

## Eddie Robot Platform

(Assembled: #28990; Unassembled: #28992)

Eddie is a turnkey hardware solution to create a mobile robot with your own laptop and Kinect camera — a perfect platform to foster creativity, innovation, and experimentation.

Once fully assembled, simply connect your own laptop and Kinect camera (not included) over USB and Eddie is up roaming the house in minutes. Compatible with Microsoft Robotics Developer Studio 4 (RDS 4), Eddie can navigate autonomously and see in 3D using the power of the Microsoft Kinect camera.

The Eddie Control Board uses the Propeller™ multicore microcontroller to directly control two high-torque 12 V motors and collect data from multiple sensors mounted on the robot. Eddie is controlled over a simple USB connection and a convenient command interface.



### Features

- Compatible with Microsoft Robotics Developer Studio 4 (RDS4)
- Dual-platform design with plenty of room for electronics and on-the-go programming laptop access
- Two drive wheels with high-torque 12 VDC motors and position controllers
- Front and rear dual-tire caster wheels for platform stability
- Durable pneumatic rubber tires easily traverse hard floors and carpet
- Five distance sensors (three infrared and two ultrasonic) for collision avoidance
- Fully integrated control board handles all lower-level hardware operations to drive motors and collect sensor data
- Simple USB connectivity between control board and your laptop
- 12 V, 14.4Ah gel-cell batteries for 4–7 hours of continuous operation
- Built-in charging jack (charger included)

### Key Specifications

- Communication Interface: Serial commands over USB interface
- Operating temperature: 32 to 158 °F (0 to 70 °C)
- Dimensions: 21.75" (55.25 cm) high, 17.8" (45.2 cm) diameter, assembled
- Weight: 25.3 lbs (11.5 kg), excluding laptop and Kinect camera

### Application Ideas

- Autonomous navigation and mapping
- Development and testing of machine vision systems
- Tele-presence robots
- Voice-activated personal assistant robots
- Security and surveillance robots
- Crowd interaction and advertising

### Additional Items Required

- Laptop Computer
- Kinect Camera
- Philips (cross-head) screwdriver
- Scissors
- 5/32" Allen wrench
- Microsoft RDS software

## Precautions

- After switching main board power off, wait at least 5 seconds before switching power back on. Rapid and repetitive power cycling of the board and motor power supplies causes significant stress on electronic components and may damage the board and/or connected electronic accessories.
- Use caution when handling the drive motors or Control Board as some components may become hot after prolonged operation.
- As in most electronic devices, Eddie contains components which are sensitive to static discharge. Exercise proper grounding practices prior to touching or working on the robot.

## Assembly Instructions

Note: For pre-assembled Eddie (28992), go to Step 10

**Step 1:** Pre-assemble the Motor Mount and Wheel Kit and the Caster Wheel Kits, by following the instructions that came with each of those products. Set them aside for now.

**Step 2:** After you have completed the assembly of the Motor Mount and Wheel Kit and the Caster Wheel Kits, carefully unpack the remaining components and sort them into their respective groups. You should have the following:

## Bill of Materials

Part #	Quantity	Description
28994	1	Eddie Motor Mount and Wheel Kit w/ Position Controller
28971	2	Caster Wheel Kit
765-28977	1	Robot Base
765-28990	1	Eddie Second Deck
700-00235	1	Eddie Wiring Harness
721-00013	2	Kinect Mounting Cam Hook
452-00072	4	Eddie Kinect Cable Clip
800-28990	1	Eddie Kinect Power Cable
713-00049	4	Standoff, 5", 1/2" Diameter
713-00050	2	Standoff, 12", 1/2" Diameter
721-00014	1	Eddie Laptop Screen Clamp
765-00003	1	Eddie Battery Shelf
752-00007	2	Battery, 12 V, 7.2 Ah, SLA
28015	2	Ping)))™ Ultrasonic Distance Sensor
28995	3	Sharp 2Y0A21YK0F Distance Sensor
550-28990	1	Eddie Control Board
805-00002	2	Servo-extension Cable, 14" Length
805-28995	3	Sharp IR Sensor to Servo Cable
725-28995	3	Sharp IR Stand Acrylic
725-32008	2	Ping))) Stand Acrylic
710-00033	10	Screw, Cap, SKT, 6-32x1/2"
710-00035	24	4-40 x 5/8" black pan head screw
713-00005	6	Spacer, nylon, #4, 1/4" thick
713-00019	6	Spacer, nylon, #4, 1/8" thick
713-00015	4	Spacer, nylon, #4, 1/16" thick
700-00240	1	Eddie Battery Charger

