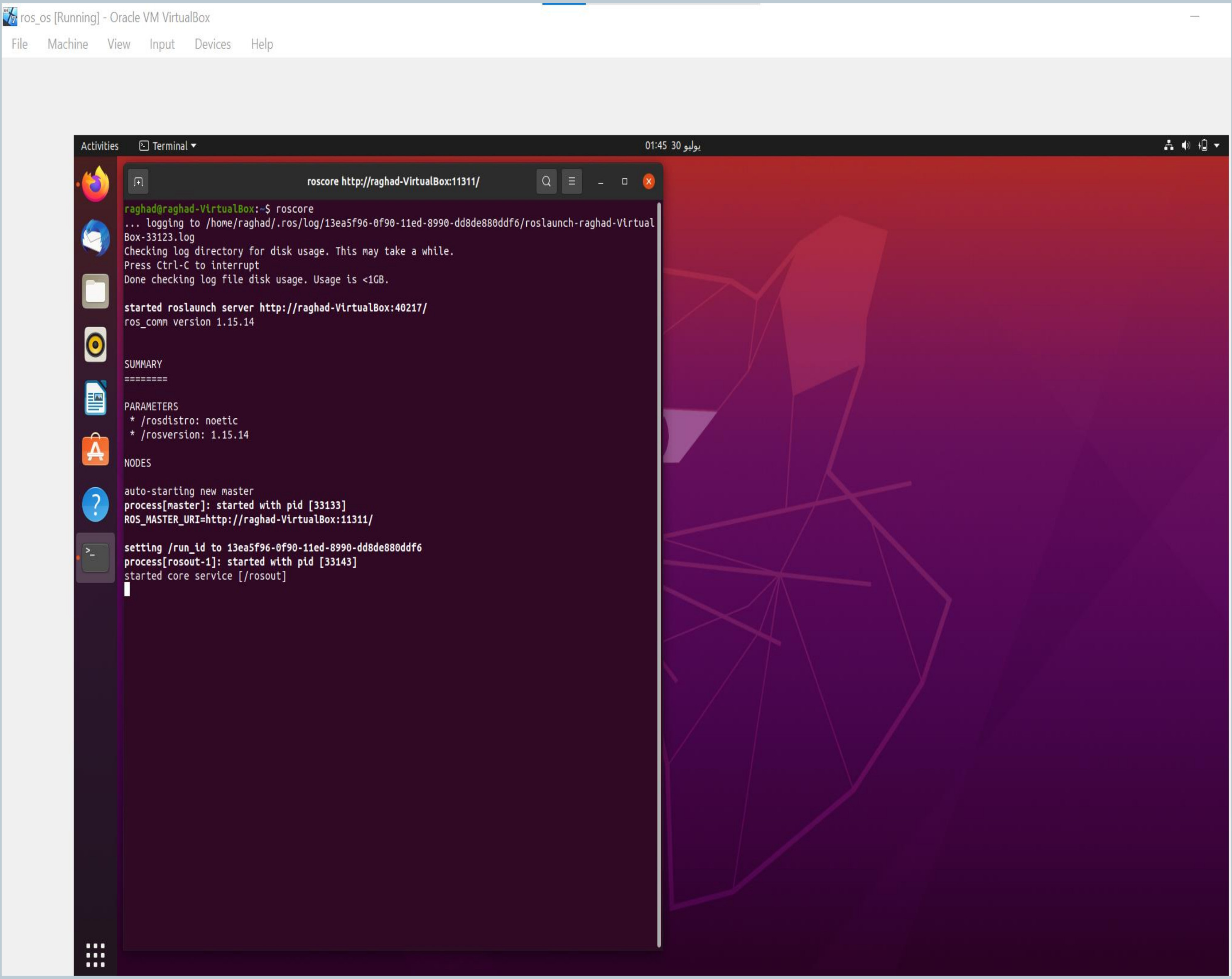
Arduino Robot Arm

step1: Ensure that the ROS system is installed correctly



ros_os [Running] - Oracle VM VirtualBox
File
Machine
View
Input
Devices
Help
Activities
Terminal
01:45 30 يوليو
roscore http://raghad-VirtualBox:11311/

```
raghad@raghad-VirtualBox:~$ roscore
... logging to /home/raghad/.ros/log/13ea5f96-0f90-11ed-8990-dd8de880ddf6/roslaunch-raghad-Virtual
Box-33123.log
Checking log directory for disk usage. This may take a while.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

started roslaunch server http://raghad-VirtualBox:40217/
ros_comm version 1.15.14


SUMMARY
========

PARAMETERS
 * /rosdistro: noetic
 * /rosversion: 1.15.14

NODES

auto-starting new master
process[master]: started with pid [33133]
ROS_MASTER_URI=http://raghad-VirtualBox:11311/

setting /run_id to 13ea5f96-0f90-11ed-8990-dd8de880ddf6
process[rosout-1]: started with pid [33143]
started core service [/rosout]
```

step2: Writing commands to install the arm in the terminal

```
$ sudo apt-get install ros-noetic-catkin

$ mkdir -p ~/catkin_ws/src

$ cd ~/catkin_ws/

$ catkin_make

$ cd ~/catkin_ws/src

$ git clone https://github.com/smart-methods/arduino_robot_arm.git

$ cd ~/catkin_ws

$ rosdep install --from-paths src --ignore-src -r -y

$ sudo apt-get install ros-kinetic-moveit

$ sudo apt-get install ros-kinetic-joint-state-publisher ros-kinetic-joint-state-publisher-gui

$ sudo apt-get install ros-kinetic-gazebo-ros-control joint-state-publisher

