Microcontrollers for IOT Prototyping – Part 2

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Introduction

- The Internet of Things is considered by many to be the 4th Industrial Revolution.
- But unlike the first three, it is not a new technology. It is a new way of integrating *existing* technologies. As a result, it will not require a new kind of engineer.
- Instead, to implement IoT, anyone hoping to embed IoT-enabled capabilities in applications should gain a general understanding of the technologies.
- Our intent is not to describe every conceivable aspect of the IoT or its enabling technologies but, rather, to provide an easy reference in your exploration of IoT solutions and plan potential implementations.

Introduction

ACTUATORS
Motors
Water Engines
Hydraulic
Motion control
Servomechanisms

INTERNET OF THINGS

CONNECTIVITY

Ethernet

Wi-Fi
Bluetooth
ZigBee

SENSORS
Compass
Magnetometer
Accelerometer
Touch sensor
Gyroscope
Altimeter/pressure
Temperature
Humidity

MICROCONTROLLERS
8, 16, 32-bit
Low Power
Frequency of operation
Memory
Inputs/Outputs
Serial Interfaces & Connectivity
Built-in Analog and Sensors

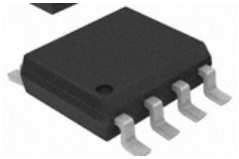
Sensor Selection

Choosing a sensor (for example, a temperature sensor) for an IOT application may seem like a straightforward decision. However, selecting the right sensor involves taking many factors into account:

- Cost
- Supplier: How trustworthy is this seller? (Look at reviews from other buyers)
- Accuracy & Precision
- Availability: Some components can only be in large quantities.
- Measurement Range: What ranges will it work for?
- Power Consumption: Will it work with the power source I have?

Sensor Selection

Example: Temperature Sensor

			
Texas Instruments LMT84LP	Atmel AT30TSE754A-S8M-T	Sparkfun DS18B20	Texas Instruments LM35DZ
Cost: $0.91 Accuracy: +/- 0.4°C Range: -50°C to 150°C Voltage: 1.5V – 5.5V Availability: >10	Cost: $0.53 Accuracy: +/- 2°C Range: -55°C to 125°C Voltage: 1.7V – 5.5V Availability: >4000	Cost: $9.95 Accuracy: +/- 0.5°C Range: -55°C to 125°C Voltage: 3.0V – 5.5V Availability: >5	Cost: $1.86 Accuracy: +/- 1.5°C Range: 0°C to 100°C Voltage: 4V – 30V Availability: >10

IoT Development boards

- IoT development boards enable makers to prototype their ideas. They combine microcontrollers and processors with wireless chips and other components in a pre-built, ready-to-program package.

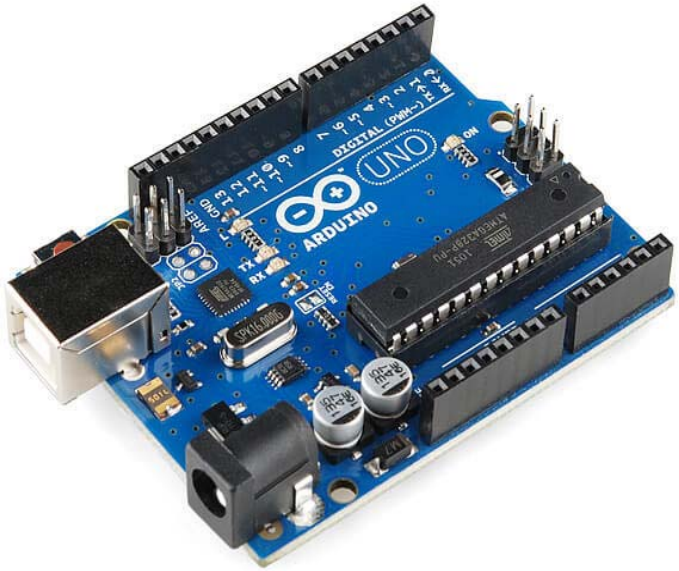
- In the last 18 months, the DIY market exploded with the availability of a variety of boards. Whatever the needs of your project or product, there's sure to be a board that fits your exact requirements.

