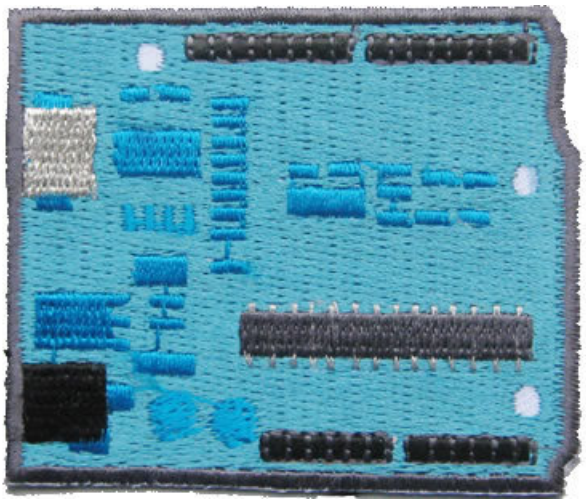
adafruit learning system

Skill Badge Requirements: Microcontrollers

Created by Adam Kemp



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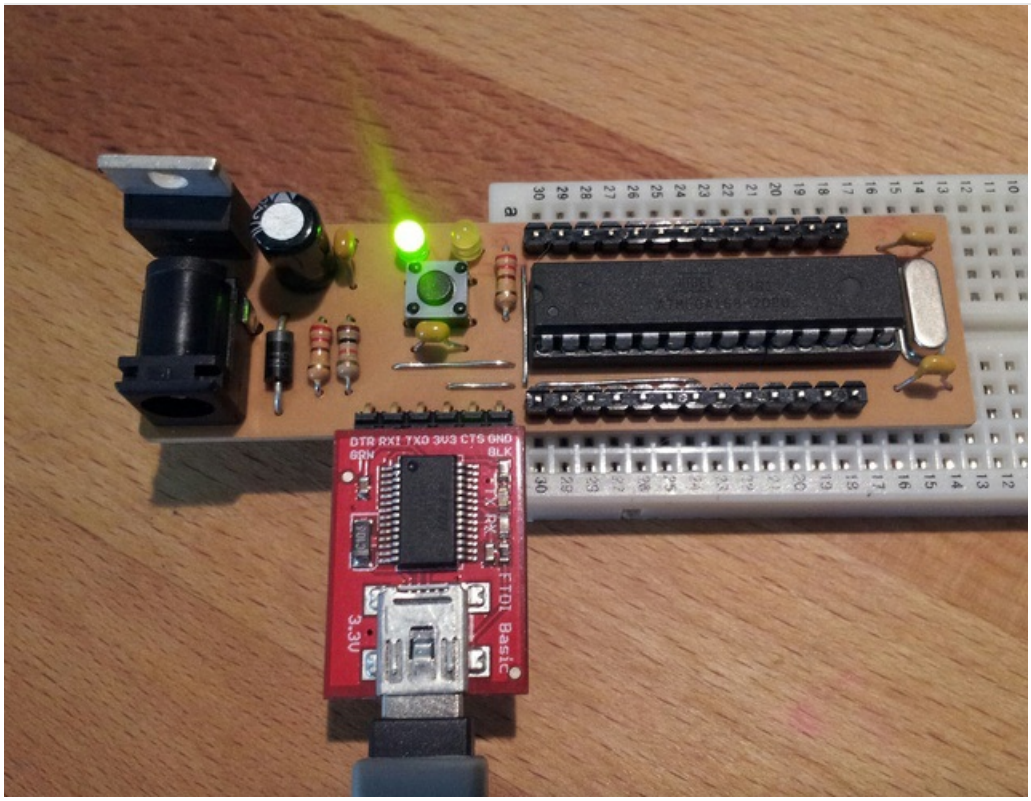
Guide Contents

Overview



In the early 1970's, two engineers from TI produced the World's first micro-controller, the TMS 1000. Although Intel had produced an earlier 4-bit CPU, the Intel 4004, it required external circuitry to operate and is therefore considered the first complete CPU on chip. The TMS was a true micro-controller in that it integrated all of the components necessary to function onto one chip and provided an economical embedded solution for electronic devices. Fundamentally there is little difference between the micro-controllers of today and the ones from the 1970's. Their objective it to provide a low-power stand-alone computer for embedded applications. Each micro-controller contains a CPU, memory and input/output peripherals and range in speed from a few KHz to a few hundred MHz. This badge will explore the fundamentals of micro-controller design and use and how you might use one in your next awesome project!

