Autonomous Mobile Platform Using the Kinect Sensor

Joan Aguilar Mayans
Faculty Advisor: James E. Bobrow
Mechanical and Aerospace Engineering

The Henry Samueli School of Engineering, UC Irvine
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Background and Goal

Background

- Release of the Microsoft Kinect for Xbox 360 console about a year ago.
- Similar performance to similar devices (like LIDAR) but with a lower price.
- Outperforms cheaper types of sensors.

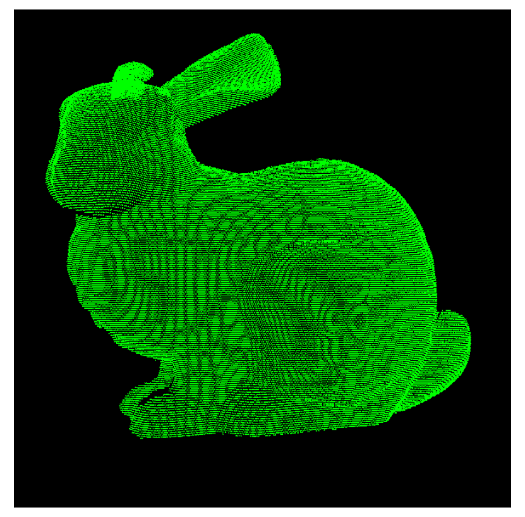
Goal

- Creation of an autonomous mobile platform using the Kinect sensor.
- The platform should be able to process the information gathered with the Kinect to drive the motors in a proper way.
- Explore the possibilities of the Kinect, the ROS (Robot Operating System) and the Arduino microcontroller.

The Kinect Sensor

- RGB camera and depth sensor.
- The data it produces it is saved in a format called PointCloud2.
- Specs:

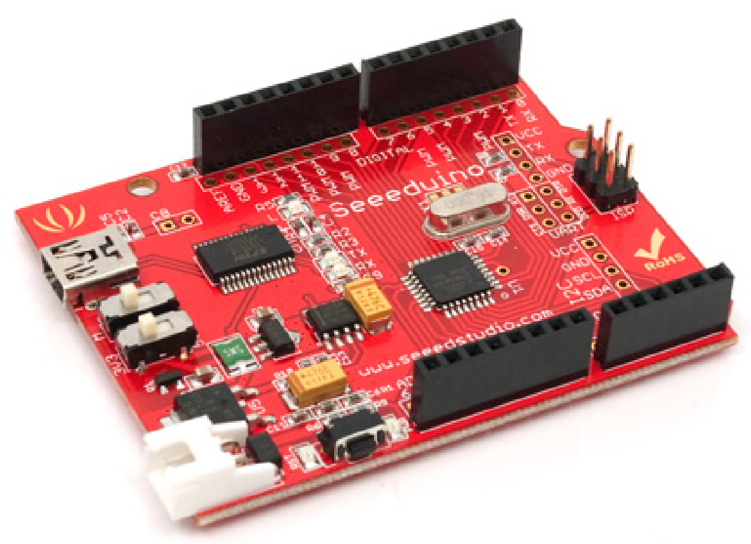
Frame rate	30 Hz
Resolution	VGA 640 x 480
Ranging limit	0.7 – 6 m
Horizontal field of view	57 degrees
Vertical field of view	43 degrees



