

Introduction to ROS

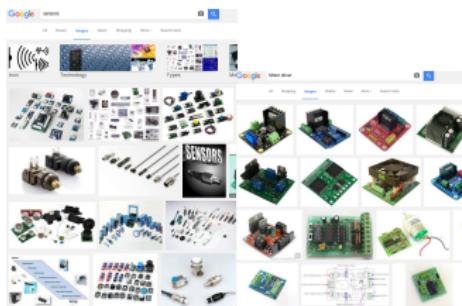
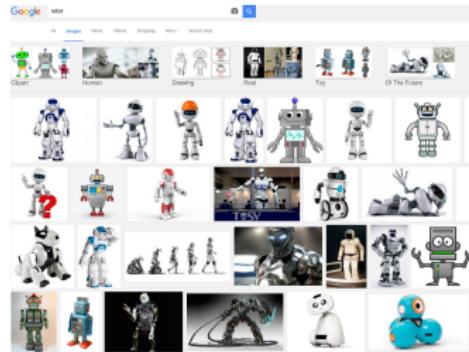
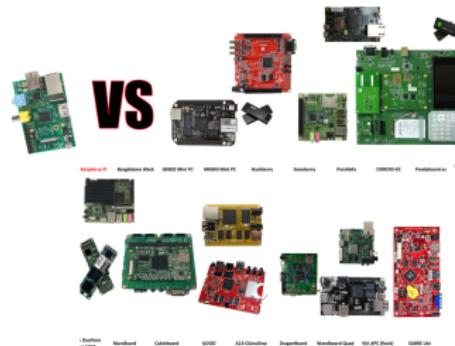
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March 19, 2016

Why We need ROS?

- ▶ Lack of standards for robotics.
- ▶ Thousand of sensors.
- ▶ Every day new embedded board create.
- ▶ Motors driver.



What is ROS?

- ▶ ROS is an open-source robot operating system.
- ▶ A set of software libraries and tools that help you build robot applications that work across a wide variety of robotic platforms.
- ▶ Originally developed in 2007 at the Stanford Artificial Intelligence Laboratory and development continued at Willow Garage.
- ▶ Since 2013 managed by OSRF (Open Source Robotics Foundation)
- ▶ [ROS celebrating 5 years video](#)

ROS releases ...

Distro	Release date	Poster	EOL date
Kinetic Kame	May, 2016	TBA	2021-05-30
Jade	May 23, 2015		2017-05-30
Indigo	July 22, 2014		2019-04-30
Hydro	September 4, 2013		2014-05-31
Groovy Galapagos	December 31, 2012		2014-07-31

ROS Supported Platforms

- ▶ ROS is currently supported only on Ubuntu, other variants such as Windows and Mac OS X are considered experimental (will be supported on ROS 2.0).
- ▶ ROS distribution supported is limited to \leq 3 latest Ubuntu versions.
- ▶ ROS Jade supports the following Ubuntu versions:
 - ▶ Vivid (15.04)
 - ▶ Utopic (14.04)
 - ▶ Trusty (14.04 LTS)
- ▶ ROS Indigo supports the following Ubuntu versions:
 - ▶ Trusty (14.04 LTS)
 - ▶ Saucy (13.10)