$ sudo apt-get install ros-kinetic-ros-controllers ros-kinetic-ros-control

$ sudo nano ~/.bashrc
```

at the end of the (bashrc) file add the follwing line

```
(source /home/wesam/raghad/devel/setup.bash)
```

Not: Raghad's name in the code differs from person to person. Place your registered username in its placeز

then

ctrl + o

```
$ source ~/.bashrc

$roslaunch robot_arm_pkg check_motors.launch
```

Dependencies

run this instruction inside your workspace:

```
$ rosdep install --from-paths src --ignore-src -r –y
```

make sure you installed all these packages ↓

for kinetic distro

```
$ sudo apt-get install ros-kinetic-moveit
```

```
$ sudo apt-get install ros-kinetic-joint-state-publisher ros-kinetic-joint-state-publisher-gui
```

```
$ sudo apt-get install ros-kinetic-gazebo-ros-control joint-state-publisher
```

```
$ sudo apt-get install ros-kinetic-ros-controllers ros-kinetic-ros-control
```

for melodic distro

```
$ sudo apt-get install ros-melodic-moveit
```

```
$ sudo apt-get install ros-melodic-joint-state-publisher ros-melodic-joint-state-publisher-gui
```

```
$ sudo apt-get install ros-melodic-gazebo-ros-control joint-state-publisher
```

```
$ sudo apt-get install ros-melodic-ros-controllers ros-melodic-ros-control
```

for noetic distro

```
$ sudo apt-get install ros-noetic-moveit
```

```
$ sudo apt-get install ros-noetic-joint-state-publisher ros-noetic-joint-state-publisher-gui
```