PointCloud2

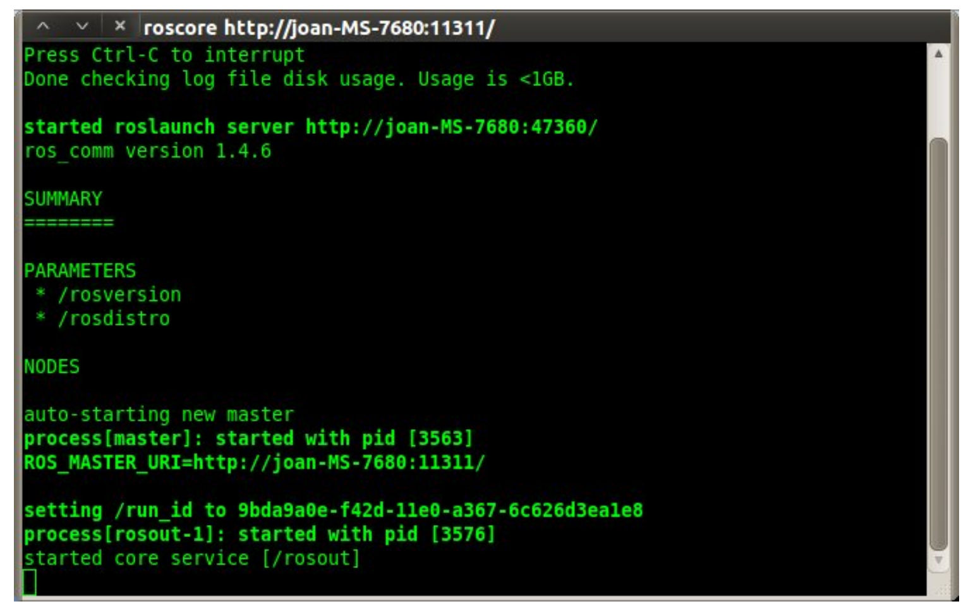
- Data type to store a set of points in the space.
- Data stored as a 1D or 2D array.
- Each element contains information about the point (at least the coordinates in space).

Arduino



- Open-source single-board microcontroller.
- Programmed using the open-source Arduino Environment with simplified C++ language.
- Its Pulse-Width Modulation (PWM) capabilities are used to drive the motors.

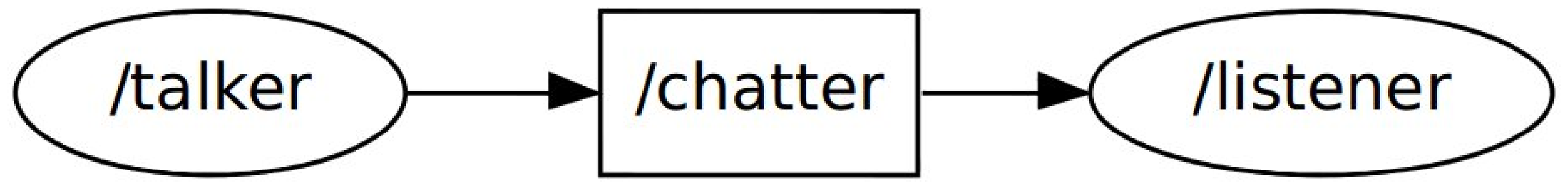
Robot Operating System (ROS)



