
WidowX Documentation

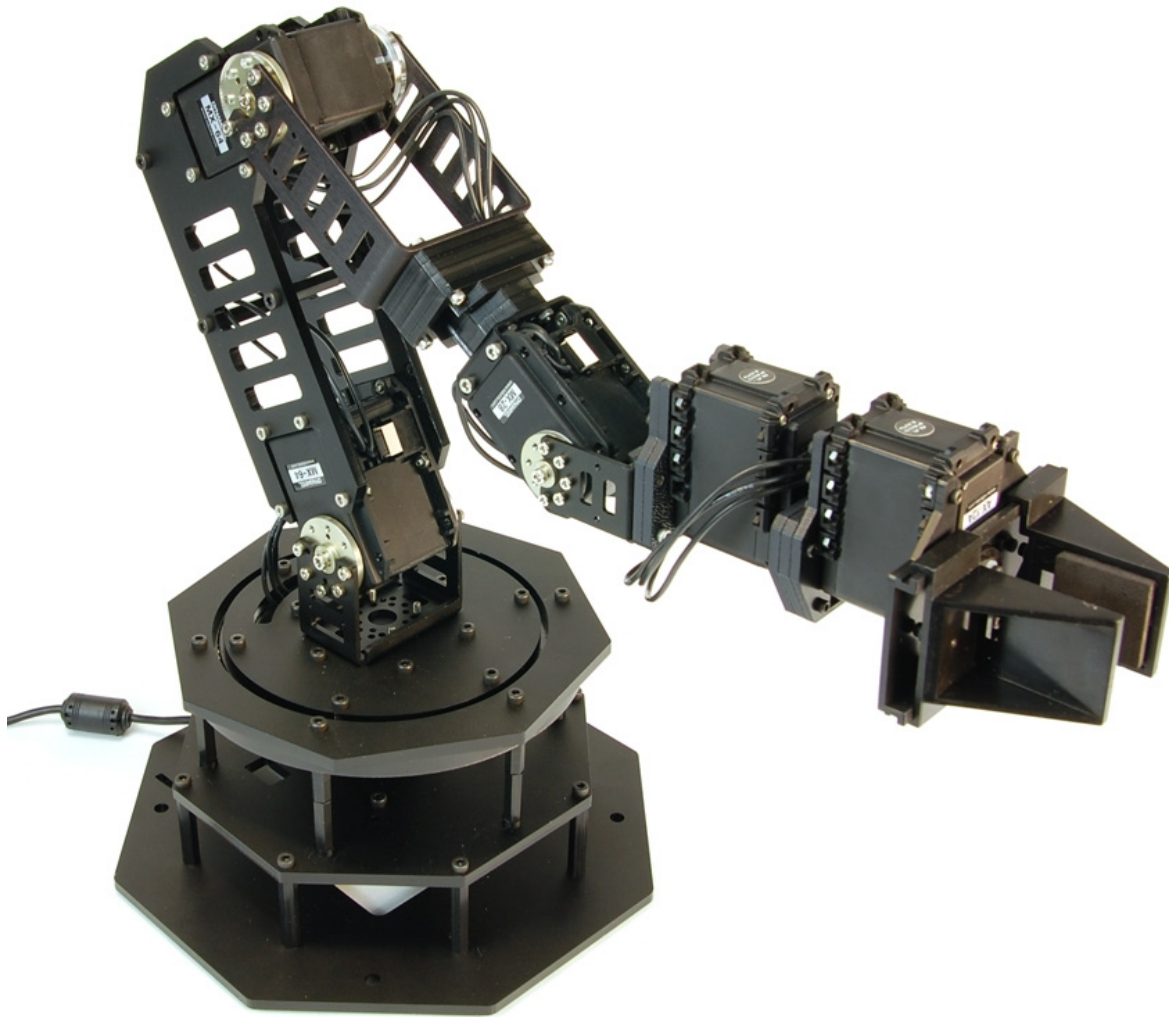
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Dabit Industries

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CHAPTER 1

About

This documentation describes the setup of Trossen Robotics' WidowX ARM with ROS. It was tested on Ubuntu 16.04 and ROS Kinetic. The content is adapted from the original documentation from Trossen Robotics.

