CLEARPATH ROBOTICS™

RESEARCH AUTONOMY KIT

All-in-one Autonomous Navigation

USER MANUAL

VERSION 1.2

CONTENTS

SETUP

Before You Start

What's in the Box

- ARK Computer System
- Power Cable
- Ethernet Cable

Your System

Computer

- Running Ubuntu or some other form of Linux
- Can be networked using ethernet
- Has ROS Indigo installed
- Can drive a robot or simulation of a robot

Network

The ARK should be connected to the robot or simulation:

- Using an ethernet cable (not wireless)
- Either directly or through a single ethernet switch
- Using a network that does not block multicast traffic
- Using no more than 5 hops - https://en.wikipedia.org/wiki/Hop_(networking)

Robot/Simulation

- Either a Ridgeback, Jackal, or Husky robot
- Simulation in Gazebo or a real robot

User Install

If you have received this ARK as an integrated payload on a Clearpath robot, this entire section can be ignored. The ARK and robot have already been set up and tested by our team.

Install LCM

LCM is the middleware that communicates with the ARK.

```
cd ~
sudo apt-get install -y unzip libglib2.0-dev build-essential
wget https://github.com/lcm-proj/lcm/releases/download/v1.3.1/lcm-1.3.1.zip
unzip lcm-1.3.1.zip
cd lcm-1.3.1
./configure
make
sudo make install
cd ~
```

Setup Your Workspace

If your robot has a workspace already, you can use it and skip ahead. If not, follow the next step to create a workspace for ARK.

```
mkdir ~/ark_ws
cd ~/ark_ws
mkdir src
cd src
catkin_init_workspace
```

Clone the necessary repositories

```
git clone https://github.com/autonomyresearchkit/ark_bridge.git
# Clone the correct interface version depending on the type of robot you have
git clone https://github.com/autonomyresearchkit/jackal_cpr_ark_navigation.git
git clone https://github.com/autonomyresearchkit/ridgeback_cpr_ark_navigation.git
git clone https://github.com/autonomyresearchkit/husky_cpr_ark_navigation.git
```

Create the ARK bridge nodes

```
cd ~/ark_ws/src/ark_bridge
./build_client.sh

cd ~/ark_ws
catkin_make
```

Setup Networking

You need to find out exactly what interface your ARK is attached to. This can be done by running ifconfig, then plugging in your ARK and running ifconfig again to see which interface is now showing as connected. Once you know what interface you will be using, edit /etc/network/interfaces. That interface needs to be removed from any bridge that might be setup, and it must be given a static IP of 192.168.132.1. You also need to route all multicast traffic through this port. Below is an example

The intefaces file below is just an example and should be modified to match your robot's actual setup

```
iface eth0 inet static # INTERFACE STATIC DECLARATION #
  address 192.168.132.1 # STATIC IP #
  netmask 255.255.255.0 # NETMASK #
  up route add -net 224.0.0.0 netmask 240.0.0.0 dev eth0 # MULTICAST SETUP #
  bridge_maxwait 0
```

Expand Network Buffers

Network buffers need to be expanded to handle the larger message types.

```
sudo su
echo net.core.rmem_max=2097152 >> /etc/sysctl.conf
echo net.core.rmem_default=2097152 >> /etc/sysctl.conf
exit
```

After completing everything above, restart your robot before continuing

Connect the ARK

Network

Connect the ARK using a CAT5 or CAT6 Ethernet cable to an ethernet switch, or directly to your robot. Make sure to use the correct ethernet port.

Infrastructure

The ARK should be connected to the robot or simulation:

Figure 1: ARK Network Connection

- Using ethernet cables (not wireless)
- Either directly or through a single ethernet switch
- Using a network that does not block multicast traffic
- Using no more than 5 hops - https://en.wikipedia.org/wiki/Hop_(networking)

Power

Connect the power adapter to 110V - 240V AC power, and the other end to the power port on the ARK

Figure 2: ARK Power Connection

Note: If the power is connected, the ARK will automatically turn on

Establishing Connection

Ensure the ARK is powered on From your robot, ping 192.168.132.111

Connect the ark_bridge to the ARK (and leave running)

In a terminal on the robot, run:

```
# Run the correct version for your platform
roslaunch ridgeback_cpr_ark_navigation ridgeback_ark_navigation.launch
roslaunch husky_cpr_ark_navigation husky_ark_navigation.launch
roslaunch jackal_cpr_ark_navigation jackal_ark_navigation.launch
```

In a new terminal, you can run:

```
rostopic echo /ark_bridge/clock_echo
```

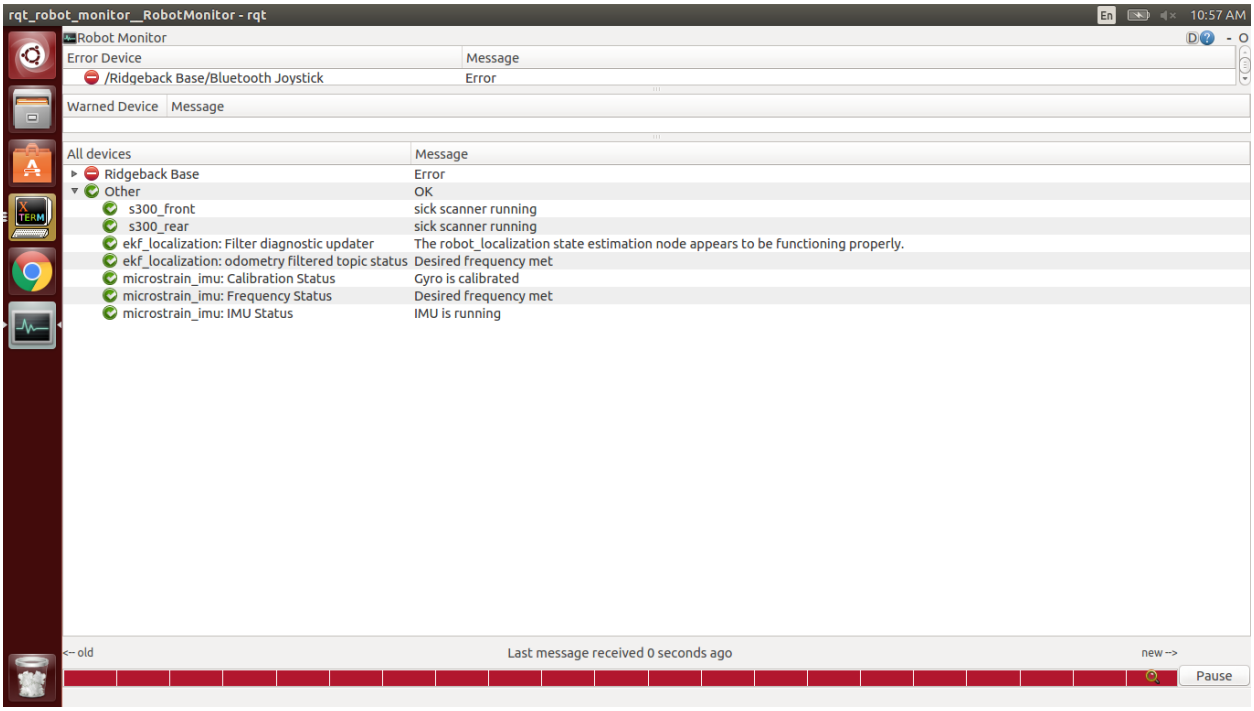
You should see a timestamp message approximately every second. If you do, the bridge and ARK are running properly. If you don't, contact Clearpath Support.

Diagnostics

Diagnostics will be published out of the ark_bridge on the ”ark_diagnostics” topic. This topic can be subscribes to and watched, or it can be relayed to the local /diagnostics topic and viewed using a monitor such as rqt_robot_monitor

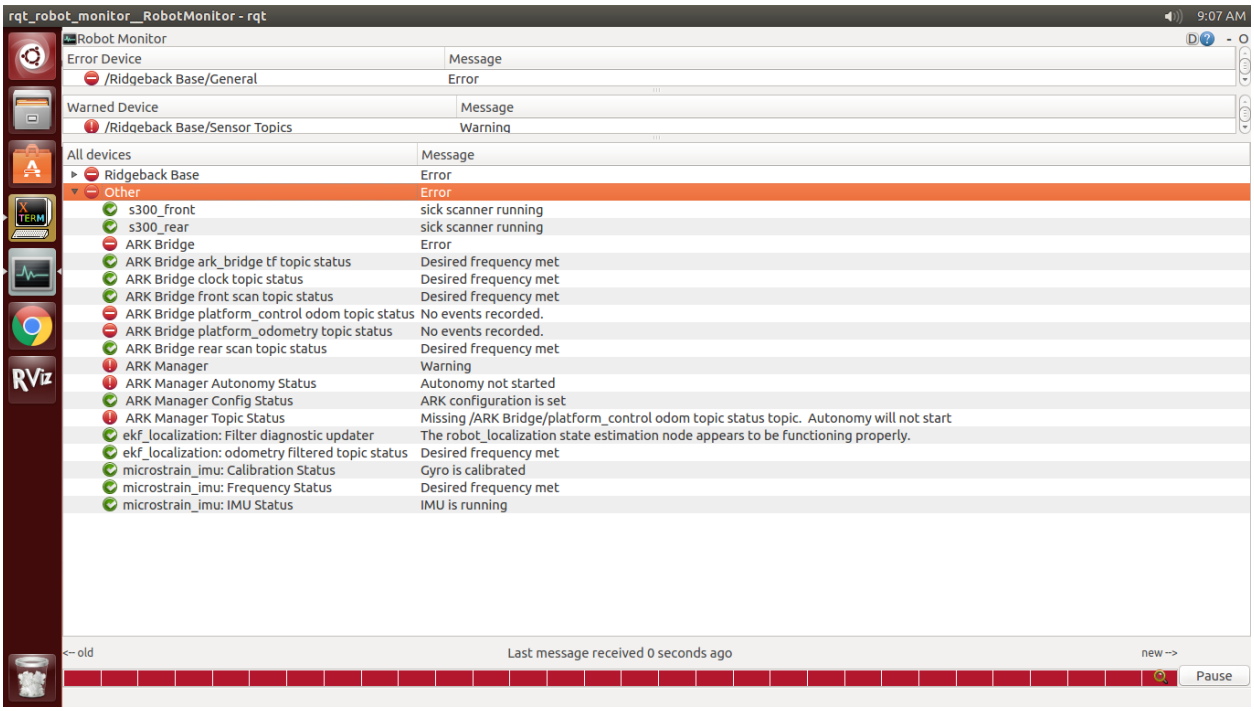
```
rosrun rqt_robot_monitor rqt_robot_monitor
```

Without the ark_bridge running, you will see something similar to below:



These are standard robot and sensor diagnostics only, no messages from the ARK

Once you start the ark_bridge, you should see diagnostics about the required messages and their frequency. The frequency limits are just recommendations. All monitored topics must be provided to the Ark for it to work properly. If required topics are missing, the ARK will not start.



