Important Safety Instructions

Safety Measures:

1. Do not place Joshua in the device while the controls are turned on.
2. The safety strap must be connected when the controls are turned on (To make sure Joshua cannot jump while the device is moving)
3. The control bracket must be folded away and fastened while the device is turned on.
4. Joshua’s safety strap should only be unhooked when the control mount is secured away and the controls are turned off and the caster wheels’ brakes are set.
5. The parental control must be attached for the system to function, and contains an emergency stop button that should be engaged if the device needs to be stopped immediately.
6. The device is intended for indoors with limited performance outdoors; refrain from using this device in outside environments.
7. Make sure a path is cleared before moving the device.
8. Keep hands and fingers away from moving parts and bolts to avoid injury.
9. Keep out of the way of the device when it is moving.
10. Keep liquids away from the device.
11. Do not use strong cleaning solutions when cleaning the surfaces on the device.
12. Be careful when removing or loosening the 80/20 materials, as the beams will begin to slide downward even with minimal loosening.
13. Ensure the bolts are tightened before using the device after taking it apart.
14. Do not tilt the device at any time.
15. Be sure to inflate the rear wheels periodically.
16. Inspect and clean the black caster wheels periodically as well to ensure the best performance.
17. Parental supervision is required at all times, especially when the device is being moved.
Parts and Accessories

- (2) NPC-41250 Motors

- (2) IFI VEX Pro Victor 884 Speed Controllers

- SafeWaze SMALL HARNESS W/ADJ BACKPAD BACK & WAIST D-RINGS
• Customized Miratron T-1 Standard Belly Pack Transmitters

• R-4P Field Programmable Receiver
- 80/20 Frame and Platforms
  - 72 inch Vertical Beams
  - (6) 28 inch Horizontal Beams
  - (7) 31 inch Horizontal Beams
- (2) 31 X 28 X 0.5 inch Platforms

- (2) Centennial BCI Group 26 Sealed 12V Automotive Battery 550CCA
• (2) Gray Knotbone Adjustable Bungee Cords 10in-48in

• (4) Black Keeper Home Depot Bungee Cords 24in
• (2) 12 1/2 x 2 1/4 inch Wheels

• Black caster wheels with small brakes

• VideoSecu Articulating LCD TV Wall Mount
Features

- Two Transmitter Control System
- Differential Motor System
- Battery Powered Electrical System
- Adjustable Harness Size
- Adjustable Bungee Length
- Anchoring Safety Strap
- Black Caster Wheels with Brakes
- Parental Control Equipped with Emergency Stop Button
  - Requires Parental Control Attachment to Function
- Up to 4mph speed
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1 Introduction

1.1 General Overview

Joshua’s Jumper is designed to meet Joshua’s needs as he continues to grow. The Frame is made from 80/20 Erector Set 15 Series beams which are held together by Anchor fasteners that can be loosened or tightened using a 0.25 inch Allen wrench (preferably one with a ball head for easier access to the sockets of the anchor fasteners between the 80/20 beams). The frame houses two platforms: the top platform is where Joshua will stand on and jump and the bottom platform which houses all of the motor components and wiring that is included. Two DC motors are attached to motor mount plates which are welded to each lower, rear corner of the frame. Each motor is secured to its respective motor mount plates by five screws, each with lock washers to prevent loosening of the screws via vibration when the motors are running. The motor components include a battery, two speed controllers (one for each DC motor), a receiver, a relay, and the wires needed to connect all the components. The battery provides the power for both motors as well as the other electronics. L-brackets are screwed into the bottom platform to hold the battery in place. The speed controllers are directly mounted to the platform with screws and nuts through their built in mounts.

Figure 1.1: 80/20 bolt in the socket of a beam.
Figure 1.2: Finished device with harness connected to bungees and safety strap attached.

