
sensor-documentation Documentation

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Contents:

1.1 Introduction

This document provides insight into some of the sensor used in robotics. But first, I would like to start with discussing the need for sensors in robots. To operate in real world environment robots need to see the obstacles and possibly manipulate them depending on application. The sensors considered here mostly focus on laser based sensing. To allow for remote sensing, means the robot should be able to tell some characteristics of an object from a distance. When a laser is used to measure the distance in an arc around the robot, it is called LIDAR. LIDAR is combination of Light and Radar, essentially a sweeping radar beam, using light.

The following sections provide user manual for installation and testing of software for the respective sensors. All the installation was performed on system running Ubuntu 16.04 LTS unless otherwise specified.

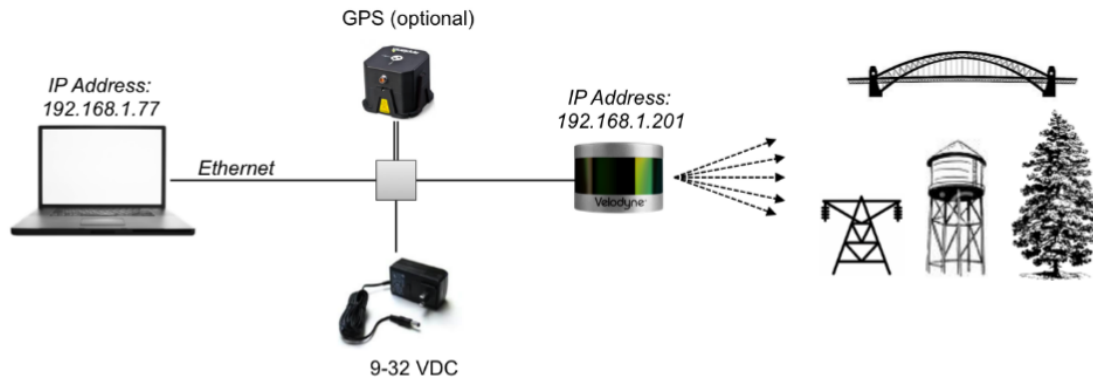
1.2 Velodyne VLP - 16

1.2.1 Introduction

The VLP-16 creates 360° 3D images by using 16 laser/detector pairs mounted in a compact housing. The housing rapidly spins and the lasers fire thousands of times per second, providing a 3D point cloud in real time. Figure 1 shows an imaging system where LiDAR is used.

Some of the important features include:

1. Horizontal Field of View (FOV) of 360°
2. Vertical Field of View of 30°
3. Rotational speed of 5-20 rotations per second (adjustable)
4. Returns of up to 100m (useful range depends on application).



1.2.2 Software Installation

The following guide walks you through the installation steps for using the VeloView software that comes with Velodyne VLP-16. This guide developed by installing the software on system running Ubuntu 16.04LTS. For installation steps on other platforms refer the site VeloView wiki and downloads.

Installation steps:

1. Getting the source code

Open the terminal and change the directory where you want to install the software. Then use the following command to pull the source files.

Note: This assumes git is already installed on the system, if not use `$ sudo apt-get install git` command before following the next steps.

```
$ git clone git://public.kitware.com/VeloView.git
```

2. Configuring and building

1. First we need to install all the dependencies if they are already not installed. Follow the instructions below to set it up on your system:

```
$ sudo apt-get install cmake-curses-gui
$ sudo apt-get install build-essential
$ sudo apt-get install libboost-all-dev
$ sudo apt-get install libxt-dev
$ sudo apt-get install libbz2-dev
$ sudo apt-get install libqt4-dev
$ sudo apt-get install qt4-default
$ sudo apt-get install qt4-dev-tools
$ sudo apt-get install zlib1g-dev
```

2. Next, we need to check the installed version of cmake. To do this use `cmake --version` in the terminal. Note that CMake `>= 3.2` is sufficient to build VeloView.