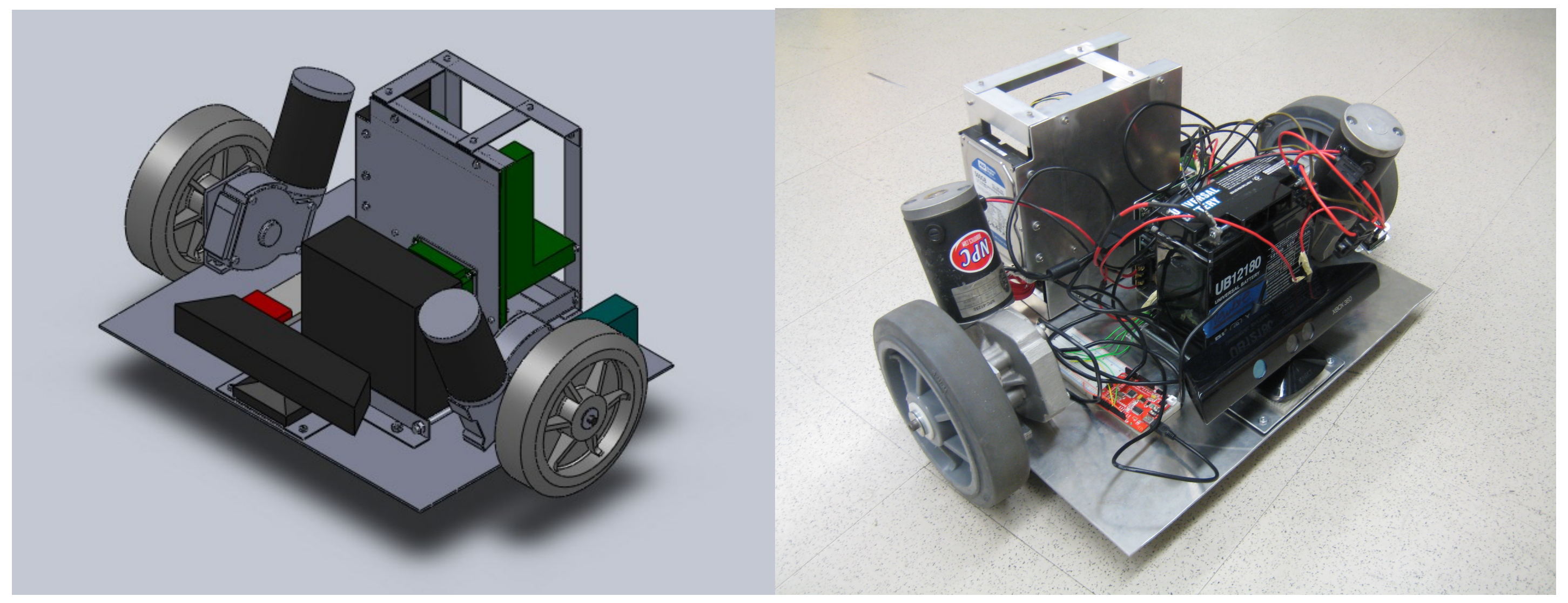
```
roscore http://joan-MS-7680:11311/
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

started roslaunch server http://joan-MS-7680:47360/
ros_comm version 1.4.6

SUMMARY
========

PARAMETERS
 * /rosversion
 * /rosdistro

NODES

auto-starting new master
process[master]: started with pid [3563]
ROS_MASTER_URI=http://joan-MS-7680:11311/

setting /run_id to 9bda9a0e-f42d-11e0-a367-6c626d3ea1e8
process[rosout-1]: started with pid [3576]
started core service [/rosout]
```

- ROS is a software framework for robot software providing operating system-like functionality.
- It is mainly used in the project to communicate the Kinect and the Arduino to the computer.
- It is maintained by Willow Garage.
- According to Willow Garage:

"ROS provides libraries and tools to help software developers create robot applications. It provides hardware abstraction, device drivers, libraries, visualizers, message-passing, package management, and more. ROS is a completely open source (BSD) and free for others to use, change and commercialize upon. Our primary goal is to enable software developers to build more capable robot applications quickly and easily on a common platform."