ARK Bridge

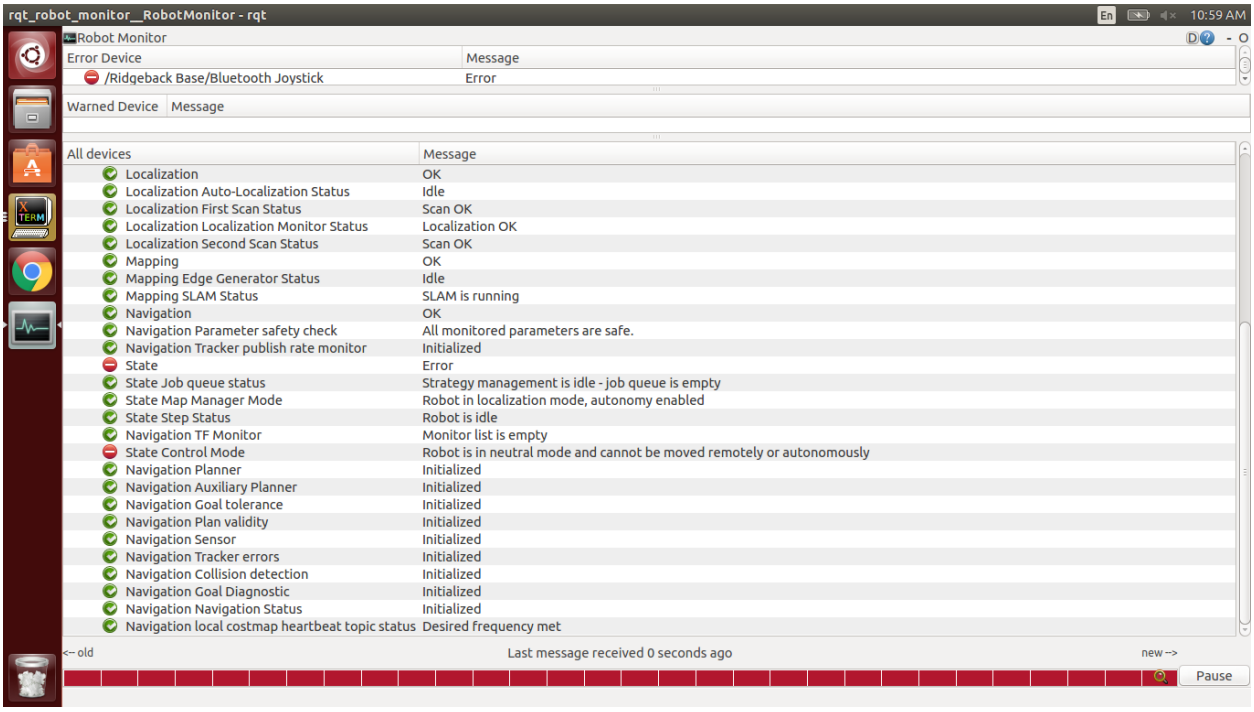
Diagnostic	Info
tf topic status	Status of /ark_bridge/tf
clock status	Status of /ark_bridge/clock
front scan topic status	Status of /ark_bridge/front_scan
rear topic status	Status of /ark_bridge/rear_scan
platform_control odom topic status	Status of /ark_bridge/platform_control_odom
platform_odometry topic status	Status of /ark_bridge/platform_odometry

ARK Manager

Diagnostic	Info
Autonomy status	Whether Autonomy has been started on the ARK or if just the bridge is setup
Config status	Whether the ARK has been configured for your robot. If not, see ”Setup ARK for Your Robot” below
Topic status	Checks if all of the required topics are being published to the ARK properly

After the ark_bridge is connected properly, the Ark can be started (See ”Starting and Stopping the ARK”). Once started,

a new block of diagnostics topics will be published. These cover topics like Navigation, Mapping, Planning, and the general State of the Ark.



Setup ARK For Your Robot

1. Make sure the ARK_Bridge is running and connected (see Ark - Establishing Connection)
2. Configure the ARK to match your robot setup (choose a pre-made configuration yaml depending on your machine)

All of the platform-specific ARK packages have a pre-made configuration file under the config folder. You can use these or create one of your own

- husky_cpr_ark_navigation
- jackal_cpr_ark_navigation
- ridgeback_cpr_ark_navigation

Navigate to the config folder inside your platform-specific package and run the configure_ark node and pass your yaml as an argument

```
rosrun ark_bridge configure_ark.py ridgeback_ark_configuration.yaml
```

If this works, you should see ”Success” as the response

To see the settings that can be configured for your ARK, please see the ”Configuring ARK” section of this manual

QUICKSTART

Starting and Stopping the ARK

Once the ARK is connected (Establishing Connection) and configured (Configuring ARK), the Autonomy Research Kit can be started. Autonomy does not run on boot. Start the autonomy core by calling the start_autonomy service from a Terminal, telling the ARK to start

```
rosservice call /ark_bridge/start_autonomy "req_data: {}"
```

Verify that the ARK started by checking Diagnostics and opening a web browser and visiting port 5000 of at the ARK's IP Address (default: 192.168.132.111:5000)

```
google-chrome http://192.168.132.111:5000
```

More information about how to use ARK Mapper is available in Quickstart

If you are moving the ARK to another robot or simulation, the ARK must be stopped and restarted. To stop the ARK, publish a message from the Terminal, telling the ARK to stop.

```
rosservice call /ark_bridge/stop_autonomy "req_data: {}"
```

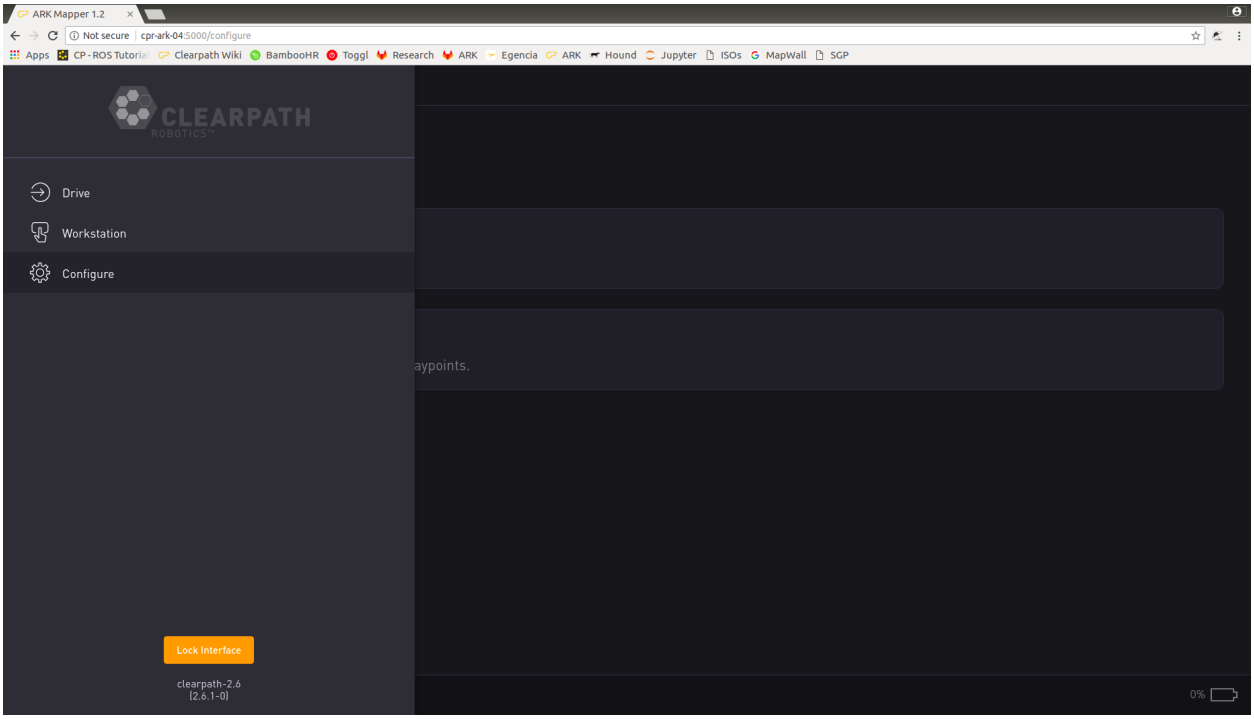
It may take a minute for everything to stop and restart on the ARK

ARK MAPPER

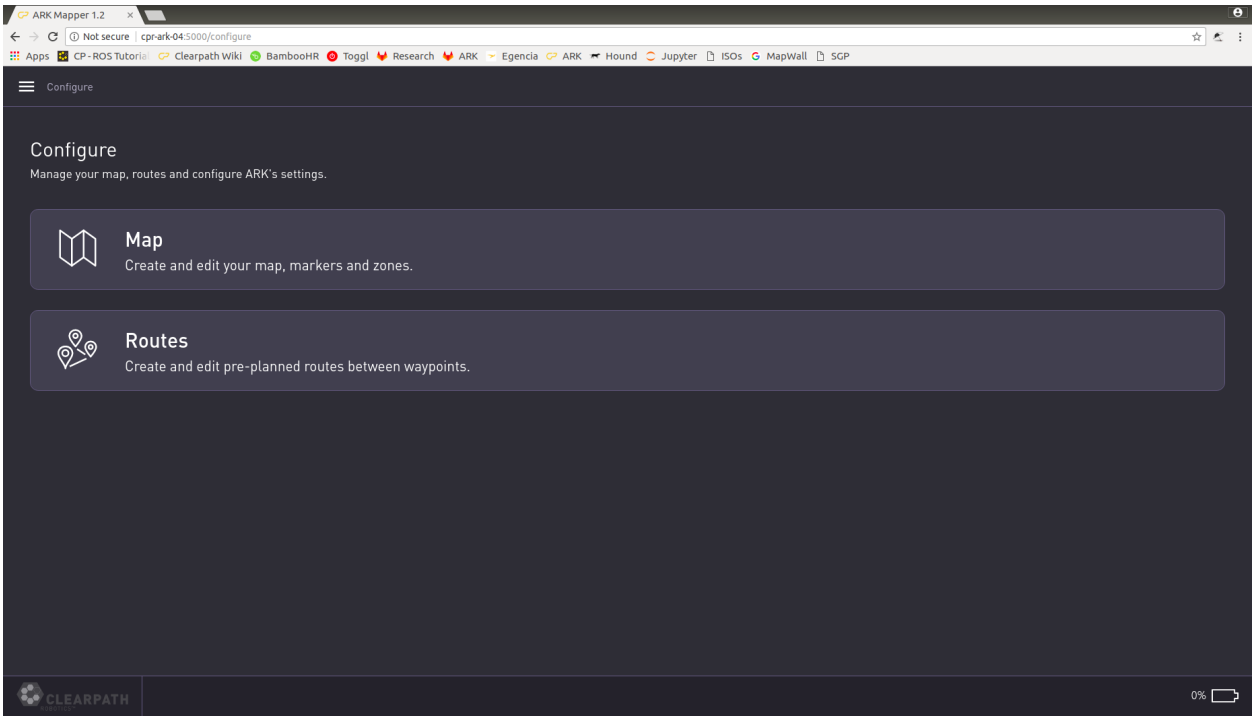
Mapping

To use ARK Mapper, you must use the Google Chrome browser

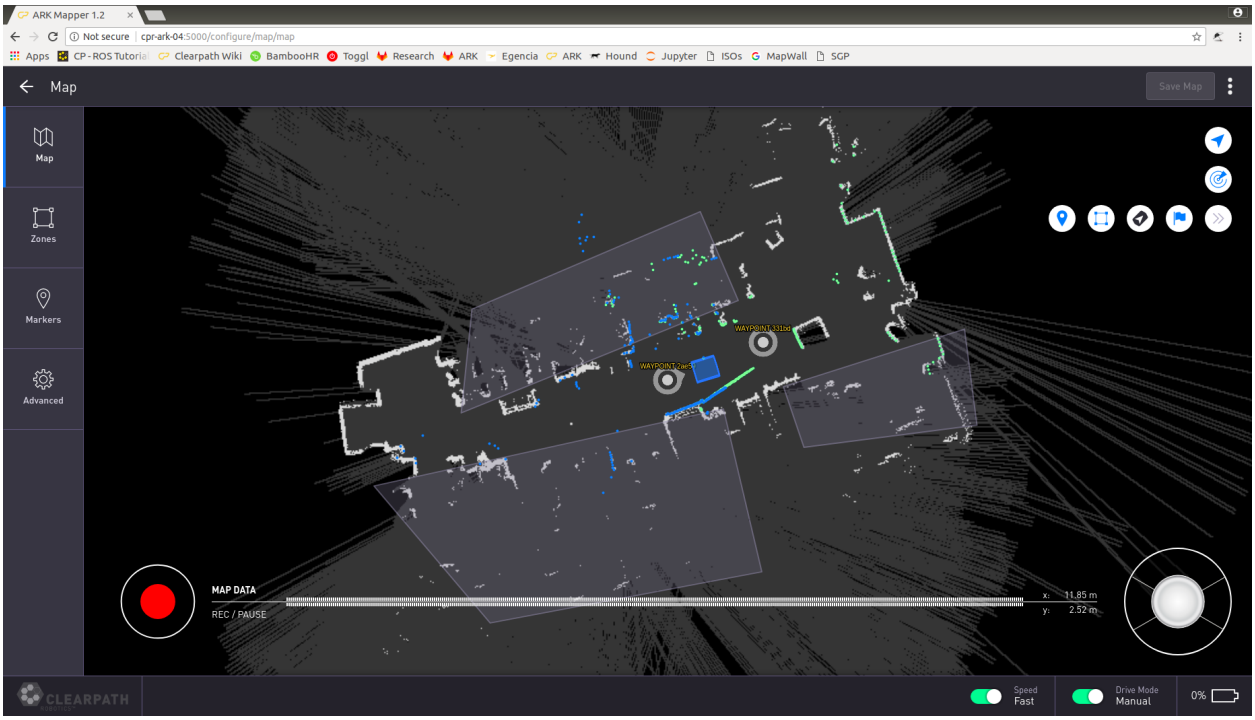
Before ARK can navigate, you must first make a map. This can be done through the Configure option in the main menu (top-left)



