



FAMU-FSU  
College of Engineering

# Operations Manual

The Robotic Trash Cart (RTC)

Artists in Waste Removal

## Contents

<b>Overview</b> .....	3
Component/Module Description.....	3
<b>General Warnings / Before You Use Your RTC</b> .....	5
Integration: .....	5
Operation.....	5
<b>Caring for Your Batteries</b> .....	7
<b>Battery Replacement</b> .....	8
<b>Charging Precautions</b> .....	9
<b>Charging Your Batteries</b> .....	9
<b>Manual Brake Release Levers</b> .....	10
<b>Owner Maintenance/Troubleshooting</b> .....	10
<b>Caster Wheel Replacement</b> .....	10

## Overview

The Robotic Trash Cart (RTC) is a device that carries two waste containers and transports them from the home base to the curb for waste removal. This process is non strenuous for the user because the user controls the RTC using a wireless controller. The RTC is designed to be easy to control and safe to use. The RTC is a patent-pending product developed by Artists in Waste Removal (AWR).

## Component/Module Description

The frame of the Robotic Trash Cart (RTC) is made from aluminum due to its lightweight, high strength, and anti-corrosive properties. It is powered by a 24 V battery source supplying two center mounted motors. Each motor is controlled separately enabling zero point turning. There are caster wheels on the front and back of the RTC. It is equipped with a gate which lowers to allow easy access to the containers. To operate the RTC, a wireless controller is used to steer by varying the speed of each motor. Figure 1 below shows the dimension of the RTC in inches. The RTC is 5.617 feet in length, 2.279 feet in height, and 2.292 feet wide. The caster wheels are seen on either end of the RTC with a motorized wheel in the middle of the RTC. The gates are seen on either side of the middle wheel allowing easy access to the waste bins.

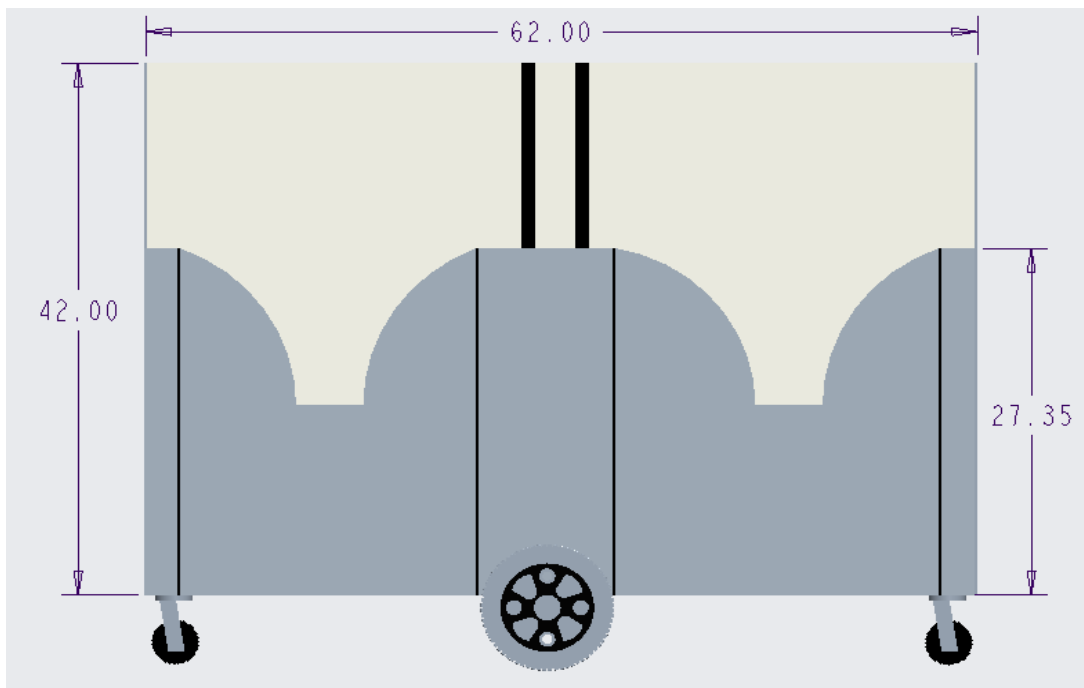


Figure 1: *Front View of the RTC*

The width of the RTC is shown below in Figure 2. The caster wheels can be seen at the bottom of the frame in the center of the RTC.