Instructions for completion:

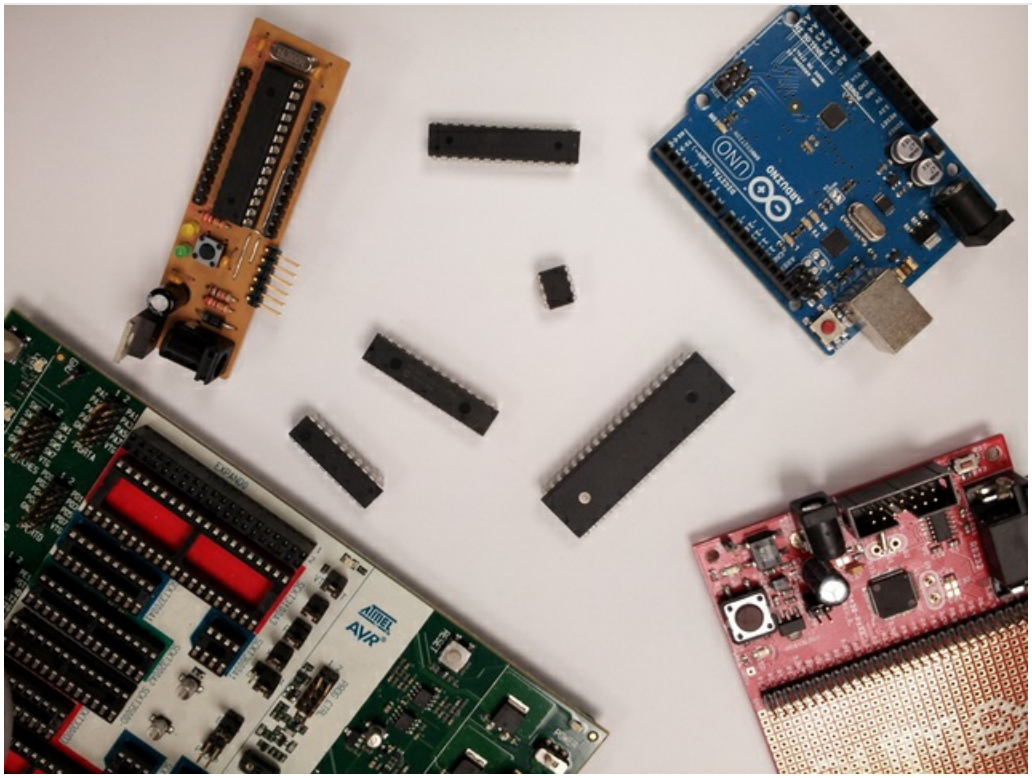
Record the section, item number and requirement before each response on your notepaper. This will assist your instructor when evaluating the completion of the requirements.

Example:

2.1 Measure and calculate the surface area (Aeff) of the solar cell supplied by your instructor.

- I calculated the surface area (Aeff) of my solar cell to be 2 square inches, with the dimensions of 2in x 1in.

Section 1: Microcontroller concepts



This section focuses developing an understanding of the concepts that make up much of today's micro-controller technology

