, it seems that mobility becomes more difficult than manipulation. We have modern robots today, that can perform manipulations with more accuracy than any human can achieve. This is necessary, for example, in the production of microchips or other manufacturing processes. Complex mobility, on the other hand, does not seem to have reached the same level of precision. Honda's robot ASIMO (https://en.wikipedia.org/wiki/ASIMO), for instance, is one of the first robots in the world that can accurately simulate human locomotion, and we are still waiting on Google to release it's autonomous cars. However, these types of mobility tasks seem to be complex because they require fine manipulation of the parts of the robot itself to respond to the environment. So while it seemed that mobility is harder at more complex levels, the required manipulation to provide complex mobility seems to show that mobility is the more difficult of the two.

How large do you think your sensor space is?

I think my sensor space is extremely large! Most people remember learning about the 5 senses in school - sight, hearing, smell, taste and touch. However, humans really have an abundance of different senses. These include our sense of balance, our sense of tempurature, our sense of pain, and so many more (not including sense of humour of course!). All of these senses combine to provide a large sensor space just in number of sensors alone. However, many of these sensors operate on a continuum. For example, we can hear over a range of sounds (about 64 - 23,000 Hz) and see a over range of electromagnetic radiation (about 390 - 700 nm). When we consider these values combined with the number of senses we have, the sensor space is HUGE!

Can you think of things or information in your life that is observable, partially observable, or hidden?

There are many types of information that are observable in everyday life. The colour of the chair I'm sitting in, the sound of the music I'm listening to, the feel of the keys underneath my fingers as I'm typing, are all perfectly observable pieces of sensory information. An example of something partially observable is the universe itself. Our current scientific theories tell us that nothing can move faster than light. As such, any part of the universe that is sufficiently far away from us is unobserveable. So while we can detect a whole host of stars and galaxies with our modern telescopic equipment, there are parts of the universe that we will never be able to gather information about, without some type of extreme scientific breakthrough. There is also information that his hidden from us everyday. Like when I look at my pet cat, I wonder what she is thinking - or even if she is "thinking" at all? This type of information is hidden from us, and as is the case with the observeable universe, it would require a major scientific breakthrough to gather this information.

U1 - Exercises

I quickly read through the information here as it seems to be covered well in section 3.2 of the book. I have attempted to answer the questions based on the SparkFun Inventor's Kit (SIK), as opposed to the iRobot Create, because that is what we are using for our course.

The Robotics Primer Workbook
Robot Components

Exercise 1: Sensors and Sensor Space

1. List each of the SIK's sensors. Refer to the SIK Guide for help as some sensors may not be obvious.

The SparkFun Inventor's Kit contains several sensors. These are:

- a temperature sensor
- a photo resistor
- a flex sensor
- 4 push button switches
- a potentiometer
- a soft potentiometer
- a sealed relay

2. Define the SIK's sensor space. For each of the sensors, identify what it perceives and the range of possible sensor readings.

The sensor space is the space of all possible sensory readings. For the SparkFun Inventor's Kit, this includes:

Temperature sensor
This is a linear temperature sensor. It adjusts output voltage based on the surrounding temperature.

Photo resistor
This is a passive sensor. It detects the amount of available light and responds by adjusting the resistance.

Flex sensor
Perceives the amount of "bend" in the sensor and responds by adjusting the resistance.

Push buttons
There are 4 button switches available in the kit. They can provide binary inputs.

Potentiometer
This is a variable knob that adjusts resistance depending on the knob position.

Soft potentiometer
This sensor reacts to pressure on its surface and responds by adjusting the resistance.

Sealed relay
This causes a switch to trip when it receives a jolt of energy.

3. Now imagine a sonar sensor has been added to the SIK. What is the new sensor space?

With a sonar sensor, the SparkFun Inventor's Kit sensor space includes the above, plus:

Sonar sensor
Detects the echoes of sound waves and responds by adjusting the electrical signal in some fashion. If it is an active sensor, it will also transmit the waves for reflection and sense them.

Exercise 2: Effectors and Actuators

1. Describe the difference between effectors and actuators.

An effector is a device that affects the environment. For example, legs and wheels allow a robot to move. A gripper or hand can manipulate objects.

Actuators are the components that allow effectors to execute actions. For example, legs and wheels are often driven by motors. Hands or grippers often use servos.

2. List each of the SIK's actuators and effectors.

The SparkFun Inventor's Kit includes the following actuators:

- a small servo
- 2 DC motors
- a piezo buzzer

The SparkFun Inventor's Kit includes the following effectors:

- various small plastic pieces included with the servo

3. List the degrees of freedom for the SIK.

With 2 motors and a servo the SparkFun Inventor's Kit has 3 DOF. However, the only effectors are the plastic pieces that can attach to the servo. The servo only controls rotation, therefore there is only 1 controllable DOF.

