CURTIN ROBOTICS CLUB

TinyBot

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Contents

1 Introduction

There are many different components of a robot; the most important being the microcontroller (the brain), the motors (the legs), and any sensors (how the robot sees the world).
This guide will take you through building a simple robot dubbed TinyBot. It has 2 wheels, a caster wheel, a battery, an arduino, and a breadboard.

2 Assumed Knowledge

The below knowledge is assumed for this project. Feel free to ask other CRoC members for help or explanation of the below concepts.

- Basic circuit knowledge
  - Current, Voltage, Resistance
  - Series and Parallel
- Breadboards
- Basic coding skills

3 Components

Component	Quantity	Price	Sources
Arduino Uno	1	\$5-\$80	Arduino's are discussed in Section 5. A genuine Arduino will cost about \$80, however Arduino clones can be bought online for as little as \$5. Ebay is a good starting point for finding an Uno.
Breadboard	1		
N20 Motor	2		
Dual H-Bridge	1	\$7 - \$16	Altronics stocks both motor drivers and motor controllers, though they can also be found on eBay and sites such as RS components. For this tutorial, only a basic H-bridge driver is necessary (costing about \$7), though more expensive motor controllers can be used as well.
Wheels	2	\$0	The wheels for this project are 3D printed, and are supplied by the club.
Caster Wheel	1	?	The caster wheel consists of 2 parts, a marble and it's 3D printed casing. The 3D print will be supplied by the club at no charge, however you must source your own marble.

Additional sensors can be bought and integrated with TinyBot, however that is not covered in this project guide.

4 Construction

5 Microcontroller

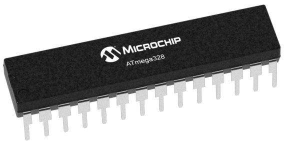


Figure 1: A Microchip

A microcontroller is a really small microcomputer on a very small chip, see Figure 1. These are used in a variety of devices; including robots, vending machines, phones, computers, etc.

Arduino's are a development board; consisting of an microcontroller, power regulation, and input/output (also known as IO) pins. As microcontrollers are very tiny prototyping with them or using them to build something would be really difficult. The purpose of an arduino is to provide a medium that allows easy development with microcontrollers. There are many different kinds of arduinos, each using a different microchip.

The Arduino used in this project is the Arduino Uno, which has an ATMega328p microchip as shown in Figure 1. Figure 2 is what a real Arduino Uno looks like, though the colour and text may be different from brand to brand. Genuine Arduinos are quite expensive, and there are many clones available which are much cheaper. Figure 3 shows a stylised view of an Uno, labelling all the different pinouts.

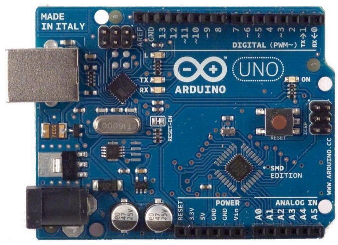


Figure 2: An Arduino Uno

Arduino's and other development boards are used extensively by hobbyists, they are cheap, easy to use, and extremely versatile. Arduino's are used in nearly every CRoC project, and can be used in countless DIY projects.

An Uno has many different ports and pins. Figure 3 shows and labels all the different ports on a standard Uno.

An important distinction to make is between the pins 5V, 3.3V, and VIN. VIN stands for voltage in; and this port is used to supply power to the arduino from batteries. Power can also be supplied through the barrel jack connection, see the black rectangle like block on figure 3.
The 5V and 3.3V pins supply 5 volts or 3.3 volts respectively for powering other commponents, such as LEDs, ICs, or sensors.

!	Never put supply voltage into the 3.3V or 5V pins; this will break the Arduino.

