

NIGEL (4WD4WS) BOM								
NAME	SPECIFICATIONS	COMMENTS	LINK	RATE	QTY	PRICE	COST	
Chassis								
Acrylic cutouts	24"x24", 1/8" thick acrylic sheet	Chassis cutouts source files (laser cutting)	Houston Acrylic	\$ 20.99	1	\$ 20.99	\$	20.99
Brass standoffs	M3×15 (F-F) standoffs		Amazon	\$ 0.36	4	\$ 1.44	\$	8.99
Brass standoffs	M3×20 (M-F) standoffs		Amazon	\$ 0.19	4	\$ 0.76	\$	9.89
Brass standoffs	M3×40 (M-F) standoffs		Amazon	\$ 0.50	4	\$ 2.00	\$	10.19
Bolts	M2X10 bolts		Amazon	\$ 0.07	24	\$ 1.68	\$	7.49
Bolts	M2X25 bolts		Amazon	\$ 0.18	4	\$ 0.72	\$	8.99
Bolts	M2.5X8 bolts		Amazon	\$ 0.09	4	\$ 0.36	\$	9.49
Bolts	M2.5X25 bolts		Amazon	\$ 0.18	8	\$ 1.44	\$	8.99
Bolts	M3X6 bolts		Amazon	\$ 0.08	22	\$ 1.76	\$	7.99
Bolts	M3X8 bolts		Amazon	\$ 0.08	20	\$ 1.60	\$	8.49
Bolts	M3X14 bolts		Amazon	\$ 0.08	4	\$ 0.32	\$	8.49
Bolts	M4X10 bolts		Amazon	\$ 0.08	33	\$ 2.64	\$	8.49
Nuts	M2 nuts		Amazon	\$ 0.08	38	\$ 3.04	\$	8.49
Nuts	M2.5 nuts		Amazon	\$ 0.04	8	\$ 0.32	\$	4.14
Nuts	M3 nuts		Amazon	\$ 0.06	4	\$ 0.24	\$	6.07
Nuts	M4 nuts		Amazon	\$ 0.08	33	\$ 2.64	\$	8.02
L-Bracket	20x20 mm stainless steel L-bracket		Amazon	\$ 0.08	8	\$ 0.63	\$	7.90
Servo horn	25T horn for MG996R servo motor		Amazon	\$ 1.00	4	\$ 4.00	\$	9.99
Wheels	65 mm rubber tyre wheels		Amazon	\$ 0.99	4	\$ 3.96	\$	3.99
Strap belt	9" LiPo battery strap belt	Optional to strap-on LiPo battery	Amazon	\$ 0.89	1	\$ 0.89	\$	8.99
Power Electronics								
LiPo battery	11.1V 5200mAh 3S 40C/80C LiPo		Amazon	\$ 36.50	1	\$ 36.50	\$	72.99
LiPo charger	2S-3S balance LiPo battery charger		Amazon	\$ 9.68	1	\$ 9.68	\$	9.68
Voltage checker	1S-8S LiPo battery voltage checker		Amazon	\$ 5.49	1	\$ 5.49	\$	5.49
Master switch	12V 10A M22 ring light push button (blue)		Amazon	\$ 15.99	1	\$ 15.99	\$	15.99
Buck converter	12A DC-DC CC CV buck converter		Amazon	\$ 10.58	1	\$ 10.58	\$	10.58
Motor driver	12V 1.2A Dual TB6612FNG motor driver	Small PCB footprint	SparkFun	\$ 13.95	2	\$ 27.90	\$	27.90
Auxilliary Board PCB	Custom PCB	PCB source files	DKRed	\$ 22.22	1	\$ 22.22	\$	88.88
PVC wires	30' 24 AWG PVC wire	Red and black color	Amazon	\$ 7.98	1	\$ 7.98	\$	7.98
Battery connector	XT60 connector (male)		Amazon	\$ 2.99	1	\$ 2.99	\$	8.99
DC jack	2.5×5.5 mm DC power jack (male)	Required to power Jetson Nano	DigiKey	\$ 4.97	1	\$ 4.97	\$	4.97
Screw terminal	2 pin 5.08 mm pitch screw terminal block		Amazon	\$ 0.14	6	\$ 0.84	\$	8.39
Header pins	2.54 mm male and female header pins		Amazon	\$ 11.99	1	\$ 11.99	\$	11.99
Header wires	M-M, F-F, M-F header wires		Amazon	\$ 6.98	4	\$ 27.92	\$	27.92