Part #	Quantity	Description
806-00001	1" x 10"	Snap Velcro
700-00028	4	Screw, Pan Head, Zinc, Phillips, 4-40 x 1/4"
700-00083	4	4-40 x 1/2", F/F Hex Standoff
710-00024	4	Screw, Button Head SS, 1/4"x20 x 1/2"
710-00032	6	Screw, Cap, SS, #6-32 x 3/8"
710-00034	4	Screw, Flat Head, Black 1/4-20 x 5/8"
721-00012	1	Eddie Kinect Platform
710-00040	4	Screw, Pan Head, Black 4-40 x 1/2"
710-00100	2	Screw, Pan Head, Black 4-40 x 1/4"
710-00105	10	Screw, Button Head, 1/4-20 x 5/8"
710-00106	2	Screw, Button Head, Blk, 1/4-20 x 3/4"
712-00008	2	Washer, 1/2" dia, .060 Delrin
713-00001	6	Standoff, 4-40 x 5/8" F/F Round
713-00022	4	Standoff, 4-40 x 1.5" F/F Hex
725-00021	1	Ball-End Hex Key 7/64"

### Step 3: Ping))) and IR Sensor Module assembly

Figure 3a shows the components for each sensor assembly. You will need a small Phillips screwdriver to assemble each sensor module.

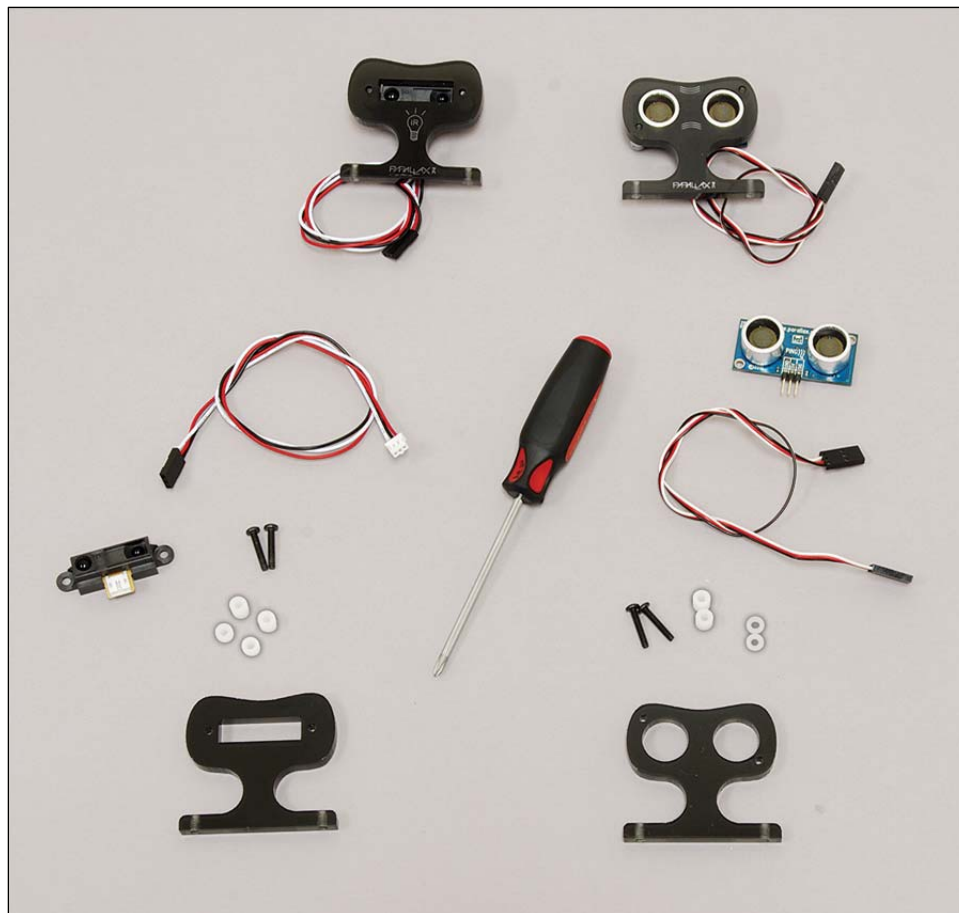


Figure 3a

Each Ping))) assembly consists of:

- (1) Ping))) sensor (#28015)
- (1) Cable, servo extension (#805-00002)
- (2) 4-40 x 5/8" black machine screws (#700-00028)
- (2) 1/16" thick nylon spacers (#713-00015)
- (2) 1/4" thick nylon spacers (#713-00005)
- (1) Acrylic Ping))) stand (#725-32008)

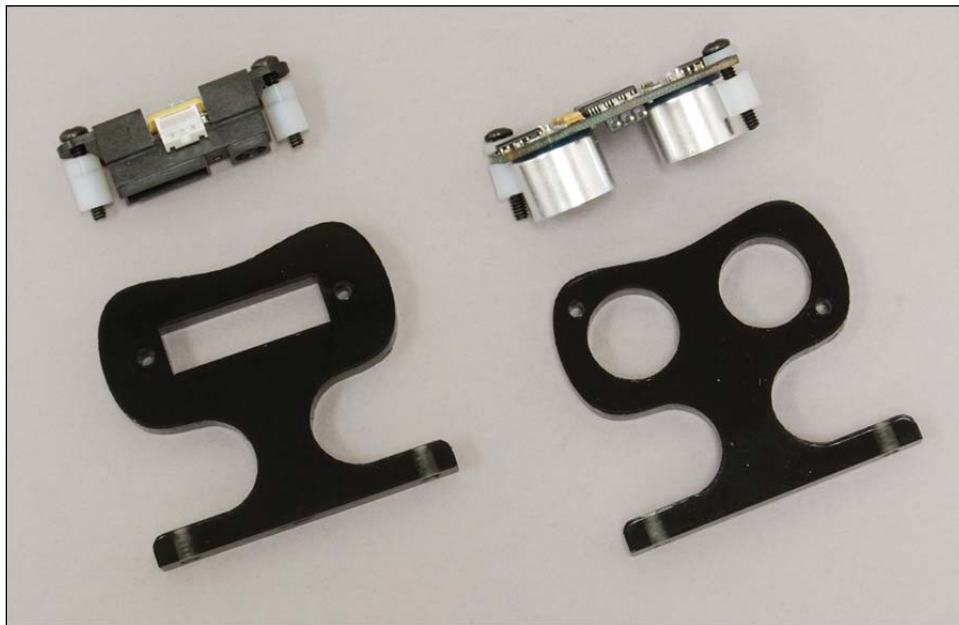
Each IR sensor assembly consists of:

- (1) IR sensor (#28995)
- (1) IR Sensor to servo cable (#805-28995)
- (2) 4-40 x 5/8" blk mach. screws (#710-00035)
- (2) 1/8" thick nylon spacers (#713-00013)
- (2) 1/4" thick nylon spacers (#713-00005)
- (1) Acrylic IR Stand (#725-28995)

Refer to Figure 3b, and note the different locations of the spacers on each assembly. In each case, make sure the label-etched sides of the Stands are on the opposite side from the sensor assemblies.

For the IR module, insert two 5/8" long, black machine screws through the mounting holes from the backside of the module. Place (1) of the 1/8" long spacers and (1) of the 1/4" long spacers on each of the machine screws (as shown in Figure 3b). Carefully align this assembly onto the backside of the acrylic IR stand, and gently tighten each of the machine screws until they're snug. Nuts are not required. The machine screws will cut their own threads as you screw them into the acrylic. Do not over tighten.

Assemble the Ping))) module by sliding a 1/16" thick nylon spacer onto each of the two 5/8" long, black machine screws. Insert these screws (with the 1/16" washers) through the Ping))) sensor's PCB mounting holes. Place two 1/4" long spacers onto the screws, and align the screws to the self-tapping mounting holes on the acrylic stand. The screws will cut their own threads. Screw them all the way in, but do not over-tighten.