Tools Need

- ▶ Setup Ubuntu
- ▶ Setup ROS

Setup Ubuntu

- ▶ Download ISO files
- ▶ Using a DVD
- ▶ Using a USB drive

Create Live USB Ubuntu from Windows 01

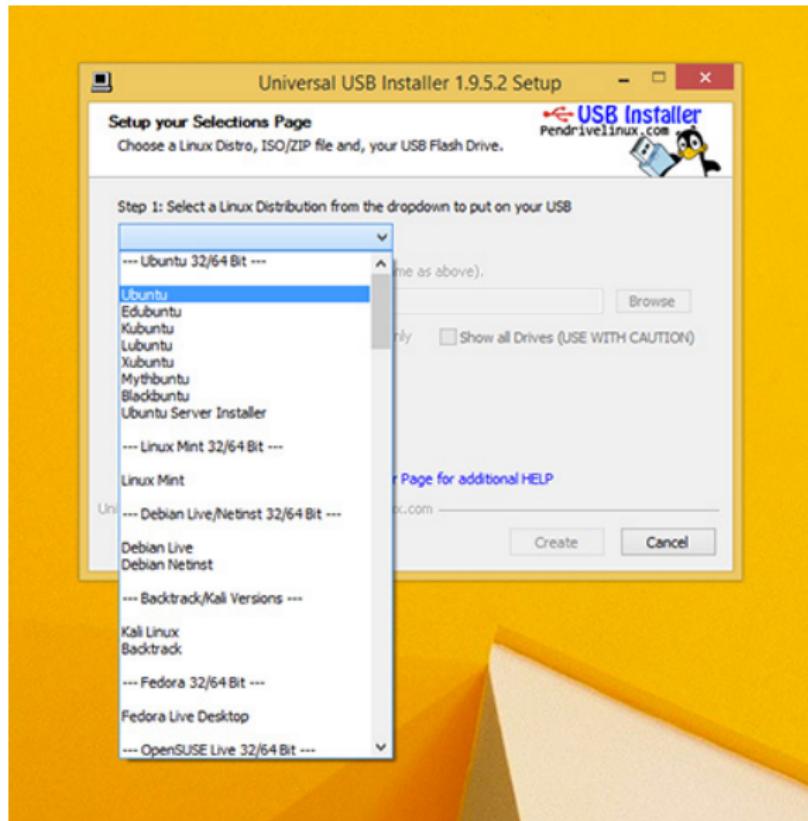


Figure : 1

Create Live USB Ubuntu from Windows 02