The top platform is set on top on the motor mount plates to provide more stability and strength to the motor mount plates. Additionally, two sets of L-brackets attach each of the motor mount plates to the top platform beams to provide the third point of connection for the motor mount plates. The space left between the top and bottom platforms are covered to protect the motor components housed there.

Two 12 ½ x 2 ¼ inch tire wheels are attached to each DC motor at the spindles. Extensions and modified keys are made with a coupler to accommodate the compatibility differences between the motor shaft and the inner wheels. Four black caster wheels equipped with brakes are mounted to the bottoms of the 80/20 beams in the front of the frame as well. A total of six wheels will provide the necessary support and strength for this jumper.
Six eye bolts are attached to the top and sides of the top portion of the frame where the bungee cords will be attached to. Each eye bolt corresponds to an attachment on the harness. The arrangement of six points of attachment ensures the maximum stability and control for when Joshua is strapped into the harness and jumping around on the top platform. Additionally, an anchoring strap is attached to the bottom of the harness and the bottom platform to provide even more stability for Joshua while he is using the jumper. The harness has been modified to accommodate Joshua’s small figure while leaving the necessary room to accommodate his growth and extend the time of usage for the device.
A controller mount is attached to the upper, right hand side of the frame. The mount is retractable and rigid enough that it will not move wildly when the device is moving or when Joshua is jumping. Joshua may use the joystick to control movements of the device. However, to ensure safety there is a master controller used by his parents to override Joshua’s controls at any time. A master kill switch is included for emergency shutting down of the device should any unforeseen problem occur.

1.2 Operating Joshua’s Jumper

Before the device is to be used, the owner should make sure the device is up to the maintenance and safety standards outlined in this document. The user should be practiced in the control of the device before Josh is ever placed inside it. It would be beneficial for the

Before Joshua can be placed in the jumper, his harness must be attached. The waist strap should be buckled and the excess should be slid through the loops to remain close to his body. The same should be done with the two leg straps, making sure they are fastened securely. The top upper chest buckle should be clicked together into place. Each of the buckles should be tested for security before going any further. Figures 1.5 through 1.7 below shows the different buckles fastened.

![Figure 1.5: Leg strap on harness.](image)
Both controls must be in the off position and the status LEDs should not be lit. The parental control should be in a safe place out of the hands of individuals that should not be controlling the device. Joshua’s transmitter should be pushed to the side out of the device and fastened to the pole. The small brakes on the four front wheels should be locked into place to prevent movement. All of the bungee cords should be clipped to their respective eye hooks on the frame. Once it has been determined that all precautions have taken place, Joshua may be assisted onto the platform and hooked to the bungee cords via the carabiner clips. If the device is to remain powered off, Joshua
can begin bouncing. If the device is to be powered on, the following steps must be taken.

Once Joshua is in the device, the red safety strap should be attached to the bottom of the harness. This should be tight enough so that he cannot move too far in either direction. The small brakes on the wheels can be released. The area should be cleared for the device to move about. To be safe, the device should be free of any objects that could come into contact with Josh on his route. An accidental misdirection that could be incurred when using the control should be taken into account. If Joshua is using his control, it may be pushed forward and put within his reach. If not, it may remain outside the device, room permitting.

![Safety strap clipped to the harness.](image)

**Figure 1.8:** Safety strap clipped to the harness.

When the device is deemed safe to move, the controls may be powered on using the On/Off switch. The control is on when the STATUS LED is lit blue. To move the device smoothly without jolting, the joystick should be moved slowly in the desired direction. The control is labeled with which direction is which on the outer parts of the joystick, as shown in the figure below. If it is necessary to stop power to the device immediately, the red emergency stop button should be pushed.
Figure 1.9: Parental control with emergency stop button, Status LED, ON/OFF switch, and directional joystick.

Figure 1.10: Joshua’s control with Power ON/OFF, Status LED, and directional joystick.