**Figure 3b**

You should now have assemblies that look like those shown in Figure 3c. Repeat these steps for the remaining Ping))) sensor and IR sensor assemblies.



**Figure 3c**

Connect the appropriate cables to each of the sensors. Be sure to observe proper polarity on the Ping))) sensor cables, as shown in Figure 3c. The IR cables are polarized. Line up the tab on the cable, and insert it into the receptacle. Be sure to fully insert them – they should “click” into place.

Set these assemblies aside for now.

#### **Step 4: Battery Shelf Preparation**

As shown in Figure 4a, the Battery Shelf components consist of a Delrin shelf, (6) 1/2" tall, round aluminum standoffs, and (6) 4-40 x 5/8" screws.



**Figure 4a**

The physical sizes of SLA batteries differ depending on brand and capacity. Figure 4b shows typical locations for standoff placements, for the batteries that come with the Eddie platform. Mount the standoffs in hole locations that provide the tightest fit for the batteries that you're using.

Place the Delrin shelf so that the Parallax Logo is face down, and attach the standoffs as depicted in Figure 4b.



**Figure 4b**

Set the Battery Shelf Assembly aside for now.

### **Step 5: Main Base Assembly**

Place the two pre-assembled Casters and Motor Mounts a shown in Figure 5a. Orient the Base Plate "face up" so that the two sets of three holes (in a triangular pattern) are visible, as shown in Figure 5a. These are "blind" holes (they do not go all the way through). The Caster assemblies are attached from the bottom of the Base with short screws that do not mar the finish of the top-side.



**Figure 5a**

Use the 7/64" ball-end, Allen wrench to screw in the (3) 3/8" long socket-head cap screws to attach each of the Caster Wheel assemblies to the Base, as shown in Figure 5b. Make them snug, but do not over tighten.

Before you mount the drive wheels to the Base, verify that the ID jumpers (A and B) on the Position Controller for the left motor are set to "1" (both jumpers installed) and that the ID jumpers on the right Position Controller are set to "2" (A installed, B removed). (See Motor Mount and Wheel Kit for additional information).



**Figure 5b**

Flip the Base over (as shown in Figure 5c), and attach each pre-assembled drive motor unit to the Base using (2) 1/4 x 20 button head screws for each motor, as shown. Tighten using a 5/32" Allen wrench.

Connect the long, three-pin servo extension cable to the left Position Controller on the header marked "To Controller". Connect the other end of the cable to the same header on the right Position Controller. It is recommended that the cable is routed across the top side of the robot platform. This configuration allows both Position Controllers to be connected to the Control Board on the same bus.



**Figure 5c**

## Step 6: Control Standoff Assembly

Insert (8) 4-40 x 5/8" black oxide screws from the underside of the Base, and fasten to the two sets of (4) of standoffs, as shown in Figure 6a. The 1/2" long standoffs are for the Eddie Control Board, and the 1.5" standoffs are for the Wiring Harness / Switch Plate assembly.



Figure 6a

Place (but do not attach) the Wiring Harness / Switch Plate assembly onto the Base as shown in Figure 6b. Carefully thread the Red and Black wires through the hole that's between the set of short standoffs. Double-check to make certain that the Power Switches are both "off" as shown in Figure 6b.