If you would like to setup the ARM and ID the servos then you should start with the original documentation that can be found [here](#).

The WidowX Robot Arm Mark II is the update to Interbotix Labs' entry level arm offering for the MX series of DYNAMIXEL Servos. The Mark II has a few improvements that we've made based upon our own testing as well as customer feedback. We've upgraded the elbow servo from an MX-28 to an MX-64 complete with custom aluminum brackets for added frame strength, replaced the Arbotix with the new Arbotix-M, and streamlined the arm structure to be lighter, simpler, and stronger. The MX series actuators provide a full 360 degree freedom of movement in the base, ultra-high resolution of 4096 positions, user-definable PID parameters, and extremely smooth interpolation. The hefty MX-64 shoulder & elbow servos gives the WidowX very strong lifting strength in a slim frame. If you are looking for medium lifting strength and desire smooth control, high accuracy and repeat-ability the WidowX is a great mid-level arm choice.

1.1 Use Cases

Identify and Sort

Motion Planning

Pick and Place

1.2 Product features

- Industry Leading MX-64, MX-28 and AX-12 Servos
- Solid 14cm Ball Bearing Base
- Arbotix Robocontroller for Onboard Processing

- Custom Parallel Gripper
- Mounting Brackets for Cameras & Sensors

1.3 ROS Package Includes

- 2x MX-64 Dynamixel Actuators
- 2x MX-28 Dynamixel Actuators
- 2x AX-12A Dynamixel Actuators
- WidowX Arm Hardware & Frame Kit
- ArbotiX Robocontroller
- 12v 10a Power Supply
- FTDI 5v Programming Cable
- Intel SR300 Camera & Stand w/ measurement tool
- Laptop - ROS pre-installed and tested

1.4 Comprehensive Kit Includes

- 2x MX-64 Dynamixel Actuators
- 2x MX-28 Dynamixel Actuators
- 2x AX-12A Dynamixel Actuators
- WidowX Arm Hardware & Frame Kit
- ArbotiX Robocontroller
- 12v 10a Power Supply
- FTDI 5v Programming Cable

1.5 No Servos Kit Includes

- WidowX Arm Hardware & Frame Kit
- ArbotiX Robocontroller
- 12v 10a Power Supply
- FTDI 5v Programming Cable

The documentation assumes that ROS Kinetic is already installed on the host pc (Ubuntu 16.04). If not, follow the instructions below.

2.1 Install ROS Kinetic

<http://wiki.ros.org/kinetic/Installation/Ubuntu>

Open a terminal and type in the following

```
sudo sh -c 'echo "deb http://packages.ros.org/ros/ubuntu $(lsb_release -sc) main" > /  
→etc/apt/sources.list.d/ros-latest.list'  
sudo apt-key adv --keyserver hkp://ha.pool.sks-keyservers.net:80 --recv-key_  
→421C365BD9FF1F717815A3895523BAEEB01FA116  
sudo apt update  
sudo apt upgrade  
sudo apt install ros-kinetic-desktop  
sudo rosdep init  
rosdep update  
echo "source /opt/ros/kinetic/setup.bash" >> ~/.bashrc  
source ~/.bashrc
```

2.2 RealSense ROS Package Install

There are a few prerequisites.

```
wget -O enable_kernel_sources.sh http://bit.ly/en_krnl_src  
bash ./enable_kernel_sources.sh
```

Sensor package

```
sudo apt install ros-kinetic-librealsense ros-kinetic-realsense-camera
sudo reboot
```

Kernel 4.10 installation work-around

```
sudo apt-get install libglfw3-dev
cd ~
git clone https://github.com/IntelRealSense/librealsense.git
cd librealsense
mkdir build && cd build
cmake ../
make && sudo make install
cd ..
sudo cp config/99-realsense-libusb.rules /etc/udev/rules.d/
sudo udevadm control --reload-rules && udevadm trigger
./scripts/patch-realsense-ubuntu-xenial.sh
```