Wire sleeve	Spiral wire sleeve		Amazon	\$ 5.99	1	\$ 5.99	\$	5.99
Sensors								
Throttle sensor	Virtual sensory feedback (firmware)	Virtual (firmware)	NA	NA	1	NA	NA	
Steering sensor	Virtual sensory feedback (firmware)	Virtual (firmware)	NA	NA	1	NA	NA	
Incremental encoders	16 PPR 2-channel hall-effect magnetic encoder	Pre-installed on the motors	NA	NA	4	NA	NA	
Microphone	KY-037 microphone module		Amazon	\$ 1.49	1	\$ 1.49	\$	8.99
IPS	AprilTag marker	Sticker print	NA	NA	1	NA	NA	
IPS	Retroreflective marker	Optional (if motion capture system is available)	NA	NA	4	NA	NA	
IMU	MPU9250 9-axis IMU		Amazon	\$ 15.99	1	\$ 15.99	\$	15.99
LIDAR	RPLIDAR A1M8 (with mini-USB adapter)		Amazon	\$ 99.00	1	\$ 99.00	\$	99.00
RGB cameras	8 MP Raspberry Pi Camera v2.1 (with CSI adapter)		SparkFun	\$ 25.00	2	\$ 50.00	\$	50.00
RGB-D camera	Intel RealSense D435i Depth Camera		Amazon	\$ 324.99	1	\$ 324.99	\$	324.99
Tracking camera	Intel RealSense T265 Tracking Camera		Amazon	\$ 520.00	1	\$ 520.00	\$	520.00
Computational Resources								
Jetson Orin Nano	NVIDIA Jetson Orin Nano Developer Kit		Amazon	\$ 499.00	1	\$ 499.00	\$	499.00
Arduino Mega	Arduino Mega 2560 Rev.3 development board	Unsoldered version	Alexnld	\$ 43.19	1	\$ 43.19	\$	43.19
Arduino Mega	Arduino Mega 2560 Rev.3 development board	Soldered version	Amazon	\$ 20.99	1	\$ 20.99	\$	20.99
Communication Systems								
LIDAR cable	USB Type-A to Micro-USB Type-B cable	Comes with LIDAR	NA	NA	1	NA	NA	
CSI cables	22-15 pin camera serial interface (CSI) cable	Required for Jetson Orin Nano	Amazon	\$ 3.50	2	\$ 6.99	\$	6.99
MCU cable	USB Type-A to USB Type-B cable	Comes with Arduino	NA	NA	2	NA	NA	
Wi-Fi adapter	TP-Link TL-WN725N USB Wi-Fi adapter	Optional (if Jetson Nano does not come with a WiFi card)	Amazon	\$ 9.99	1	\$ 9.99	\$	9.99
DP emulator	DisplayPort emulator plug	Optional (if required by Jetson Nano)	Amazon	\$ 6.99	1	\$ 6.99	\$	6.99
HDMI emulator	HDMI emulator plug	Optional (if required by Jetson Nano)	Amazon	\$ 2.66	1	\$ 2.66	\$	15.99
Actuators								
Drive actuators	6V 120 RPM 120:1 TT L motor (with encoders)	L-configuration	RobotShop	\$ 7.99	4	\$ 31.96	\$	31.96
Steering actuator	MG996R servo motor	Metal gear	Amazon	\$ 7.49	4	\$ 29.96	\$	29.98
Lights and Indicators								
LEDs	5 mm red, white and amber LEDs	Pre-wired LEDs (pack of 120)	Amazon	\$ 0.11	12	\$ 1.32	\$	12.99
Buzzer	12 mm passive buzzer		Amazon	\$ 0.60	1	\$ 0.60	\$	5.99
						TOTAL	\$ 1,907.59	\$ 2,186.84

NIGEL (AS) BOM									
NAME	SPECIFICATIONS	COMMENTS	LINK	RATE	QTY	PRICE	COST		