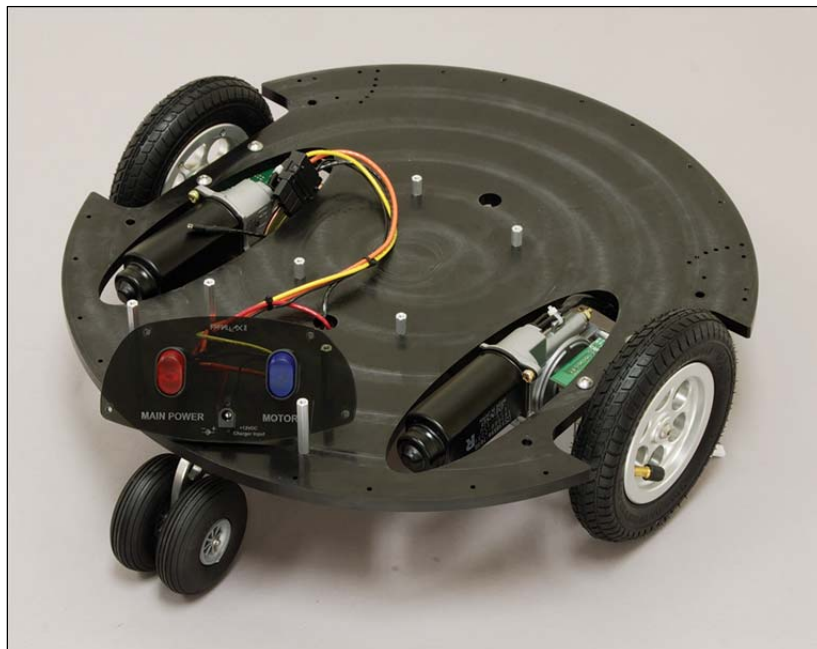


Figure 6b



## Step 7: Battery Shelf Installation

Flip the Base over, place the two Sealed Lead Acid batteries on the bottom of the Base, and connect the Red and Black wires to the corresponding colored terminals, as shown in Figure 7a.

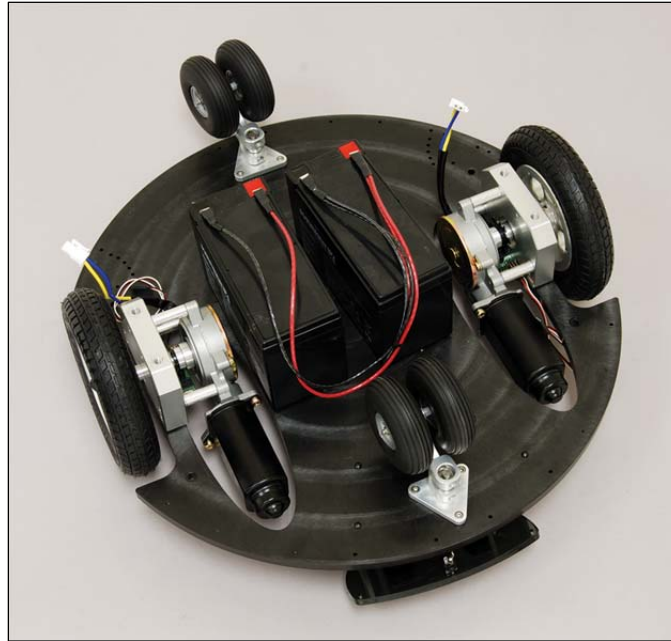


Figure 7a

Refer to Figure 7b. Carefully rotate the batteries, and gently place them between the two drive motor assemblies. This should be a nice, tight fit. Be careful to not short the terminals of the batteries against the frames of the motor assemblies. See Figure 7b.



Figure 7b

Place the pre-assembled Battery Shelf over the cells and slide it into alignment so that the the thru holes line up with the tapped holes in the Motor Bearing Block. Secure the Battery Tray with (4)  $\frac{1}{4}$ -20 x  $\frac{1}{2}$ " long button head screws, as shown in Figure 7c.