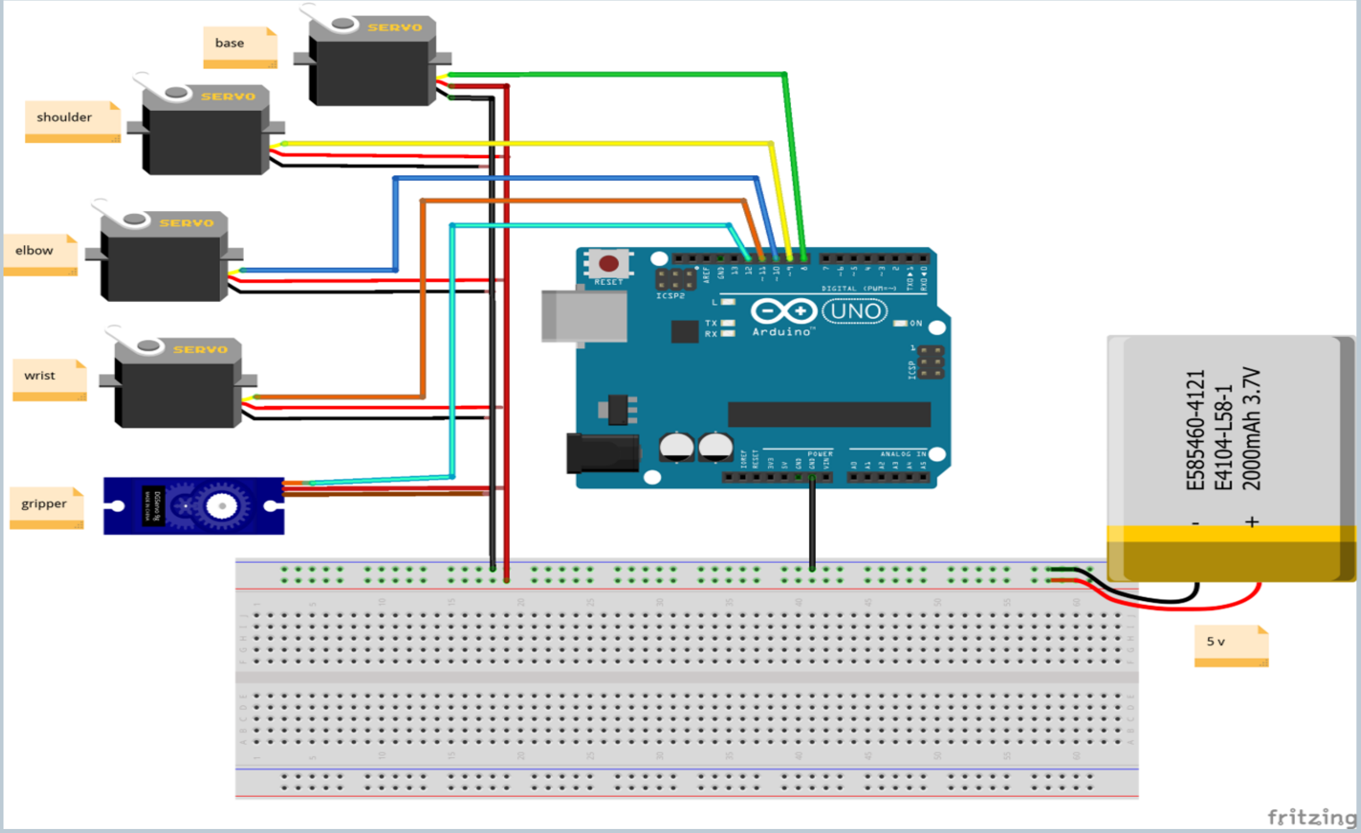
```
$ sudo apt-get install ros-noetic-gazebo-ros-control joint-state-publisher
```

```
$ sudo apt-get install ros-noetic-ros-controllers ros-noetic-ros-control
```

Robot Arm

The robot arm has 5 joints only 4 joints can be fully controlled via ROS and Rviz, the last joint (gripper) has a default motion executed from the Arduino code directly.

