

Appendix

Appendix 1: Hardware Specifications of the Camera and Processor

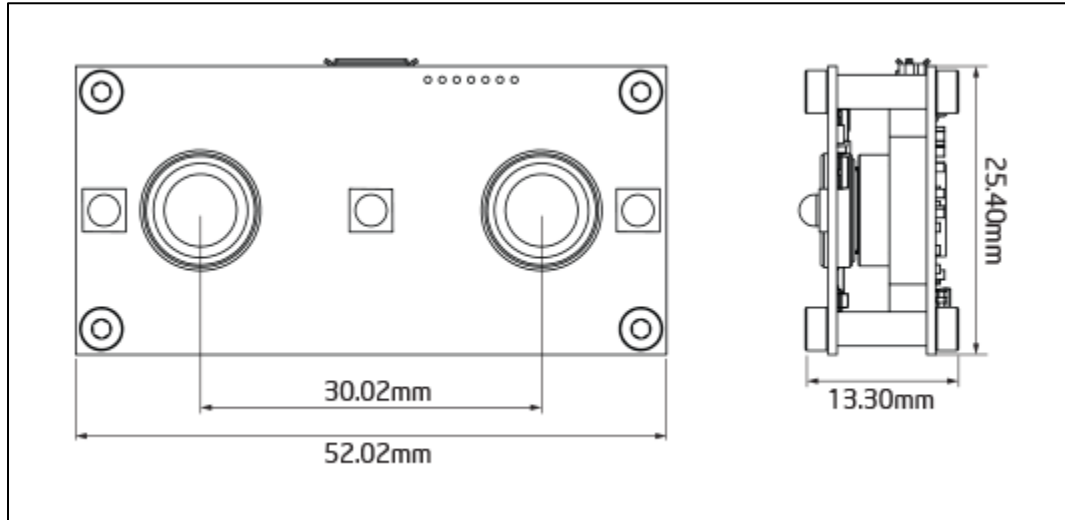


Figure A1.1: Dimensions of the Stereo Camera
(source: <https://duo3d.com/product/duo-minilx-lv1#tab=specs>)

Table A1.1: Specifications of the Stereo Camera (based on details from the manufacture, Code Laboratory Inc.)

Model	DUO-MINILX-LV1 (DUO MLX R2)
Baseline	30.0 mm
Frame Rates	0.1 – 3000+ FPS
Stereo Resolutions	Configurable Binning / Windowing: - 45 FPS @ 752x480 - 49 FPS @ 640x480 - 98 FPS @ 640x240 - 192 FPS @ 640x120 - 86 FPS @ 320x480 - 168 FPS @ 320x240 - 320 FPS @ 320x120
Pixel Size	6.0 x 6.0 μ m
Shutter Speed	0.3 μ sec ~ 10 sec
Lens Mount	Standard M8 x P0.5
Field of View	170° Wide Angle Lens Low Distortion < 3%
Focal Length	2.0mm - 2.1mm
Filters	850-870nm Narrow Band-Pass
Illumination	Fully Programmable LED Array 3 Independently controlled 3.4W 850nm IR LEDs 170° light cone

Illumination Control	Individual brightness sequence programmable in 256 linear steps
Motion Sensing	100Hz Sampling Rate Six Degree of Freedom (DoF) Accelerometer/Gyroscope IMU/Temperature
Colour Modes	Monochrome (S/N Ratio > 54dB Linear)
Control Functions	Exposure/Shutter/Brightness
Scanning Modes	Progressive Scan/Global Shutter
Power Consumption	~2.5 Watt @ +5V DC from USB
Interface	480 Mbps - USB 2.0 Interface (Micro USB)
Weight	12.5g
Operating Systems	DUO OS -Custom Linux Kernel, Linux, Mac OS or Windows
Operating Temperature	0° to 40-50° C (32° to 104-122° F)
Storage Temperature	-20° to 45° C (-4° to 113° F)
Relative Humidity	0% to 90% non-condensing

