Getting started with IoT

Throughout my experiences with IoT (Internet of Things) development, I have found that many people don't fully understand what IoT actually is and what the fundamental concepts of IoT are. Also, people who are new to IoT development do not necessarily know the differences between microcomputers and microprocessors; this article differentiates the two. Finally, this article lists a few sites that can help provide inspiration to developers who want to build something but don't know what. I hope the collection of information below assists in your development with IoT.

IoT has become a popular buzz word to businesses and hobbyists alike. Understanding how to pick the correct resources will help projects reach their full potential. This is a common place of error for novice hobbyists. Before discussing common resources let me describe what IoT is to ensure we are talking about the same thing.

What is IoT

IoT is a movement which connects devices to the internet to share data and sometimes to performs events in defined conditions. This connection is accomplished by connecting devices to the same network typically using Wi-Fi and occasionally Ethernet. A common structure for IoT is either setting up either a network server or a centralized hub on a LAN (Local Area Network) to collect, react to, and/or display the information through connected controllers. These central devices can also be connected to the public Internet to allow control from any device – such as a phone or computer – connected to the internet anywhere. A few good examples of IoT include "Smart" houses, automated transportation, and connected cars.

What device to use

One challenge many developers have when developing is choosing the right device for their project. This holds true to IoT development. This section is divided into three main categories: microcontrollers, microcomputers, and sensors.

Microcontrollers

All microcontrollers have a set of pins that read inputs or write outputs at one time. These pins are called GPIO (General Purpose Input Output) pins. Microcontrollers loop endlessly through a sequence of predefined code that is based reads inputs – typically sensor data – and writes outputs – typically to controllers, such as motors or displays, or to a communication port, like Wi-Fi or Ethernet.

Arduino

"Arduino is an open-source electronics platform based on easy-to-use hardware and software." Arduinos are known for controlling multiple devices at once as well as reading sensor data. IoT projects use Arduinos for reading sensor data or executing events. Currently, there are about 20 different types of Arduino products. Here, only a few will be discussed. More information about the different boards can be found here. Many Arduino products are compatible with optional shields to enhance functionality, like network capability. All Arduino products by default are programmed in C++ but there are ways to use other languages but that is not discussed in this article.

Arduino Uno

The Arduino Uno does not have built in networking capability so an external shield will need to be connected before IoT features can be put in place. This board is a classic starting board for hobbyists because of its general purpose uses and low cost.

Arduino Ethernet

As the name of this device suggests, this device is an Arduino that has Ethernet built in. The other differences between this board and the Uno is the presence of an SD card mount. Also, this device is about twice the cost of an Uno.

Microcomputers

Microcomputers are small devices that are capable of running a computer Operation System. It is common for a Linux system to run on these devices, though, the processing power is noticeably less than that of a computer.

Raspberry Pi

Because Raspberry Pis are a microcomputer, they can execute complex tasks which are particularly software based tasks. Raspberry Pis also are manufactured with built in ethernet and USB capabilities. Below is a list of different Raspberry Pis and their differences. More details about other Raspberry Pi products can be found here.

Raspberry Pi 3 B+

The Raspberry Pi 3 B+ is built with one Ethernet port, 4 USB ports, built-in Wi-Fi and Bluetooth modules, and a HDMI port. Also, there are GPIO pins similar to Arduinos which can be programmed using any language that the Raspberry Pi supports. If you are looking at the Raspberry Pi 2 B+ as an alternative, the only difference is the built in Wi-Fi and Bluetooth.

Raspberry Pi Zero W

The raspberry Pi Zero is very similar to the Raspberry Pi 3 B+ except slightly slower in speed and much smaller. With it being smaller, it only has one micro USB port and a micro HDMI port. Though it is smaller, it still has the same set of GPIO pins as the other types. The Raspberry Pi Zero W includes Wi-Fi and Bluetooth (the non-W version has neither built in).

Microcomputer vs Microprocessor

Microprocessors are geared for simple tasks that repeat throughout time whereas microcomputers are geared toward complex tasks. Microcomputers demand a much more stable power supply as it is running an operation system but the microprocessors loop over predefined code from the time it powers up and to the time power is removed. In general, microprocessors are a cheaper product than microcomputers as they are designed to perform easier tasks.

ESP 8266*

While the ESP 8266 isn't a typical microcontroller, some models can be used as one. The base of the ESP 8266 is a Wi-Fi module which can be used to connect a device such as an Arduino to a Wi-Fi network. This device is fairly cheap and has lots of community support.

Sensors

Sensors are typically connected to a microcontroller/microcomputer through their GPIO pins programmed as inputs. Some types of sensors include temperature and humidity sensors, motion sensors, door or windows sensors, and other miscellaneous sensors such as water level sensors, gas sensors, sound or light sensors, and soil moisture sensors. Some sites that these sensors can be found include Sparkfun and Adafruit.

The combination of sensors with either a microcomputer or a microprocessor is what makes up the bulk of IoT applications. Now that you are more familiar with these, you are more prepared to start making a project. Don't worry if you don't completely know what you want to try creating as there are plenty of online sites that can spark ideas.

Sources for instruction or inspiration

Some of the sites previously linked to also contain great community resources from forums to how-to descriptions to tutorials. The Arduino site in particular has a "Learning" and "Community" section on their website. The Adafruit site also has a blog section and a forum section, both of which are great resources. One other good resource for project ideas is Hackaday, whose slogan is "Fresh hacks every day".

Thank you for taking the time to discover useful resources for IoT development. I hope that this article will guide you in making your dream IoT devices. Should you have additional questions or want further advice please contact me at mdh5389@psu.edu.

Self-Assessment

The strength of this communiqué is the combining of differentiation of microcomputers and microcontrollers with providing options to use for each. This is the strongest point because many sources I have found online either compare microcomputers and microcontrollers, or provide different options for either of the two groups.

I think cohesion between the topics could be better because right now I feel like everything is similar to a long bullet list. Granted, my goal was to provide information. I do provide information but I feel that it is more like a manual rather than a welcoming informative document. The other thing that can be improved in this document is the length of the document. I am aware that the assignment asked for 500-750 words but I did not feel like I could adequately cover what I intended to cover in 750 words or less.

The comments from Melanie Cumberbatch were probably the most helpful as a unit. While I did know I did not complete my rough draft that was submitted, the rest of the comments I tried taking into consideration. While my title is “Getting started with IoT”, it seemed like there was still confusion about who this document is for so I tried making that more explicit.