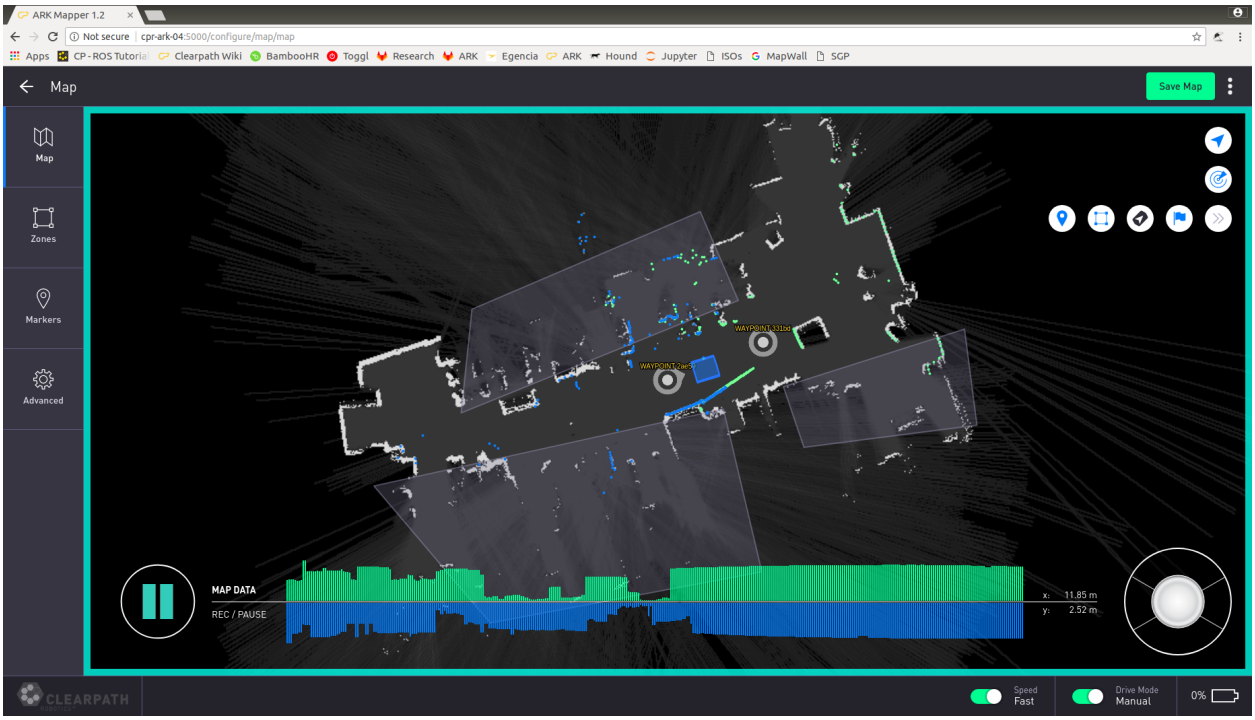
In this menu, select Map to create a new map or edit the current map



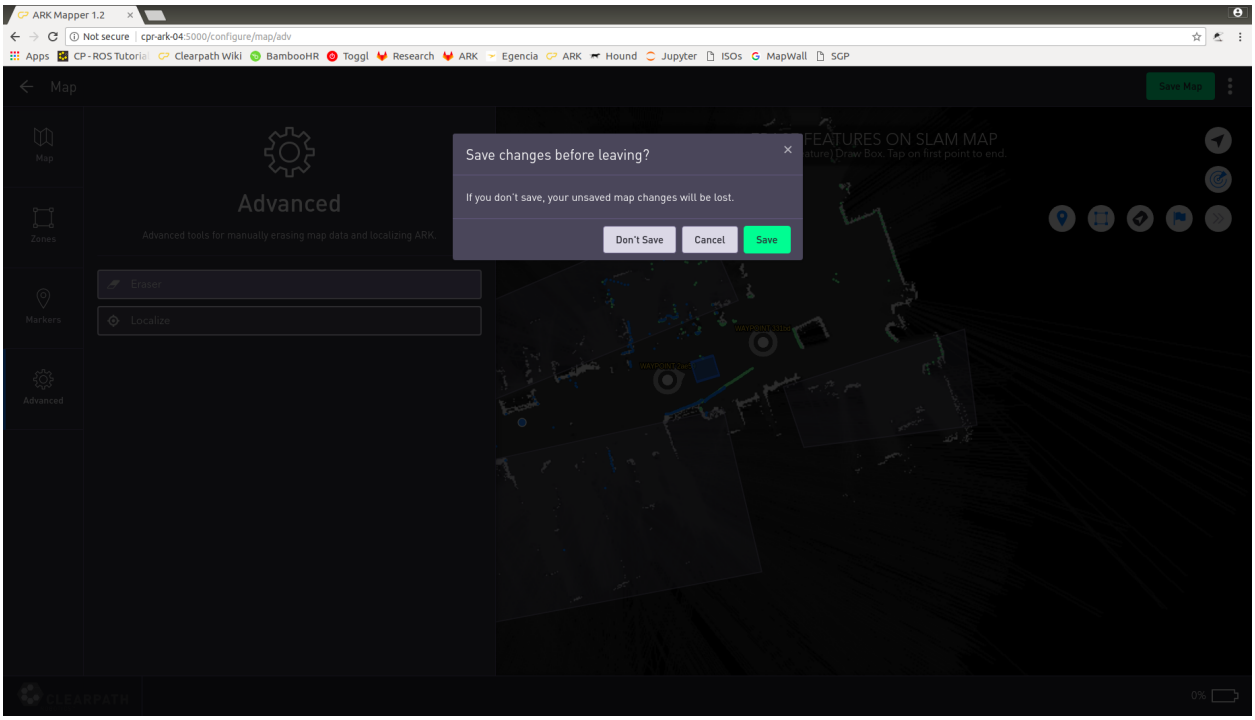
When configuring the map, you can see the current map. Pressing the record button will turn mapping on again and modify the current map.



To start a new map, click the 3 dots in the top-right and click Create New Map. This will reset the current map, start a new blank map, and start recording.



Once you are done mapping, you can click the Pause button to stop adding to the map. When you press tje Back button in the top-left of the window, it will likely ask you to save your map. You can also force the map to save immediately by clicking the Save Map button in the top-right of the screen.

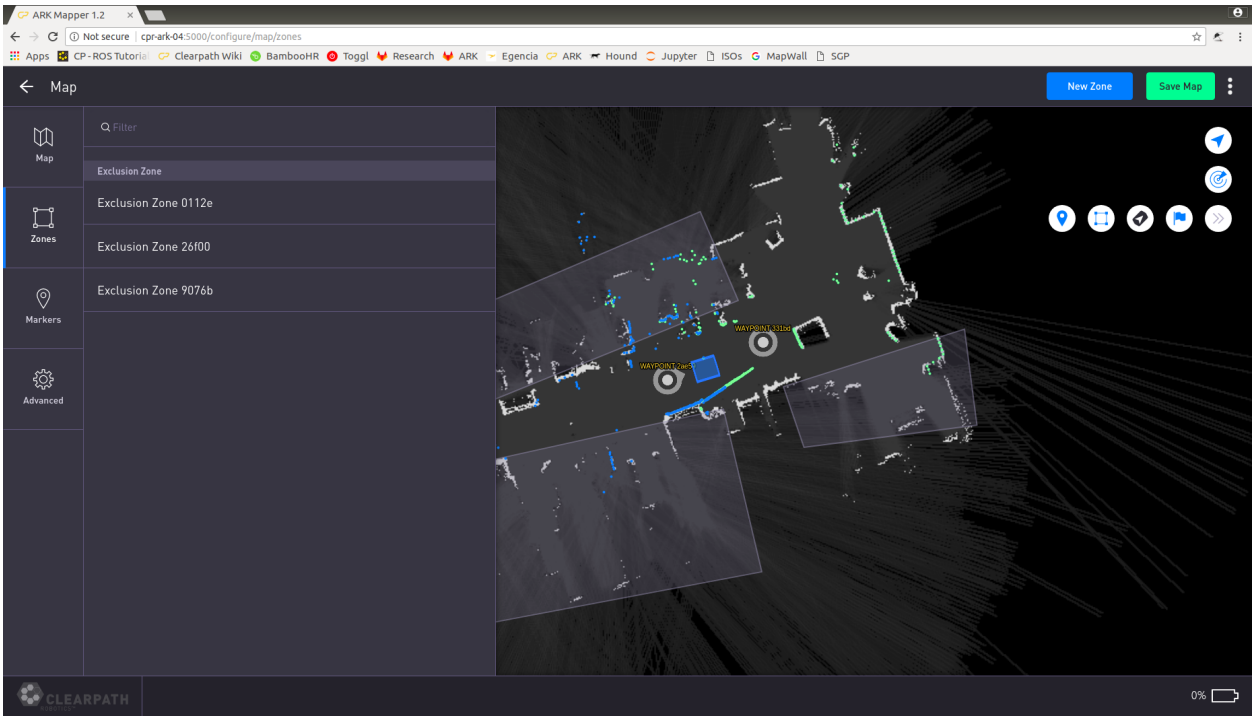


When the map interface loads, you will see the robot, and the lasers. The front laser shows up as green dots and the back laser shows up as blue dots