- New developers can find it difficult to select the right IoT prototyping board.

IoT Development boards - Selection

- Cost
- Specifications: Memory, Processor, I/O capability, etc.
- Programming support/options
- Open design: active user community, timely enhancements, forums.
- Reliability of supplier.
- Compatibility with sensors and actuators

1. Arduino Uno



(approx. $12)

- Arduino Uno remains the top favorite of absolute beginners and experts.
- Considered to be one of the first microcontroller-based development boards, the Arduino Uno R3 is simple, yet a very powerful prototyping environment.
- Arduino enjoys the best community participation and support. From sensors to actuators to libraries, it has a thriving ecosystem.
- The board layout has become almost the gold standard for microcontrollers. Almost every prototyping environment tries to be compatible with the Arduino pin breakout.
- The open source IDE to develop programs is another reason for its popularity. With a simple syntax based on 'C' language, the code is easy to learn.

Arduino hardware versions

As of 2016, 17 versions of the Arduino hardware had been commercially produced.

- Arduino Diecimila in Stoicheia
- Arduino Duemilanove (rev 2009b)
- Arduino UNO
- Arduino Leonardo
- Arduino Mega
- Arduino MEGA 2560 R3
- Arduino Nano
- Arduino Due (ARM Cortex-M3 core)
- LilyPad Arduino (rev 2007)
- Arduino Yun

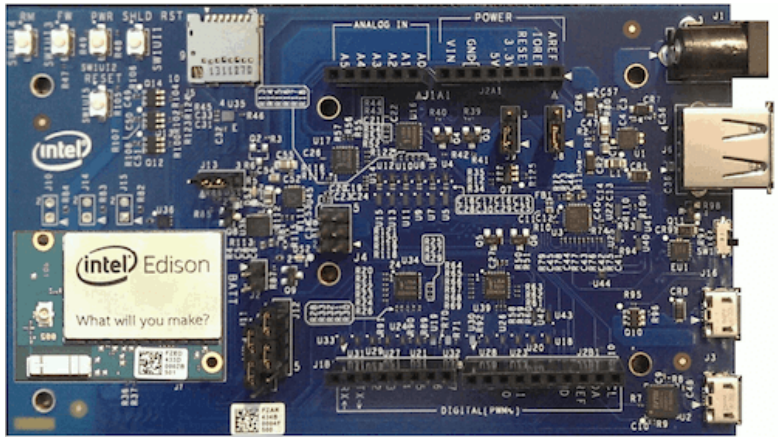
In 2017, Arduino Primo and Otto (specifically for IoT) will be launched – Primo is the first IoT development board to feature all the traditional wireless standards, such as Wi-Fi, Bluetooth low-energy, near-field communications (NFC), and infrared.

2. Raspberry Pi

(approx. $50)

- The Raspberry Pi is a series of credit card-sized **single-board computers** developed in the UK.
- The new Raspberry Pi 3 includes built-in WiFi and Bluetooth making it the most compact and standalone computer, with a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor and 1GB RAM.
- The HDMI port makes it further easy to hook up A/V sources.
- With four USB ports and 40 GPIO pins, you can connect many peripherals and accessories to the Pi. There are third party breakout boards to connect various Arduino shields to the Pi.