2.3 Additional dependencies

```
sudo apt install git http
sudo apt install ros-kinetic-moveit ros-kinetic-pcl-ros
```

2.4 Setting dialout permission for Arbotix

Replace yourUserAccount with the system account you are using

```
sudo usermod -a -G dialout yourUserAccount
sudo reboot
```

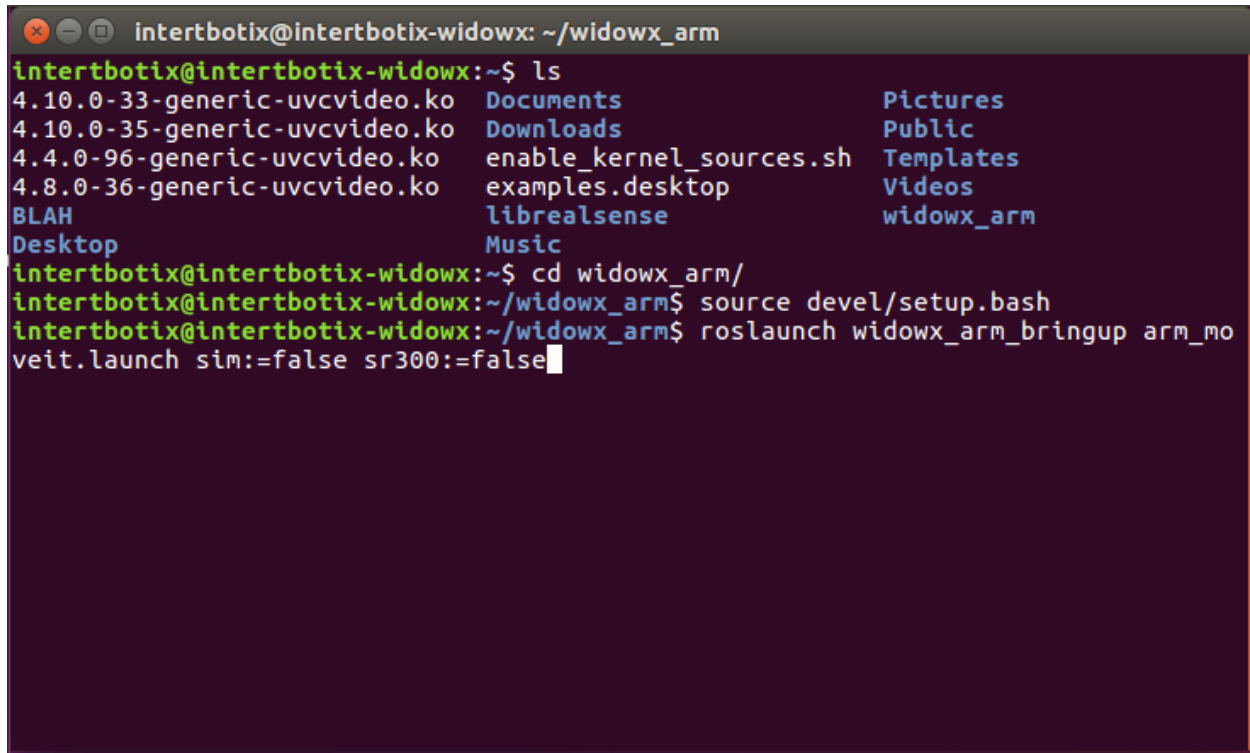
2.5 Clone widowx_arm repository and build

```
mkdir -p ~/widowx_arm/src
cd ~/widowx_arm/src
git clone https://github.com/Interbotix/widowx_arm.git .
git clone https://github.com/Interbotix/arbotix_ros.git -b parallel_gripper
cd ~/widowx_arm
catkin_make
```