2 Maintenance

2.1 Electrical

2.1.1 Batteries

Ensure that the battery terminals are clean and not rusting. Also make sure that the attached connectors are in good contact with the terminals. Check to see that the wing nuts for each terminal connector are tightly secured and have not become loose due to movement of the device. To replace the 12V automotive battery, remove the front horizontal bar of the top platform. Then remove the Plexiglas housing. After removing the two wing nuts from the battery terminals, remove the wires and replace the old battery with the new one. The connectors to the battery terminals will have to be transferred to the new battery before reattaching the wires to the proper terminals and
securing the wing nuts in place. The white and red wires indicate a positive voltage while the black and green wires indicate the negative terminal.

2.1.2 Transmitters

There are two transmitters that will remain outside of the motor housing. The parental controls run on three D-batteries. Be sure to replace the batteries when the status LED does not light up after powering on the system. Replace the batteries at least once a year. Keep the transmitters clean and dust free. Joshua’s controls are mounted to the frame and have a cable connection that runs into motor housing. Make sure that the bolts attaching the mount to the transmitter are secure. If necessary, remove the screws of the panel on the back of the transmitter and tighten the two nuts and bolts that are secured to the mount. Then reattach the panel to the transmitter before use.

2.1.3 Wires

All of the wiring is contained in the housing in the bottom of the device. If any wires are exposed, the device should not be operated. Turn off all power before touching any of the wiring. The wiring should only be troubleshooting by someone with electrical experience or under the instructions of a professional. Please refer to the wiring diagram in the appendix to troubleshoot the transmitter, receiver and relay wiring.

2.2 Mechanical

2.2.1 80/20 Erector Set 15 Lite Series beams

The 80/20 erector set beams have a finishing coating which give the materials more wear resistance. Simply clean the frame periodically with a wet cloth or paper towel but refrain from using any strong cleaning agents. Avoid exposing the beams to any sharp objects as they may damage the aluminum. Be sure to clean out any blockages to the slots in the beams. Never force any objects between the slots as it may deform the notch which can result in incompatibility of the beams to other 80/20 parts.

2.2.2 80/20 Platforms

The platforms are hard plastic and they are much more durable than normal plastic but use caution when handling the platform as they may remain bended or crack if handled improperly. The corners are cut out to fit between the 80/20 beams so make
sure that the corners are not tempered with. If the corners are misshaped then simply cut them till they fit properly once again. The platforms should always be inserted with the rough side up. Be sure to insert the rubber strips in between the top platform and beam notches to increase the stability of the platform.

Avoid any contact with liquids due to the electronic components of this device. If this happens quickly clean up the liquids before any can leak down toward the electronic components.

### 2.2.3 Black caster wheels

Be sure to set the brakes on each wheel before cleaning. It would be beneficial to oil these wheels periodically for maximum performance. Keep away from water to prevent rusting. Use a wrench to loosen the screws before removing the wheels.

Figure: Black caster wheels attached to bottom of frame

### 2.2.4 Harness

Clean whenever necessary and check the buckles periodically to ensure that they are working as intended. Avoid tangling the straps together and never insert objects through the holes to prevent damage.

### 2.2.5 Safety Strap

Check to make sure the safety strap is not fraying or worn. Make sure the strap is kept out of the way when not in use.

### 2.3 Environmental

Joshua’s Jumper is made for indoor use only. This device can only handle the elements if there are flat and even surfaces for the device to move upon and no danger of being exposed to rain or excessive moisture. Decks and driveways are possible locations but grass, gravel, etc. are unfit surfaces and this device will not be able to operate on them. Make sure that Joshua is not strapped into the device when clearing thresholds or other small mound structures.

### 3 Technical Description

This section details each of the parts in the system complete with photographs. The following is a photo of the complete device:
3.1 Control System

3.1.1 Transmitters

The transmitters being used for this design were created by Miratron Inc. Two controllers are being implemented; one for Joshua to use and the other for use by a guardian. Both sets of controls are very simple to use and contain a number of safety features. The T-1 Standard Belly Pack Transmitters were used for both controls. The control for Joshua was designed with a simple ON/OFF switch and a joystick to control the device. The transmitter also contains an LED that lights up blue when the controller is in use. Because Josh’s controls were mounted to the frame, the handles were removed for easier use of the joystick.
Figure 3.2: Joshua’s control courtesy of Miratron Inc.

