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1 Introduction

Thank you for taking the time to look at this project and consider building it. I have worked many hours to refine this design so that it is easy to assemble by 3D printer, and that it is useful for building skills of 3D printing, electronics, and software development. This manual with instruct you how to build your own Hexabot, how to trouble shoot any problems that present themselves along the way.

1.1 Glossary

3D printer

3D parts

Servo driver

Raspberry pi

PCA9685

Servo

PWM

1.2 Safety Disclaimer

The building of this robot will require the use of techniques and tools which when used incorrectly could result in physical harm. When using these tools, please take the time to follow the safety instructions listed with each tool and technique. Overall personal protection equipment (PPE) should be used when using most tools.

This part of the text contains important information, either about safety or about the construction of Hexabot

This part of the text contains helpful tips and information about the construction of Hexabot

2 Overview

Hexabot is hexapedal 3D printed robot that is designed to walk around in developed areas to gather visual data and to scout the area. The rigid design allows the robot to be sturdy, and also to be able to carry heavy loads on its back. Each of the 6 legs has 3 servo motors: two for the X and Y axis, and one for Z axis. Each leg's motors are connected to a breakout board that connects each motor to

power and signal. The signal wires of the motors are connected to 2 Adafruit 16-Channel I2C Servo Driver called the PCA9685. This board controls the PWM signal for the motors and allows the motors to be controlled by the brains of the robot: a Raspberry Pi 4. The robot is powered by a 7500mAh LiPo battery that is connected by a slot-in battery design that allows for easy connection of the battery.

3 Components and Tools List

This robot requires multiple tools and components to fully construct it. Most of the components for the body are 3D printed, however there are some parts that are not to connected everything together.

3.1 Components

This list contains all the components and their quantities required to build Hexabot. The links provided are where I purchased the supplies, however the same or similar products form different supplies also satisfactory. Just make sure that their dimensions are the same, as they may not be compatible with the 3D prints.

3.1.1 Threaded inserts

Purchase link: https://nz.rs-online.com/web/p/threaded-inserts/2040616/

Quantity: 800

Notes: 800 is enough to assemble Hexabot, however if any mistakes are made and some parts are needed to be remade, wasting some inserts, and more will be required.

3.1.2 Screws

Purchase link: https://nz.rs-online.com/web/p/socket-screws/0281192/

Quantity: 800

3.1.3 Servos

Purchase link: https://nz.banggood.com/URUAV-URS001-180-20KG-Digital-Metal-Gear-Servo-Waterproof-CNC-For-RC-Car-Models-or-Quadcopter-or-Helicopter-or-Robot-or-Intelligent-Robot-Arm-p-1691893.html?cur_warehouse=CN

Quantity: 18

3.1.4 Servo Drivers

Purchase link: https://learningdevelopments.co.nz/products/adafruit-16-channel-12-bit-pwm-servo-driver-i2c-interface

Quantity: 2

3.1.5 Raspberry Pi 4

Purchase link: https://www.pbtech.co.nz/product/SEVRBP0206/Raspberry-Pi-4-Model-B-4GB-LPDDR4-FIRST-28nm-Based

Quantity: 1

Notes: The purchase link has a 4GB model attached to it, but a 2GB or 8GB model will also be sufficient.

3.1.6 Power switch

Purchase link: https://www.jaycar.co.nz/spst-mini-rocker-switch/p/SK0984

Quantity: 1

3.1.7 Wires

3.1.8 Wire crimps large/small

Purchase link: https://www.jaycar.co.nz/red-black-gold-crimp-cable-small-eye-terminals-pk-2/p/PT4560

Quantity: 2 sets of 2

Purchase link: https://www.jaycar.co.nz/eye-terminal-red-pk-100/p/PT4515

Quantity: 100

Notes: 100 will not be needed, but it is good to have so spare.

3.1.9 Power screws

Purchase link: https://www.mitre10.co.nz/shop/hillman-machine-screws-m5-x-40mm-pack-of-6-zinc-plated/p/325944

Quantity: 1 pack of 6

Purchase link: https://www.mitre10.co.nz/shop/bremick-hex-nuts-m5/p/349125

Quantity: 6

Notes: 6 will not be needed but having extra is useful if a mistake is made.

3.1.10 PCB and header pins

Purchase link: https://jlcpcb.com/

Quantity: 10

Notes: I used JLCPCB for my PCBs, however other companies are also good. To order them, upload the PCB .gerber file to the website and order 10 PCBs with default settings **but** with **an outer copper weight of 2 oz**.

Purchase link: https://www.jaycar.co.nz/40-pin-header-terminal-strip/p/HM3212

Quantity: 2 sets of 40

Notes: These are used for the wire connection to the PCBs, and the spares pins are used for the power indicator circuit.