Chassis									
Acrylic cutouts	3 mm thick acrylic cutouts (laser cut)		GitHub	NA	21	NA		NA	
Brass standoffs	M3×60 (M-F) standoffs		Amazon	\$ 1.29	4	\$ 5.16	\$		12.99
Brass standoffs	M3×40 (F-F) standoffs		Amazon	\$ 0.99	10	\$ 9.90	\$		9.99
Bolts	M2X10 bolts		Amazon	\$ 0.09	36	\$ 3.24	\$		7.99
Bolts	M2.5X8 bolts		Amazon	\$ 0.09	4	\$ 0.36	\$		10.19
Bolts	M2.5X25 bolts		Amazon	\$ 0.20	8	\$ 1.60	\$		8.99
Bolts	M3X6 bolts		Amazon	\$ 0.07	5	\$ 0.35	\$		7.49
Bolts	M3X8 bolts		Amazon	\$ 0.09	20	\$ 1.80	\$		8.99
Bolts	M3X10 bolts		Amazon	\$ 0.08	6	\$ 0.48	\$		8.99
Bolts	M3X14 bolts		Amazon	\$ 0.09	6	\$ 0.54	\$		8.49
Bolts	M3X25 bolts		Amazon	\$ 0.11	5	\$ 0.55	\$		9.99
Bolts	M4X10 bolts		Amazon	\$ 0.10	4	\$ 0.40	\$		9.49
Nuts	M2 nuts		Amazon	\$ 0.09	56	\$ 5.04	\$		8.49
Nuts	M2.5 nuts		Amazon	\$ 0.04	8	\$ 0.32	\$		4.51
Nuts	M3 nuts		Amazon	\$ 0.06	18	\$ 1.08	\$		6.06
Nuts	M4 nuts		Amazon	\$ 0.08	4	\$ 0.32	\$		8.06
Plastic spacer	M4X5 spacers	Optional for motor driver	NA	NA	4	NA		NA	
Servo horn	25T horn for MG996R servo motor		Amazon	\$ 1.00	1	\$ 1.00	\$		9.99
TT motor gearboxes	100 RPM TT motor gearbox	Optional for 2WD configuration	NA	NA	2	NA		NA	
Wheels	65 mm rubber tyre wheels		Amazon	\$ 0.99	4	\$ 3.96	\$		3.99
Strap belt	9" LiPo battery strap belt	Optional to strap-on LiPo battery	Amazon	\$ 1.59	1	\$ 1.59	\$		7.99
Power Electronics									
LiPo battery	11.1V 5200mAh 3S 40C/80C LiPo		Amazon	\$ 36.50	1	\$ 36.50	\$		72.99
LiPo charger	2S-3S balance LiPo battery charger		Amazon	\$ 9.68	1	\$ 9.68	\$		9.68
Voltage checker	1S-8S LiPo battery voltage checker		Amazon	\$ 5.49	1	\$ 5.49	\$		5.49
Master switch	12V M12 ring light push button (blue)		Amazon	\$ 2.33	1	\$ 2.33	\$		13.98
Buck converter	12A DC-DC CC CV buck converter		Amazon	\$ 10.58	1	\$ 10.58	\$		10.58
Motor driver	20A motor driver with braking		Robokits	\$ 7.80	1	\$ 7.80	\$		7.80
Motor driver	12V 2A L298N motor driver	Alternative motor driver	Amazon	\$ 6.99	1	\$ 6.99	\$		6.99
Prototype board	6x8x cm universal prototype board		PCB source files Amazon	\$ 1.49	1	\$ 1.49	\$		14.90
PVC wires	30' 24 AWG PVC wire	Red and black color	Amazon	\$ 2.99	1	\$ 2.99	\$		8.99
Battery connector	XT60 connector (male)		Amazon	\$ 2.99	1	\$ 2.99	\$		8.99
DC jack	2.5x5.5 mm DC power jack (male)	Required to power Jetson Nano	DigiKey	\$ 4.97	1	\$ 4.97	\$		4.97
Screw terminal	6 pin 5.08 mm pitch screw terminal block		Amazon	\$ 0.15	2	\$ 0.30	\$		8.98
Header pins	2.54 mm male and female header pins		Amazon	\$ 11.99	1	\$ 11.99	\$		11.99