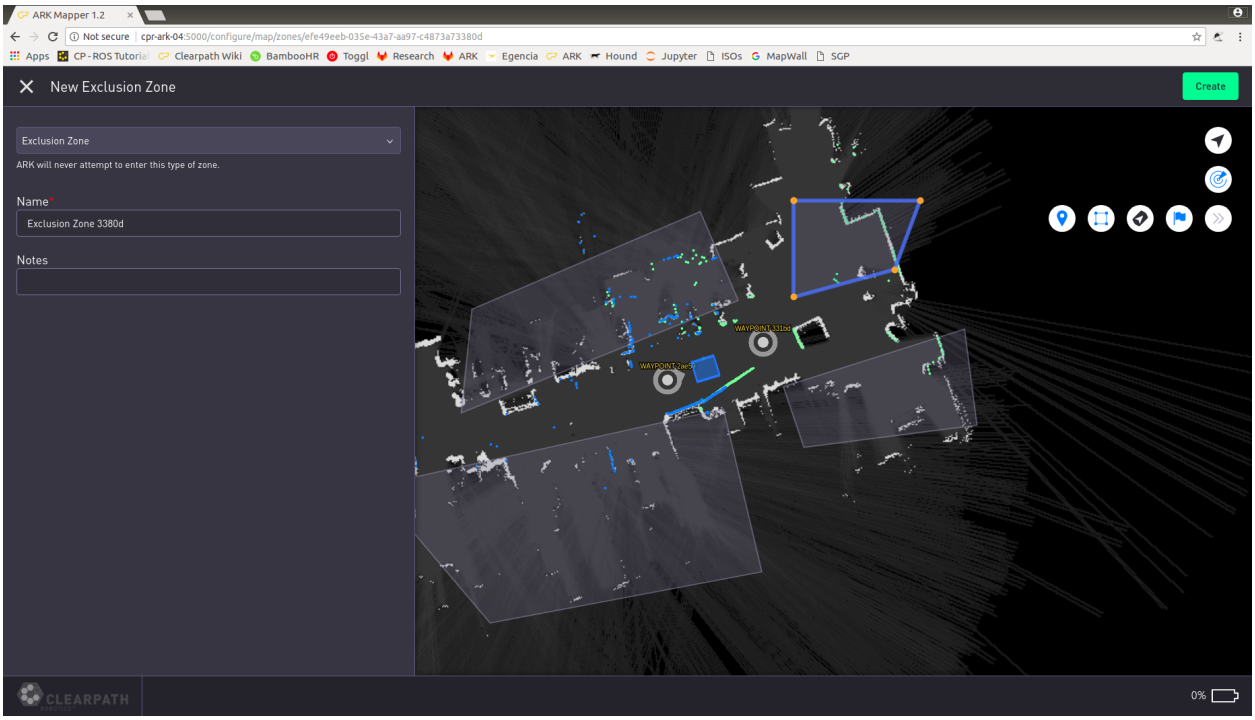
Zones

Zones can be used to keep your ARK from going to places where you don't want it to go. For example, many robots can't tell where stairs are since they are below the sensors. To make sure the ARK doesn't end up at the bottom of those stairs, you can add a zone around them, which will stop the ARK from planning or driving into that zone.

To add a zone, make sure you are in the map editor. You can then select the Zones menu item on the left. This will show all of the current zones in your map. It will also allow you to add a new zone through the New Zonebutton in the top-right.



When you add a zone, click and drag inside the map, This will create a box that defines your zone. You can drag the corners of the box to adjust the positioning. You can also double-click to add or remove a point to adjust the shape even more. Make sure to set a recognizable name for the zone so it is obvious later if you need to modify the zone.

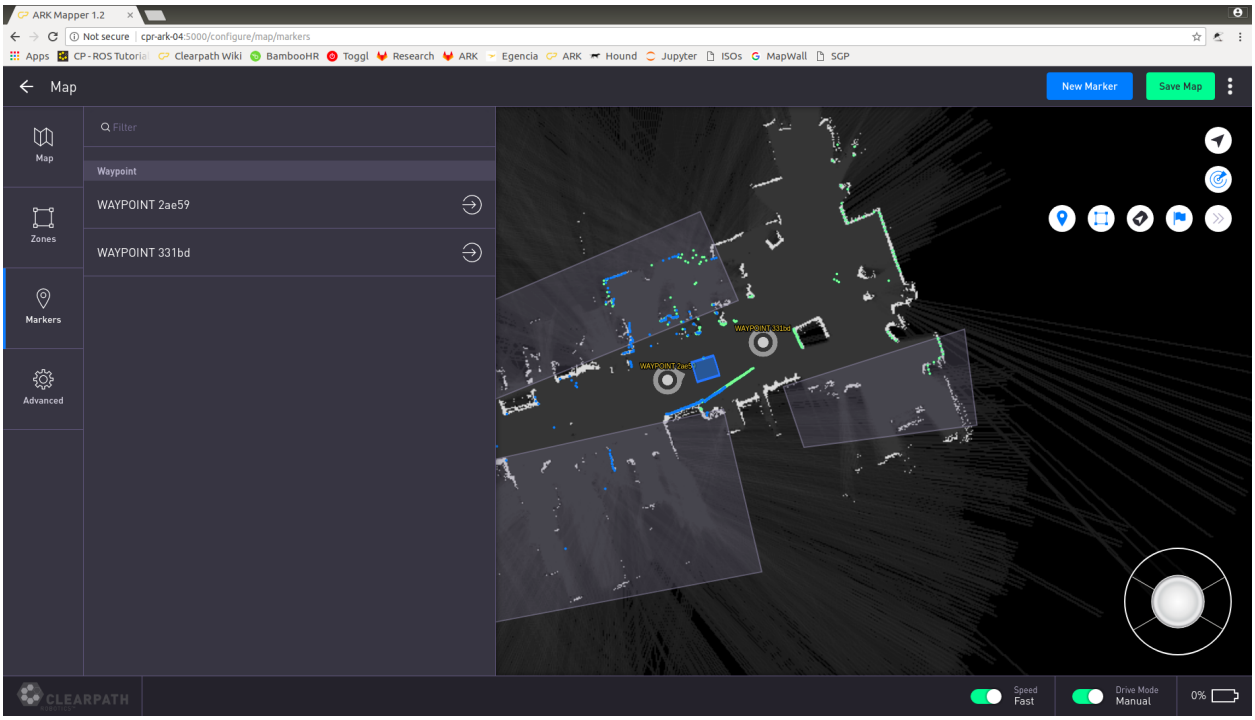


Once you have created your zone, hit Save to confirm your selection. Zones are saved to the map.

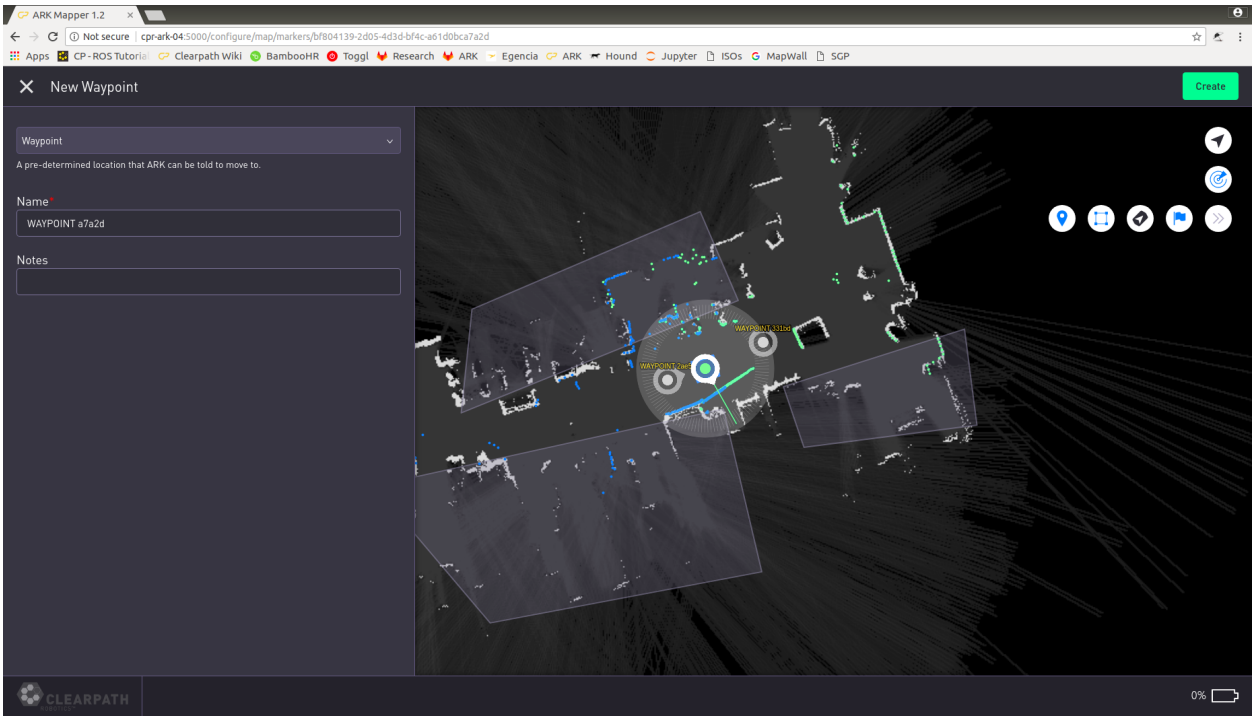
Markers

Markers are known locations in the map. Saving Markers in the map is an easy way to recall positions and is necessary for Routes. Having consistent naming will make writing external commanding programs simpler.

To add a Marker, make sure you are in the map editor. You can then select the Markers menu item on the left. This will show all of the current Markers in your map. It will also allow you to add a new Marker through the New Marker button in the top-right



When you add a Marker, it will add one at the robot's current position in the map. You can rotate the dial that is around your robot to adjust the orientation of the Marker. Make sure to set a recognizable name for the Marker so it is obvious later if you need to modify the Marker.



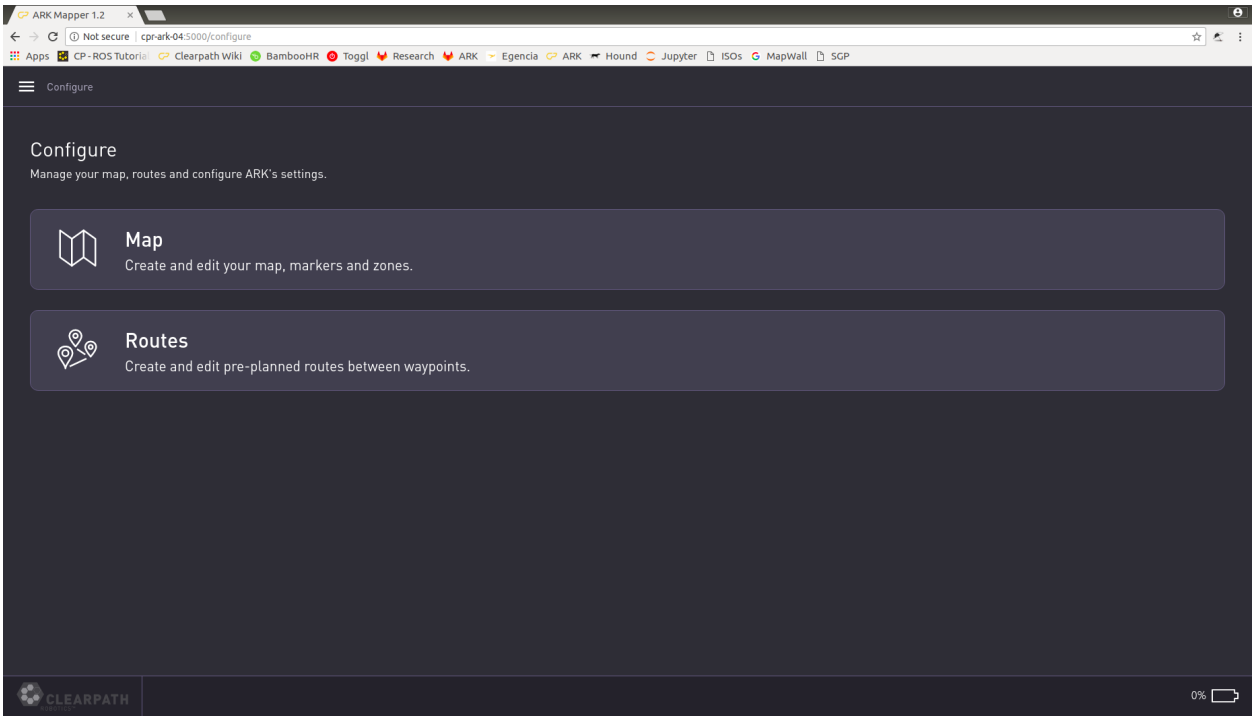
Once you have created your Marker, hit Save to confirm your selection. Markers are saved to the map.