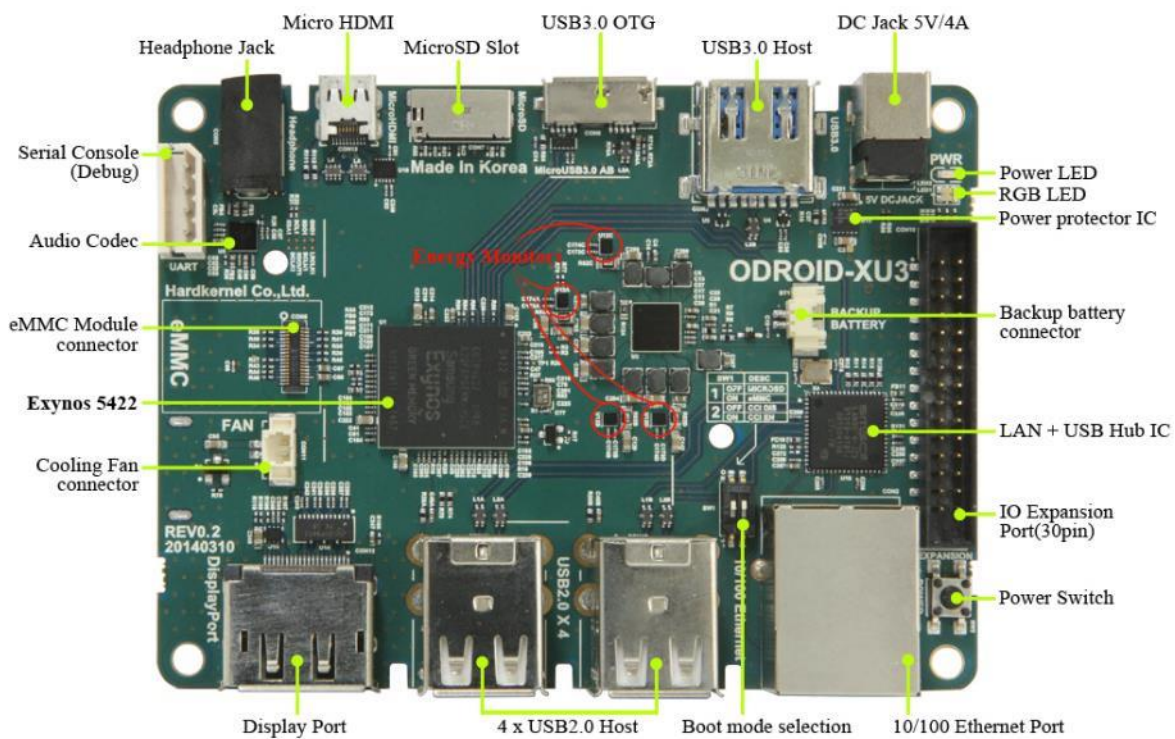


Figure A1.2: Board detail of Odroid XU₃ from the manufacture, Odroid HardKernel Co., Ltd.

Table A1.2: Specifications of Odroid XU3

CPU	Samsung Exynos-5422 : Cortex™-A15 2GHz and Cortex™-A7 big.LITTLE processor with 2GByte LPDDR3 RAM
GPU	Arm Mali-T628 (MP6)
eMMC 5.0 module	16GB/32GB : Sandisk iNAND Extreme 64GB : Toshiba eMMC
LAN/USB Hub	LAN9514 4-port Hi-Speed USB 2.0 hub and 10/100 Ethernet controllers from SMSC/Microchip
USB Load Switch	NCP380 Protection IC for USB power supply from OnSemi.
Audio Codec	MAX98090 is a full-featured and high-performance audio CODEC from Maxim
Power protector	NCP372 Over-voltage, Over-current, Reverse-voltage protection IC from OnSemi.
LED indicator	Tri-color RGB LED to display the status of operating system
HDMI connector	Standard Micro-HDMI, supports up to 1920 x 1080 resolution
DisplayPort connector	Standard DisplayPort, supports up to 3840 x 2160 resolution
IO Ports	USB 3.0 Host x 1, USB 2.0 Host x 4, USB 3.0 OTG x 1, PWM for Cooler Ethernet RJ-45, Headphone Jack, 30 Pin : GPIO/IRQ/SPI/ADC
Storage slot	Micro-SD slot, eMMC 5.0 module connector
DC Input	5V / 4A input, plug specification is inner diameter 2.1mm and outer diameter 5.5mm
Energy Monitor	4 separated current sensors to measure the power consumption of Big CPU, Little CPU, GPU and DRAM in real time