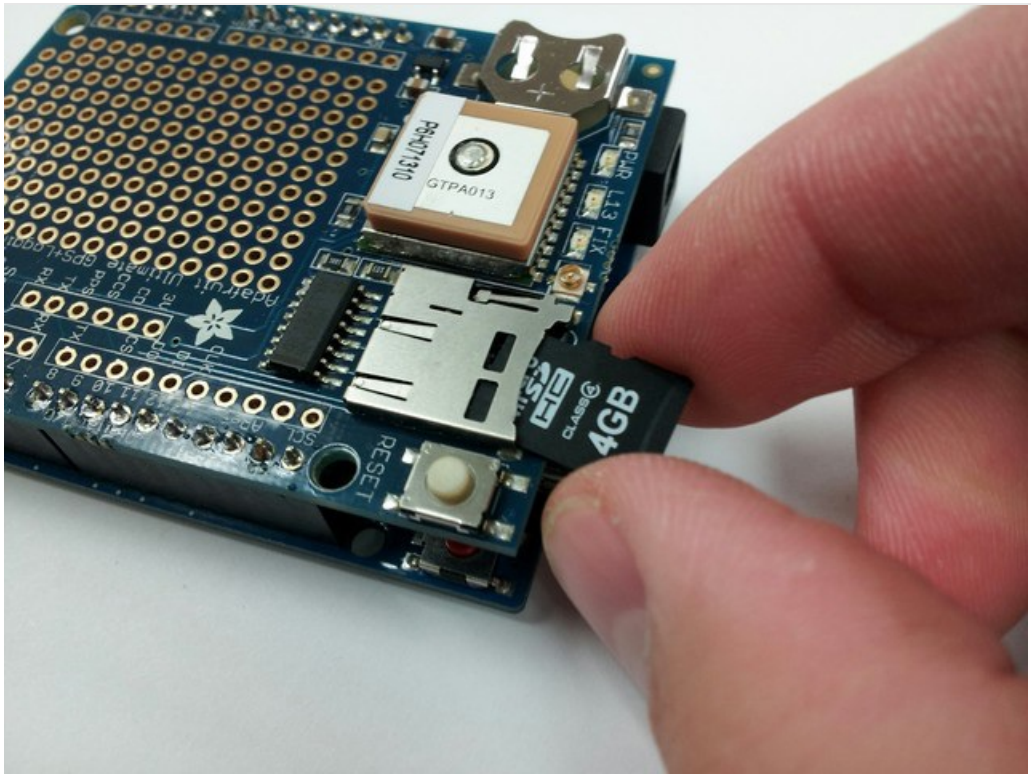
1.1 Do EACH of the following and submit to your instructor:

- Identify and describe the micro-controller's three primary components
- Identify and describe the roll of Architecture in a micro-controllers function
- Identify and describe the differences between 4, 8, 16, 32 and 64 Bit computing. Include instances where each computing type would be necessary
- Identify and describe FIVE different IC package types micro-controllers typically use
- Compare and contrast 5 different micro-controller platforms
- Identify and describe the use of a Development Board

1.2 Do EACH of the following and submit to your instructor:

- Identify and describe where the operating specifications of a micro-controller could be found
- Identify and describe the standard operating voltages for a micro-controller
- Identify and describe the effect of operating voltage on clock speed
- Identify and describe the use of an external clock signal
- Identify and describe the difference between a resonator and a crystal
- Identify and describe the role of a watchdog timer