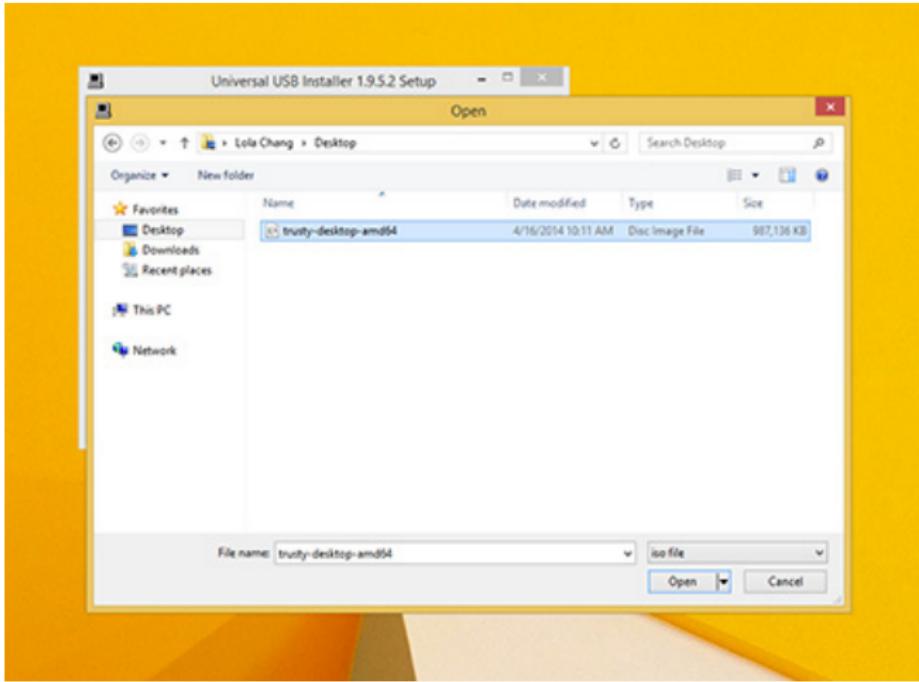


Figure : 2

Create Live USB Ubuntu from Windows 03

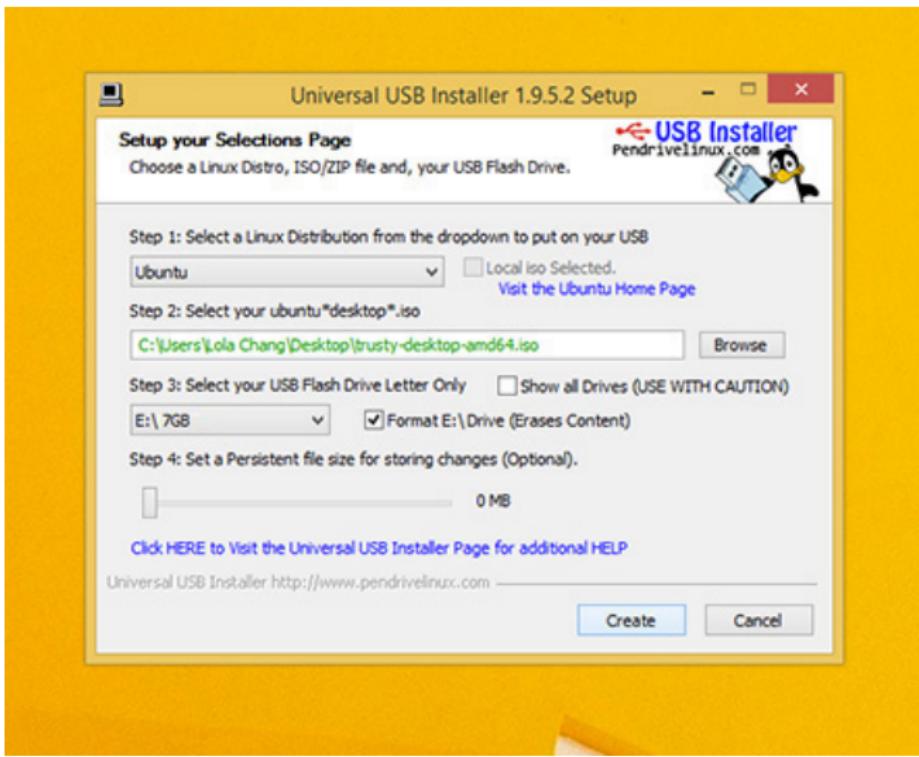


Figure : 3

setup ubuntu 01

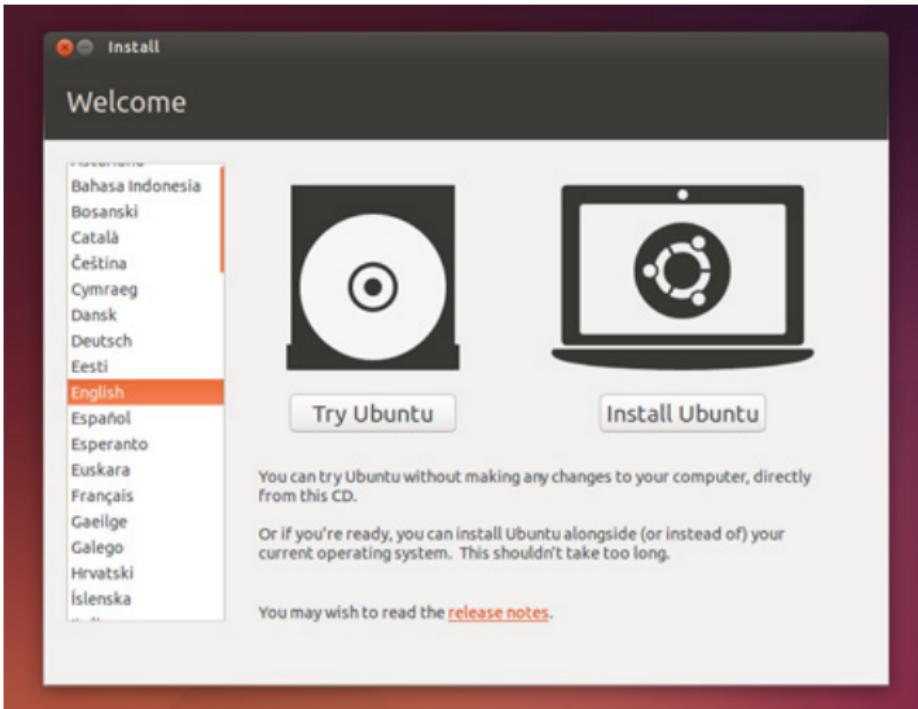


Figure : 1

setup ubuntu 02

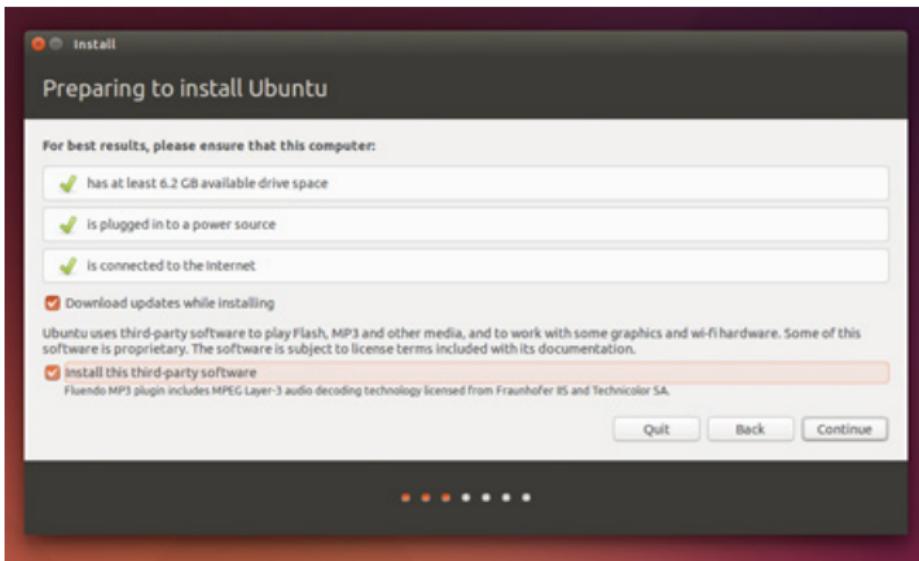


Figure : 2