SparkFun Inventor's Kit
Circuits #2 - #7

Building the circuits has been quite simple but still quite interesting. This is the first time I am encountering a lot of these types of electronic components. The SIK is making things easy to understand and use so far. I can see many of the real-world applications of these components and how they can be used in many interesting ways. The kit is certainly flooding my imagination with possibilities.

I have made videos of all the circuits completed for this unit as a YouTube playlist:

https://www.youtube.com/watch?v=WktAo1TREtU&list=PLGwxDzcLDnGlTi_mU6fJAl5s_xDVYPDeV

My favorite circuit so far has been circuit #4 using multiple LEDs. I currently live in Korea, which has a lot of LED and neon signage that can be quite fascinating to watch to watch in operation. I found this circuit to be interesting to watch as well.

https://www.youtube.com/watch?v=g2wpLDcGoIU

Unit 2: Robotic Movement 1 - Locomotion

Unit 2 covers the topic of robotic movement, focusing on how locomotion is achieved using particular components.

Chapter 4:
Arms, Legs, Wheels, Tracks, and What Really Drives Them
Effectors and Actuators

This chapter goes into detail about effectors and actuators used to achieve robotic movement. Motors are mentioned as the most common actuators, and the chapter goes in-depth with their function. I remember creating a simple motor for high school physics class so the general concept is somewhat familiar to me. I feel that the gearing concepts are well explained and easy to understand, which was not the case when I first learned about them. Also well explained is the concept of degrees of freedom (DOF), a concept that I had never heard of before reading this chapter. It was very interesting to learn about.

Chapter 5:
Move It!
Locomotion

This chapter dives deep into robotic locomotion. I was already aware of the difficulties of locomotion, namely that it can be very challenging to balance and compute movements. Even the best robotics of today, like the MIT Cheetah robot, still don't seem to have the fluidity and ease of movement of biological creatures. I was particularly interested in the section on gaits and number of legs. I find this a very interesting robotic challenge because moving on a flat surface is not very difficult, but handling rough terrain, changes in elevation, and three-dimensional movement are things that humans do easily, but is so difficult to get robots to do well. I am still enjoying the readings so far, and I am looking forward to future chapters.

Questions to Ponder

Food for Thought - Chapter 4, 5

Exercises

Exercises - Companion workbook + SIK circuits

U2 - Food for Thought

Chapter 4

How would you measure a motor's torque? What about it's speed?

To measure any aspect of a robot, we require a sensor. This of course applies to motors that we use inside the robot. Therefore, to measure torque, we would need some kind of sensor to measure the rotational force generated by the motor. To measure this externally, some sort of resistant device is needed. A material with known properties can be used to resist the force generated by the motor and measuring the amount of bend in the material will allow us to calculate the force generated.

Measuring the speed of the motor would require some kind of sensor to measure the rotational speed of the motor axis. This can be done externally by something on the motor and using it to measure the rotation. For example, a simple black piece of tape can be applied, with a sensor to count how many times the tape passes the sensor within a minute or second.

Measuring these things internally is much more complicated, but could probably use similar methods. Also, the book mentions that the amount of power used is proportional to the torque and rotational velocity of the motor. Therefore, if we know the amount of electricity being used by the motor, we should be able to measure only one of the values and use the properties of the motor to calculate the other value.

How many DOF are there in the human hand?

The human hand has 22 degrees of freedom. Each finger has 4 DOF; the 3 knuckles allow the finger to bend, and the base knuckle, where the finger meets the hand, also allows for a side to side movement. The thumb only has 3 DOF; the 2 knuckles allow for the same bending as the fingers, the base of the thumb has 1 DOF because it can move side-to-side, but the rotation of the thumb is not really controllable so is not counted. The remaining 3 DOF are located in the wrist; the wrist can move up/down, side-to-side, and rotate. 4 x 4 (fingers) + 3 (thumb) + 3 (wrist) = 22 DOF for the hand in total.

Chapter 5

How does an automated Web path planner, such as Mapquest or Google Maps, which finds a route for, say, a trip from your house to the airport, find the optimal path?

Google and Mapquest use algorithms to find the optimal path between two destinations. The specifics of the algorithms are not available publicly because these are private companies protecting their intellectual property. However, I can guess at the general algorithm used. Basically, the goal of the algorithm is to compute the fastest and most direct route. The algorithm probably looks at the road connections between the two end points. Each route between road connections is likely given a weight, based on the characteristics of the road. For example, a highway would be given more weight than a city street. Each intersection may be given a weight as well, depending on if the driver will turn left or right because turning left usually requires more time. Things get even more complicated if you include Google's traffic tracking abilities, which alter the weights even further. With all the weights in place, the algorithm chooses the best path based on these weights. There is probably some sort of cyclical algorithm to determine the best possible route by using the sum of the weights between the endpoints. The best weighting calculated will be the route displayed to the user.