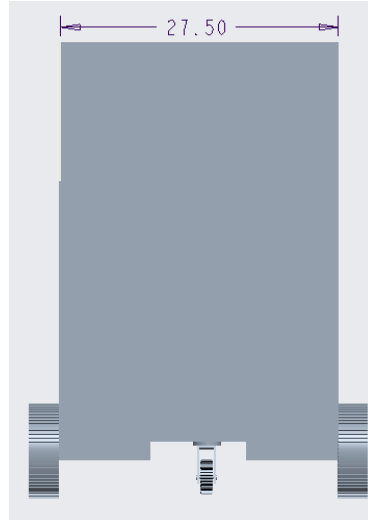


Figure 2: *Side View of the RTC*

Figure 3 shows the top view of the RTC. This view shows the fiberglass grating used for the base. The grating is used to prevent pooling water. The RTC is assumed to be stored outside in South Florida, where rain and humidity are prevalent. Fiberglass is used due to its durability and lightweight properties.

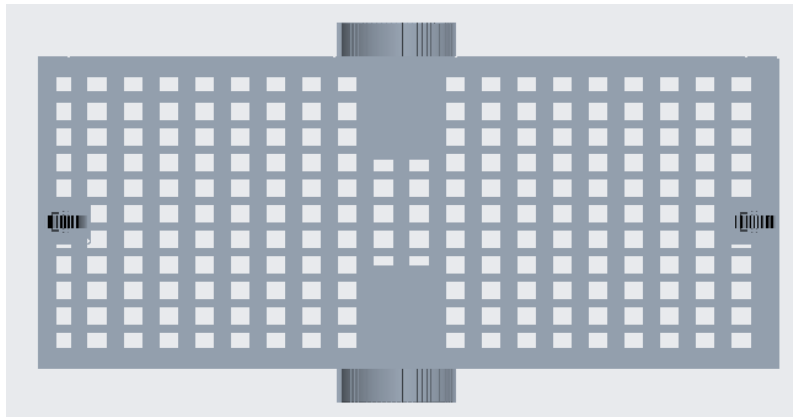


Figure 3: *Top View of the RTC*

Figure 4 below shows a 3D view of the RTC from the front of the cart. The operation controls are stored in junction box J1. It stores the toggle switch that provides power to the control system, the battery fuel gauge display, and the circuit breaker. Junction box J2 stores the control system including the motor controller (Cytron SmartDriveDuo) and the ESP32. Junction box J3 stores the wireless charger and has the motor and battery connections.

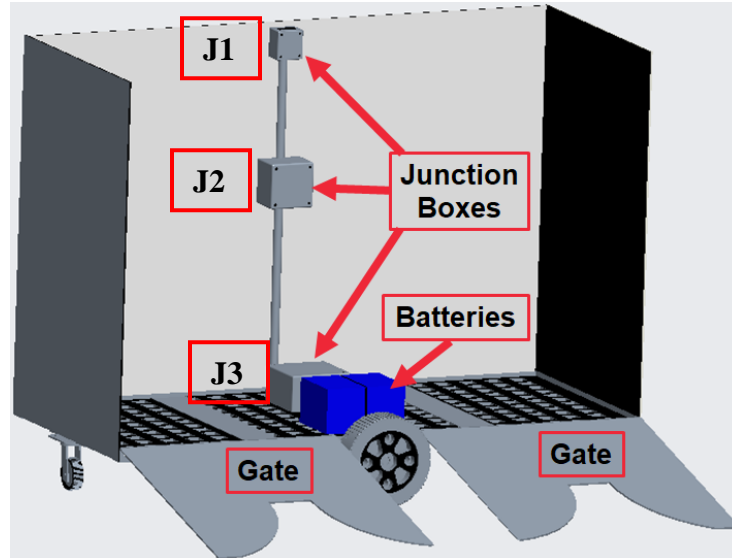


Figure 4: 3D Front View of the RTC with the Gates Lowered

## General Warnings / Before You Use Your RTC

The RTC is a battery-operated motor vehicle. The operation of the RTC requires you to exercise caution and consideration for your personal safety and the safety of others around you. Never modify your RTC, and do not use accessories other than those developed for use specifically with your RTC.