Circuit diagram



Robot initial positions

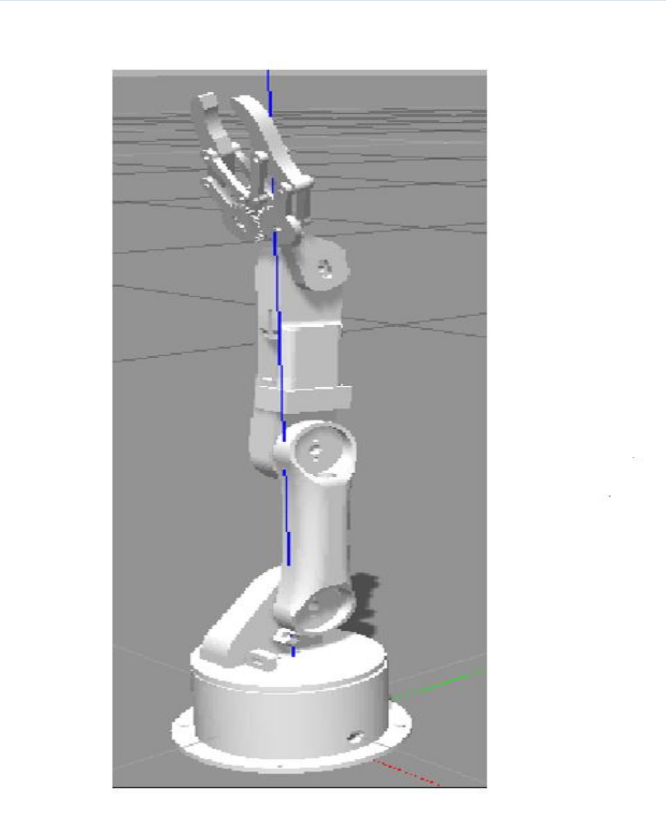
the base 90

The Shoulder 90

The Elbow 90

The Wrist 90

Gripper 0 closed



Usage

Controlling the robot arm by joint_state_publisher

```
$ roslaunch robot_arm_pkg check_motors.launch
```

You can also connect with hardware by running:

```
$ rosrun rosserial_python serial_node.py _port:=/dev/ttyUSB0 _baud:=115200
```

(Note: You may need to use ttyACM)

Simulation

Run the following instructions to use gazebo

```
$ roslaunch robot_arm_pkg check_motors.launch
```

```
$ roslaunch robot_arm_pkg check_motors_gazebo.launch
```

```
$ rosrun robot_arm_pkg joint_states_to_gazebo.py
```

(You may need to change the permission)

```
$ sudo chmod +x ~/catkin_ws/src/arduino_robot_arm/robot_arm_pkg/scripts/joint_states_to_gazebo.py
```

Controlling the robot arm by Moveit and kinematics

```
$ roslaunch moveit_pkg demo.launch
```

You can also connect with hardware by running:

```
$ rosrun rosserial_python serial_node.py _port:=/dev/ttyUSB0 _baud:=115200
```

(Note: You may need to use ttyACM)

Simulation

Run the following instruction to use gazebo

```
$ roslaunch moveit_pkg demo_gazebo.launch
```

Pick and place by using OpenCV

Preparation

Download webcam extension for VirtualBox

https://scribles.net/using-webcam-in-virtualbox-guest-os-on-windows-host/

Testing the camera and OpenCV

Run color_thresholding.py to test the camera

Before running, find the camera index normally it is video0

```
$ ls -l /dev | grep video
```

If it is not, update line 8 in color_thresholding.py

```
8 cap=cv2.VideoCapture(0)
```

Then run

```
$ python color_thresholding.py
```

Using OpenCV with the robot arm in ROS

- **In a terminal run**

```
$ roslaunch moveit_pkg demo.launch
```

this will run Rviz

- **connect with Arduino:**

1. **select the Arduino port to be used on Ubuntu system**
2. **change the permissions (it might be ttyACM)**

```
$ ls -l /dev | grep ttyUSB
```

```
$ sudo chmod -R 777 /dev/ttyUSB0
```

3. **upload the code from Arduino IDE**

```
$ rosrun rosserial_python serial_node.py _port:=/dev/ttyACM0 _baud:=115200
```

- **In another terminal**

```
$ rosrun moveit_pkg get_pose_openCV.py
```

This will detect blue color and publish the x,y coordinates to /direction topic

(Note: check the camera index and update the script if needed)

- **Open another terminal**

```
$ rosrun moveit_pkg move_group_node
```

This will subscribe to /direction topic and execute motion by using Moveit move group

The pick and place actions are performed from the Arduino sketch directly.

In simulation (Gazebo)

- **In a terminal run**

```
$ roslaunch moveit_pkg demo_gazebo.launch
```

this will run Rviz and gazebo

- **In another terminal**

```
$ rosrun moveit_pkg get_pose_openCV.py
```

This will detect blue color and publish the x,y coordinates to /direction topic

(Note: check the camera index and update the script if needed)

- **Open another terminal**

```
$ rosrun moveit_pkg move_group_node
```

This will subscribe to /direction topic and execute motion by using Moveit move group