**Figure 7c**

### **Step 8: Switch Plate and 5" Upper Deck Supports Installation**

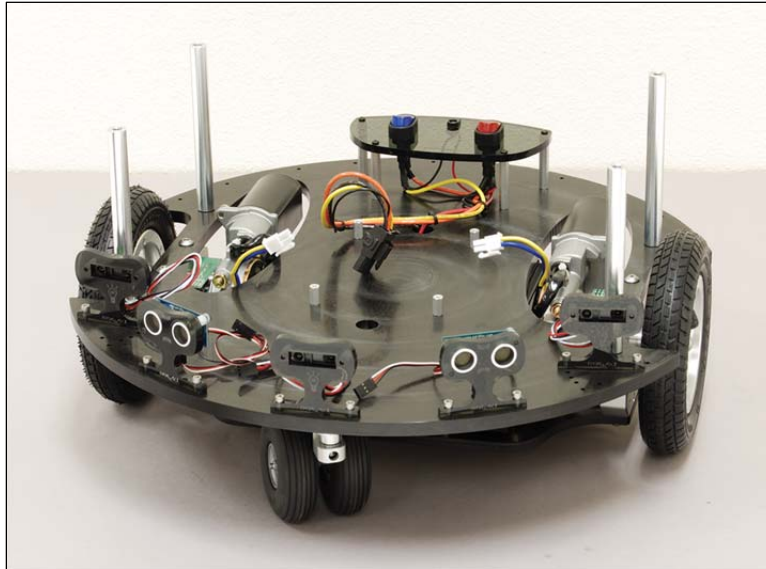
Place the assembly on its side, as shown in Figure 8a. Attach (4)  $\frac{1}{2}$ " diameter by 5" long machined aluminum standoffs with  $\frac{1}{4}$ -20 x  $\frac{5}{8}$ " long button head screws as shown.

Connect the Switch Plate to the (4) 1.5" tall standoffs with (4) #4-40 x  $\frac{1}{2}$ " long black, phillips head screws, as shown in Figure 8a as well.



**Figure 8a**

Attach the Ping))) and IR Sensors to the Base as shown in Figure 8b. Place the #6/32 x 1/2" socket head cap screw through the holes in each of the stands and then carefully screw them down evenly into the Base. Take it slow and easy. Make a few turns on one screw and then a few turns on the other, gently bringing the assembly down into full contact with the Base. Make them snug, but do not over-tighten.



**Figure 8b**

### **Step 9: Eddie Control Board Installation**

Orient the Control Board as shown in Figure 9, and use (4) 4-40 x 1/4 " machine screws to attach it to the (4) hex standoffs in the center of the platform.

Be certain that the switches are in their "Off" positions (the switches light up when they're "ON"). Connect each of the motor drive connectors to their respective receptacles on the Control Board. Connect the Main Power connector (coming from the Switch Plate) to the large power connector on the Control Board.



**Figure 9**

Viewing Eddie from the front, (as in Figure 9a), connect the left-most IR Sensor cable to "AD1", the center IR sensor to "AD2", and the right-most IR Sensor to "AD3". Connect the left-most Ping))) to I/O "1" and the right-most Ping))) to I/O "2" on the Eddie Control Board. Be sure to observe proper polarity – the black wires (ground) should be attached to the outer-most pins of the 3-pin headers.

Connect the three-pin cable from the right Position Controller to Pin-set 11 in the "Encoders" section of the Control Board. The black wire should be on the outer-most pin of the three-pin header.

Locate the power enable switch on the Control Board near the USB connector. Slide the "Motors – Board – Off" switch to the "Motors" position (all the way closest to the USB connector). This switch will leave board power and motor power enabled since they are switched externally using the high-current red and blue power switches.

### **Step 10: Second Deck Installation**

The Second Deck's "top" side is indicated by the (4) counter-sunk holes that line up with the (4) 5" long aluminum standoffs. The "counter sink" is the top.

Attach the two 12" long standoffs to the Second Deck by inserting (2) ¼ - 20 x 5/8" button head screws from the bottom side of the Second Deck.

Place the Second Deck onto the 5" standoffs as shown in Figure 10, and fasten with (4) ¼ -20 Flat head Black Screws.



**Figure 10**

### Step 11: Kinect Plate Assembly

The Kinect is attached to Eddie in a non-destructive manner. That is, there are no modifications necessary to the Kinect unit itself.

The bottom of the Kinect unit has two rectangular holes as shown in Figure 11a. Note the orientation of the “Kinect Cam Hooks” below the device.

