# Introducing the robot and our development environment

This is a book about robots and artificial intelligence, so we really need to have a robot to use for all of our practical examples. As we will discuss in Chapter 2 at some length,I have selected robot hardware and software that would be accessible to the average reader,and readily available for mail order. In the Appendix, I go through all of the setup of all of the hardware and software required and show you how I put together this robot and wired up his brain and control system. The base and robot arm were purchased as a unit from AliExpress, but you can buy them separately. All of the electronics were purchased from Amazon. As shown in the photo, our robot has tracks, a mechanical six degree-of-freedom arm, and a computer. Let's call him TinMan, since, like the storybook character in The Wizard of Oz, he has a metal body and all he wants for is a brain.
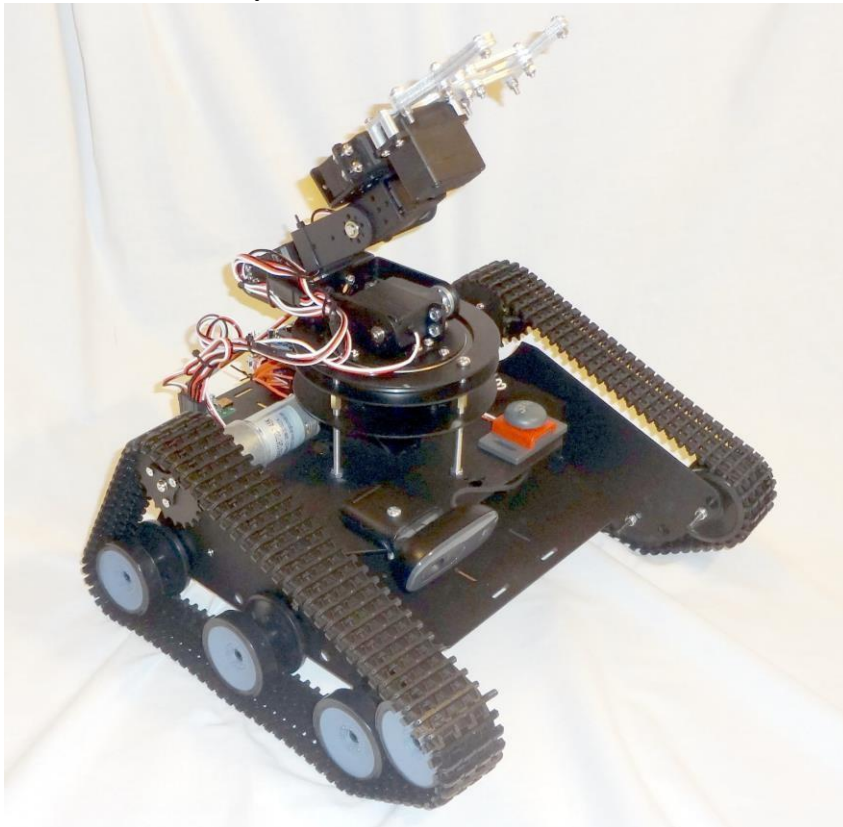
Our tasks in this book center around picking up toys in an interior space, so our robothas a solid base with two motors and tracks for driving over a carpet. Our steering method is the tank-type, or differential drive where we steer by sending different commands to the track motors. If we want to go straight ahead, we set both motors to the same forward speed.If we want to travel backward, we reverse both motors the same amount. Turns are accomplished by moving one motor forward and the other backward (which makes the robotturn in place) or by giving one motor more forward drive than the other. We can make any sort of turn this way. In order to pick up toys we need some sort of manipulator, so I've included a six-axis robot arm that imitates a shoulder – elbow – wrist- hand combination that is quite dexterous, and since it is made out of standard digital servos, quite easy to wireand program. You will note that the entire robot runs on one battery. You may want to splitthat and have a separate battery for the computer and the motors. This is a common practice,and many of my robots have had separate power for each. Make sure if you do to connect the ground wires of the two systems together. I've tested my power supply carefully and have not had problems with temperature or noise, although I don't run the arm and drive motors at the same time. If you have noise from the motors upsetting the Arduino (and youwill tell because the Arduino will keep resetting itself), you can add a small filter capacitorof 10 µf across the motor wires.