### Integration:

The RTC has a box design with an open front face to allow access for the trash cans to roll up. The frame of the RTC was constructed from Aluminum 6061 angle bar, square tubing, and flat bar. Aluminum 6061 is highly corrosion resistant, as well as a high strength to weight ratio. The base of the RTC is made from angle bar formed into a rectangular shape to hold the flooring on it. The four-square tube sides are welded on the four corners vertically with a flat bar running along the top to make three closed sides and secure the trash cans. The floor of the RTC was made of heavy duty fiberglass grating to allow water to pass through without collecting.

There are wires running along the backside of the RTC from the batteries up to the control system. The control system is made up of two development boards, a toggle switch to turn the control system ON/OFF.

### Operation

A toggle switch turns on the control system. It closes the circuit between the development boards and the batteries. Figure 5 depicts the toggle switch.



Figure 5: *Toggle Switch*

Figure 6 depicts the battery fuel gauge. It turns OFF/ON as you press the toggle the left push button on it. Pressing it once turns it on and displays the amount of charge the batteries have. Pressing it again displays the voltage output by the batteries. Pressing it a third time turns the battery fuel gauge off.



Figure 6: *Battery Fuel Gauge*

Figure 7 depicts the BLE JoyStick application interface. You connect to the ESP32 using BLE. The left joystick is disabled. The right joystick controls the speed and direction of the RTC. The front of the RTC is the side with the gate attached to it. If you are facing the front of the RTC and turn to the left, this direction is assumed to be the forward direction. If you face the RTC and turn to the right, this direction is assumed to be the reverse direction. The operation of the RTC using the BLE JoyStick App is described below.

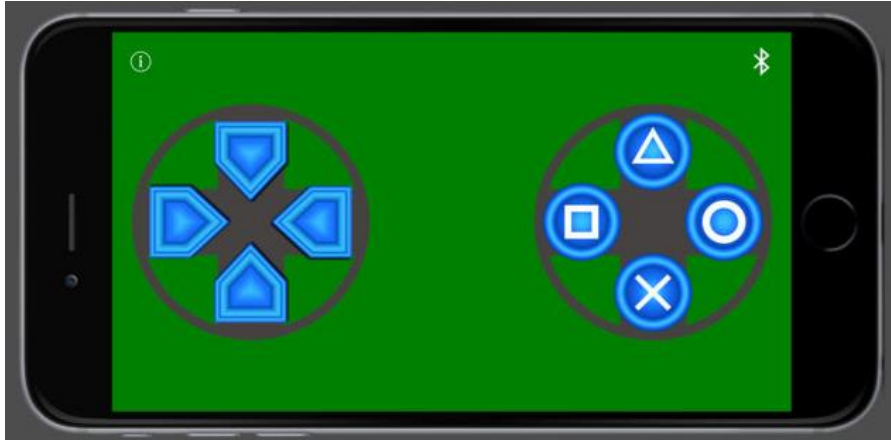


Figure 7: BLE JoyStick Application Interface

The basic operation is described below. It is assumed that the RTC is off.

- Turning the RTC on: Press the toggle switch to turn the control system on
- Connecting to the BLE JoyStick App: Open the app and connect to RTC Service device
- Pressing the triangle button: Moves the RTC forward direction
- Pressing the X button: Moves the RTC in the reverse direction
- Pressing the circle button: Moves the RTC to the right
- Pressing the square button: Moves the RTC to the left

## Caring for Your Batteries

The RTC uses two Sealed Lead Acid (SLA) 12-Volt batteries of the UI size. The battery pair is connected in a series configuration to provide 24-Volts of power. The batteries supplied by AWR are of the sealed-type that require no maintenance. These batteries are classified as “wet-non-spill” and may be transported by air, land or sea. They are deep cycle rechargeable batteries. Figure 8 below depicts the warning label from AWR.