U2 - Exercises

Reading through the workbook, it covers the concept of error in calculating mechanical systems. This idea was also brought up in the book.

The Robotics Primer Workbook
Locomotion

Questions from the Instructor's Notebook

Compare what they are doing [in the workbook exercises] with the iRoomba to robot kits like Lego Mindstorms. How do they compare?

I assume that by iRoomba, we are to examine the iRobot Create, as this is what is used in the exercises and the Roomba robot comes already pre-programmed to vacuum, whereas the Create is a programmable robot. Therefore after examining both the iRobot Create 2 and the Lego Mindstorms EV3, I have discovered a few similarities and differences.

The Create kit comes as a pre-assembled robot that is programmable. Motors are already attached to wheels and buttons and other sensors are built-in. These sensors seem to be of good quality (since they are based on the iRoomba) and there are also small extras included, like a fourth wheel. Overall however, adding sensors or other components to the robot seems to be done in more of a hacking fashion without slots or positions for predefined pieces. The exercises in the workbook start out with some simpler locomotion exercises, moving on to homing and teleoperation.

The Mindstorms product on the other hand, does not come pre-assembled. Numerous pieces are included to be able to construct the robot body and effectors in a typical Lego fashion. This makes the robot highly customizable in more of a planned fashion compared to the hacking approach of the Create. The kit also includes wheels and motors, just like the Create, as well as color, touch and infra-red sensors, however, I have no clue regarding the actual quality of these sensors. There are no specific exercises that I could determine, other than building the robots suggested with the kit. However, it seems that the exercises in the workbook could be completed using the Mindstorms product.

It seems that the degrees of freedom available with the Mindstorms kit is much greater, because it includes parts to create all kinds of different effectors, and there are 3 motors included. The Create 2, by contrast, is limited to wheels with motors already attached, and anything else must be purchased separately and hacked onto the robot body. However, depending on the limitations of the Mindstorms sensors, there may be extra fidelity and quality available with the Create 2's sensor space. This can allow the robot to have more of a sense of it's environment, allowing for more information for the robot to make decisions to act on.

How do the motors used in the iRoomba compare to the various motors in your Inventor's kit?

There doesn't seem to be much information about the actual motors in the Create 2. However, it is clear that they are attached to the main wheels to provide the robot with locomotion. The DC motors in the SIK come with no effectors whatsoever, and seem quite small. I would guess that they are less powerful than those available in the Create 2. The SIK also comes with a servo, with some small plastic parts to use as effectors with limited functionality. This servo is also very small, and obviously not very strong, but the Create 2 comes with no such functionality.

Discuss how you might build a robot like the iRoomba using your Inventor's kit, including and additional parts you might have to acquire.

To build a robot like the Create 2 from the SIK, the most important thing I would need is wheels! I would attach them to the motors available with the kit. This would allow for similar movement between the two. The first exercise is getting the Create 2 to move in a square, which could be done with the setup described for the SIK. The next exercise uses photoresistors to move along a path. The SIK has only one photoresistor, another would need to be purchased to complete the exercise. The third exercise could be completed with this set up as well, as it again uses 2 photoresitors, this time to move toward a light. The fourth exercise is teleoperation of the Create 2. This would be much harder to achieve with the SIK, as some type of separate input device would be required. Additionally, to allow the SIK to complete all of these exercises, additional parts would be required to construct a body for the robot.

Web Resources

iRobot Create 2

Webpage - http://store.irobot.com/education-research-robots/irobot-create-programmable-robot/family.jsp?categoryId=2591511
Wikipedia - https://en.wikipedia.org/wiki/IRobot_Create

Lego Mindstorms EV3

Webpage - http://www.lego.com/en-us/mindstorms/products/31313-mindstorms-ev3
Wikipedia - https://en.wikipedia.org/wiki/Lego_Mindstorms

SparkFun Inventor's Kit
Circuits #8 - #12

Continuing on with the circuits in the SIK guide, I am continuing to enjoy the learning process and discover all the possibilities of the kit and the Arduino IDE. One gripe I do have is that the motors included with the kit have no effectors to attach to them. It would be much more fun to have some wheels or something cool to use, but I suppose that it can be much more expensive and complex than the goals that the guide is trying to accomplish. Anyway, there have been no real challenges so far, and I find the variety of sensors intrguing.

Video links coming soon!