setup ubuntu 03

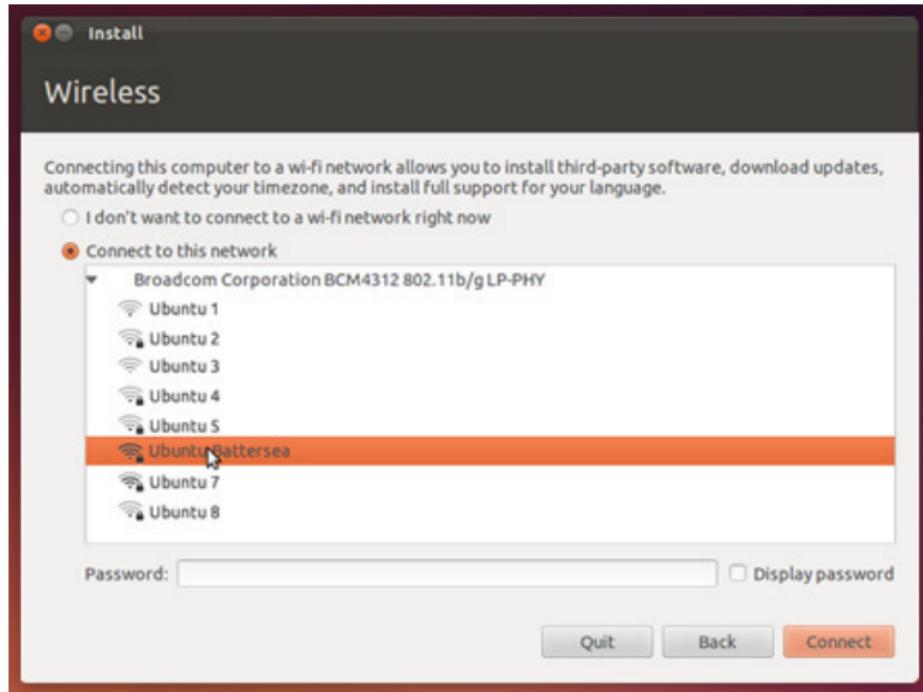


Figure : 3

setup ubuntu 04

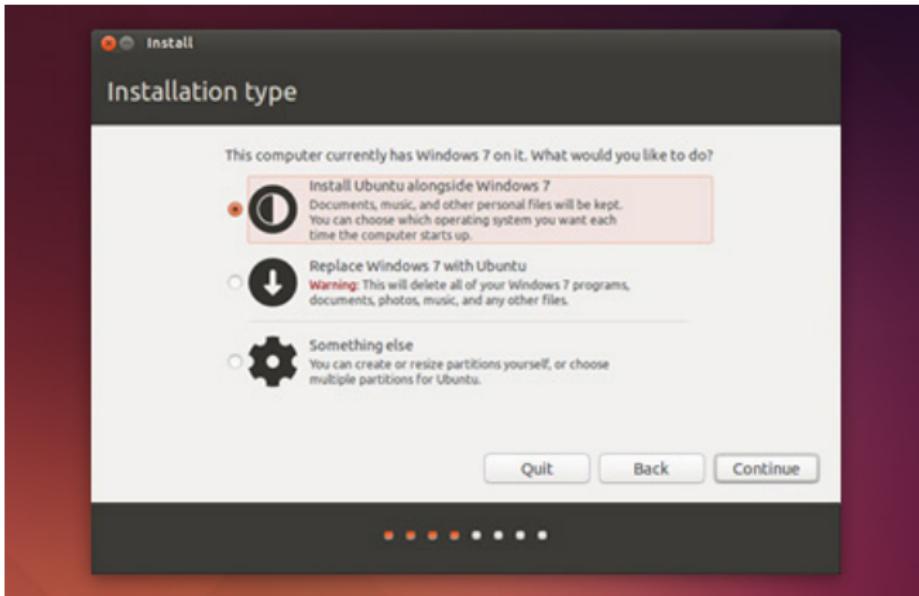


Figure : 4

setup ubuntu 05

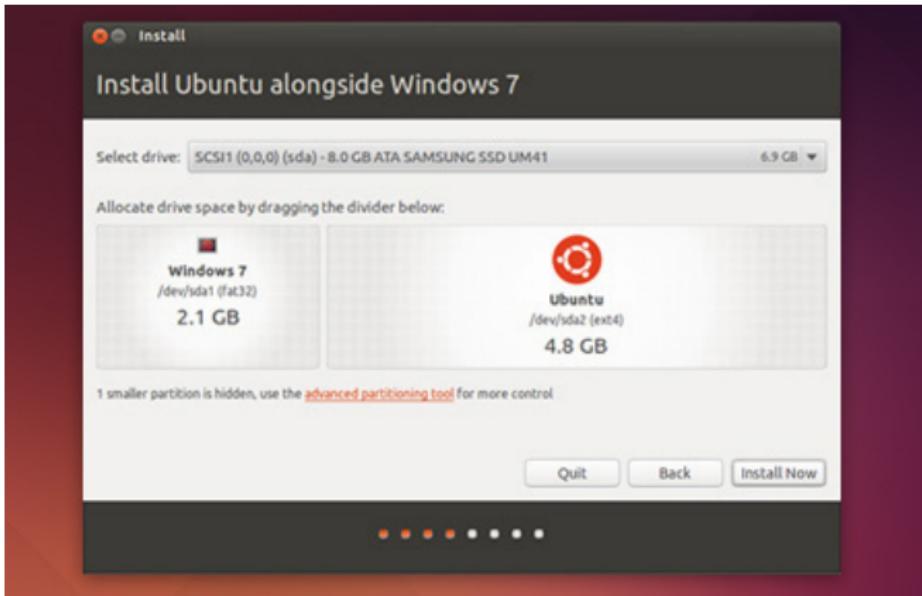


Figure : 5

setup ubuntu 06

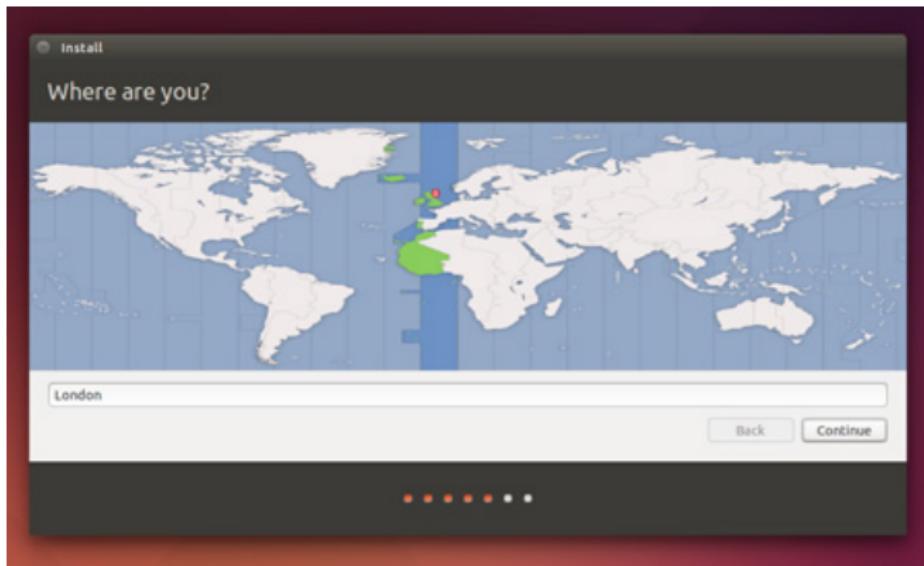