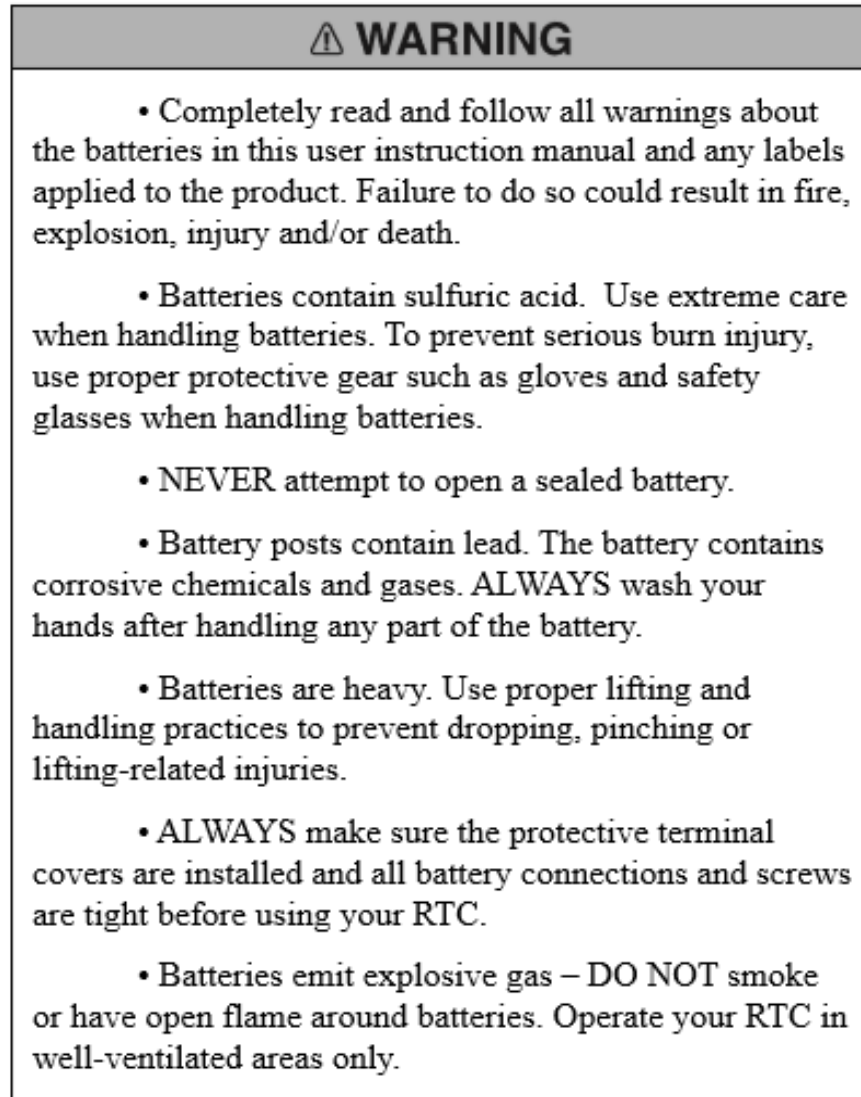


Figure 8: *Battery Warning Label from AWR*

## Battery Replacement

ALWAYS refer to the supplied wiring diagram located on the base of your RTC when installing the batteries.

- ALWAYS install and use the correct fuse as specified on the battery label. This will prevent battery and wire overload.
- ALWAYS dispose of batteries in accordance with EPA regulations.
- Do not leave the battery charger connected to a power source when not charging.
- Do not let your batteries run down.

When it becomes necessary to replace batteries, consult with AWR Technical Support. We will provide you with the replacement battery to ensure the proper operation.



## Charging Precautions

Your RTC is equipped with an on-board charger. Please follow the operating instructions for the appropriate charger. The charging time for the batteries will vary based on the amount of use the RTC has had. It may take up to 8 hours for a full recharge. The battery fuel gauge depicts the amount of charge your batteries currently have. We recommend an overnight charge after 8 days of use or if the gauge reads below 25%. Figure 9 depicts the battery charger warning label from AWR summarizing the precautions you must take.