2.6 ROS control of the arm independent of the SR300 Sensor

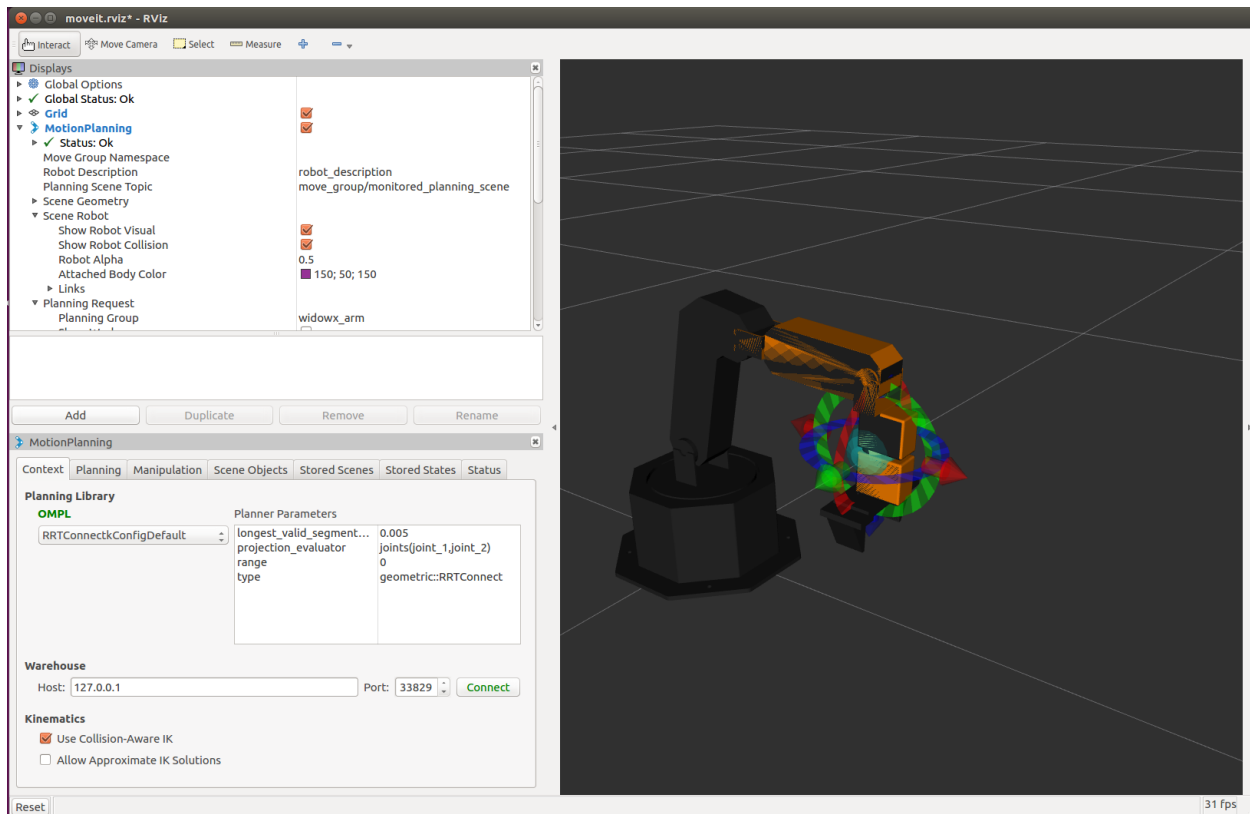
Open up a terminal window and enter the following commands.

```
cd ~/widowx_arm
source devel/setup.bash
roslaunch widowx_arm_bringup arm_moveit.launch sim:=false sr300:=false
```