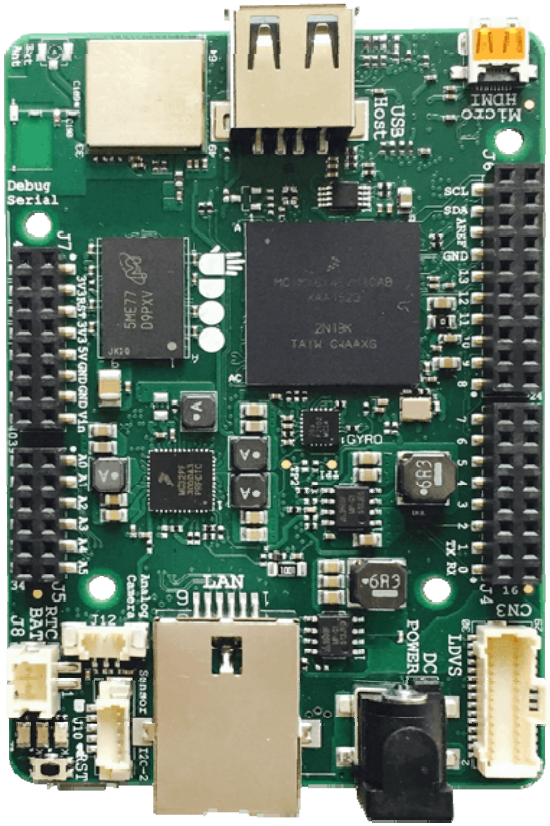
3. Intel Edison



(approx. $75)

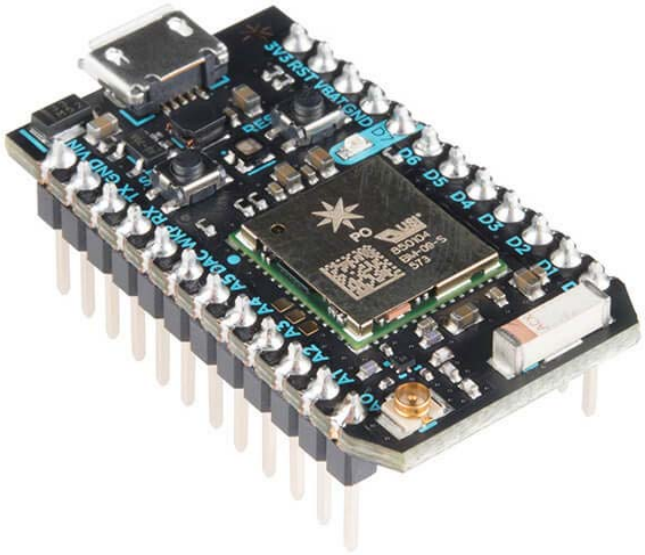
- Intel Edison is a high-performance, **dual-core CPU** with a single core micro-controller that can support complex data collection.
- Intel Atom™ 500MHz dual-core x86, 1GB RAM, Wi-Fi 802.11n, Bluetooth 4.0
- Edison comes with two breakout boards – one that's compatible with Arduino and the other board designed to be a smaller in size for easy prototyping.

4. Udoo Neo



- Udoo Neo is a full-blown computer that also has an Arduino-compatible microcontroller.
- It's positioned as the combination of Raspberry Pi and Arduino. The board has the same pinout as Arduino Uno.
- Neo embeds two cores on the same processor – a powerful 1GHz ARM Cortex-A9, and an ARM Cortex-M4 I/O real-time co-processor.
- Wi-Fi + Bluetooth 4.0 module.

