CHASER BOT

Submitted By

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For the completion of

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Introduction

The Mobile Robot Detect and Chase White Ball

This project involves designing and building a mobile robot that is capable of chasing and following white colored balls and to detect and chase the ball, this bot employed a camera to capture frames and do image processing using open cv.The ball's characteristics, such as color, shape, and size, can be employed. goal was to create a rudimentary prototype for a bot that can detect and follow color.

The ROS project consists of 2 packages, my_robot and ball_chaser. The my_robot package contains the robot and world models which can be visualised in the Gazebo simulator when the package is run using the roslaunch command. The ball_chaser package is responsible for detecting and moving towards any white object in front of the robot by reading the feed from the camera attached to the front of the robot.

Objective

- Design and Construct a 2 Wheeled Mobile Robot Which Detect and Chase The Specific Colour Ball
- We Implement This Robot in Robotic Operating System (ROS) and Simulation in Gazebo Environment

Software Used

- Ros Noestic
- Gazebo

Structure of the Robot

There are two packages within this repository:

1. my_robot

This package defines the mobile robot under URDF as well the world that it is housed within.

2. ball_chaser

This package contains two nodes which are responsible for locating the position of the white ball in the camera field of view and then sending the corresponding commands to the mobile robot to follow the white ball.

IMPLEMENTATION

WORKING PRINCIPLE:

- The camera fixed on top of the robot captures the image.
- Then the image is processed and converted into pixel data.
- Then it search for white colour with pixel value as “255”.
- If the spherical white colour is detected, Then the robot starts following it
- If the ball presents in the right side of the robot then the robot move in right side with angular velocity “-1” until it is straight with the robot
- If the ball is present in the left side of the robot then the robot moves in left side with the angular velocity “1” until it is straight to the robot
- When ball is straight to the robot then angular velocity is 0
- If the white pixel is detected, the robot assumes it to be the ball and it starts following it.
- But if the pixels are not detected, it captures the image until it detects a white pixel.
- This description of the robot motion will be in the script files

Script Files

We created 2 scripts files, the first one is **process_image.cpp** helps us to process the image and gives the direction,velocity and angular velocity for the robot, which act as subscriber it subscribes the image from the gazebo and process it, determines whether the ball is present or not. Based on the placement of the ball it assigns the linear and angular values for the variables in the srv file (DriveToTarget.srv). (User defined

service file) and **drive_bot.cpp** act as publisher and it publishes the linear velocity and angular velocity for the robot in gazebo

Service file:

DriveToTarget.srv

home > ameen > catkin_ws > src > ball_chaser > srv > DriveToTarget.srv

```
float64 linear_x
float64 angular_z
---
string msg_feedback
```

Script Files:

process_image.cpp

```
#include "ros/ros.h"
#include "ball_chaser/DriveToTarget.h"
#include <sensor_msgs/Image.h>

// Define a global client that can request a service
ros::ServiceClient client;

void drive_robot(float lin_x, float ang_z)
{
    ROS_INFO_STREAM("Moving robot");

    // Request motor commands
    ball_chaser::DriveToTarget srv;
    srv.request.linear_x = (float)lin_x;
    srv.request.angular_z = (float)ang_z;

    // Call the command_robot service and pass the requested motor commands
    if (!client.call(srv))
        ROS_ERROR("Failed to call service command_robot");
}

// The callback function continuously executes and read the image data
void process_image_callback(const sensor_msgs::Image img)
{
    int white_pixel = 255;
```

```
    bool found_ball = false;
    int column_index = 0;

    for (int i=0; i < img.height * img.step; i += 3)
    {
        if ((img.data[i] == 255) && (img.data[i+1] == 255) && (img.data[i+2]
== 255))
        {
            column_index = i % img.step;
            if (column_index < img.step/3)
                drive_robot(0.5, 1);
            else if (column_index < (img.step/3 * 2))
                drive_robot(0.5, 0);
            else
                drive_robot(0.5, -1);
            found_ball = true;
            break;
         }
     }

     if (found_ball == false)
         drive_robot(0, 0);
}

int main(int argc, char** argv)
{
    // Initialize the process_image node and create a handle to it
    ros::init(argc, argv, "process_image");
    ros::NodeHandle n;

    // Define a client service capable of requesting services from
command_robot
    client =
n.serviceClient<ball_chaser::DriveToTarget>("/ball_chaser/command_robot");

    // Subsribe to /camera/rgb/image_raw topic to read the image data inside
the process_image_callback function
    ros::Subscriber sub1 = n.subscribe("/camera/rgb/image_raw", 10,
process_image_callback);

    // Handle ROS communication events
    ros::spin();
```

```
    return 0;
}
```