The parental controls contained the same features, but with the addition of an emergency stop button which would cut all power to the motors. The parental control also has the ability to override any movement of Joshua’s joystick. This ensures that there is parental supervision when the device is in motion. As a final safety feature, the power would be cut to the motor if for some reason either controller was disconnected from their cable or out of range of the receiver. The parental controls are pictured below in Figure 3.3.

Figure 3.3: Parental control with emergency stop.

3.1.2 Receiver

The receiver used was also donated to the group by Miratron Inc. and was compatible with both of the transmitters. The R-4P Field Programmable Receiver was used to properly transmit the signals from the joysticks to the two motors of our differential motor system. Using pulse-width modulation, the signal was split into two and was responsible for the power distribution to each motor. The receiver is programmed to accommodate for gradual ramping of the voltage to each motor, thus
providing a gradual increase in the speed of the motors. The receiver is also connected to the relay, an added safety feature. If the emergency stop button is pushed, or if either of the transmitters are turned off or out of range, the relay will cut all power to the motors. This safety feature ensures that there is parental supervision when the device is in motion. Figures 3.4 and 3.5 below show pictures of the receiver and the relay, respectively.

Figure 3.4: Miratron Inc. R-4P Field Programmable Receiver.

Figure 3.5: Relay.
3.2 Electrical/Motor System

3.2.1 Motors

Two NPC-41250 12V DC motors were purchased from Robot MarketPlace. Each motor operates at 93 RPM with a 34:1 gear ratio and can output a maximum torque of 260 in./lbs., which is far more than the required 26 in./lbs. of torque required to move this device. This motor is ideal for middleweight robots and will produce the necessary horsepower and torque to power the device with minimal current draw. Two motors were purchased to create a differential drive system that could be used to make the device more maneuverable. To align the two motors properly, one was flipped around so that the 1/2 inch shaft diameters were in alignment. Figure 3.6 shows one of the motors. Later sections will describe and show the motor in system with the wheel and mount.

Figure 3.6: NPC-41250 Motor.

3.2.2 Speed Controllers

To power the two motors, two separate IFI VEX Pro Victor 884 speed controllers were purchased. The controller is capable of withstanding a maximum current draw of 40 amps while maintaining a low voltage drop and can be powered by a wide voltage range of 6 to 15 V. Upon movement of the joysticks, the speed controllers input a pulse-width modulation (PWM) signal from the receiver. Once this signal is received, it is converted to a voltage which powers the motors. These particular speed controllers are capable of ramping the speed of the motors by gradually increasing the output voltage, as well as having an adjustable maximum speed at which the motors will be powered. Both of these features are vital to the safe operation of the device. Difficulties were incurred with these devices, as the team was later informed of their inconsistency of function. Once a working speed controller is received, it will function as desired. However, several speed controllers were received that did not function in the system initially, causing return/shipping hassles. Figure 3.7 below shows a wired speed controller attached to the bottom platform.
3.2.3 Battery

To power the motor components for this device a 12V automotive deep cycle battery was used. Due to the deep-cycling, the battery can provide sufficient power to the system for an extended period of time. The battery is rated to last anywhere from four to eight years. It was determined that maximum current can be drawn for approximately five to six hours before the battery would be drained. We have also provided a replacement battery with the device.
3.2.4 Wiring

Wires in the device were connected using butt connector and crimp connectors. As a general rule, white and red are hot wires and black and green are ground. This means the black wires are generally connected to the negative terminal in the system. A picture of the wiring can be found below in Figure 3.9. Additionally, block diagrams of the circuit wiring as well as a circuit diagram provided by Rod Seely of Miratron Inc. are in the Appendix (Section 5).