If this is not the case after running `cmake --version`, follow the next step, others can skip the following commands and read further.

```
$ sudo apt-get install software-properties-common
$ sudo add-apt-repository ppa:george-edison55/cmake-3.x
$ sudo apt-get update
$ sudo apt-get install --reinstall cmake
```

3. On Linux, libpcap can either be installed as a package or built from source. If you want to build from source, you would additionally need to install flex and byacc. This guide uses the package version.

```
$ sudo apt-get install libpcap-dev
```

4. Now go back to the directory where you cloned the git repository for VeloView if already not there, then execute:

```
$ mkdir build
$ cd build
$ cmake -DENABLE_veloview:BOOL=ON ../Superbuild
```

This may not succeed, and might fail with an error as shown in figure below:

```
-- Enabling boost since needed by: libblas;veloview
-- Enabling eigen since needed by: veloview
-- Enabling libblas since needed by: veloview
-- Enabling veloview as requested.
-- PROJECTS_ENABLED qt;png;python;pythonqt;paraview;pcap;boost;eigen;libblas;veloview
CMake Error at CMake/ParaViewModules.cmake:188 (include):
  include could not find load file:
    png
Call Stack (most recent call first):
  CMakeLists.txt:120 (process_dependencies)

CMake Warning (dev) at /usr/share/cmake-3.5/Modules/ExternalProject.cmake:451 (message):
  value '' with no previous keyword in PVExternalProject_Add
Call Stack (most recent call first):
  CMake/PVExternalProject.cmake:49 (_ep_parse_arguments)
  CMake/ParaViewModules.cmake:319 (PVExternalProject_Add)
  CMake/ParaViewModules.cmake:189 (add_external_project_internal)
  CMakeLists.txt:120 (process_dependencies)
This warning is for project developers.  Use -Wno-dev to suppress it.

CMake Error at /usr/share/cmake-3.5/Modules/ExternalProject.cmake:1915 (message):
  No download info given for 'png' and its source directory:
    /home/apoorv/Dropbox/Semester 3/field-robotics/VeloView/build/png/src/png
  is not an existing non-empty directory. Please specify one of:
    * SOURCE_DIR with an existing non-empty directory
    * URL
    * GIT_REPOSITORY
    * HG_REPOSITORY
    * CVS_REPOSITORY and CVS_MODULE
    * SVN_REVISION
    * DOWNLOAD_COMMAND
Call Stack (most recent call first):
  /usr/share/cmake-3.5/Modules/ExternalProject.cmake:2459 (_ep_add_download_command)
  CMake/PVExternalProject.cmake:147 (ExternalProject_Add)
  CMake/ParaViewModules.cmake:319 (PVExternalProject_Add)
  CMake/ParaViewModules.cmake:189 (add_external_project_internal)
  CMakeLists.txt:120 (process_dependencies)

-- Configuring incomplete, errors occurred!
See also "/home/apoorv/Dropbox/Semester 3/field-robotics/VeloView/build/CMakeFiles/CMakeOutput.log". parallel make is not supported on
apoorv@apoorv-XPS-13-9350:~/Dropbox/Semester 3/field-robotics/VeloView/build$
```

In this case change back to VeloView directory and execute the following commands:

```
ccmake Superbuild
```

This will open CMake configuration file in the terminal. Enable the options shown below by navigating to the option and pressing the Enter key.

```
ENABLE_veloview=ON
USE_SYSTEM_boost=ON
USE_SYSTEM_python=ON
USE_SYSTEM_qt=ON
```

Note: All the options might not be on the same page, in such a scenario press c to configure by enabling the options available, this will bring up other options and continue the process.

Once all the options are enabled press g, which will save the configurations and exit.