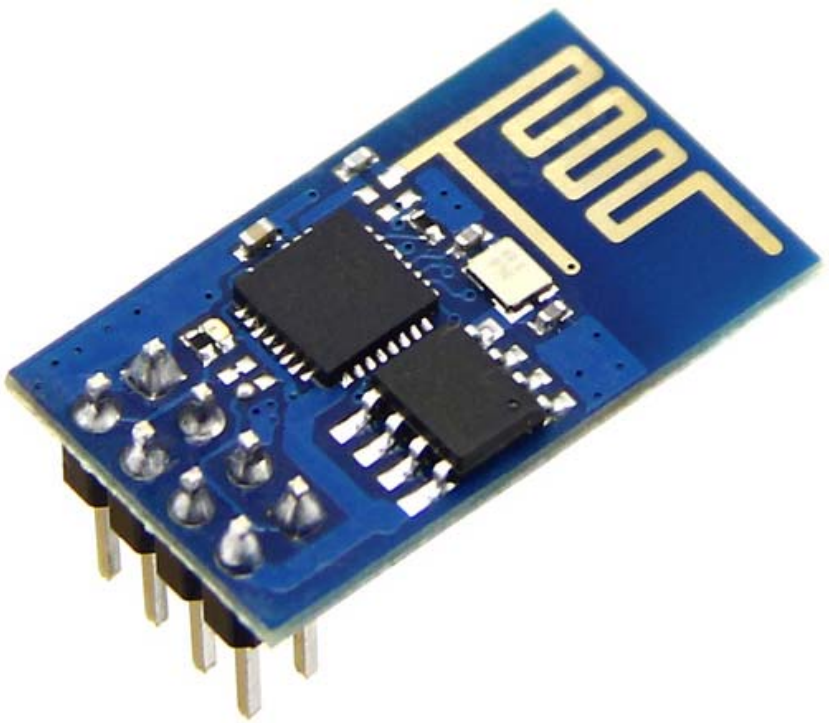
5. Particle Photon



(approx. $30)

- Photon is one of the smallest prototyping boards available in the market. Powered by the STM32F205 120Mhz ARM Cortex M3 processor, Photon has 1MB flash, 128KB RAM and a built-in WIFI module.
- Once configured, the board is accessible from the Internet, which makes it an ideal prototyping platform to build connected applications.
- The board comes with five analog pins and eight digital pins for connecting various sensors and actuators.
- Developers can also buy a variety of shields for interfacing with relays, motors, and the broader Arduino Uno ecosystem.

6. ESP8266



As from $2

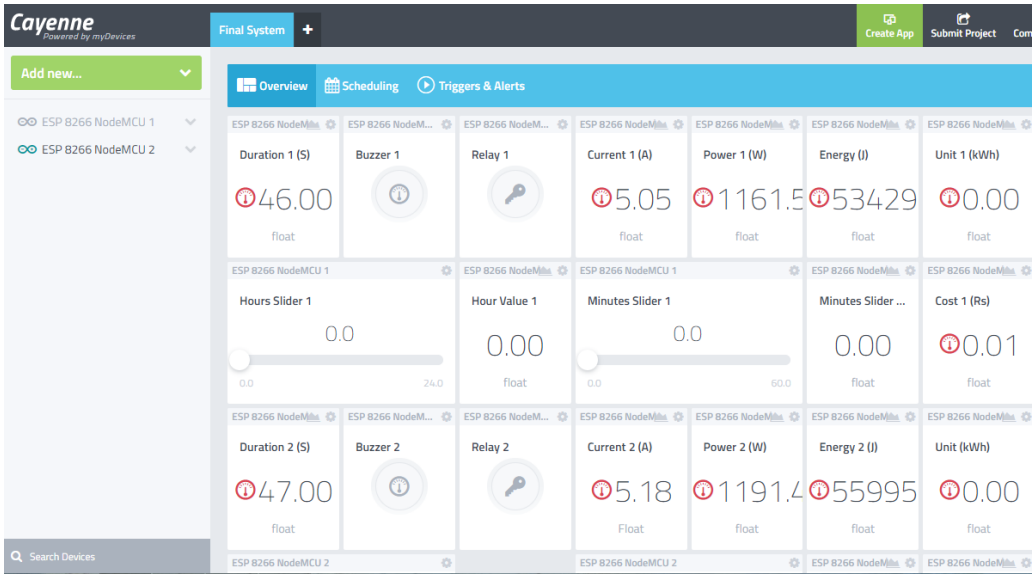
- The ESP8266 is a low-cost chip with a microcontroller supplemented with capabilities for 2.4 GHz Wi-Fi, 16 GPIO and 1 MB built-in flash.
- This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections.
- ESP8266 offers a complete and self-contained Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor.

Student Projects implemented at UoM

- **Smart Power Monitor**

✓Monitors power consumption of appliances.

✓Controls appliances remotely.