Header wires	M-M, F-F, M-F header wires		Amazon	\$ 6.98	4	\$ 27.92	\$		27.92
Wire sleeve	Spiral wire sleeve		Amazon	\$ 6.49	1	\$ 6.49	\$		6.49
Cooling fan	5V DC 4020 cooling fan	Optional to cool Jetson Nano	DFRobot	\$ 6.90	1	\$ 6.90	\$		6.90
Sensors									
Throttle sensor	Virtual sensory feedback (firmware)	Virtual (firmware)	NA	NA	1	NA		NA	
Steering sensor	Virtual sensory feedback (firmware)	Virtual (firmware)	NA	NA	1	NA		NA	
Incremental encoders	16 PPR 2-channel hall-effect magnetic encoder	Pre-installed on the motors	NA	NA	2	NA		NA	
IPS	AprilTag marker	Sticker print	GitHub	NA	1	NA		NA	
IMU	MPU9250 9-axis IMU		Amazon	\$ 15.99	1	\$ 15.99	\$		15.99
LIDAR	RPLIDAR A1M8 (with mini-USB adapter)		Amazon	\$ 99.00	1	\$ 99.00	\$		99.00
Cameras	8 MP Raspberry Pi Camera v2.1 (with CSI adapter)		SparkFun	\$ 25.00	2	\$ 50.00	\$		50.00
Computational Resources									
Jetson Nano	NVIDIA Jetson Nano Developer Kit - B01		Amazon	\$ 149.00	1	\$ 149.00	\$		149.00
Arduino Nano	Arduino Nano Rev.3 development board		Amazon	\$ 6.66	1	\$ 6.66	\$		19.99
Communication Systems									
LIDAR cable	USB Type-A to Micro-USB Type-B cable	Comes with LIDAR	NA	NA	1	NA		NA	
CSI cables	Camera serial interface (CSI) cable	Comes with camera	NA	NA	1	NA		NA	
MCU cable	USB Type-A to Mini-USB Type-B cable	Comes with Arduino	NA	NA	2	NA		NA	
Wi-Fi adapter	TP-Link TL-WN725N USB Wi-Fi adapter	Required if Jetson Nano does not have a WiFi card	Amazon	\$ 9.99	1	\$ 9.99	\$		9.99
Actuators									
Drive actuators	6V 120 RPM 120:1 TT I motor (with encoders)	I-configuration better for RW	DFRobot	\$ 7.40	2	\$ 14.80	\$		29.60
Drive actuators	6V 120 RPM 120:1 TT L motor (with encoders)	L-configuration better for FW	DFRobot	\$ 7.99	2	\$ 15.98	\$		31.96
Steering actuator	MG996R servo motor	Metal gear	Amazon	\$ 7.49	1	\$ 7.49	\$		14.99
Lights and Indicators									
LEDs	5 mm red, white and amber LEDs	Pre-wired LEDs (pack of 120)	Amazon	\$ 0.11	12	\$ 1.32	\$		12.99
						TOTAL	\$ 553.33	\$ 813.83	

INFRASTRUCTURE BOM									
NAME	SPECIFICATIONS	COMMENTS	LINK	RATE	QTY	PRICE	COST		
Obstruction Modules									
Construction box	3 ply boxes (4×4×12 inches)	Pack of 25	Amazon	\$ 28.91	4	\$ 115.64	\$	115.64	
Surveillance Elements									
Camera	Smartphone camera		NA	NA	1	NA		NA	
Camera stand	Desk Mount Clamp Gooseneck Stand		Amazon	\$ 10.99	1	\$ 10.99	\$	10.99	
Calibration grid	A0 camera calibration grid	A0 laser print	GitHub	NA	1	NA		NA	
Preconfigured Maps									
Driving School	10×5 ft Driving School map	10×5 ft flex printing	GitHub	NA	1	NA		NA	
					TOTAL		\$	126.63	\$ 126.63