Figure : 6

setup ubuntu 07

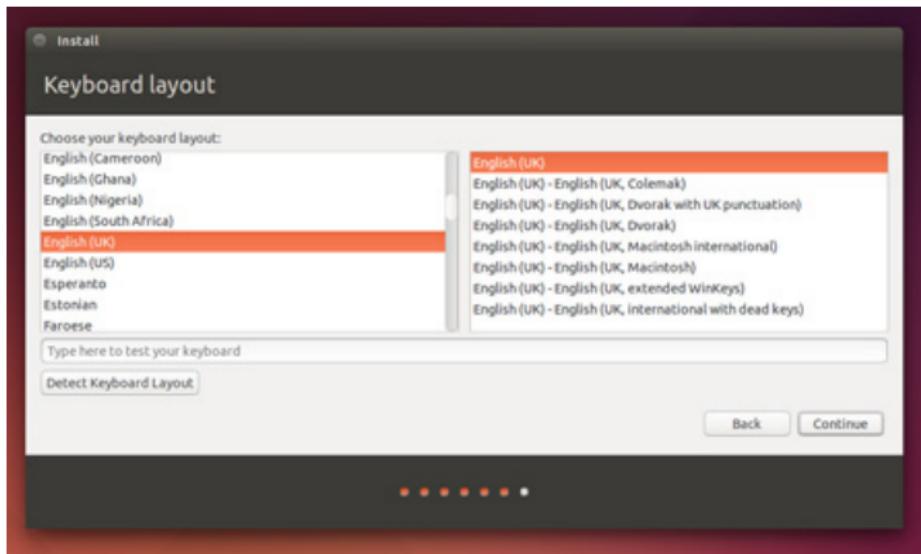


Figure : 7

setup ubuntu 08

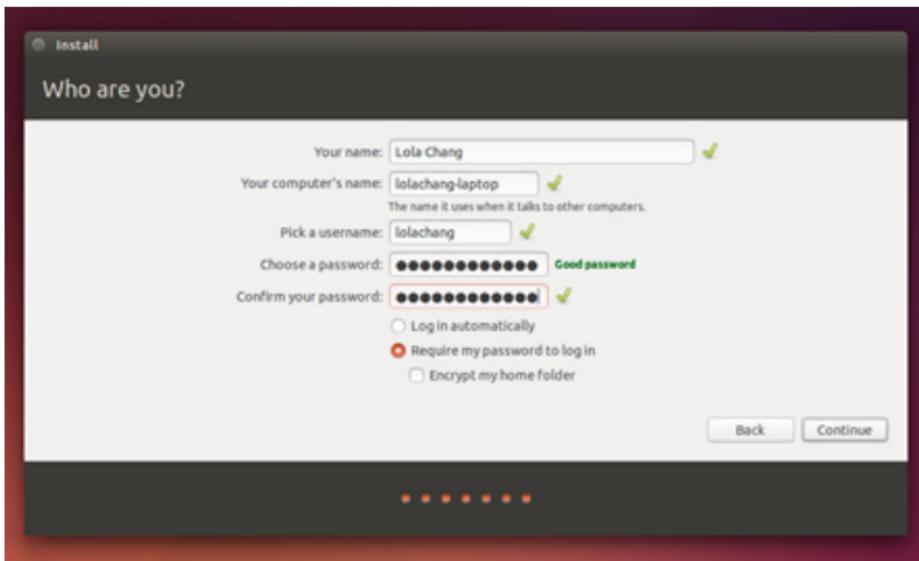


Figure : 8

setup ubuntu 09



Figure : 9

setup ubuntu 10

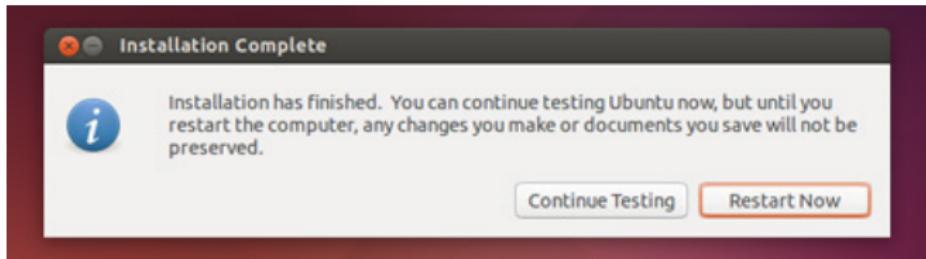


Figure : 10

Virtual Box

- ▶ login: viki
- ▶ password: viki

Setting	32bits VM	64bits VM
RAM	1024MB	3092MB
CPU	1 core	2 cores
HDD	50GB dynamically allocated	50GB dynamically all
Video Memory	12MB	32MB
2D/3D Video Acceleration	No/No	Yes/Yes
Bidirectional Copy/Past	Yes	Yes
Bidirectional Drag'n Drop	Yes	Yes