A terminal window titled 'intertbotix@intertbotix-widowx: ~/widowx_arm'. The prompt is 'intertbotix@intertbotix-widowx:~\$'. The user enters 'ls', and the output is a three-column list of files and directories: '4.10.0-33-generic-uvcdvideo.ko', '4.10.0-35-generic-uvcdvideo.ko', '4.4.0-96-generic-uvcdvideo.ko', '4.8.0-36-generic-uvcdvideo.ko', 'BLAH', 'Desktop', 'Documents', 'Downloads', 'enable_kernel_sources.sh', 'examples.desktop', 'librealsense', 'Music', 'Pictures', 'Public', 'Templates', 'Videos', and 'widowx_arm'. The user then enters 'cd widowx_arm/' and 'source devel/setup.bash'. Finally, the user enters 'roslaunch widowx_arm_bringup arm_mo' and 'veit.launch sim:=false sr300:=false' on two separate lines.

```
intertbotix@intertbotix-widowx: ~/widowx_arm
intertbotix@intertbotix-widowx:~$ ls
4.10.0-33-generic-uvcdvideo.ko  Documents          Pictures
4.10.0-35-generic-uvcdvideo.ko  Downloads          Public
4.4.0-96-generic-uvcdvideo.ko   enable_kernel_sources.sh  Templates
4.8.0-36-generic-uvcdvideo.ko   examples.desktop      Videos
BLAH                             librealsense         widowx_arm
Desktop                          Music
intertbotix@intertbotix-widowx:~$ cd widowx_arm/
intertbotix@intertbotix-widowx:~/widowx_arm$ source devel/setup.bash
intertbotix@intertbotix-widowx:~/widowx_arm$ roslaunch widowx_arm_bringup arm_mo
veit.launch sim:=false sr300:=false
```

This should load RVIZ with the proper WidowX arm bringup. You can move the arm using the visual representation on screen, choosing one of the many “Planning Library” under the Context tab and then hitting “Plan and Execute” under the Planning Tab. There are also several presets you can choose from. Once you’re done, you can close the program by returning to your terminal window and pressing CTRL + C.