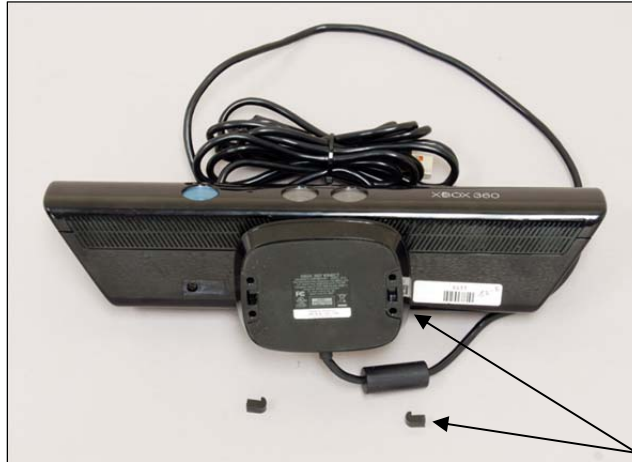


Figure 11a

Place a Cam Hook into one of the rectangular slots as shown in Figure 11b.



Figure 11b

Rotate or “cam” the hook into the slot as shown in Figure 11c. Do the same with the remaining cam hook in the other slot.



**Figure 11c**

The assembly should now look like the one shown in Figure 11d.



**Figure 11d**

Place the Mounting Plate onto the bottom of the Kinect, such that the Cam Hooks go into the rectangular holes. The Cam Hooks will not come all the way through – they’ll be just below the surface of the acrylic. Now, place washers onto the 4-40 x ¼” long, black, pan head phillips screws and screw them into the tapped holes in the bottom of the Kinect Cam Hooks, as shown in Figure 11e.



**Figure 11e**

## Step 12: Kinect Mounting and Cable Connections

Slide the rectangular Screen Clip down onto one of the 12" long standoffs as shown in Figure 12a.

Using two 1/4-20 x 3/4" black button head screws attach the Kinect Plate assembly to the top of the two 12" long aluminum standoffs.

Route the Kinect cable alongside the remaining 12" standoff, attach it with the (4) cable clips, and pass the cable down through the large thru-hole in the Top Plate.

Attach the Kinect Cable to the Kinect Cable Adapter, and then plug the two-pin power jack (on the Kinect Cable Adapter) into the Kinect Power plug on the Eddie Control Board.

Connect a USB mini-B cable to the USB connector on the Control Board, and route it up through the cable hole on the Top Plate.



**Figure 12a**



**Figure 12b**

A strip of self-adhesive Velcro-like material is included if you wish to mount your laptop computer onto Eddie's Second Deck.

Although you can attach your laptop anyway you choose, a convenient way to do so is to cut the strip into (8) 1" square pieces, and then "snap" them together into (4) sets, as shown in Figure 12a. Peel off one side of the adhesive (on each of the four sets) and stick them to the underside of your laptop. Then remove the protective film from the four sets and carefully place your laptop onto the upper deck.

If properly applied, you should be able to remove your laptop and re-attach it as required.

Your Robot should now resemble that shown in Figure 12b.

Using the (5) zip-ties, bundle excess lengths of wire so that all conductor routing is clean and organized.

This completes Eddie's hardware assembly – Congratulations!

## Additional Specifications

Parameter	Value
Robot Footprint	17.8" (45.1 cm) diameter circle
Height (without Kinect)	21.75" (xx cm)
Height (with Kinect)	24.50" (65.4 cm)
Overall Weight	27.5 lbs (11.5 kg)
Maximum Cargo Capacity <sup>(1)</sup>	50 lbs (22.7 kg)
Run Time <sup>(2)</sup>	4 to 7 hours
Ground Clearance <sup>(3)</sup>	0.88" (2.23 cm)
Wheel Center-to-center Distance	15.4" (39.0cm)
Operating Temperature <sup>(4)</sup>	32 to 158 °F (0 to 70 °C)

Notes:

1. Maximum cargo capacity is the suggested maximum cargo weight for typical operation. The robot may be able to carry additional weight, but this is not guaranteed and may result in diminished performance, or mechanical failure.
2. Run time is approximate and depends on many factors.
3. Ground clearance is limited by the screws to mount the battery support tray. Minimum ground clearance is directly between the two main drive wheels. Clearance in other areas is greater.
4. Eddie is designed to be operated indoors.

## Additional Resources and Downloads

Visit [www.parallax.com/eddie](http://www.parallax.com/eddie) for additional information and the latest product documentation and downloads, including:

- Eddie product documentation – this document.
- Eddie Control Board product documentation – provides details and specifications about the control board hardware.

## Revision History

### Version 1.2

BOM updated.