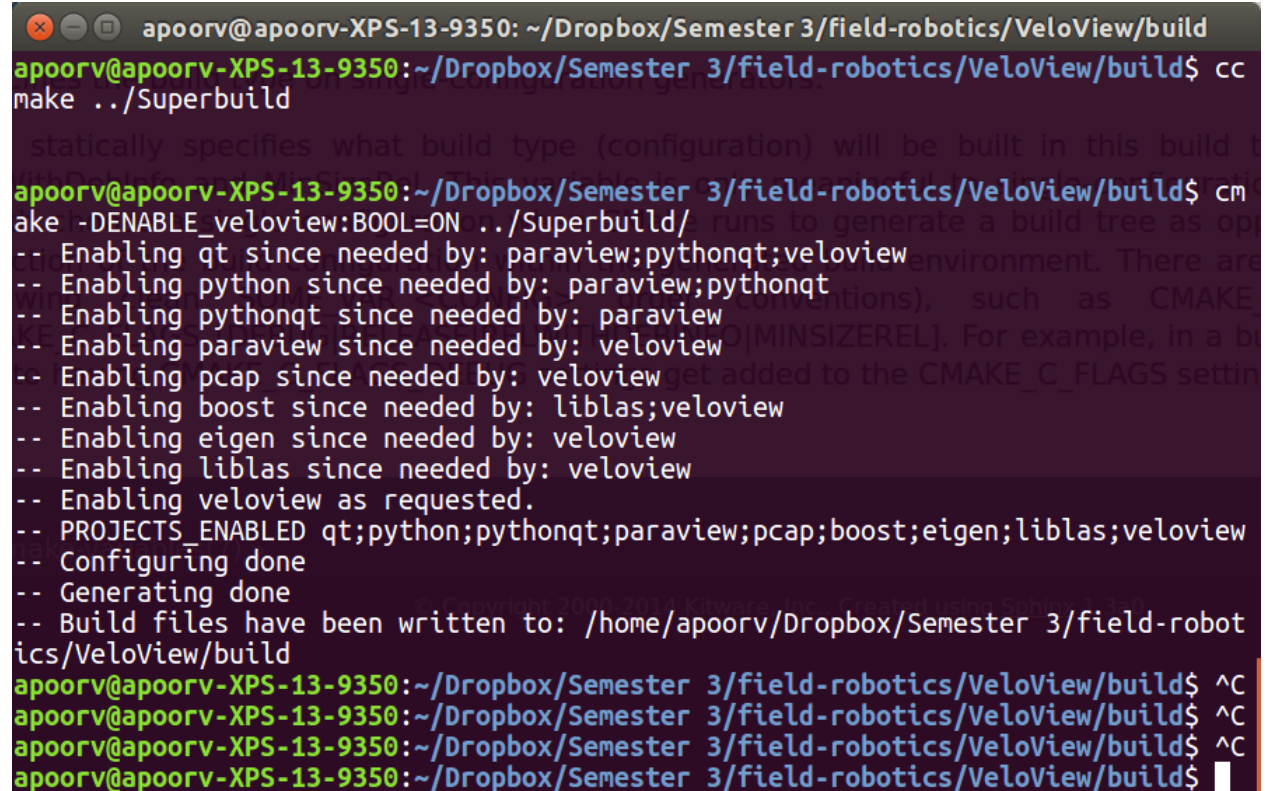
At this point try the command below again

```
cmake -DENABLE_veloview:BOOL=ON ../Superbuild
```

Other possible reason for failure would be your system has both Qt4 and Qt5 installed, in which case you need to choose Qt4 before building. To do that, run the following in the bash:

```
$ export Qt_SELECT=qt14
```

Now you should see the message Configuring done and Build files have been written to build directory as shown in the screenshot in Figure 3.