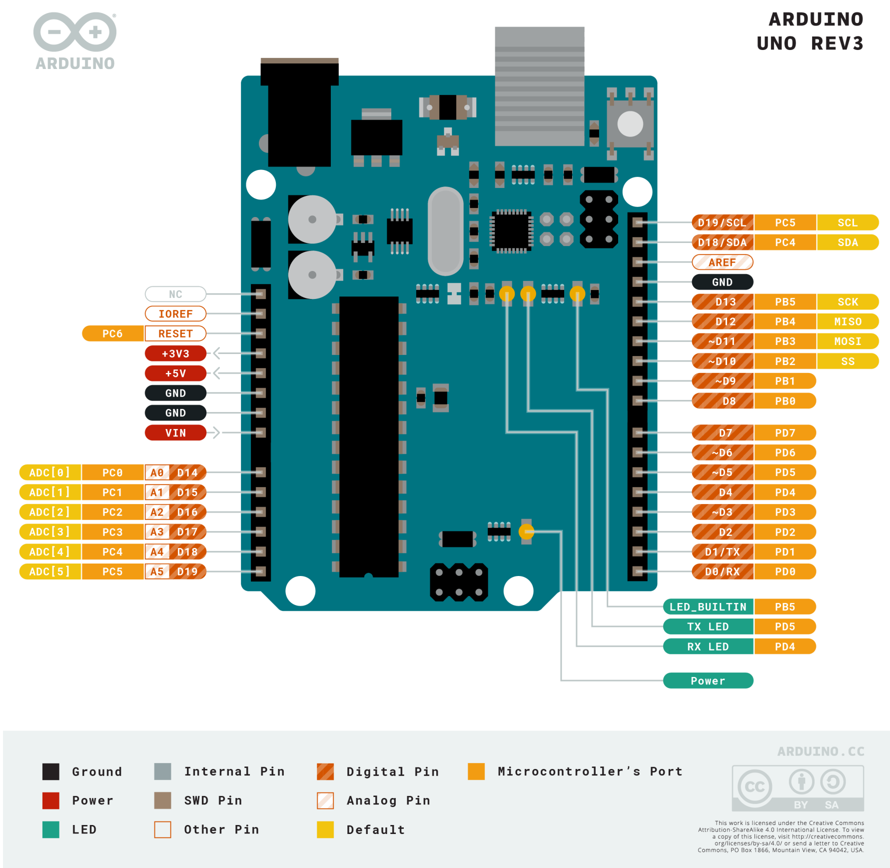


Figure 3: Pinout of Arduino Uno

6 Motor

gearbox, motor

To follow this guide it is not necessary to have an understanding of how motors work, though it may be interesting for you to learn. This link has a good indepth explanation.

Motors turn in proportion to the amount of current put through them. More current means a faster motor.

When a motor stalls, it stops rotating. This happens when there is more force acting on the motor shaft than the motor can overcome. The stall torque of a motor is the maximum current drawn when a motor stalls, in other words, applying its maximum torque.

Similarly, free current is the current drawn when the motor is rotating freely, under no load.

Each motor has a certain amount of torque it can provide. Gearboxes can be attached to a motor to increase the amount of torque provided, and change the rotations per minute (RPM) of the motor.

7 Motor Controller

The motors used in this guide, the N20 motors, have a stall current of 1.6A (see section 6 for what stall current means). The digital pins on an Arduino Uno supply at most 40mA. This is not enough to power the motors.

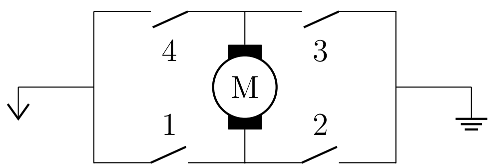
To get around this, the Arduino instead interfaces with a **motor controller**. Motor controllers have a separate power supply that can supply enough current to drive the motor. Motor controllers also have digital inputs that allow control of the motor.

An added benefit of using a motor controller is that it is possible to control the direction and the speed of the motor.

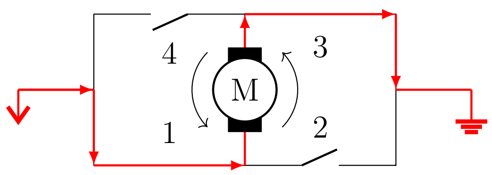
The phrase motor controller is often used as a generic term for any device, circuit, or IC which controls a motor. However, motor controllers are a circuit that consists of a motor driver and some digital harness that acts as an interface to the driver. Motor controllers can be dropped into a circuit and easily controlled, allowing feedback from the motor and more control than a simple driver provides.

7.1 Motor Driver

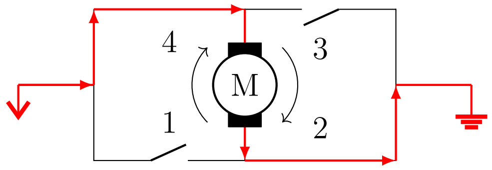
A basic motor-**driver** is a H-bridge. The simplest H-bridge is shown in the below schematics, as well as an explanation of how using a H-bridge allows control over the motors direction.



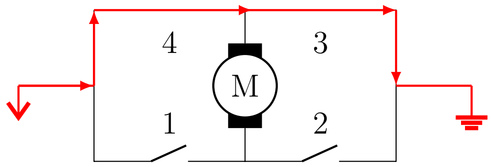
When switches 1 and 3 are closed, the current will flow through the motor making it turn anticlockwise.

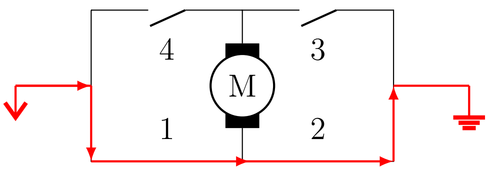


In the same vein, closing switches 2 and 4 will cause the motor to turn clockwise.



If pins 4 & 3 or pins 1 & 2 are closed at the same time, a short circuit will be formed and the H-bridge will break.





Breaking a H-bridge is fairly common, especially the cheaper low power ones. Some higher end H-bridges are designed to prevent the H-bridge from shorting if the wrong pins are closed. Most motor-controllers will have this protection built-in, though most motor-drivers do not.
While working on this guide, don't worry if your H-bridge stops working suddenly, it is quite common to short them out.

7.2 Motor Controller

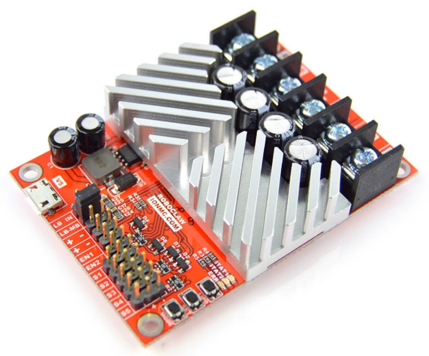


Figure 4: RoboClaw Dual Channel DC Motor Controller

A motor controller has a lot more features than a motor driver. See, for example, the RoboClaw (see Figure 4) which has in built features such as PID tuning, data logging, diagnostic LEDs, and serial control.

The in-built control modes, as well as being capable of serial communication, is present only in motor controllers. Motor drivers are far simpler in comparision.

8 Driving