Routes

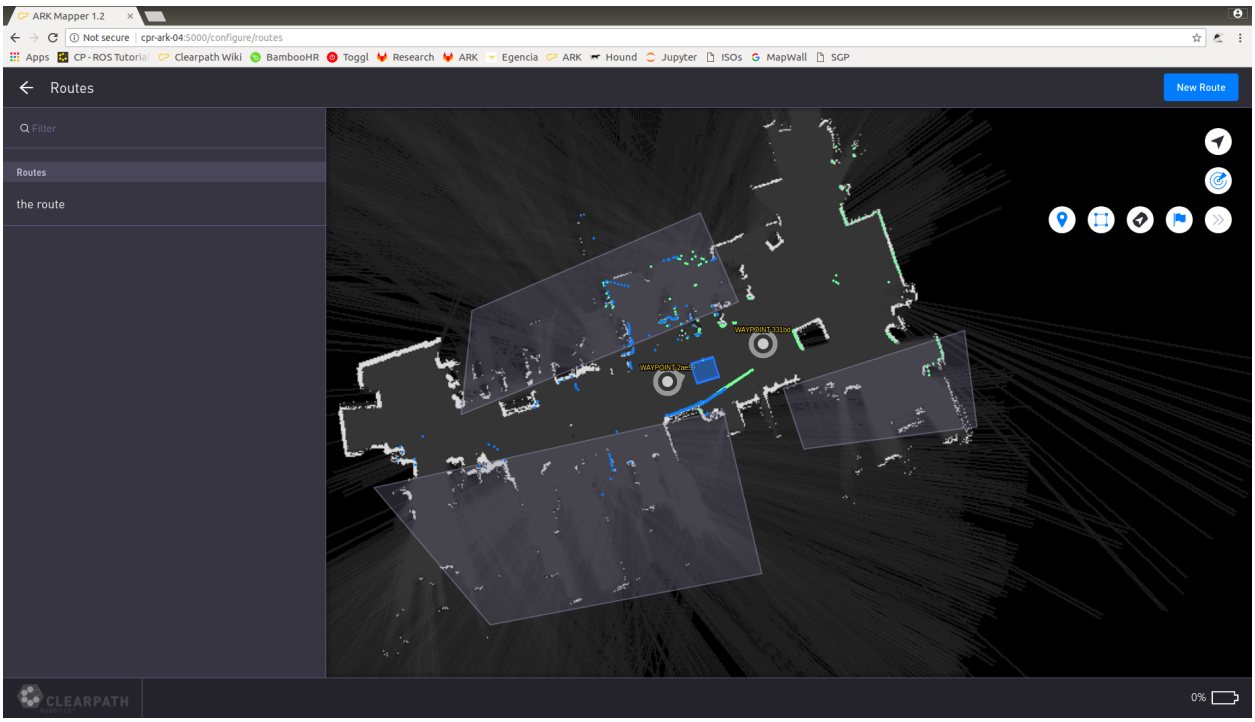
Routes are a a defined set of Markers that the robot should proceed to in order. Once the robot completes one of the steps, it will wait for 5 seconds, then proceed to the next step. You must have at least 2 Markers defined to create a Route.

*Note - Routes are stored locally in your browser and are not saved into the map. This means that if you load the interface on another device, you will need to remake your Routes

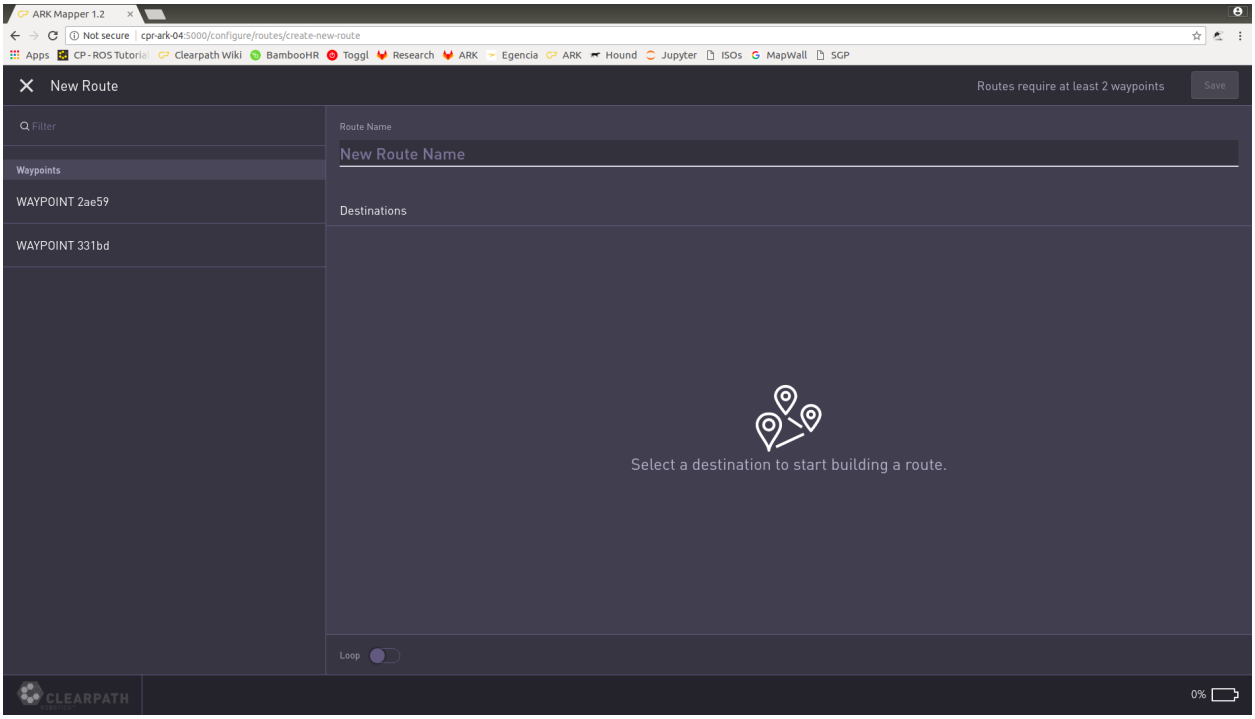
To create or edit Routes, select Routes under the Configure menu



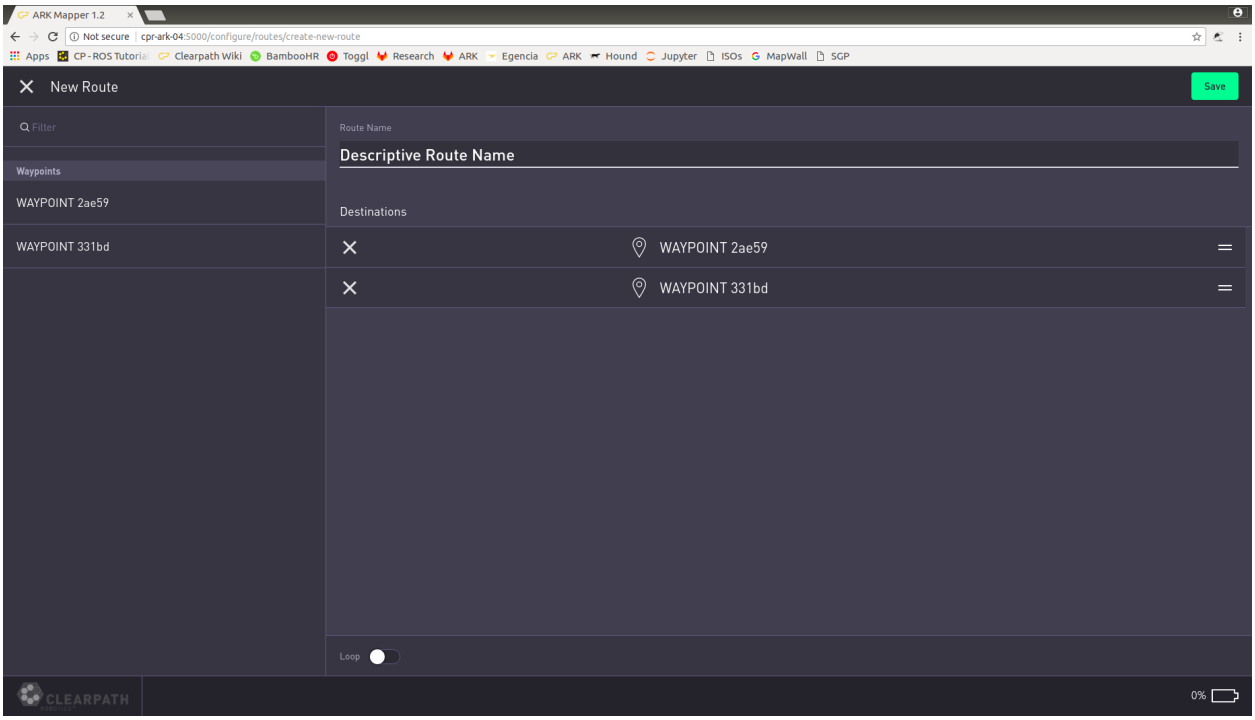
You should see the list of Routes that already exist.



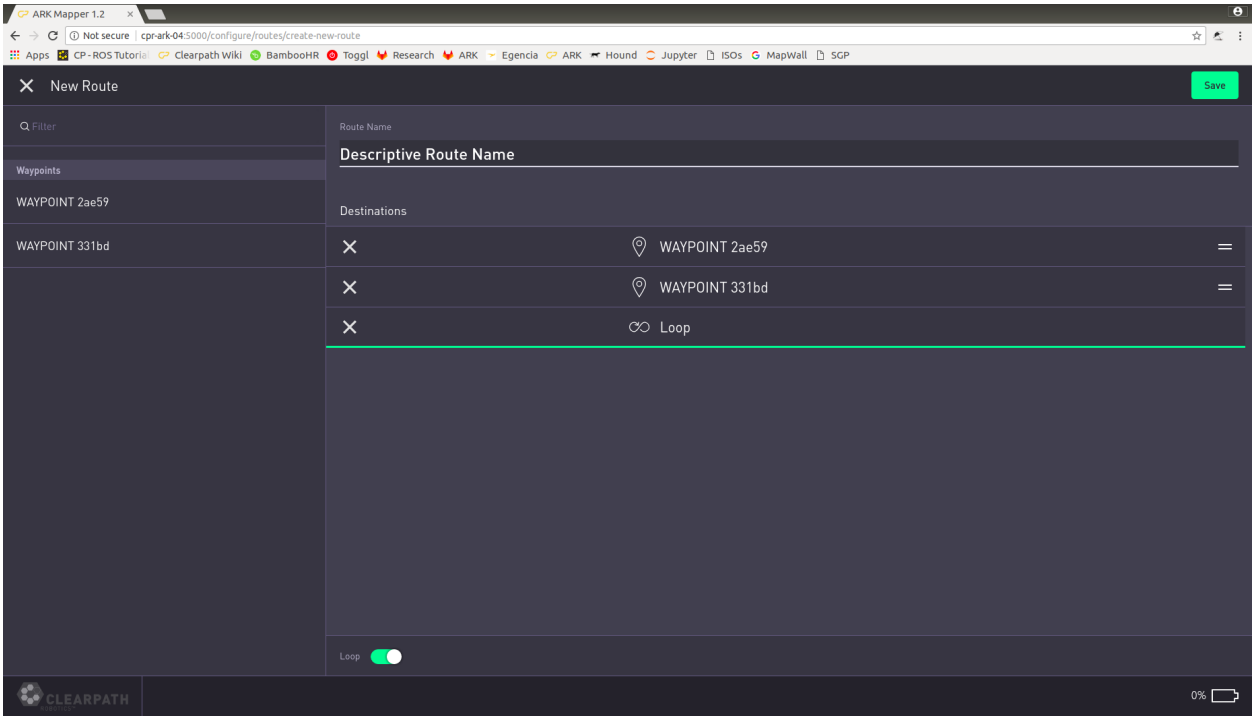
In the top right, you will see New Route. Selecting this will create a new Route.