Appendix 2: Design Details of the Data Collection Instrument

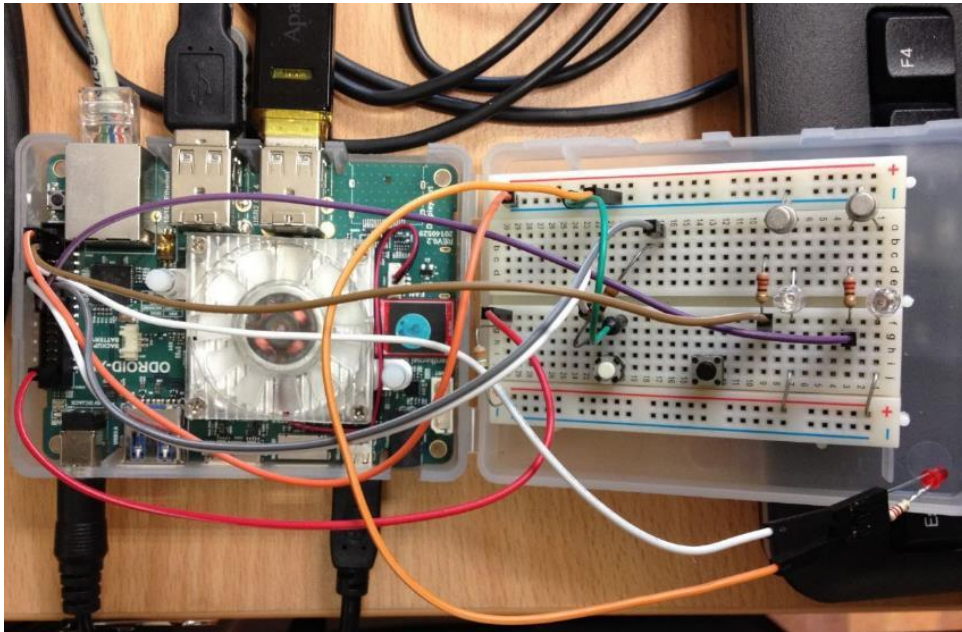


Figure A2.1: ODROID XU₃ board (left) and a breadboard (right) during the initial phase of designing the circuitry. The circuit was designed mainly to operate data capturing during this phase.