Figure 3.9: Complete photo of the Wiring of the system.
3.3 Mechanical System

3.3.1 Frame

The frame is constructed from 80/20 erector set 15 Lite series aluminum beams. The vertical height of the frame is at 72 inches which is composed of four 72 inch 1502 Lite Smooth T-Slotted Aluminum Extrusions. The dimensions for the horizontal beams have been reduced to 33 inch Length X 31 inch Width to allow the device to maneuver through the doors in the client’s house. Four 31 inch 1502 Lite Smooth T-Slotted Aluminum Extrusions, two 31 inch 1501 Lite Smooth T-Slotted Aluminum Extrusions, four 28 inch 1503 Lite Smooth T-Slotted Aluminum Extrusions, and two 28 inch 1501 Lite Smooth T-Slotted Aluminum Extrusions are used the make up the horizontal beams of the frame. Anchor fasteners are used as the connections between all the 80/20 15 Lite series beams to one another. The anchor fasteners require pre-drilled holes in the 15 Lite series beams which were already done by 80/20 prior to shipping. The anchor fasteners are tightened using hex wrenches and they provide sufficient stability and strength to the frame so that it may withstand up to hundreds of pounds of weight which is more than enough for what have prepared for this device.

Figure 3.10: Finished 80/20 Frame.
3.3.2 Platforms

The frame houses two platforms which will be referred to as the top and bottom platforms. The platform dimensions are 31 inches long by 28 inches wide by 0.5 inches thick. Notches were pre-cut on the corners by 80/20 Inc. prior to shipping so the platforms would fit into the slots of the horizontal poles of the frame. The bottom platform cannot move along the frame and it has two motor mount plates welded to each of the 31 inch 1501 Lite Smooth T-Slotted Aluminum Extrusions at the back two corners of the frame. The top platform can be adjusted in height along the vertical axis of the frame, which allows the platform to be raised for easier access to the motor components housed between the bottom and top platforms. The platforms will support around 150 pounds of weight which is more than enough strength for this application.

The bottom platform has L joining plates mounted to prevent the battery and other large components from moving around on the platform. The platforms are made of hard plastic, which allows for easy drilling of holes while maintaining structural integrity. Figure 3.11 below shows the platform with its corner notches taken out. The platform in system can be seen in Figure 3.10 above.

Figure 3.11: Top platform by itself.
3.3.3 Motor Mount

The motor mounts are welded parallel to the 31 inch 1501 Lite Smooth T-Slotted Aluminum Extrusions, one at each on the rear corners of the frame. The plates sit on top of the bottom platform so careful welding was necessary. Because the 80/20 15 Lite series are made of aluminum, the plate material must also be aluminum in order for welding. The mount plates’ dimensions are 0.25 inches thick, 10 inches tall, and 12.5 inches and 15 inches in length for the two mount plates. It was necessary for one to be longer than the other due to the orientations of the motors. The shafts of the motors must be concentric and since they are identical yet facing opposite directions, the motor plates had to take this into account for adequate support. The motors are laid down on their sides to allow for better overall clearance underneath the device when paired with the wheels. This is not an ideal configuration for stability; however, the motor mounts provide the necessary immovability and strength to hold up the frame off the ground. The motors have six points of connections via screws so the motor mount plates were pre-drilled with this hole formation before the welding process. The motor mount plates have the corners cut out to fit into the frame and sit on the bottom platform simultaneously. L-brackets were used to secure the motor mount plates to the middle beams holding the upper platform, which provides the motor mount with three points of connection to the frame to ensure maximum strength of stability. Visualizations of these plates after welding and in system are shown in Figures 3.12 and 3.13.
Figure 3.12: Plates after welding to the frame.

Figure 3.13: Motor mount with motor inside and top platform lowered above.