When creating a new Route, make sure to enter a descriptive name, then select Markers in the order that you would like the ARK to follow.



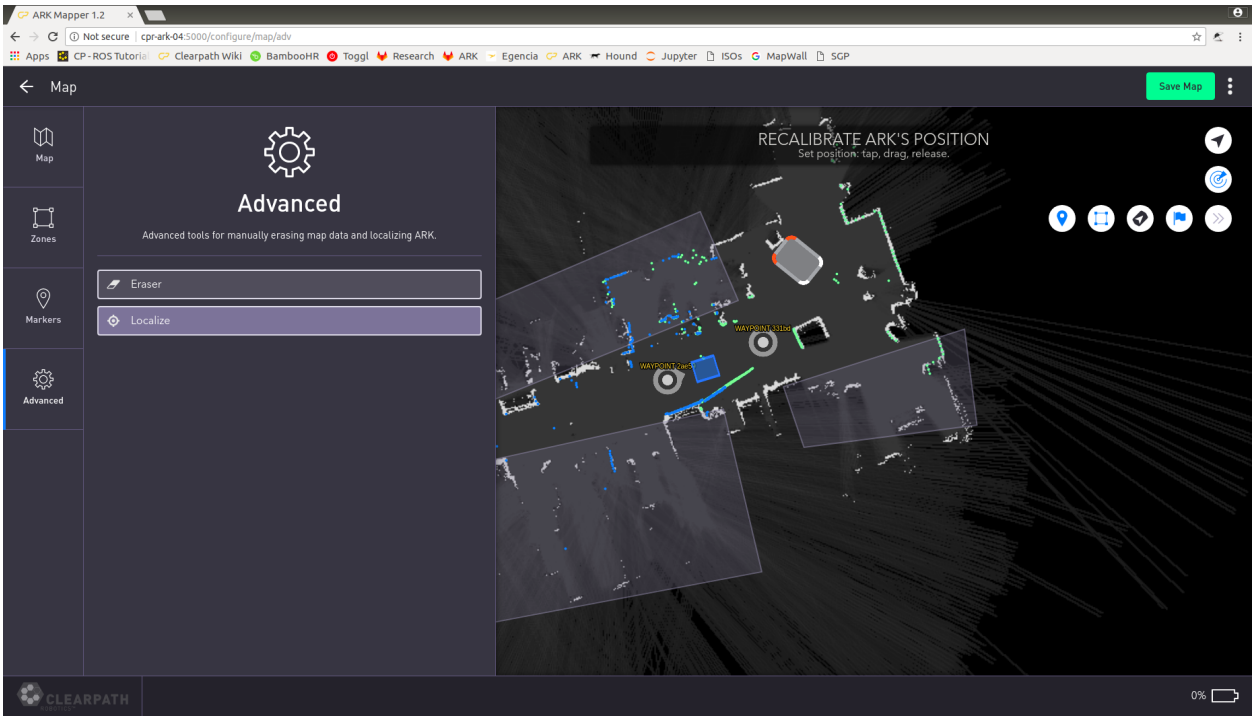
If you would like the robot to run the Route over and over again, you can enable Loop in the bottom left of that Route.



Advanced

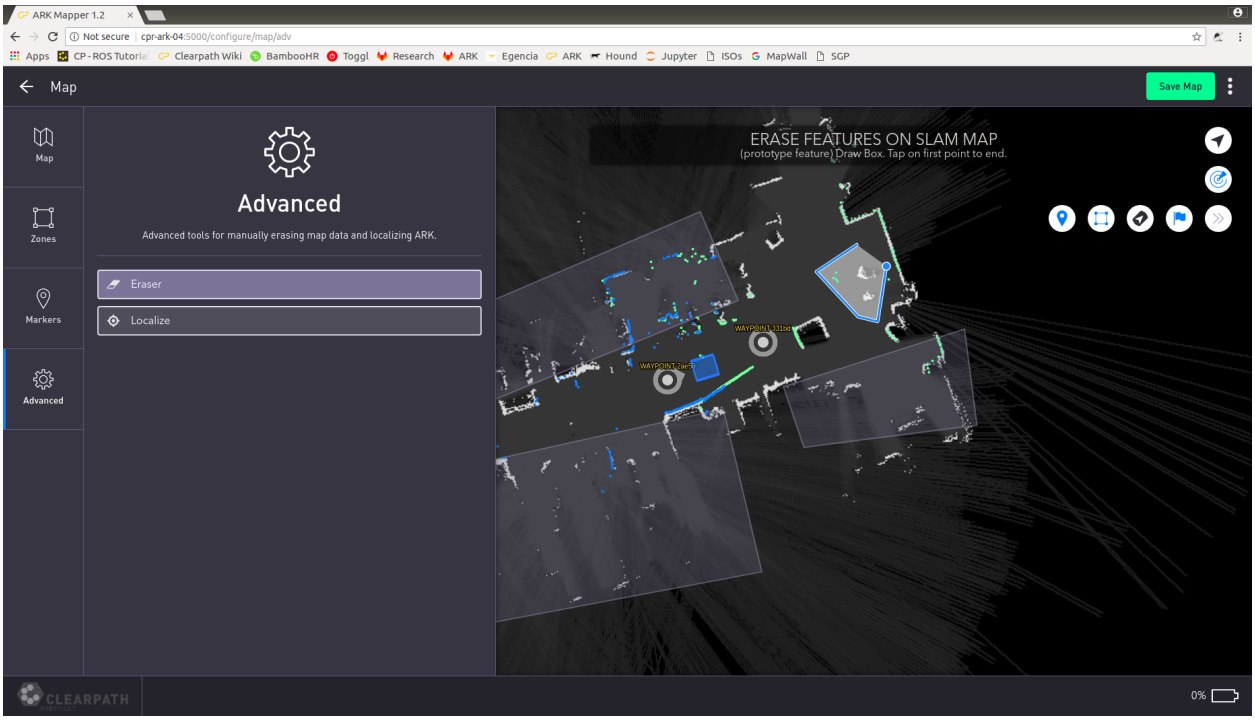
There are some cases where the robot might get lost, such as the real world not matching the map anymore or the ARK starting in an area that has a highly regular pattern. If this happens, you can tell the robot where it is in the map using the Localize feature. This is in the mapping interface, under Advanced.

Select Localize, then click and drag inside the map indicating location and orientation of the robot. The ARK will then try to localize itself to that area.



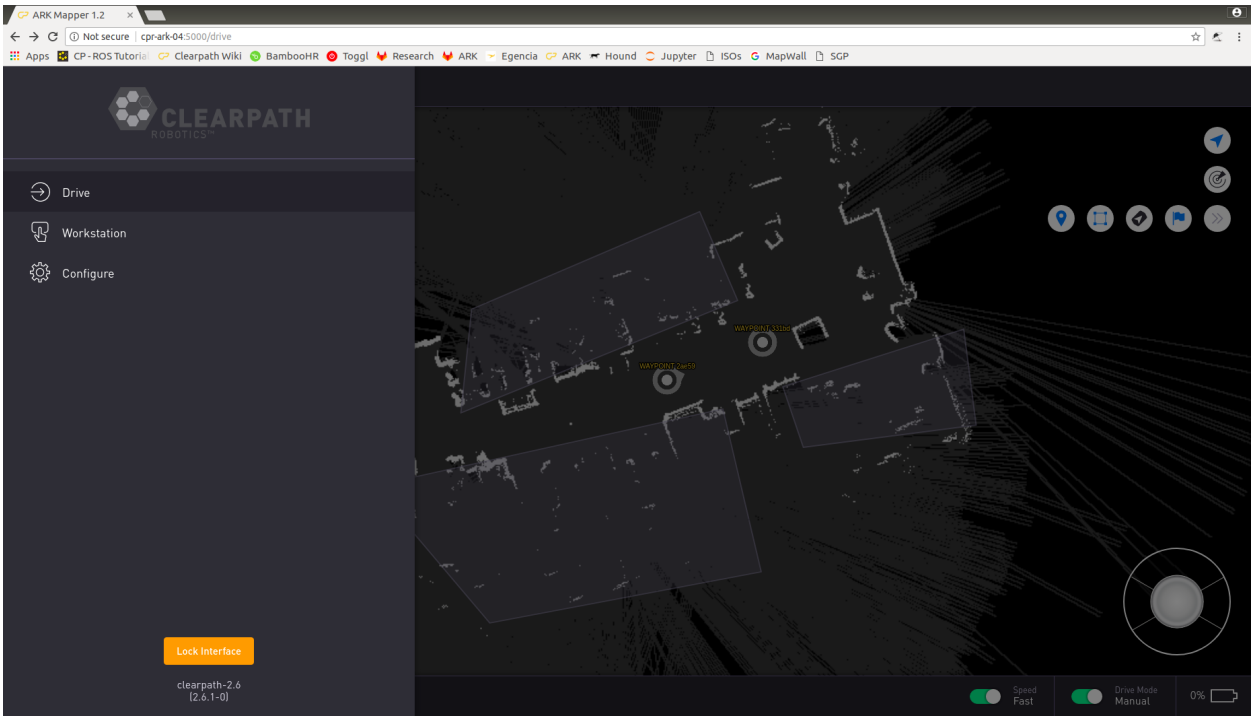
If your environment has changed, you can modify your map by removing areas that are no longer relevant using the Eraser tool. This will allow you to manually modify the map. This is in the mapping interface, under Advanced.

Select Eraser, then click to create a shape that surrounds the area you want to remove from the map. When you close the shape, the map points inside it will be removed from the map.



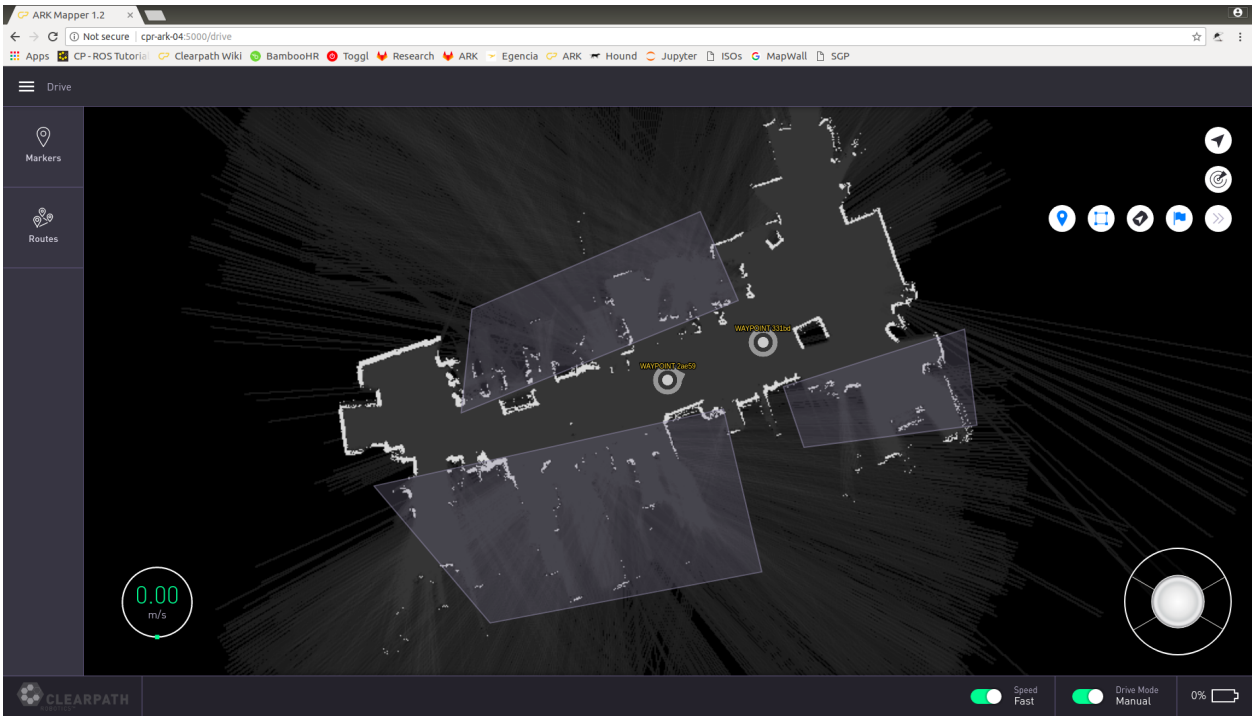
Driving the Robot

There are multiple places in the interface where the ARK can be controlled and the robot driven, but this section will focus on the Drive menu as that is where you can find all of the movement controls.