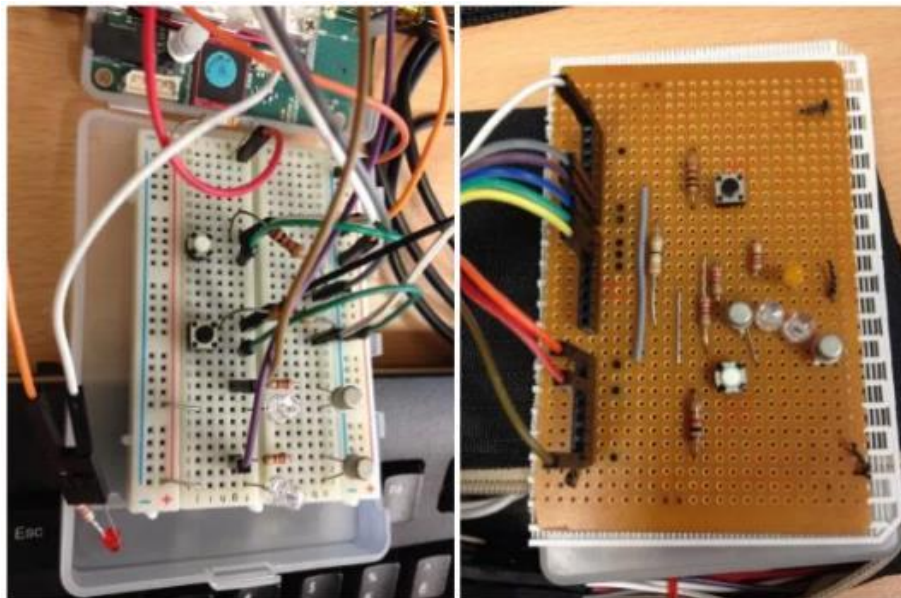


Figure A2.2: Once finalized, the workable circuit on the left photo was moved to a Veroboard as shown on the right photo to make it handy for outdoor usage. 3 LEDs were added as indicators during data collection to indicate: (1) power status, (2) readiness of the system for data capturing, and (3) data storing status.