Figure : 11

ROS Installation

Select Your Platform

Supported:



Source installation

Experimental:



Unofficial Installation Alternatives:



Or Select Your Robot

By browsing the robots supported here: [Robots](#)

- ▶ After install Ubuntu, you can follow the instructions:
<http://wiki.ros.org/indigo/Installation>.
- ▶ Select Your Robot or stand installation.
- ▶ Or You can download a VM with ROS Indigo preinstalled.

Turt

1. Portals

Portal pages help you install and use ROS software on specific robot platforms.

Setup Turtlebot

The screenshot shows the ROS.org website with the URL <http://ros.org>. The main navigation bar includes links for Documentation, Browse Software, News, and Download. Under the Documentation section, there is a link to Robots/TurtleBot. The page content for TurtleBot includes a brief description, two images of the robot, and a sidebar with a table of contents. The table of contents lists sections such as Overview, Alsted, Preparation, Bringup, Applications, Simulation, Development Concol, Appendix, Contributing, and Support.

ROS.org

About | Support | Status | answers.ros.org

Search: Submit

Documentation Browse Software News Download

Robots/ [TurtleBot](#)

TurtleBot

TurtleBot combines popular off-the-shelf robot components like the iRobot Create, Yujin Robot's Kobuki, Microsoft's Kinect and Asus' Xtion Pro into an integrated development platform for ROS applications. For more information about hardware, please see <http://turtlebot.com>.

curlie	diamondback	electric	fuerte	groovy	hydro	indigo	jade	kinetic
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BDFLs: [Tully Foote](#) (OSRF), [Melonee Wise](#) (Fetch Robotics)

ROS SW Maintainers: [Michael Ferguson](#) (Fetch Robotics), [Tully Foote](#) (OSRF), [JihoonLee](#) (Yujin Robot), [Daniel Stonier](#) (Yujin Robot)

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- 2. Alsted
- 3. Preparation
- 4. Bringup
- 5. Applications
- 6. Simulation
- 7. Development Concol
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- 10. Support

- ▶ You can follow the instructions:
<http://wiki.ros.org/Robots/TurtleBot>.
- ▶ Install from ISO file, the ISO file will install:
 - ▶ Ubuntu 14.04.2
 - ▶ ROS Indigo
 - ▶ Turtlebot Library
- ▶ Link to download ISO file
<http://download.ros.org/downloads/turtlebot/ubuntu-14.04.2-desktop-amd64-turtlebot-RC0.iso>

ROS Environment

- ▶ ROS relies on the notion of combining spaces using the shell environment.
- ▶ This makes developing against different versions of ROS or against different sets of packages easier.
- ▶ After install ROS, we need to setup the Ubuntu environment to recognize the ROS functions.
- ▶ We need to add `source /opt/ros/indigo/setup.bash` to **.bashrc**

ROS with Turtlebot Environment

If we use the Trutlebot "White Robot", we need to setup our environment with the following, edit and add to **.bashrc**:

```
export TURTLEBOT_BASE=create  
export TURTLEBOT_STACKS=circles  
export TURTLEBOT_3D_SENSOR=kinect  
export TURTLEBOT_SERIAL_PORT=/dev/ttyUSB0
```

Test ROS

Tutorials from simple instructions to advance programming can be found in this link <http://wiki.ros.org/ROS/Tutorials>

ROS Philosophy

- ▶ **Peer to Peer:** ROS systems consist of numerous small computer programs which connect to each other and continuously exchange messages.
- ▶ **Tools-based:** There are many small, generic programs that perform tasks such as visualization, logging, plotting data streams, etc.
- ▶ **Multi-Lingual:** ROS software modules can be written in any language for which a client library has been written. Currently client libraries exist for C++, Python, LISP, Java, JavaScript, MATLAB, Ruby, and more.
- ▶ **Thin:** The ROS conventions encourage contributors to create stand-alone libraries and then wrap those libraries so they send and receive messages to/from other ROS modules.
- ▶ Free and open source.

