Contact Information

If you have any questions about the controller or base station in terms of hardware selection, design, wiring, etc., please contact Sam Gerstner through the contact information provided by Dr. Srougi.

All Items Ordered

Component Name	Component ID	QTY	Price	Price Total	Link
USB Bluetooth Dongle	Combination WiFi + Bluetooth 4.0 USB Adapter	1	$14.95	$14.95	https://www.digikey.com/en/products/detail/adafruit-industries-llc/4827/13688274
360 Magnets		1	$8.99	$8.99	https://www.amazon.com/TRYMAG-Magnets-Whiteboard-Neodymium-Science/dp/B09SKXNSSP?source=ps-sl-shoppingads-lpcontext&ref_=fplfs&smid=ADYVACFWX90EO&th=1
300 Springs		1	$9.99	$9.99	https://www.amazon.com/Dianrui-Compression-Assortment-Mechanical-K-P-051-300/dp/B0BVTDP29W/ref=sr_1_3?crid=3LGN4LTD48ZE&dib=eyJ2IjoiMSJ9.B9q0atkenJRq4xFEpuA6kf0xvpWVwtjE_6Jrg8n_wl4AshShWy0niXyGcGODS_RPB5TLhmazVgs-Qwx8HSKN6JME1vJPzGmxJKrSJi3v9j9eyQDMCBJYSqKMMt5h4j3zoEr5e-ryrXt19ujwe94cvhnJp7JKU7mKEi8uZDyFq5GFPaRdmS3cwmIDYF1ZNgBa_kqawmkpx0HjheSVsjkQPbFdnFwWvjw1_L16hqNEAzE.FmYSZ0k3yNbExxVM6XqJJVCFdnnJwAWHJjAC8_eATII&dib_tag=se&keywords=compression%2Bspring%2Bkit&qid=1727206260&sprefix=compression%2Bspring%2Bkit%2Caps%2C116&sr=8-3&th=1
180 Buttons		1	$8.99	$8.99	https://www.amazon.com/OCR-180PcsTactile-Momentary-Switches-Assortment/dp/B01MRP025V/ref=sr_1_8?crid=2RLKFHJ1MG6TZ&dib=eyJ2IjoiMSJ9.ScUSB5OWgNs8pLD17iOMcP7bp_FxMK4gap0C8o0fuvq-W3CFHKA-jI9NtCcnrnqTFUbeiMzNcS1gKbUjt_3RJYII6vrRSMag8d9TfoGQidZrfZMyOiBdbM0upPN1HW1krYzcfdaVbhZ1wUJJtOhbbB39Pi9uN_p4Yzqksaq3U0XIIIZNbcL73RnAzsv2SnuBJySRW4QM9fueKFFoJSeOfmZep95OB75M580Cox_Mgq0.q4P31AExNWBgvui5RQWRhi_gcxaZlT7V9OjP

					T2mieeo&dib_tag=se&keywords=small%2Bpush%2Bbuttons&qid=1727206552&sprefix=small%2Bpush%2Bbuttons%2Caps%2C120&sr=8-8&th=1
Microcontroller w/ Bluetooth		3	$7.49	$22.47	https://www.digikey.com/en/products/detail/seeed-technology-co-ltd/113991114/19285530?s=N4IgTCBcDaIIxwMwE5kLgFhAXQL5A
IMU + Gyro		3	$9.95	$29.85	https://www.digikey.com/en/products/detail/adafruit-industries-llc/4503/16637690
Battery		3	$7.95	$23.85	https://www.digikey.com/en/products/detail/adafruit-industries-llc/1578/5054539
SPDT switch		3	$2.00	$6.00	https://www.digikey.com/en/products/detail/cw-industries/G-1132-0003/161127
Hall effect sensor		4	$1.22	$4.88	https://www.digikey.com/en/products/detail/texas-instruments/DRV5056A1ELPGMQ1/10434634
Rumble Motor		2	$6.99	$13.98	https://www.digikey.com/en/products/detail/adafruit-industries-llc/1201/5353637
Battery Connector		3	$0.75	$2.25	https://www.digikey.com/en/products/detail/adafruit-industries-llc/3814/9380221

Power Switch		1	$10.90	$10.90	https://www.amazon.com/Prewelded-Self-Locking-Momentary-Green6pcs-lkelyonewy/dp/B0927153HN/ref=sr_1_18?crid=35W2SX4DTZPB9&dib=eyJ2IjoiMSJ9.foD7gRd03X3fx-74m_hfXEBo42uSvEDN2Sjt5x1gTbGmr_Nv39upIP_fyA38wUgUYhwS2klSjnISFNlal0mq9fwjXJ8pENJ3PfZfqccjLvZ_WxSFxvOzAUsSM330fSCut0qZjWtHuiSGH_G1fGy_ZKQWTE3lI1yRRbIpusETtNsFZCy94FFYCslwA4BqKsqURWTtlV3q6q3Dxt9arkhN_4IXhMgA0cdsJGkHh0Jp1jQ.szOmu20K_e4pkMTCkPCWAPsefaep20ar5vB2goJHeEM&dib_tag=se&keywords=small+toggle+switch&qid=1728661813&sprefix=small+toggle+switch%2Caps%2C102&sr=8-18
Electrical Wire		1	$15.19	$15.19	https://www.amazon.com/TUOFENG-Electronic-Prototyping-Circuits-Breadboarding/dp/B07TX6BX47/ref=sr_1_5?crid=1I3K7IDDPBCT5&dib=eyJ2IjoiMSJ9.nhyepXj99xT6gmjDRY_uvlOaWheGpLbFYLuWKGIZv_T7dJXvEv3u94OpezI4W5oSzCSMtw9-8zmU5ZltqbzyuYWsQAweQO_U5rkSH4vAP5wYSFsxM-PgHzXOOyrUfpsRITt3CB4kPzFbTdK87opmZjQDY_SUsFgGix-QsPIcocSzcc14sdkpC_vzCn93a96zPP2_QVG8CzBbbOk2XuoaKDARGLxcQ8XxonPQ4qqj5IMGN6rYTSEwb2bXv19lbeNN1t