3.3.4 Control Mount

The control mount is a VideoSecu Articulating LCD TV Wall Mount which was modified to be attached to Joshua’s controller. The control mount allows for adjustable reach as well as tilting of the head to match Joshua’s preference. Whenever the device is not being moved electronically, the mount can simply be pushed to the side outside of the frame. This will prevent Josh from coming into contact with the transmitter or mount. The control mount is secured to the front, right side of the frame via two 80/20 5/16-18 screws and nuts. This is because Josh’s mother has noted that when Josh does use his extremities, he has better use of his right hand. The height of the control mount can be adjusted along the vertical 80/20 15 series beams if necessary. This option was determined to be cleaner and simpler than adding a tray table in the front of the device. It would be much more difficult to keep out of reach when Josh is jumping, and would also be hard to move close enough to his body for him to operate it.

Figure 3.14: Control mount attached to the back of Josh’s transmitter.
3.3.5 Wheels

Two 12 inch wheels were left over from a previous senior design year and were perfect for our project. Couplers were manufactured to securely attach the wheels to the motor shaft. These couples were cylindrical in shape with key slits made on the outer and inner surfaces. When keys, or small rectangular prism metal objects, are pushed in these slots between surfaces, they promote the connection and allow for the motor and wheel to turn in unison. The couplers were threaded to allow for a large screw to be placed through the wheel and into the coupler.

Figure 3.15: Control mount screwed into the 80/20 frame and attached to the transmitter.

Figure 3.16: Outer view of wheel with large screw through to coupler.
In addition to the two large wheels, four small swivel wheels were added to the front of the frame. The slots in the bottom of the lower horizontal poles provided the
connection of small caster wheels to the frame. Two wheels were placed on the ends of
the front bar while one wheel was placed on each of the left and right bars. This
configuration allowed for added stability and movement. Each small wheel also contains
a small brake to provide extra security when the device is to be stationary for a
significant amount of time (Figure 3.20).

![Figure 3.20: Small caster wheel with brake.](image)

### 3.4 Support System

#### 3.4.1 Bungee Cords

Keeper 24 in. Carabiner-Style Bungee Cords were purchased at Home Depot. There were advertised as having super duty strength, ideal for large weight applications. Although this does not involve a great amount of weight, the idea is to make sure the bungees could support Josh without wearing quickly or breaking. Four of the 24 in bungees are used in connection with the waist rings on the harness to the four vertical poles. After additional research, better adjustable bungee cords that contain closeable ends were found and purchased from Cabela’s. The Nite Ize® KnotBone™ Adjustable Bungee Cord adjusts from 10 in. to 48 in. These bungees are used on the horizontal top, back pole and connected to the top, back ring on the harness. The carabiners attached on either side of the bungees allow for quick connections from the frame to Josh’s harness, making it easy for his guardians to place him in the device. Images of the purchased bungees are in Figures 3.21 and 3.22. Additionally, an image with the bungees connected in the system is in Figure 3.23.
Figure 3.21: Nite Ize® KnotBone™ Adjustable Bungee Cord

Figure 3.22: Keeper 24 in Carabiner-Style Bungee Cord.
3.4.2 Bungee-Frame Connection

In order to attach the bungee cords from the harness to the frame, a connection was needed on the 80/20 poles. The black nut was inserted into the 80/20 slot, and then the eye-bolt was screwed into the nut. These eye-hooks provide easy connections of the carabiners on the bungees to the frame. Figures below display the eye-hook and nut, in addition to the eye hook inserted into the 80/20 beams.
3.4.3 Harness

The SafeWaze SMALL HARNESS W/ADJ BACKPAD BACK & WAIST D-RINGS from Global Stores Group Industrial & Safety Division was chosen as the harness for this device. Children’s harnesses were not sufficient because they did not have enough support and padding. In order to make the harness fit Josh, extra holes were put into the leg straps and waist belt. This was accomplished using a grommet kit purchased from Mansfield Supply. Four extra belt holes were put in each of the leg straps and two additional holes were put in the waist belt. The SafeWaze harness contains shoulder strap padding as well as a strong back support to help hold Joshua in an upright position while maintaining comfort. Josh must be able to stay in this harness for long periods of time if he so desires. As described in the bungee connection section, two bungees will connect to each waist ring on the harness, which will be hooked to the frame. Additionally, the two longer bungees will be fastened from the back D-ring to the top of the frame. The actual harness used in system is shown in Figure 3.26.
3.4.4 Safety Strap

