Title: Give your Raspberry Pi Robot Powers!

### Introduction:

The Robot revolution is coming. Robots are no longer just machines of science fiction, from self-driving cars, to flying drones, robots are on the march. Over the next few years robots are going to be seen all over the place and will be increasingly used in agriculture, manufacture, medicine, education, as well as in our own homes. The amazing thing is that now almost anyone can become a roboticist and if you have a Raspberry Pi you’re actually already half way there.

Part one of this two part article will give an introduction to this exciting new world of robotics and will detail all the things you need to consider when embarking on building your own robot. As an example we’ll cover the building of the simplest robot possible that I’ve called the the Raspberry Pico Bot. Next month in part 2 of the article I’ll then cover more advanced robots and show how you can build and then program these robots to do some really interesting things.

Before we get into the what and how to’s of any robotics the first question may be why would you want to build a robot with a Raspberry Pi in the first place? Also what kind of things will a Raspberry Pi robot be able to do?

Personally I first got interested in Raspberry Pi robots when I realised how good they can be for learning about technology and also the teaching of technology to others. The great things about robots is really how real world and immersive they can be. Instead of getting output to pixels on a screen, a robot is in your personal space, and its movements, lights, and sounds go way beyond the limits of a screen. With the Raspberry Pi and some low cost hardware not only can you make a robot move you can also make a robot that can speak, dance, and a whole lot more besides! Why wouldn’t you want to turn a Raspberry Pi into a robot?

What makes the Raspberry Pi so good for robotics (as well as so many other projects) is its special GPIO pins (General Purpose Input Output). This allows the Raspberry Pi to connect to all kinds of electronics and hardware. The fundamental requirements for the most interesting robots are the ability to both **sense** and **interact** with their environment, and its the GPIO pins of the Raspberry Pi that makes this possible. Before going into further details for building a Raspberry Pico Bot lets first consider some robot fundamentals.

### What makes a robot robotic?

Wikipedia defines a robot as:

“a machine capable of carrying out a complex series of actions automatically, especially one programmable by a computer.’

In addition to this requirement to perform complex actions a proper robot should also have **autonomous** ability. Automonity allows a robot to act independently in the world and this makes them different from things like radio controlled vehicles (e.g. remote controlled cars) that are not able to function by themselves. The Raspberry Pi’s processing ability (both cpu and gpu) along with its GPIO gives it lots of potential for developing autonomous behaviour. As a simple expample lets take a look at the classic line following robot.

A line following robot has the ability to move, change direction, and detect a line on the ground and this is a classic example of autonomous behaviour. No matter where the line leads the robot is programmed to follow the line without the need of any external control.

Whilst autonomous behavior can be very useful in a robot it can also be a lot of fun to control it directly too. Some of the most interesting applications actually happen when a robot combines the two. Imagine a flying robot that can fly around to your commands but can be programmed never to crash into walls and other obstacles too. Wouldn’t that be useful.

The last thing i’d like to mention on robot fundamentals is the social robot. Social robots are designed to be particularly good at interacting with humans, other robots and even animals and the Raspberry Pi has some innate capabilities for social robotics applications. Not least is the fact that it can be set up to do speech recognition as well text-to-speech talking and this alone opens up some amazing possibilities. I’ll cover some of these social applications in part two of the article but for now lets look at the Raspberry Pi-coBot and see what’s involved in making the simplest of robots.

Anatomy of a Raspberry Pi Robot. What you need to get started.

Lets go through all the things you’d need to build your own robot using a Raspberry Pi and as an example I’ll detail a minimal possible Raspberry Pi robot step by step.

These basic steps are:

* Remote Access to the Raspberry Pi.
* Making a robot Chassis
* Breaking free - Powering a Raspberry Pi without cables.
* Making the robot move
* Adding sensors

The first hurdle for turning a Raspberry Pi into a robot is to untether it from all wires and cables and the first two tasks will cover this.

### Remote Access

Mosts people will be familiar with interfacing to a Raspberry Pi using a conventional monitor - keyboard - mouse, though this is just not going to work for a robot. The best thing for connecting remotely will be a wireless dongle connected to the Raspberry Pi USB port. I won’t go into all the details for doing this here though if you’d like a detailed guide please follow the link (xxxx) Another interesting thing to also note is that you can either connect wirelessly across an existing network though it’s also possible to turn the Raspberry Pi into a wireless hotspot and connecting to it via its own network. (see link for this)

Rather than using the Raspian Desktop on the robot ,a terminal interface is going to be most suitable. With communication across the wireless network, a remote ssh terminal session is going to be the best way to start interfacing with the robot. (For details of ssh please see this guide).

### Building a Robot Chassis

Whilst it’s possible to use some kind of existing chassis to build your robot, it can also be fun to make your own. Even some simple cardboard can be used for this. Below shows some pictures for a basic design. See xxx for more examples.

### Portable Robot Power

The next essentials for the robot is to get the Raspberry Pi running on portable electrical power. This topic has been covered before in the MagPi so I won’t go into how to do this here. If you do want tips and a guide for doing this please see the following: PiJuice.com/powering-a-raspberry-pi-from-batteries

### Making your Robot Move

Now that you’ve successfully untethered your Raspberry Pi and you can connect to the Raspberry Pi remotely, finally we can give it some robot powers - motion! The simplest and probably cheapest way to give your Raspberry Pi motion is by connecting a couple of continuous rotation servo’s. Normally servos can are designed to turn just 90 degrees though modified versions exist that give full rotation to be able to drive wheels. Whilst it is possible to modify a low cost servo to do continuous rotation (see this guide here) they can also be bought pre-modified (see link). If you want to be really inventive you can also make your own wheels and see here for a nice collection of these. Alternatively purpose made wheels are also available ( see here.) With two wheels left and right a third wheel or ball bearing roller can be used at the back. See picture

Now that you’ve connected servo’s to your Raspberry Pi the next task will be to learn to control them. See this guide for the code detailed explanation for doing this. (www.pibot.org/…)

### Making Your Robot Sensational

As we discussed earlier giving a robot sensors gives information that the robot can then act upon. For our MVB we can now connect a light sensor and see if.

### Moving Beyond Simple Robots

Whilst the MVP hopefully shows how simple and affordable to create a robot this kind of robot is actually pretty limited.

Comparison to an arduino robot.

See pibot.org/minimum-robot/ for the full details and code for building a minimum possible robot.

Building is actually pretty involved and, I hope though this initial article, it has given you a good idea about what’s involved and that you may be encouraged to giving it ago. The next article will build on this and give lots of details for some amazing further features you can give to a robot:

Making your robot talk,

Making your robot dance

Giving your robot Artificial Intelligence.

You to can become a roboticist.

<http://www.raspberrypi.org/education-fund/>

<http://www.teachsecondary.com/>