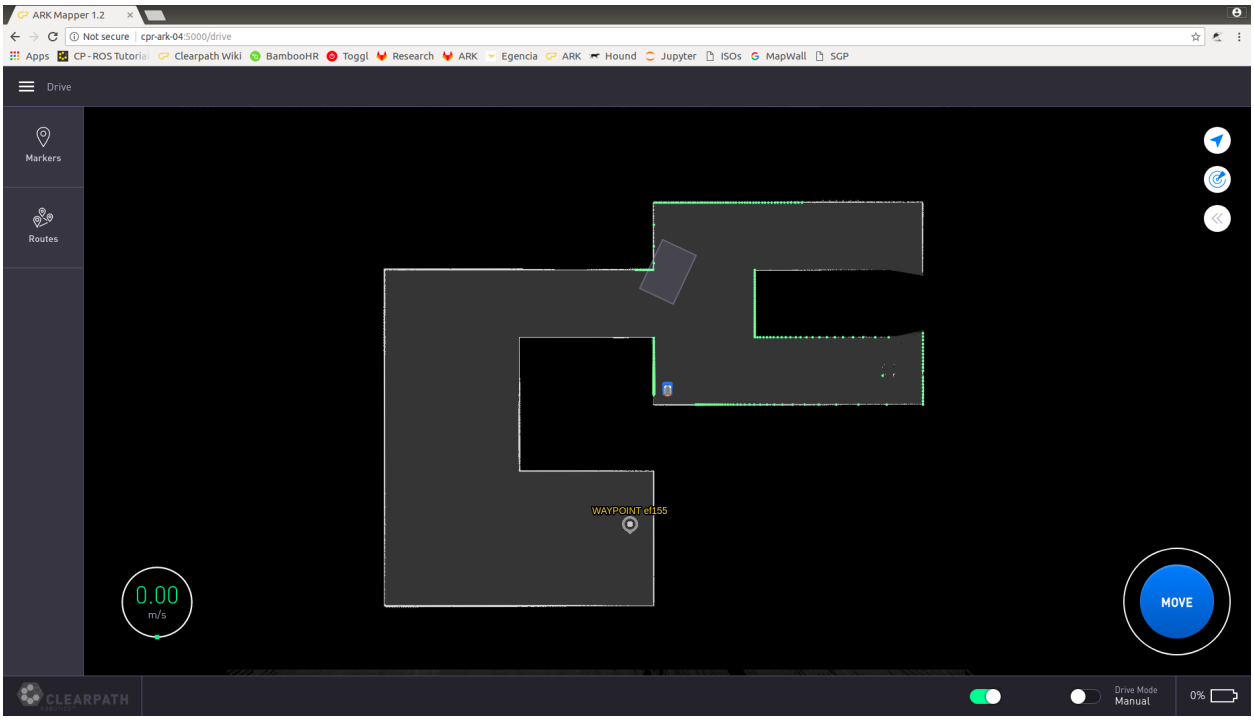
Manual Driving

If you would like to manually control the robot through the ARK Mapper interface, enable the the Manual Drive Mode slider in the bottom right. This will enable a small joystick that you can drag to manually control the robot.

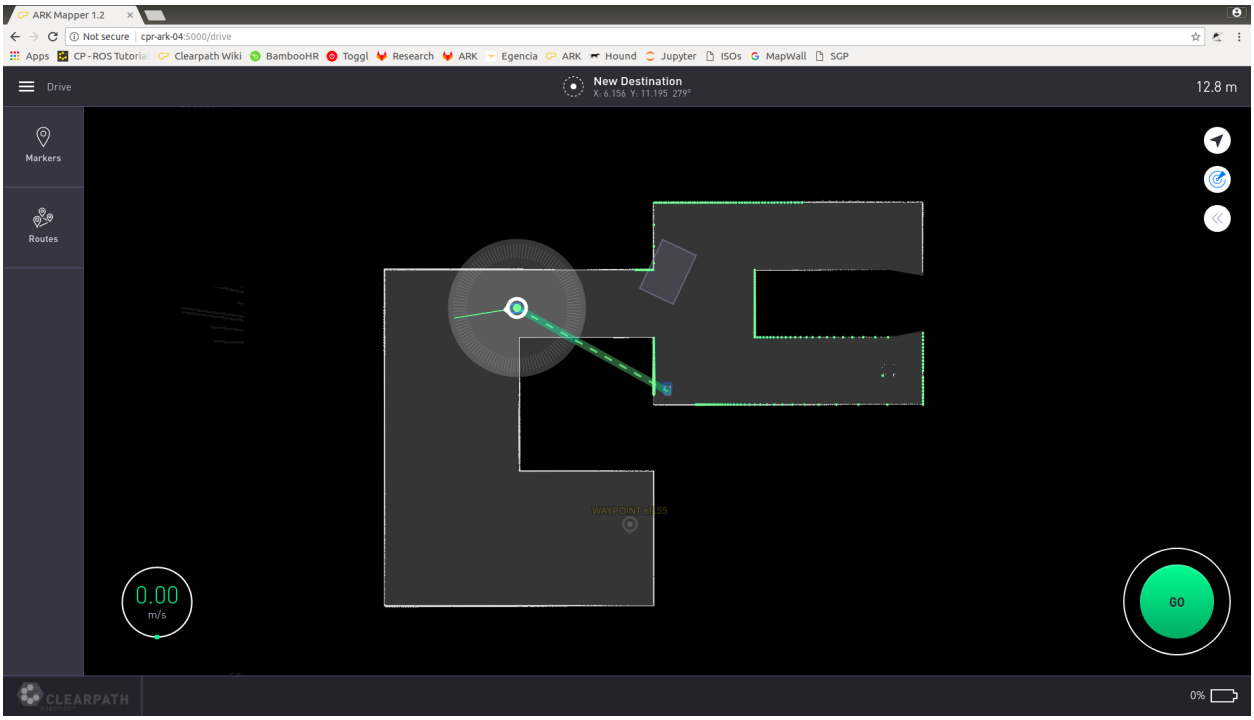


Autonomous Driving

To command Autonomous movements through the ARK Mapper interface, disable the Manual the Drive Mode slider in the bottom right. This will enable a Move button in the bottom Right.



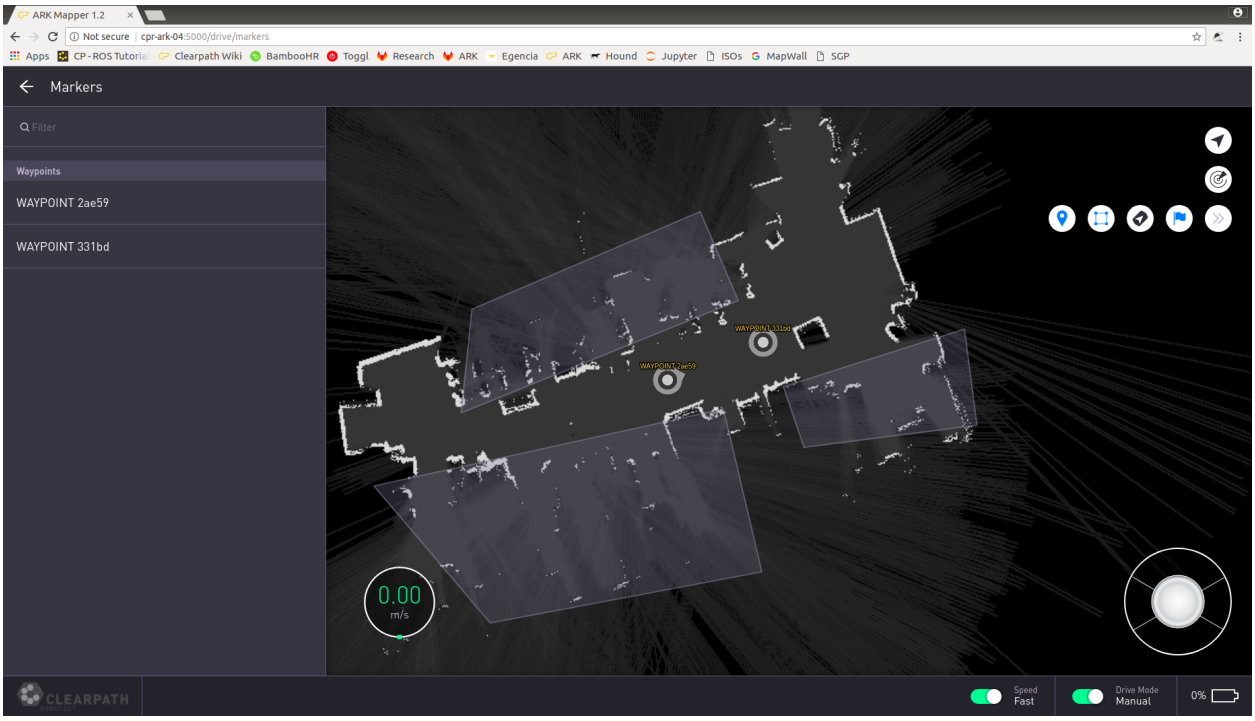
To command a movement, select Move, then choose where in the map you would like the robot to go. This will create a dial at that location with a green line pointing in the direction that the robot will point. You can grab and rotate the dial to adjust this orientation.



Once your position and orientation are selected, you can click Go in the bottom right and the ARK will calculate a path to the chosen location and begin to navigate the robot there.

Markers and Routes

On the left side of the Drive interface, you can see Routes and Markers selections. In these menus you can choose previously created Markers or Routes for the robot to traverse. Note, these must have been made previously (see Mapping).


ARK Mapper 1.2
Not secure
cpr-ark-04:5000/drive/markers
Apps
CP - ROS Tutorial
Clearpath Wiki
BambooHR
Toggl
Research
ARK
Egencia
ARK
Hound
Jupyter
ISOs
MapWall
SGP
Markers
Filter
Waypoints
WAYPOINT 2ae59
WAYPOINT 331bd
WAYPOINT 331bd
WAYPOINT 2ae59
0.00
m/s
CLEARPATH
Speed
Fast
Drive Mode
Manual
0%

TECHNICAL DOCUMENTATION

Safety Considerations

Introduction

Please take careful consideration of the safety instructions, guidelines, and thoughts that we have put below. They are for your safety, the safety of others around you, and for the integrity of the products you are using with this product. Thank you, sincerely, the Clearpath Robotics research team.

Validity And Responsibility

The end user is responsible for anything going wrong with the utility and integration of this product to their mobile systems. The end user is also responsible for consequences as a result of the utilization of this product on their mobile systems. Clearpath Robotics takes no responsibility other than to provide guidance on how to use the Clearpath ARK. It is assumed the user will clearly and responsibly understand the risks of using this product before integrating it on their platform.