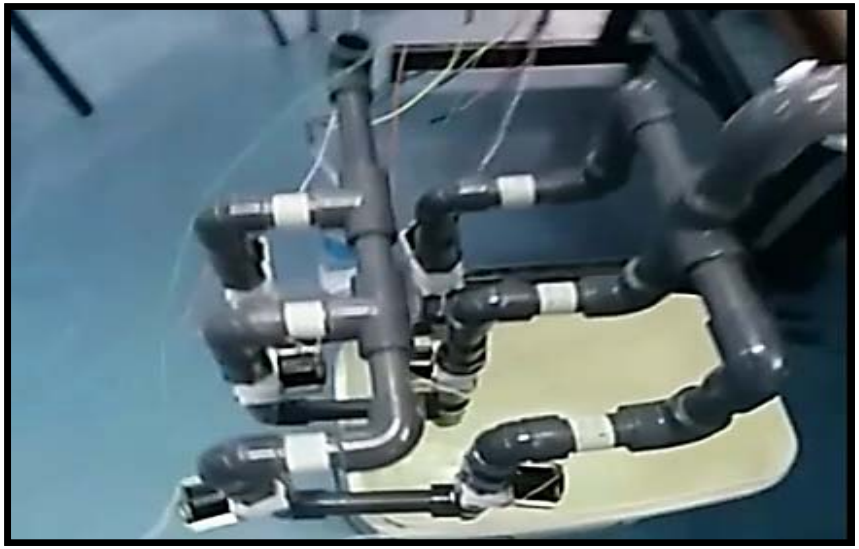
Student Projects implemented at UoM

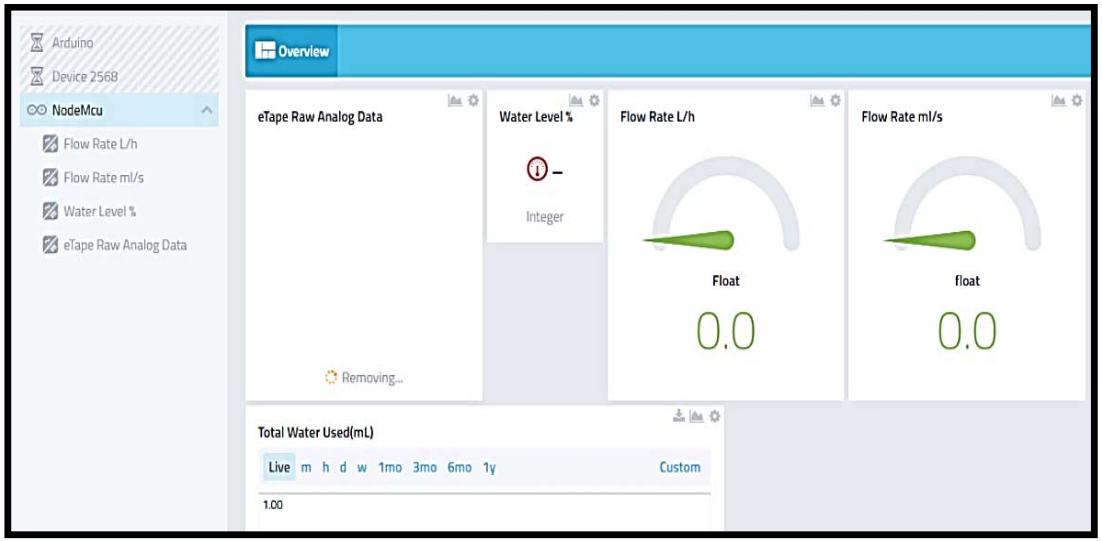
- **Smart Rainwater Harvesting System**

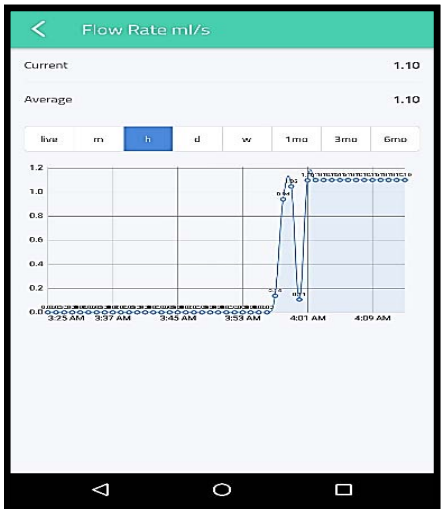
✓Domestic water distribution system that automatically shifts from utility to rainwater.

✓Monitor status (water level in tank, flow rate, volume) wirelessly

✓Activate valves remotely








THANK
YOU!