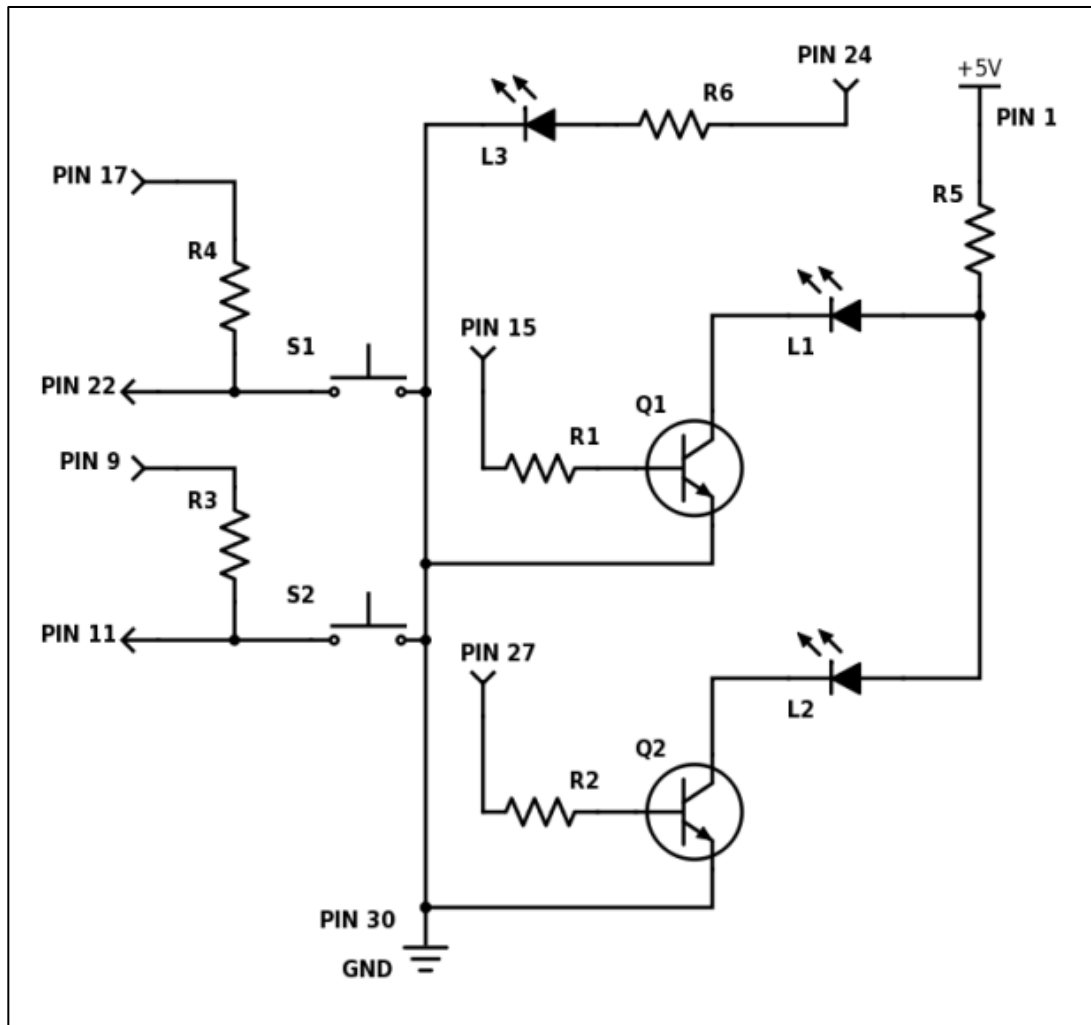


Figure A2.3: The schematic diagram of the circuit to turn the camera program and data storing function ON/OFF by accessing the GPIO on ODROID XU3. LEDs were included as indicator.

More details about the GPIO pins can be found in Appendix 1.

List of electronic components used in the circuit as labelled in Figure A2.3:

- Q1, Q2: two N2222A transistors
- L1, L2: two LEDs (3 – 5 volts)
- L3: one LED (1.5 volts)
- S1, S2: two button switches (momentary press contact)
- R1, R2, R6: three 220 Ω resistors
- R3, R4: two 1 kilo Ω resistors
- R5: one 390 Ω resistor



Figure A2.4: The lithium power source. Since ODROID XU3 is running on 5 volts, a voltage regulator (the green board) is added to convert the 11.1 volts from the lithium battery. Battery specifications: 11.1V, 2300 mAh, 30 C, Li-Polymer battery.

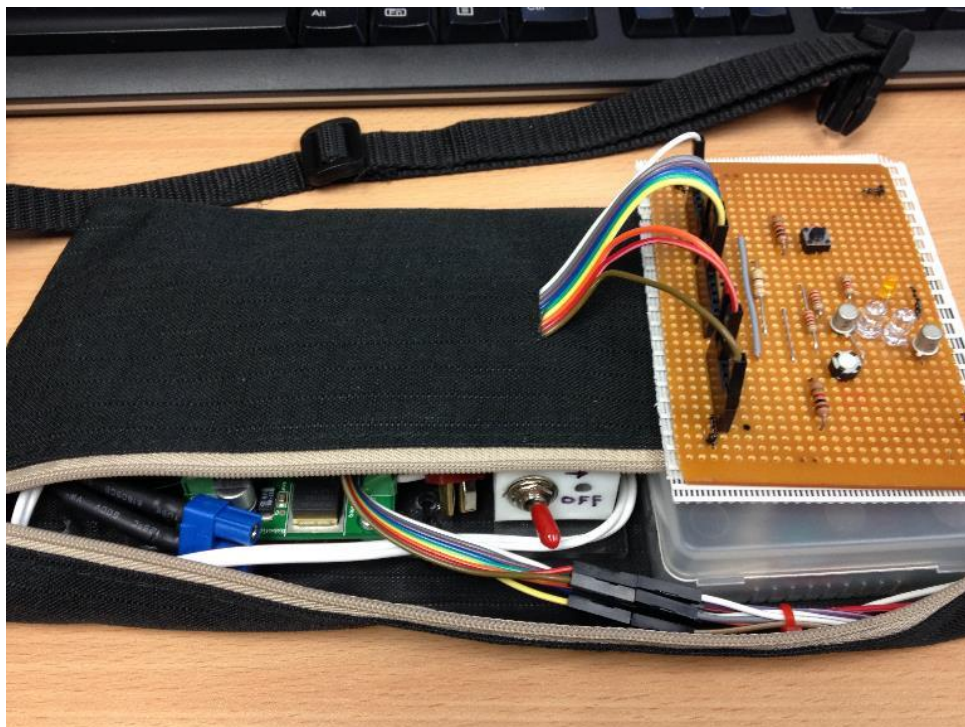


Figure A2.5: All in a waist pouch – putting together the lithium power source, the ODROID board (can be seen hidden in a plastic box inside the pouch) and the circuit board ready for data collection.



Figure A2.6: Wearing the pouch at waist level of a user.