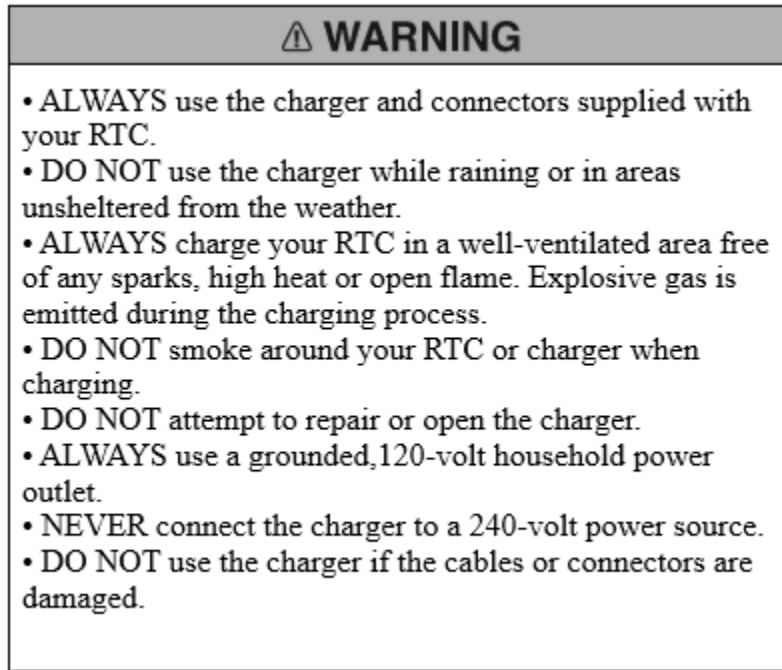


Figure 9: *Battery Charging Warning Label from AWR*

Cables and connectors can be damaged by:

- Stepping and rolling objects over the cable or connectors.
- Yanking the cable out of the wall outlet.
- Pinching the cable.
- Handling sharp objects such as knives and/or scissors in close proximity to the cable or connectors.
- **DO NOT** attempt to charge a frozen battery.

## Charging Your Batteries

1. Select a clean, dry, cool, well ventilated area to use the charger.
2. Make sure the RTC is in the OFF position.
3. Connect the charger output port into the AC extension power cord connected to a 120-volt grounded household power outlet. The charger port is located in the rear port of the RTC. Align the three pins on the plug with the three holes on the port and push the plug in

place. Make sure the plug is fully seated in the charger port. If it is not pushed all the way, the batteries will not charge or the plug may become hot.

4. Plug the AC power cord into the back of the charger.
5. Plug the other end of the AC power cord into a 120-volt grounded household power outlet.
6. When the batteries are charged, and/or you are ready to use the RTC:
  - Unplug the charger from the household power outlet.
  - Unplug the AC extension power cord from the charger port.

## Manual Brake Release Levers

On occasion, it may be necessary to push your RTC. Each motor has a manual brake release lever. To locate the manual brake release levers on your RTC, check the rear of each motor. The levers move downward to release the brake on the motor. When both manual brake release levers are released, and the power is turned OFF, the RTC can be pushed. Pull both manual brake release levers upward to re-engage the brakes.

## Owner Maintenance/Troubleshooting

### Daily Maintenance:

- Check drive tires for tread wear and tire pressure.
- Charge batteries as needed per guidelines below.
- Check that the gate latches do not show signs of wear.

### Weekly Maintenance:

- Check tire treads and pressure. (Should be 45-50 psi.).
- Check that casters are free to pivot.
- Check that caster wheels rotate freely.
- Check manual brake releases. Release each brake separately to ensure they disengage.
- Check charger cords and connectors for loose connections, damaged cables or signs of electrical damage.
- Clean the RTC.

If problems arise with your RTC, please call customer service for technical assistance.

\*Note\* Motor operational noise is normal. Audible noise levels will normally increase as the RTC ages.

## Caster Wheel Replacement

1. Remove both sides of the base fiberglass grating from the RTC.
2. Locate and remove 2 sets of 2  $\frac{3}{8}$ " X 1  $\frac{1}{2}$ " hex bolts and washers on each side of the RTC.
3. Remove each set of 4  $\frac{3}{8}$ " X 1" hex bolt and washer from the caster wheel plate attached in between RTC frame and caster wheel.

4. Replace caster wheels and reinstall the caster wheel plate in between the RTC frame and caster wheel with the 4  $\frac{3}{8}$ " X 1" hex bolt and washer.
5. Reinstall the 2 sets of 2  $\frac{3}{8}$ " X 1  $\frac{1}{2}$ " hex bolts and washers on each side of the RTC.