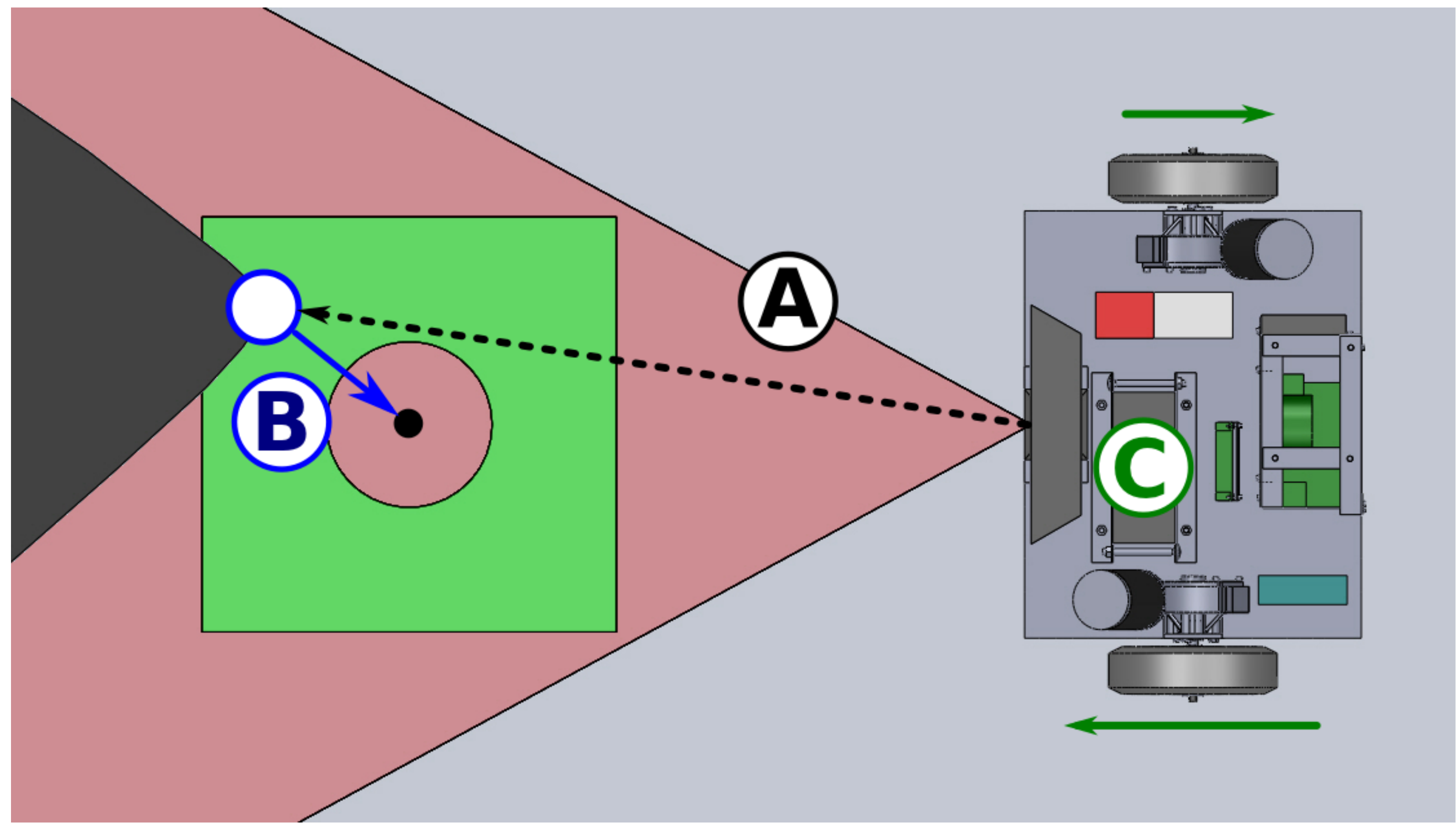

/talker → /chatter → /listener

Platform



- It was build using aluminum plate and different types of screws.
- The plate is designed so it can fit all the different components of the platform.
- List of components attached to the plate:
  - 2 x casters
  - 2 x electric servo-motors
  - 12 V battery
  - Arduino
  - Computer
  - Kinect
  - Power Supply Unit (PSU)
  - Signal amplifier

How does the platform work?



A
- The Kinect generates a point cloud and sends the data to the computer.
- The computer scans the point cloud and extracts the coordinates of the closest point to the sensor.

B
- If the coordinates of this point satisfy a certain constraints (being inside the green zone in the figure) the computer computes how to move the platform in a way that this point will end up being in the desired position (in the middle of the red circle in the figure).

C
- If the platform has to move, the computer sends the order to the Arduino which will process it and send a new order to the electric motors.

- This process will then start all over again.
- It is repeated as fast as the computer can handle.

Conclusions

- The platform is able to follow the closest point in a reliable way.
- It is possible to interact with the platform and guide it.
- The lack of sensors in the sides and in the back make the platform unable to react to certain obstacles.
- In certain cases (e.g. when close to a wall) the platform may get into a situation where it is hard to guide.

Mechanical and Aerospace Engineering - The Henry Samueli School of Engineering - University of California, Irvine

Mail: joana1@uci.edu