A safety strap was made using a leash purchased from Mansfield Supply. A small black clip that is used to adjust backpack straps was added onto this to provide for a change in length that can be done manually but will not come undone while Josh is in the system. The strap is looped through a U-bolt which is screwed through the bottom platform. A small slit was drilled through the top platform for the strap to go through. This was made as small as possible to prevent Josh from having anything on the surface that could hurt his feet while jumping. The safety strap is to be employed when Josh is moving the device around using the motorization. This prevents him from being able to move too far in any direction while moving around the house. The strap is shown attached to the bottom of the harness in the Figure 3.27 below.
4 Troubleshooting

- Problem: The anchor fasteners are loosened but the 80/20 beam cannot be removed.
  
  Possible Causes:
  1. The anchor fastener bolts are loosened too much.
  2. The 80/20 beam is slanted or twisted to a side.

  Possible Solutions:
  1. Tighten the anchor fasteners slightly and try again.
  2. Slide the anchor fasteners out from the beam sockets.

- Problem: The power switch is turned ON but the device is not moving.
  
  Possible Causes:
  1. The battery is dead.
  2. The parental control is not connected.
  3. The brakes are still set on the front caster wheels.

  Possible Solutions:
  1. Check to see if the battery is out of power and replace when needed.
  2. Connect the parental control.
  3. Set the brakes on front caster wheels to OFF.
• Problem: The harness is not supporting Joshua in the correct position.
Possible Causes:
1. The eyebolts are not in their correct locations or the bungees are connected to the wrong locations to the harness.
2. The length the back pair of bungees is not at the correct length.
3. The anchoring strap is not attached.

Possible Solutions:
1. Readjust the eyebolts or bungees’ positions.
2. Readjust the bungees to the correct lengths.
3. Attach the anchoring strap.

• Problem: Rattling sounds are heard when the device is in motion or as Joshua is jumping.
Possible Causes:
1. The anchor fasteners are not as tight as they should be.
2. The platforms are not slid into the correct place into the slots of the 80/20 frames.
3. The motor components housed on the bottom platform are not properly secured.
4. The carabineers are hitting the eyebolts as Joshua moves around.

Possible Solutions:
1. Securely tighten all anchor fasteners and eyebolts.
2. Tighten anchoring strap to reduce Joshua’s movements.
3. Double check the motor components and secure them as needed.
4. Readjust the platforms and slide in the rubber strips to reduce movement of the platforms.

• Problem: The device abruptly shuts down.
Possible Causes:
1. The parental control is disconnected.
2. The kill switch was accidentally hit.
3. The battery died or was disconnected.

Possible Solutions:
1. Reconnect the parental control or battery.
2. Replace the battery.
3. Restart the device.

• Problem: Steering is erratic.
Possible Causes:
1. The brakes are still set ON for some of the caster wheels.
2. The joystick is being press too hard.
3. Poor connection of the controls to the motor system.

Possible Solutions:
1. Make sure that the brakes are all set to OFF before turning on the device.
2. The sensitivity of the joystick can be very high so light movements are recommended.
3. Make sure the motor components are all properly secured.

- Problem: Everything is all set to go but the rear wheels are not moving.

Possible Causes:
1. The brakes are still ON for the caster wheels.
2. The rear wheels are not properly connected to the motor spindles.
3. The motors are not properly connected to the rest of the motor system.

Possible Solutions:
1. Make sure that the brakes are all set to ON.
2. Ensure all of the keys and coupler components are properly connected.
3. Make sure the large screw holding the wheel in is tightened.