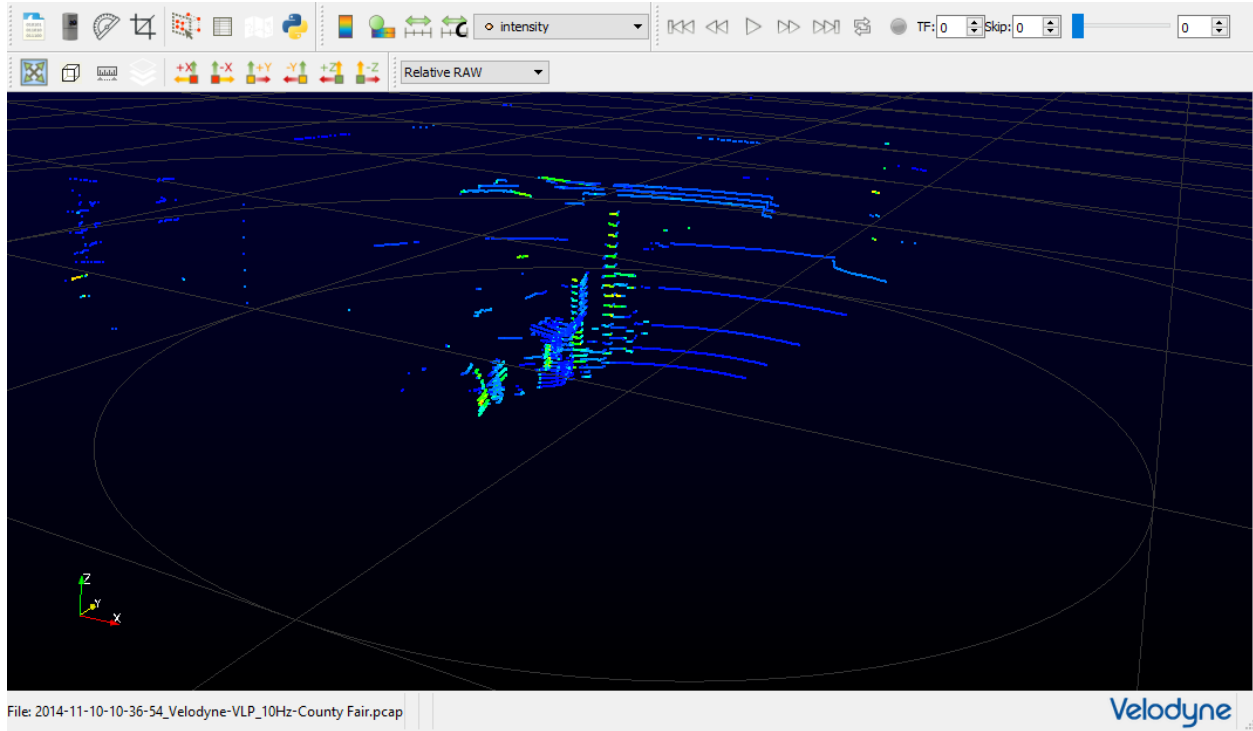


```

apoorv@apoorv-XPS-13-9350: ~/Dropbox/Semester 3/field-robotics/VeloView/build
apoorv@apoorv-XPS-13-9350:~/Dropbox/Semester 3/field-robotics/VeloView/build$ cc
make ../Superbuild
statically specifies what build type (configuration) will be built in this build t
apoorv@apoorv-XPS-13-9350:~/Dropbox/Semester 3/field-robotics/VeloView/build$ cm
ake -DENABLE_veloview:BOOL=ON ../Superbuild/ runs to generate a build tree as opt
-- Enabling qt since needed by: paraview;pythonqt;veloview
-- Enabling python since needed by: paraview;pythonqt
-- Enabling pythonqt since needed by: paraview
-- Enabling paraview since needed by: veloview
-- Enabling pcap since needed by: veloview
-- Enabling boost since needed by: liblas;veloview
-- Enabling eigen since needed by: veloview
-- Enabling liblas since needed by: veloview
-- Enabling veloview as requested.
-- PROJECTS_ENABLED qt;python;pythonqt;paraview;pcap;boost;eigen;liblas;veloview
-- Configuring done
-- Generating done
-- Build files have been written to: /home/apoorv/Dropbox/Semester 3/field-robot
ics/VeloView/build
apoorv@apoorv-XPS-13-9350:~/Dropbox/Semester 3/field-robotics/VeloView/build$ ^C
apoorv@apoorv-XPS-13-9350:~/Dropbox/Semester 3/field-robotics/VeloView/build$ ^C
apoorv@apoorv-XPS-13-9350:~/Dropbox/Semester 3/field-robotics/VeloView/build$ ^C
apoorv@apoorv-XPS-13-9350:~/Dropbox/Semester 3/field-robotics/VeloView/build$

```

Figure 4 shows VeloView software running the sample data downloaded from [2] Sample data for the VeloView application.



1.3 Hokuyo LiDARs

1.4 License

MIT License

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1.5 Help

Contact: apoorvjagtap@gmail.com

Indices and tables

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