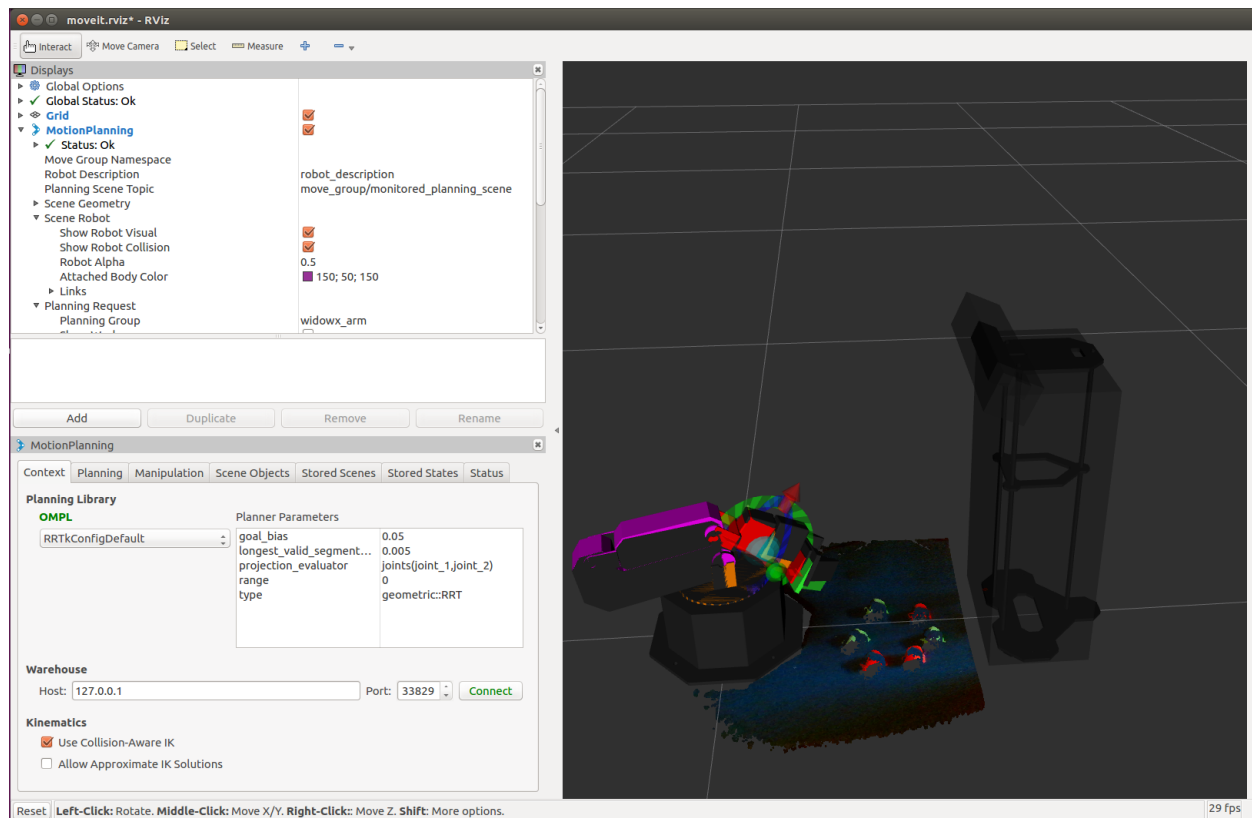


2.7 ROS control of the arm with the SR300 Sensor

Open up a terminal window and enter the following commands

```
cd ~/widowx_arm
source devel/setup.bash
roslaunch widowx_arm_bringup arm_moveit.launch sim:=false sr300:=true
```

This should load RVIZ with the proper WidowX arm bringup, as well as load in the drivers for the SR300. You should see a 3D point map representation of your workspace on the right. You can still move the arm using the visual representation on screen, and hitting “Plan and Execute” under the Planning Tab. We need to move the arm so that we can adjust the camera angle and position.



2.8 Arranging your SR300

Keep the previous terminal open and change a few things in RVIZ. Under the Planning tab, in the Query options you will find the “Select Goal State” option. Select the `pulled_back_pose` from the goal state. Press Update, then press Plan and Execute. Your arm should move back to a pulled back state, allowing the camera to see the base of the WidowX. Change your view to a side view of the arm and camera representation. Move the SR300’s angle so that the representation of the workspace is level to the base of the WidowX on-screen. Change your view to an overhead view of the workspace. Move the Camera Stand so that the outline of the base of the WidowX matches to the cutout of the WidowX base on the SR300.

Open a second Terminal window. This will be a control window, so keep it visible when possible

```
cd ~/widowx_arm
source devel/setup.bash
roslaunch widowx_block_manipulation block_sorting_demo.launch
```

This demo will allow us to do some new things that utilize the SR300’s object detection abilities! Place blocks of different colors in the workspace (default are red and green), and in the terminal, type `d` for **detection of the blocks** and hit Enter. Where the blocks were, there should be gray cubes shown on screen. At this point, you can either automatically sort all blocks detected by typing `o` (organize) in the terminal and hitting Enter or you can use the 3D representation of the object in RVIZ to pick and place the block wherever you like on the x and y axis.

Options

```

/home/intertbotix/widowx_arm/src/widowx_block_manipulation/launch/block_sorting_de
process[block_detection_action_server-1]: started with pid [6856]
process[pick_and_place_action_server-2]: started with pid [6857]
process[interactive_manipulation_action_server-3]: started with pid [6858]
process[block_manipulation_demo-4]: started with pid [6859]
[ INFO] [1508189363.159695288]: Loading robot model 'widowx_arm'...
[ INFO] [1508189363.448713797]: Gripper settings: closed=0.0160 block size=0.020
0 tighten=0.0040
[ INFO] [1508189363.448785745]: Sorting settings: z_up=0.16 target_x=0.0000 targ
et_y=-0.1500
[ INFO] [1508189363.448814637]: Finished initializing, waiting for servers...
[ INFO] [1508189363.558809970]: joint_1 -2.617 2.617 1
[ INFO] [1508189363.559231900]: joint_2 -1.571 1.571 1
[ INFO] [1508189363.559341017]: joint_3 -1.571 1.571 1
[ INFO] [1508189363.559416292]: joint_4 -1.745 1.745 1
[ INFO] [1508189363.559486746]: joint_5 -2.617 2.617 1
[ INFO] [1508189364.308711525]: 1. Found block_detection server.
[ INFO] [1508189364.308786180]: 2. Found interactive_manipulation server.
[ INFO] [1508189364.690516751]: Ready to take commands for planning group widowx
_arm.
[ INFO] [1508189364.843573692]: Ready to take commands for planning group widowx
_gripper.
[ INFO] [1508189365.112807473]: 3. Found pick_and_place server.
d - Detect, o - Organize