Source: [Programming Robots with ROS](#)

ROS Core Concepts

- ▶ Nodes
- ▶ Messages and Topics
- ▶ Services
- ▶ ROS Master
- ▶ Parameters
- ▶ Stacks and packages

ROS Basic Commands

- ▶ Try the following command: `roscore`, and dont close the terminal, to exit from roscore use `Ctrl+c`.
- ▶ In new terminal try: `rosservice list`. this will show the Service run in the background with roscore command.
- ▶ `rostopic list`. this will show the Topics run in the background with roscore command.
- ▶ `rosnode list` I think you know what it will show!!

Exit from roscore by `Ctrl+c`

turtlesim tutorial .1

- ▶ `sudo apt-get install ros-indigo-turtlesim`
- ▶ In terminal No.1 `roscore`
- ▶ In terminal No.2 `rosrun turtlesim turtlesim_node`
- ▶ In terminal No.3 try `rostopic`, `rosnode`, `rosservice`.
- ▶ In terminal No.3 `rosnode list`
- ▶ In terminal No.3 `rosnode ping turtlesim`

turtlesim tutorial .2, ROS topic

- ▶ In terminal No.3 `rosrun turtlesim turtle_teleop_key` now you can control the robot using your keyboard.
- ▶ In terminal No.4 `rostopic -h`
- ▶ In terminal No.4 `rostopic list`
- ▶ In terminal No.4 `rostopic echo /turtle1/cmd_vel`, to exit use `Ctrl+c`.
- ▶ In terminal No.4 `rostopic echo /turtle1/pose`

turtlesim tutorial .3, ROS Messages

- ▶ In terminal No.3 `rosrun turtlesim turtle_teleop_key` now you can control the robot using your keyboard.
- ▶ In terminal No.4 `rostopic list -v`
- ▶ In terminal No.4 `rostopic type /turtle1/cmd_vel`
- ▶ In terminal No.4 `rosmsg show geometry_msgs/Twist`
- ▶ `rostopic pub -1 /turtle1/cmd_vel geometry_msgs/Twist -- '[2.0, 0.0, 0.0]' '[0.0, 0.0, 0.0]'`
- ▶ for full details <http://wiki.ros.org/ROS/Tutorials/UnderstandingTopics>
- ▶ In terminal No.4
`rostopic type /turtle1/cmd_vel | rosmsg show`

turtlesim tutorial .4, ROS Services

- ▶ In terminal No.4 `rosservice list`
- ▶ In terminal No.4 `rosservice type clear`
- ▶ In terminal No.4 `rosservice call /clear`
- ▶ In terminal No.4 `rosservice type spawn | rossrv show`

.Spawns a turtle at (x, y, theta) and returns the name of the turtle. Also will take name for argument but will fail if a duplicate name.
- ▶ In terminal No.4 `rosservice call spawn 2 2 0.2 ""`

turtlesim tutorial .5, ROS Parameter Server

rosparam allows you to store and manipulate data on the ROS Parameter Server.

- ▶ In terminal No.4 `rosparam -h`
- ▶ In terminal No.4 `rosparam list`
- ▶ In terminal No.4 `rosparam set background_r 150` and then call `rosservice call clear`
- ▶ In terminal No.4 `rosparam get background_g`
- ▶ In terminal No.4 `rosparam get /`

ROS Turtlebot .1

- ▶ In terminal No.1

```
sudo apt-get install ros-indigo-turtlebot-simulator
```

- ▶ In terminal No.1

```
roslaunch turtlebot_stage turtlebot_in_stage.launch
```

- ▶ In terminal No.2

```
roslaunch turtlebot_teleop keyboard_teleop.launch
```

ROS Turtlebot .2

- ▶ In terminal No.1

```
sudo apt-get install ros-indigo-turtlebot-apps ros-indigo-turtlebot-rv
```

- ▶ In terminal No.1

```
roslaunch turtlebot_gazebo turtlebot_world.launch
```

- ▶ In terminal No.2

```
roslaunch turtlebot_teleop keyboard_teleop.launch
```

- ▶ In terminal No.3

```
roslaunch turtlebot_rviz_launchers view_robot.launch
```