- Problem: Speed controller

See Troubleshooting guidelines attached in Appendix
5 Appendix

Overall Wiring Diagram

Parental Transmitter → R4-Programmable Receiver → Joshua's Transmitter

- Left PWM Signal (White Wire to PWM Signal Driver)
- Out Enable (Red Wire)
- PWM Signal (Orange Wire to PWM Signal Driver)

Relay → 12V Automotive Battery

- 12V Power (White Wires)

Left Motor → Left Speed Controller → Right Speed Controller → Right Motor

Note: Polarity of Motor Wires is Reversed

Detailed Relay Wiring

- Black Wire to Negative Terminal
- 12V Automotive Battery
- Ground
- Red Wire to Positive Terminal
- Diode (FAK06)
- Out Enable (Red Wire)

12V Power (White Wires)
Troubleshooting

**Indication:** No ORANGE indicator on power up.
**Problem:** Input power issue or joystick trim tab off-center.
**Possible Solutions:**
1. Disconnect PWM cable.
2. If indicator blinks ORANGE, the PWM value that was being received is either between 'neutral' and 'full forward', or between 'neutral' and 'full reverse'. Check joystick trim tab to ensure the controller is not in a partial forward or a partial reverse condition. If no change, check that the joystick and receiver channels match.
3. If indicator remains off, check +V or GND connections for voltage and proper polarity.

**Indication:** Flashing ORANGE indicator on power up.
**Problem:** No PWM signal.
**Possible Solutions:**
1. Ensure the transmitter and receiver are powered ON.
2. The PWM cable may be improperly connected. Check wire color-coding at each end. Check that the connector is not off a pin at the receiver end.
3. Check for a good PWM signal by connecting a known good servo to the PWM extension cable. If the servo does not move, this can indicate either:
   a) a faulty receiver
   b) an improperly connected cable
   c) a bad PWM extension cable
**Note:** The servo requires that 5V be present on the center pin of the PWM cable. This connection is not required for the Victor.

**Indication:** Flashing RED indicator after calibration.
**Problem:** Calibration Failed.
**Possible Solutions:**
1. Inadequate travel in forward or reverse. Repeat the calibration procedure and move the joystick further forward and/or further reverse.
2. The joystick trim tab is NOT centered. Neutral cannot be extremely far from center.

**Indication:** No power output from the speed controller although the indicator LED works.
**Problem:** Possible internal damage.
**Possible Solutions:**
If the indicator on the Victor is operating properly and there is no output, the Victor may be internally damaged. This condition is typically caused by a short circuit on the output or there has been an over-current condition to cause a failure.
Check the following:
1. Ensure the indicator is changing between ORANGE, RED and GREEN with joystick movement.
2. Disconnect the motor and check the output (M+ to M-) with a voltmeter. The meter should read between + Battery voltage with corresponding full range joystick movement.
If the indicator is working properly and the outputs are not working properly, the speed controller is probably damaged. The final test to determine if the Victor is damaged is to replace it with another Victor.

**Indication:** No power output from the speed controller and the indicator does NOT work.
**Problem:** No input power or possible internal damage.
**Possible Solutions:**
If the indicator on the Victor is not operating properly and there is no output, the Victor may be internally damaged. This condition is typically caused by no input power or a reverse polarity on the input.
Check the following:
1. Disconnect the output wires.
2. Ensure the indicator on the Victor will not illuminate at any joystick position.
3. Check the input at the Victor (+ BATTERY to GND) with a voltmeter.
If the indicator is not working properly and the input is good, the speed controller is probably damaged. The final test to determine if the Victor is damaged is to replace it with another Victor.

**CAUTION:** Prior to replacing a potentially damaged speed controller, ensure that the wires connected to the output are not shorted and the input is not reversed. Also verify that neither of the motor output leads are shorted to the chassis of the motor and/or the robot.