Section 2: Memory

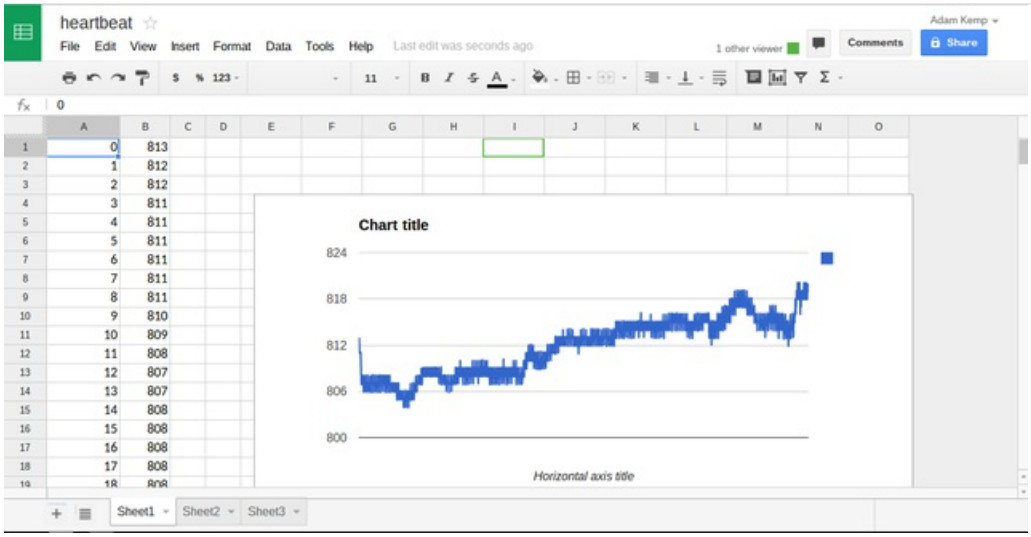


This section focuses on the types and use of the memory found in a micro-controller

2.1 Do EACH of the following and submit to your instructor:

- Identify and describe Program Memory
- Identify and describe the different types of Read Only Memory and their uses
- Identify and describe the different types of Random Access Memory and their uses

Section 3: Peripherals

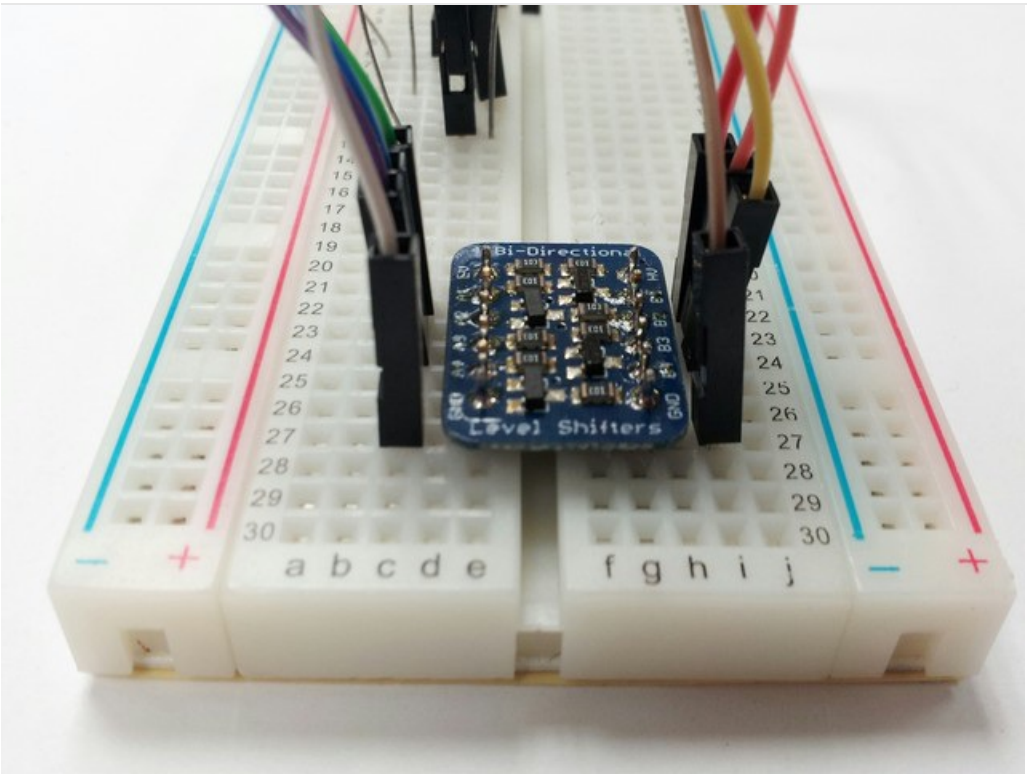


This section focuses on the types of peripherals micro-controllers commonly have

3.1 Do EACH of the following and submit to your instructor:

- Identify and describe a UART and THREE devices you could interface with this port
- Identify and describe SPI protocol and THREE devices you could interface with
- Identify and describe I2C protocol and THREE devices you could interface with
- Identify and describe an ADC and THREE devices you could interface with
- Identify and describe the use of a Voltage Reference as it pertains to an ADC
- Identify and describe the different ADC bit resolutions commonly found on a micro-controller and its relation to sensitivity
- Identify and describe a DAC and THREE devices you could interface with
- Identify and describe the different ADC bit resolutions commonly found on a micro-controller and its relation to sensitivity
- Identify and describe the term bit-banging