3.1.11 Battery

Purchase link: https://hobbystation.co.nz/giant-power-graphene-2s-7-4v-7500mah-100c-hardcase-li-po-w-bullet-to-t-plug/

Quantity: 1

3.1.12 Metal plates

Purchase link: https://www.jaycar.co.nz/rare-earth-magnet-small-pk-4/p/LM1622

Quantity: 1

Notes: I used the piece of metal that these magnets came with since it was the right dimensions and material for the battery plates. However other nickel-plated steel will work with the right dimensions.

3.1.13 Spring

Purchase link: https://nz.rs-online.com/web/p/compression-springs/0821245/

Quantity: 1

Notes: This spring may be too long. If so, cut it in half.

3.1.14 JST-XH connectors

Purchase link: https://www.jaycar.co.nz/connectors-kit-with-popular-jst-xhp-and-ph2-headers/p/PT4457

Quantity: 1

Notes: This kit has the connectors and headers to wire up the charging port.

3.1.15 Heat shrink tubing

Purchase link: https://www.mitre10.co.nz/shop/swordfish-heat-shrink-assortment-127-piece/p/228818

Quantity: 1

Notes: This kit has heat shrink tubing for all posable wire in this project. A heat source is also needed for them, e.g., lighter, matches.

3.1.16 Power indicator circuit

The power indictor circuit is made on a perfboard using hand soldering and THT (through hole technology) components.

3.1.16.1 Perfboard

Purchase link: https://www.jaycar.co.nz/connectors-kit-with-popular-jst-xhp-and-ph2-headers/p/PT4457

Quantity: 1

Notes: This kit has the connectors and headers to wire up the charging port.

3.1.16.2 Resistors

Purchase link: https://www.jaycar.co.nz/680-ohm-1-watt-carbon-film-resistors-pack-of-2/p/RR2770

Quantity: 1 set of 2

Purchase link: https://www.jaycar.co.nz/330-ohm-1-watt-carbon-film-resistors-pack-of-2/p/RR2762

Quantity: 1 set of 2

3.1.16.3 Transistors

Purchase link: https://www.jaycar.co.nz/2n2222a-npn-transistor/p/ZT2298

Quantity: 2

3.1.16.4 RGB LED

Purchase link: https://www.jaycar.co.nz/tricolour-rgb-5mm-led-600-1000mcd-round-diffused/p/ZD0270

Quantity: 1

3.2 Tools

3.2.1 Soldering iron, soldering tip, and solder

Purchase link: https://www.jaycar.co.nz/duratech-48w-temperature-controlled-soldering-station/p/TS1620

Quantity: 1

Purchase link: https://www.jaycar.co.nz/conical-0-5mm-soldering-iron-tip/p/TS1622

Quantity: 1

Purchase link: https://www.jaycar.co.nz/0-71mm-duratech-solder-200gm/p/NS3005

Quantity: 1

Note: This solder is lead-based and therefore is not RoHS (Restriction of Hazardous Substances) compliant. Lead free solder will work the same for this application so it is based on personal preference.

3.2.2 Screw drivers set

Purchase link: https://www.mitre10.co.nz/shop/number-8-precision-bits-set-23-pieces-black-and-orange/p/343370

Quantity: 1

3.2.3 Electric screwdriver

Purchase link: https://www.banggood.com/Wowstick-1F+-64-In-1-Cordless-Electric-Screwdriver-Lithium-ion-Charge-LED-Power-Screwdriver-p-1294707.html

Quantity: 1

Notes: This electric screwdriver has a good balance between price and quality and has worked well for its purpose during my time of using it. However, did have an issue with the charging port stopping charging. To Banggood's credit, they did send me a replacement. Purchase at own discretion.

3.2.4 Scraper

Purchase link: https://www.mitre10.co.nz/shop/number-8-paint-scraper-38mm/p/286933

Quantity: 1

Notes: Most 3D printers come with a scraper for removing prints from the heated bed, which can be used instead.

3.2.5 Wire crimper/stripper

Purchase link: https://www.jaycar.co.nz/heavy-duty-wire-stripper-cutter-crimper-with-wire-guide/p/TH1827

Quantity: 1

3.2.6 Tweezers

Purchase link: https://www.jaycar.co.nz/anti-magnetic-precision-tweezers/p/TH1754

Quantity: 1

3.2.7 Needle nose pliers

Purchase link: https://www.jaycar.co.nz/precision-6-long-nose-pliers/p/TH1887

Quantity: 1

3.2.8 Helping hand

Purchase link: https://www.jaycar.co.nz/third-hand-pcb-holder-tool-with-2-clips-and-heavy-base/p/TH1982

Quantity: 1

3.2.9 File set

Purchase link: https://www.mitre10.co.nz/shop/jobmate-file-set-10-piece-black/orange/p/367947

Quantity: 1

3.2.10 Clippers

Purchase link: https://www.jaycar.co.nz/precision-127mm-angled-side-cutters/p/TH1897

Quantity: 1

3.2.11 Battery charger

Purchase link: https://hobbystation.co.nz/gt-power-battery-charger-b3-lipo-1amp-2-3cell-240v/

Quantity: 1

3.3 Safety instructions

When using these tools and , there are dangers involved