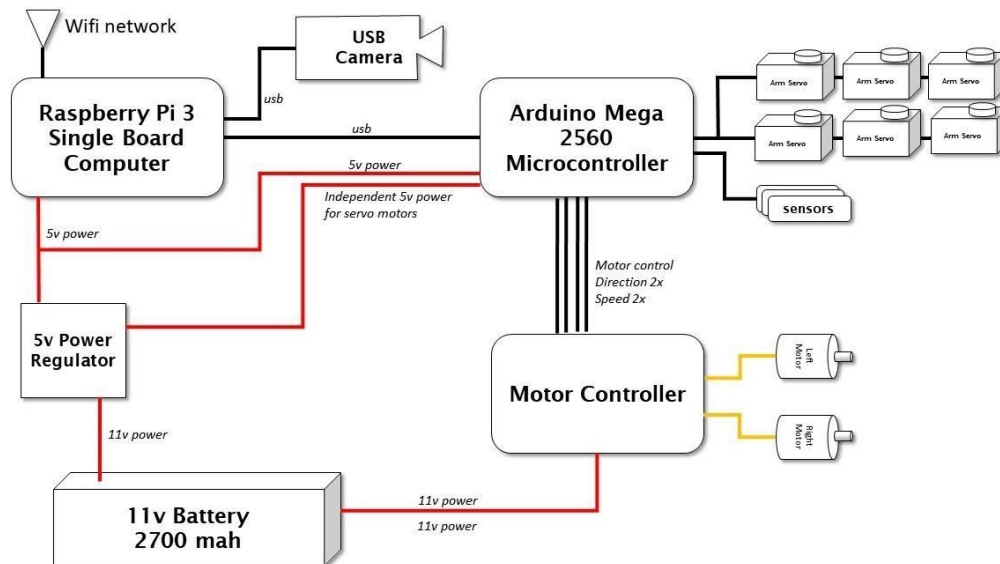
       The main control of the TinMan robot is the Raspberry Pi 3 single board computer (SBC), that talks to the operator via a built-in Wi-Fi network. An Arduino Mega 2560 controller based on the Atmel architecture provides the interface to the robot's hardware components, such as motors and sensors. You can refer to the preceding diagram on the internal components of the robot. We will be primarily concerned with the Raspberry Pi3 single board computer (SBC), which is the brains of our robot. The rest of the components we will set up once and not change for the entire book. The Raspberry Pi 3 acts as the maininterface between our control station, which is a PC running Linux in a virtual machine, and the robot itself via a Wi-Fi network. Just about any low power, Linux-based SBC can perform this job, such as a BeagleBone Black, Oodroid XU4, or an Intel Edison. Connectedto the SBC is an Arduino 2560 Mega microcontroller board that will serve as our hardwareinterface. We can do much of the hardware interface with the PI if we so desired, but by separating out the Arduino we don't have to worry about the advanced AI software runningin the Pi 3 disrupting the timing of sending PWM (pulse width modulated) controls to the motors, or the PPM (pulse position modulation) signals that control our six servos in the robot arm. Since our motors draw more current than the Arduino can handle itself, we need a motor controller to amplify our commands into enough power to move the robot's tracks.The servos are plugged directly into the Arduino, but have their own connection to the robot's power supply. We also need a 5v regulator to provide the proper power from the 11.1v rechargeable lithium battery power pack into the robot. My power pack is a rechargeable 3S1P (three cells in series and one in parallel) 2,700 ah battery normally usedfor quadcopter drones, and came with the appropriate charger. As with any lithium battery,follow all of the directions that came with the battery pack and recharge it in a metal box orcontainer in case of fire.