					bjsl-iRTbq9KIbHUc8N8MJdhRwDpP5zuWzH47IT Pk.auoBKYgNRd4LpPLSf1uMP4yhU1AUWo_Ro KS7wKaP2Pg&dib_tag=se&keywords=22%2Bgau ge%2Bwire&qid=1728591006&sprefix=22%2Bga uge%2Bwire%2Caps%2C108&sr=8-5&th=1
USB-C Cables			1	$4.99	$4.99	https://www.amazon.com/MCSPER-Charging-Brai ded-Compatible-Samsung/dp/B08D9SB161/ref=sr _1_4?crid=321MR8WHEFHLR&dib=eyJ2IjoiMSJ9 .V__LEIf_mPmVMKPr3D_jqUWTEgK2KgvvHvRV O3eG0JJ16ZZBjJ9_Jv4sUTDhEF1MNkaO3wWce v_icWS9wx9xedEoqpqFSHVbQujaCxsoYezqZCQ 2WYNZ-NV-HhYmoKJ6ZHGic18BigUqynEdjk3Pu 2iVy8WGMRXGsAmWtsAcXwclJUVCZ8OD-XT42 FptVURk7y8G-YhQ-A1LSIQH_ZBNN6XYEMniJN y-paTIa66RFaM.kFSsxvhDKGExXgjRpcoNwnVlje W4UnmST7Eys6QXyz4&dib_tag=se&keywords=s hort+usb-c+cable&qid=1728591262&sprefix=shor t+usb-c+cable%2Caps%2C101&sr=8-4
Machine Screw Kit			1	$9.99	$9.99	https://www.amazon.com/Socket-Screws-Assortm ent-Button-Assorted/dp/B0BMQGV4SW/ref=sr_1_ 4?crid=BHBQYZ4CE08C&dib=eyJ2IjoiMSJ9.gidZ svvlbVqQGkqAi5ANVgfwrR4dsUR8WQ0rwTWe4 v6VZt02fRt5fLglTo7K7nbGLysN6FRk5R6wsb3M0 wJNuZA112o1mc9ojQVh_qDiRL_O3oGNId3mrW w3GNLEA0Mc89slkvWLrBupmzvkl7asTOBx-13kr GFZg5s4jO4Qi5aVVtLa4zDx4K95lBWb7xhUnF5n TKRSgQ8GtnDr3wtRbepArHcnyyeVLw656qKt9h g.c6Bf9oek8LB833ualeuzuATg2oFPX6VTxnRUQi LtNUQ&dib_tag=se&keywords=m3%2Bbutton%2 Bhead%2Bscrew%2Bkit&qid=1728592222&sprefi x=m3%2Bbutton%2Bhead%2Bscrew%2Bkit%2Ca ps%2C94&sr=8-4&th=1

Pipette Aid Controller Overview

Microcontroller

The microcontroller used for the pipette aid controller is the Seeed Studio XIAO ESP32S3. This MCU was chosen because it is inexpensive, offers enough I/O for the project, and offers the required Bluetooth functionality.

IMU

The IMU used for orientation is the Adafruit LSM6DS3TR. This IMU was used because it gives enough data for orientation sensing and has very good documentation thanks to Adafruit.

While the IMU is wired on the controller, the data is not used and as such is not shown in the schematic.

Battery

The battery used is 500mAh in capacity and was chosen due to its capacity and overall size, allowing for easy fitment in the pipette aid controller. The current controller implementation draws roughly 100mA, giving the controller a 5-hour battery life from a full charge.

Rumble Motor

The rumble motor used to mimic the feel of the real pipette aid and was chosen due to its small size and low current draw. The motor simply requires GND and a power input, and can be driven directly by the MCU.

Hall Effect Sensor + Magnets

Hall Effect sensors use magnetic fields to calculate variable distance, allowing for the sensor to be physically disconnected from what it's sensing. The sensors detect six of the listed magnets embedded in the base of the buttons and output an analog voltage value based on how close the magnets are to the sensors. The sensors are embedded in the backing pieces that hold the springs.
- NOTE: The sensors read in two ways based on the side of the magnets pointed towards the sensors. One direction will make the output from the sensors decrease as the magnets get closer, while the other direction will make the output increase. MAKE SURE that the magnets are oriented such that they make the output increase as they get closer to the sensors.

Base Station Overview

Microcontroller

The MCU used in the base station is the same MCU that is in the pipette aid.

Interface

The base station has two buttons and two LEDS - one button for the pipette aid controller (implemented) and one for the micropipette controller (not implemented). The buttons select between the two controllers and the LEDs display which controller is to be connected to. If the LED is blinking then the base station and controller are not connected, but if the LED is solid then they are connected.