```

Detection of Blocks

```

/home/intertbotix/widowx_arm/src/widowx_block_manipulation/launch/block_sorting_de
1m z side 0.0223219m angle: 0.597225
[ INFO] [1508189627.075026251]: Adding a new block! x=0.163 y=-0.015 z=-0.008
[ WARN] [1508189627.075066259]: New block color RGB: 60, 93, 56; cluster size: 6
23
[ WARN] [1508189627.075153388]: Block detection failed on cluster 8 with size xy
z: 0.033338, 0.0216363, 0.00426657; XYZ eval: 1, 1, 0
[ INFO] [1508189627.075290549]: [block detection] Succeeded!
[ INFO] [1508189627.077689871]: Got block detection callback. Adding blocks.
[ INFO] [1508189627.077901594]: Added block # 1
[ INFO] [1508189627.077963464]: Added block # 2
[ INFO] [1508189627.078014250]: Added block # 3
[ INFO] [1508189627.078085635]: Added block # 4
[ INFO] [1508189627.078134568]: Added block # 5
[ INFO] [1508189627.078186986]: Added block # 6
[ INFO] [1508189627.079285258]: [interactive manipulation] Received goal! 0.0200
00, /arm_base_link
[ INFO] [1508189627.079377075]: Got block detection callback. Adding blocks.
[ INFO] [1508189627.079544260]: Added block # 1
[ INFO] [1508189627.079660691]: Added block # 2
[ INFO] [1508189627.079769598]: Added block # 3
[ INFO] [1508189627.079889611]: Added block # 4
[ INFO] [1508189627.080002322]: Added block # 5
[ INFO] [1508189627.080140409]: Added block # 6

```

Organize/Sort the red and green blocks

```

/home/intertbotix/widowx_arm/src/widowx_block_manipulation/launch/block_sorting_de
00, /arm_base_link
[ INFO] [1508193884.160279783]: Got block detection callback. Adding blocks.
[ INFO] [1508193884.160331014]: Added block # 1
[ INFO] [1508193884.160370122]: Added block # 2
[ INFO] [1508193884.160411425]: Added block # 3
[ INFO] [1508193884.160455477]: Added block # 4
[ INFO] [1508193884.160501196]: Added block # 5
o
[ INFO] [1508193888.983378293]: Organizing Blocks: Block # 1, RGB: 38, 85, 59
d - Detect, o - Organize
[ INFO] [1508193888.985189346]: [pick and place] Received goal!
[ INFO] [1508193888.985355778]: Replanning: yes
[ INFO] [1508193888.985404994]: [pick and place] Picking. Also placing.
[ INFO] [1508193889.250896287]: [pick and place] Move arm to [0.23x, 0.06y, 0.16
z, 0.67yaw]
[ INFO] [1508193889.250969898]: z increase: 0.160000 + 0.009403
[ INFO] [1508193889.251009458]: Set pose target [0.23, 0.06, 0.16] [d: 0.24, p:
1.08, y: 0.28]
[ INFO] [1508193891.933365797]: [pick and place] Move arm to [0.23x, 0.06y, 0.07
z, 0.67yaw]
[ INFO] [1508193891.933686107]: z increase: 0.068132 + 0.009403
[ INFO] [1508193891.933911128]: Set pose target [0.23, 0.06, 0.07] [d: 0.24, p:
1.08, y: 0.28]

```


CHAPTER 3

License

The documentation is licensed under a [Creative Commons Attribution-ShareAlike 3.0 Unported License](#).



Frequently Asked Questions

4.1 1. Where can I get more information about the TurtleBot3?

You can find more detailed information about the WidowX ARM in the following link: <http://learn.trossenrobotics.com/interbotix/robot-arms/widowx-arm>

4.2 2. Where can I order the WidowX ARM from?

You can order them at Trossen's online shopping website <http://www.trossenrobotics.com/widowxrobotarm>

4.3 3. What changed in the documentation recently?

`changelog.rst`

CHAPTER 5

Contact

For specific enquiries contact aravind AT dabit.industries

CHAPTER 6

Changelog - [development]

- Applied Sphinx RTD Theme
- Added setup procedure with ROS
- Included youtube videos in about page
- Added screenshots in ROS setup page