Limitation of Liability

Any information given in this manual regarding safety must not be construed as a warranty by Clearpath Robotics that the Clearpath ARK will not cause injury or damage even if all safety instructions are complied with

Intended Use

The product is intended to demonstrate the platforms capability of moving autonomously from point A to point B, and to be able to generate a map of its environment. The level of success which this product can accomplish this is in no way guaranteed and may not work at all under certain circumstances and environments. For details about the environmental conditions under which the robot should operate, see appendices B and D. Clearpath Robots are not equipped with special safety-related features unless otherwise requested on your order, which are purposely designed for collaborative operation, where the robot operates without fences and/or together with a human. Collaborative operation is only intended for non-hazardous applications, where the complete application, including tool, work piece, obstacles and other machines, is without any significant hazards according to the risk assessment of the specific application. Any use or application deviating from the intended use is deemed to be impermissible misuse. This includes, but is not limited to:

- Use in potentially explosive environments;
- Use in medical and life critical applications;
- Use before performing a risk assessment;

- Use where the rated performance levels are insufficient;
- Use where the reaction times of the safety functions are insufficient;
- Use as a climbing aid;
- Operation outside the permissible operating parameters

Risk Assessment

One of the most important things that an end user needs to do is to make a risk assessment. The robot itself is partly completed machinery, as the safety of the robot installation depends on how the robot is integrated (E.g. tool, obstacles and other machines). It is recommended that the integrator uses guidelines in ISO 12100 and ISO 10218-2 to conduct the risk assessment. The risk assessment shall consider at least, this scenario:

- Normal operation of the robot installation: If the robot is installed in a non-collaborative installation (E.g. when using a hazardous tool) the risk assessment might conclude that the integrator needs to connect additional safety devices (E.g. an enable device) to protect him while programming.

Clearpath Robotics has identified the potential significant hazards listed below as hazards which must be considered by the integrator. Note that other significant hazards might be present in a specific robot installation.

1. Entrapment of fingers between robot foot and base (joint 0).
2. Entrapment of fingers between the wheels and other moving components
3. Penetration of skin by sharp edges and sharp points
4. Penetration of skin by sharp edges and sharp points on obstacles near the robot track.
5. Bruising due to stroke from the robot.
6. Sprain or bone fracture due to strokes between a heavy payload and a hard surface.
7. Consequences due to loose bolts that hold the robot arm or tool.
8. Items falling out of tool, e.g. due to a poor grip or power interruption.
9. Mistakes due to different emergency stop buttons for different machines. Information on stopping times and stopping distances are found in appendix A.

Emergency Stop

Note. Not all robots ship with an emergency E-stop. The Clearpath Robotics kit by default, does not ship with an emergency stop. The software provided with the Clearpath ARK does not have software methods of interacting with a software E-stop. Some Clearpath Robotics robots may ship with an emergency e-stop, but they are in no way intended to be combined for usage with the Clearpath ARK and the integrated robot.

Supported Robots

At this time, this product only directly supports these Clearpath Robotics' robots. Pre made configurations for these platforms are available

1. Husky (husky_cpr_ark_navigation)
2. Jackal (jackal_cpr_ark_navigation)
3. Ridgeback (ridgeback_cpr_ark_navigation)

If you have questions about getting your robot supported, or to see what the current supported robots list is, please contact us by going to the Product Support and Feedback page.

Supported Platforms

- Ubuntu 14.04
- ROS Indigo
- Gazebo 2.2

ARK Bridge

When connecting to the ARK using ark_bridge, debug messages should be showing a message approximately every second indicating the health of the bridge. The messages are:

1. GOOD - The bridge and network are functioning properly
2. SLOW - The bridge and network are functioning, but there is some unexpected delay. The ARK performance may be degraded.
3. BAD - The bridge and network are functioning, but there is a lot of delay in the connection. The ARK likely will have issues planning and mapping

If the connection is consistently SLOW or BAD, check your network infrastructure and try to eliminate delays and bottlenecks. See Ark - Connect the ARK for more information If no messages are appearing, see Troubleshooting the ARK

Service Calls

All service calls to the ARK must go through the ARK Bridge, which may or may not be connected to an ARK. All service calls will respond with their information as well as the ark_service_timeout value. If this timeout value is True, there was an issue with communicating with the ARK and the service call did not succeed. Check that the bridge is running properly. If the timeout value is False, there was no timeout problem and the service call succeeded.

Robot Requirements

Kinematics

- Ground-Based
- Differential Drive/Steering

*Note: Accelerations limits must be known by the ARK, but it is assumed that the platform will enforce these limits. Because of this, make sure the acceleration limits you are using in the ARK match those set for your platform

Topics (These topics must be made available through ark_bridge

- clock
- tf
- tf_static
- platform_control_cmd_vel
- platform_control_odom
- platform_odometry

Frame Names in TF Tree

- Front Laser - front_laser.
- Rear Laser - rear_laser
- Robot Base - base_link

Stereo Camera

In version 1.1, stereo camera support was added. This must be a PointCloud2 message

The camera is not used for mapping or localization, only for obstacle avoidance to detect objects outside of the laser plane

*Note: Noisy data may cause the ARK to stop unnecessarily if it detects non-existent obstacles. Filtering the data before sending it to the ARK may be beneficial. The PCL library may help with this

Configuring ARK

Setting the Configuration: Send a message to: /ark_config_settings_call

Setting	Unit	Info
max_fwd_linear_speed	m/s	The maximum speed forward when navigating
max_rev_linear_speed	m/s	The maximum speed in reverse when navigating
min_linear_speed	m/s	The minimum speed that the robot can travel
max_linear_acceleration	m/s^2	Maximum acceleration when navigating
max_linear_deceleration	m/s^2	Maximum deceleration when navigating
max_ang_speed	rad/s	Maximum rotational speed when navigating
max_ang_accel	rad/s^2	Maximum rotational acceleration when navigating
vehicle_length	m	Length of the vehicle
vehicle_width	m	Width of the vehicle
stopping_distance_1M	m	Distance that the robot will take to stop when traveling at 1m/s. Use worst-case scenario when measuring this
lidar_spacing	m	Assuming the lidars are centred on the robot and symmetrically placed
laser_fov	deg	The scan angle range of the lasers
camera_3d_memory	sec	How long will the 3d camera ”remember” something it ”saw”
drive_direction		0 - Forward Only, 1 - Forward and Reverse *See note below

*Note: Setting ”Forward” will not lock the robot to forward-only motion, but the robot will use forward motion whenever possible. It may still travel in reverse if necessary.

*Note: When setting accelerations, see note on acceleration under Robot Requirements

Verifying it was set: Status and information response from: /ark_config_settings_response. If you don’t receive ”Success”, one or more of your parameters were incorrect and the ARK was not reconfigured

Network Setup

LAN IP Address: 192.168.132.111

Infrastructure The ARK should be connected to the robot or simulation:

1. Using ethernet cables (not wireless)
2. Either directly or through a single ethernet switch
3. Using a network that does not block multicast traffic
4. Using no more than 5 hops - https://en.wikipedia.org/wiki/Hop_(networking)

Port Forwarding

There are many cases where you may not be able to contact the ark directly from outside of the robot. This is normally not a problem, but it can be beneficial to use ARK Mapper from another external device. To do this, you can forward ports through the robot. This will make it appear as though the robot is hosting mapper.

```
sudo sysctl net.ipv4.ip_forward=1
sudo iptables -t nat -A PREROUTING -p tcp --dport 80 -j DNAT --to-destination 192.168.132.111:5000
sudo iptables -t nat -A PREROUTING -p tcp --dport 5000 -j DNAT --to-destination 192.168.132.111:5000
sudo iptables -t nat -A PREROUTING -p tcp --dport 9091 -j DNAT --to-destination 192.168.132.111:9091
sudo iptables -t nat -A POSTROUTING -j MASQUERADE
```

This should allow you to contact mapper by pointing your Chrome browser at the robot's hostname.

Install iptables-persistent to make this change permanent

```
sudo apt-get install iptables-persistent
```

It will prompt you about saving your current settings. Yes to IPV4, no to IPV6.

If it was already installed, you will not get the prompts for saving. You can run the command below to save the current configuration as the default configuration

```
dpkg-reconfigure iptables-persistent
```

Upgrading the ARK

To upgrade your ARK, ensure the DHCP network port (shown in "Connect the ARK") is connected directly to the internet. Once connected, contact Clearpath Support for remote assistance support@clearpathrobotics.com

ARK Hardware Specifications

1. Processor: Intel(R) Core(TM) i7-7700 CPU @ 3.60GHz
2. Memory: 8GiB
3. Power Requirements: 24V 4A DC
4. Ethernet Ports: 2
5. USB 3.0 Ports: 4
6. USB 2.0 Ports: 2
7. HDMI Ports: 1
8. GPU: No
9. Software: Ubuntu 14.04, ROS Indigo, Clearpath ARK v1.2

Release Notes

ARK V1.2: Friday, December 1st, 2017.

1. Mapper shows actual footprint
2. Proper platform images for each Clearpath platform
3. Routes, no-go zones, waypoints
4. Speedometer for robot speed
5. Manual Drive control speeds respect platform settings
6. Service Calls
7. Laser Odometry

ARK V1.1: Monday, July 17th, 2017.

1. Significantly improved diagnostics
2. System checks before starting Autonomy
3. ARK will bring itself down and back up when told to
4. 3D camera support
5. Greatly simplified parameters for ARK configuration
6. New packages for each supported robot

ARK V1.0: Thursday, April 27th, 2017.

1. Atlas mapper
2. Users communicate directly with ROS topics presented by the LCM bridge
3. Users have to manually download and install/configure their PCs
4. Users cannot modify/edit map
5. Users cannot set zones
6. Supports any laser as long as it is publishing on the correct topic. HOWEVER, we have only tested with SICK, Hokuyo and verified that those work with the defined performance.
7. Diagnostics topic which the user can listen to to see the status of the box
8. Robot configuration scripts available on github. allows multiple robots/easy integration with other clearpath robots

Troubleshooting the ARK

Navigation

1. Most navigation errors occur from trying to plan in the wrong environment, or trying to plan in a small space. Try to close loops if you can while mapping.
2. The robot cannot map or navigate up ramps or stairs
3. The robot requires walls or objects to localize itself, it cannot be in a barren space and find itself and generate good maps
4. The robot will solve the navigation problem given enough time and area
5. The robot will attempt to stop if an obstacle is in its way, and then re-plan. Unless you have safety lasers with a fully safety certified robot, this is not a safe activity and is not recommended or condoned by Clearpath Robotics.
6. Navigation collisions should be reported to Clearpath Robotics' by contacting our support page. All collisions reported help make this a better product for everyone.

Recovery

If the ARK thinks the robot is stuck or can't make it to where it is told to go, it may attempt some recovery behaviours. Most of these are internal and not obvious, but one behaviour will drive the robot forward or backwards a small amount. This is to get a better view of the surroundings and see if anything has changed. This is not necessarily an indication of a problem, but if it happens repeatedly, adjust the environment

Symptom(s)	Corrective Actions	Notes
The robot is moving back and forth in a straight line	Adjust the surroundings to allow the robot to move safely	

Connectivity

Symptom(s)	Corrective Actions	Notes
Can't ping the ARK	Set your IP is in the same range as the ARK, Ensure connection to the ARK, Restart the ARK	See Ark - Connect the ARK
No ARK_Bridge status messages	Check that you can ping the ARK, Ensure your network setup is correct, Check that LCM is installed on your system	See Ark - Connect the ARK
ARK_Bridge messages are indicating SLOW or BAD	Connect using ethernet cables (not wireless),Connect dither directly or through a single ethernet switch, Minimize the number of hops in your network setup - https://en.wikipedia.org/wiki/Hop_(networking), See Ark - Connect the ARK	

Mapper

Symptom(s)	Corrective Actions	Notes
Robot icon missing	Ensure you are using the Google Chrome browser	

Product Support and Feedback

Clearpath is committed to your success with ARK. If you run into any issues, please get in touch with us and we'll do our best to get you rolling again quickly! support@clearpathrobotics.com

If you have a an issue that is specifically about ROS and is something which may be of interest to the broader community, consider asking it on http://answers.ros.org. If you don't get a satisfactory response, please ping us and include a link to your question as posted there. If appropriate, we'll answer in the ROS Answers context for the benefit of the community.