Section 4: Digital I/O



This section focuses on the use of the micro-controllers I/O in controlling non-protocol devices

4.1 Do EACH of the following and submit to your instructor:

- Identify and describe the available OUTPUT current on an ATMEGA328P micro-controller
- Identify and describe why understanding OUTPUT current is important when interfacing with devices
- Identify and describe the available OUTPUT voltage on an ATMEGA328P micro-controller in how it relates to operating voltage
- Identify and describe why understanding OUTPUT voltage is important when interfacing with devices
- Identify and describe FIVE devices you could interface with a micro-controller's OUTPUT
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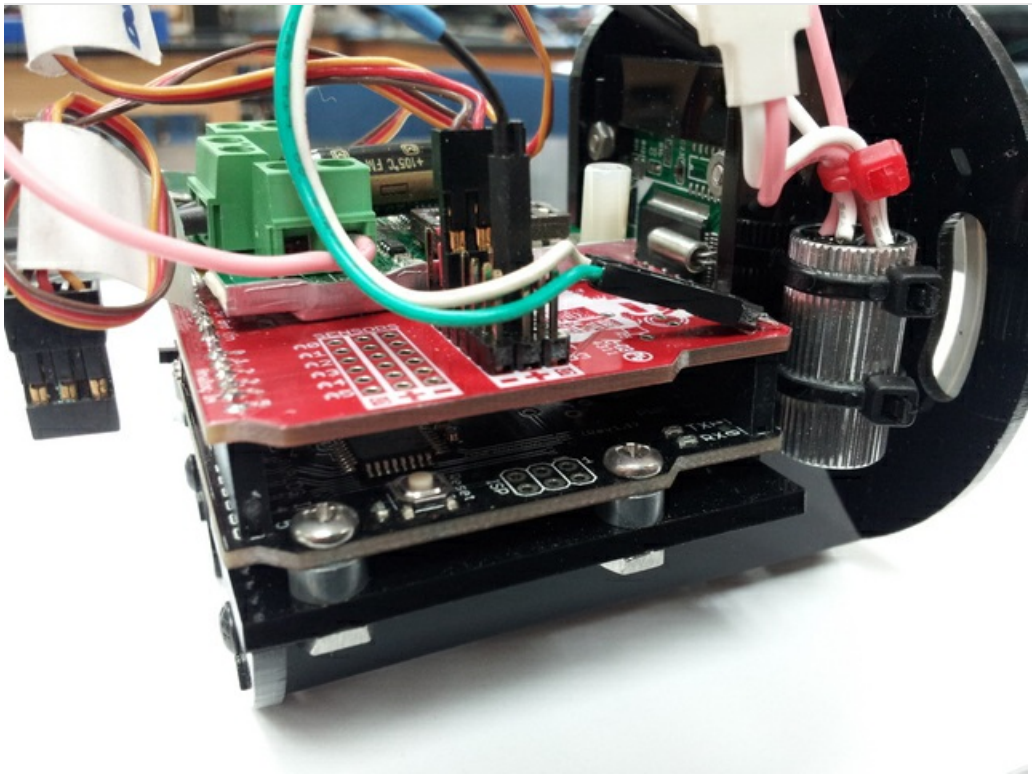
- Identify and describe why understanding INPUT voltage is important when interfacing with devices
- Identify and describe FIVE devices you could interface with a micro-controller's INPUT

Section 5: Demonstration



This section focuses on the use of a micro-controller in a project
5.1 Do ONE of the following and submit to your instructor:

- Using a micro-controller and development board of your choice, produce a project that illustrates the micro-controllers basic functionality. This includes memory, I/O and protocol based peripherals.
- Using a micro-controller of your choice, design a development board that allows for easy interfacing to the micro-controller's feature set.

Certificate of Completion