drive_bot.cpp

```
#include "ros/ros.h"
#include "geometry_msgs/Twist.h"
#include "ball_chaser/DriveToTarget.h"

// Global motor command publisher
ros::Publisher motor_command_publisher;

bool handle_drive_request(ball_chaser::DriveToTarget::Request& req,
ball_chaser::DriveToTarget::Response& res)
{
    ROS_INFO("DriveToTargetRequest received - linear_x:%1.2f,
angular_z:%1.2f", (float)req.linear_x, (float)req.angular_z);

    // Pusblish motor command request
    geometry_msgs::Twist motor_command;

    motor_command.linear.x = req.linear_x;
    motor_command.angular.z = req.angular_z;

    motor_command_publisher.publish(motor_command);

    // Return a response message
    res.msg_feedback = "Motor command set - linear_x: " +
std::to_string(req.linear_x) + " , angular_z: " +
std::to_string(req.angular_z);
    ROS_INFO_STREAM(res.msg_feedback);

    return true;
}

int main(int argc, char** argv)
{
    // Initialize the drive_bot node and create a handle to it
    ros::init(argc, argv, "drive_bot");
    ros::NodeHandle n;

    // Inform ROS master that we will be publishing a message of type
geometry_msgs::Twist on the robot actuation topic
```

```
   motor_command_publisher = n.advertise<geometry_msgs::Twist>("/cmd_vel",
10);

   // Define a drive /ball_chaser/command_robot service with a
handle_drive_request callback function
   ros::ServiceServer service =
n.advertiseService("/ball_chaser/command_robot", handle_drive_request);
   ROS_INFO("Ready to send drive commands");

   // Handle ROS communication events
   ros::spin();

   return 0;
}
```

Launch File:

world.launch

```
<?xml version="1.0" encoding="UTF-8"?>

<launch>

 <!-- Robot pose -->
 <arg name="x" default="2.8"/>
 <arg name="y" default="-0.2"/>
 <arg name="z" default="0.2"/>
 <arg name="roll" default="0.75"/>
 <arg name="pitch" default="0"/>
 <arg name="yaw" default="0"/>

 <!-- Launch other relevant files-->
 <include file="$(find my_robot)/launch/robot_description.launch"/>

 <!-- World File -->
 <arg name="world_file" default="$(find my_robot)/worlds/project1_world"/>

 <!-- Launch Gazebo World -->
 <include file="$(find gazebo_ros)/launch/empty_world.launch">
   <arg name="use_sim_time" value="true"/>
   <arg name="debug" value="false"/>
   <arg name="gui" value="true" />
```

```
    <arg name="world_name" value="$(arg world_file)"/>
  </include>

  <!-- Find my robot Description-->
  <param name="robot_description" command="$(find xacro)/xacro --inorder
'$(find my_robot)/urdf/my_robot.xacro'"/>

  <!-- Spawn My Robot -->
  <node name="urdf_spawner" pkg="gazebo_ros" type="spawn_model"
respawn="false" output="screen"
        args="-urdf -param robot_description -model my_robot
              -x $(arg x) -y $(arg y) -z $(arg z)
              -R $(arg roll) -P $(arg pitch) -Y $(arg yaw)"/>

  <!--launch rviz-->
  <node name="rviz" pkg="rviz" type="rviz" respawn="false"/>

</launch>
```

robot_description.launch

```
<?xml version="1.0"?>
<launch>

  <!-- send urdf to param server -->
  <param name="robot_description" command="$(find xacro)/xacro --inorder
'$(find my_robot)/urdf/my_robot.xacro'" />

  <!-- Send fake joint values-->
  <node name="joint_state_publisher" pkg="joint_state_publisher"
type="joint_state_publisher">
    <param name="use_gui" value="false"/>
  </node>

  <!-- Send robot states to tf -->
  <node name="robot_state_publisher" pkg="robot_state_publisher"
type="robot_state_publisher" respawn="false" output="screen"/>

</launch>
```

ball_chaser.launch

```
<launch>
```

```
<!-- The drive_bot node -->
 <node name="drive_bot" type="drive_bot" pkg="ball_chaser" output="screen">
 </node>

<!-- The process_image node -->
 <node name="process_image" type="process_image" pkg="ball_chaser"
output="screen">
 </node>

</launch>
```

Commands to Run the Simulation and Robot:

```
$ roslaunch my_robot world.launch
$ roslaunch ball_chaser ball_chaser.launch
```

World File Simulation:

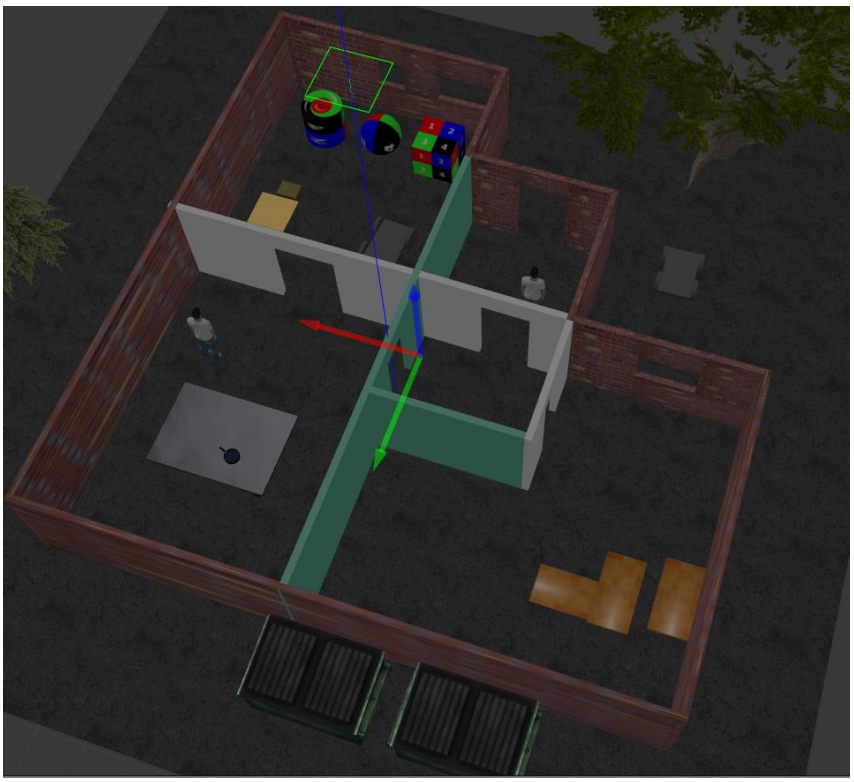
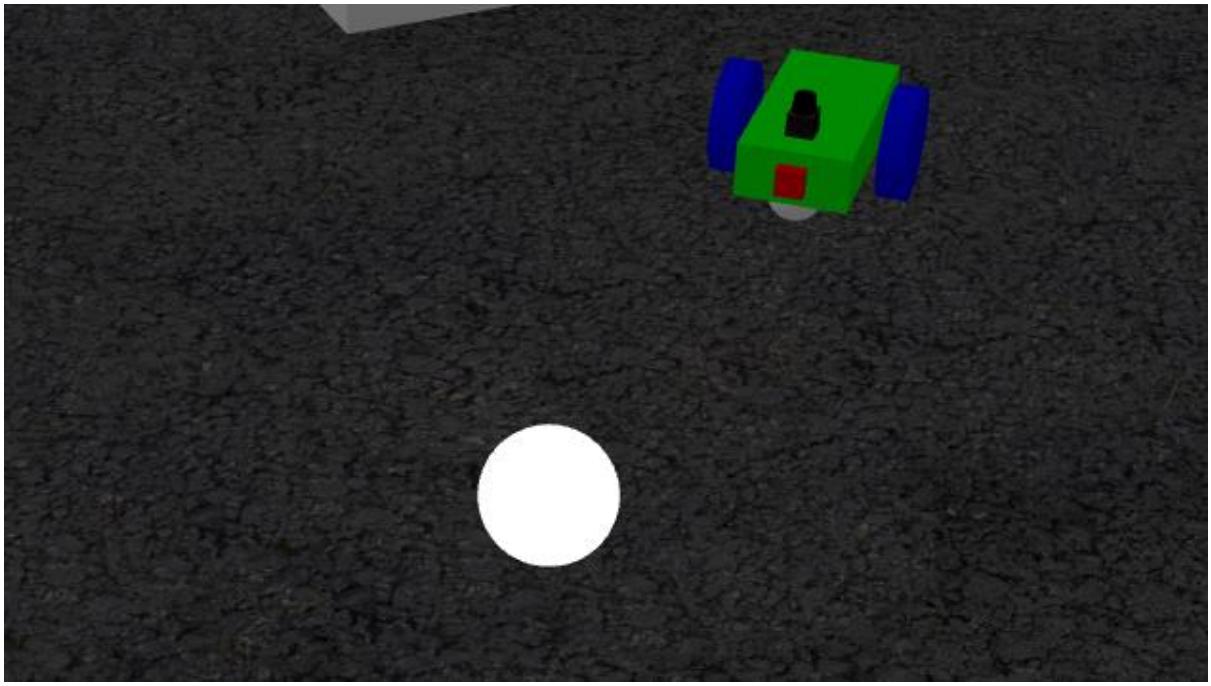
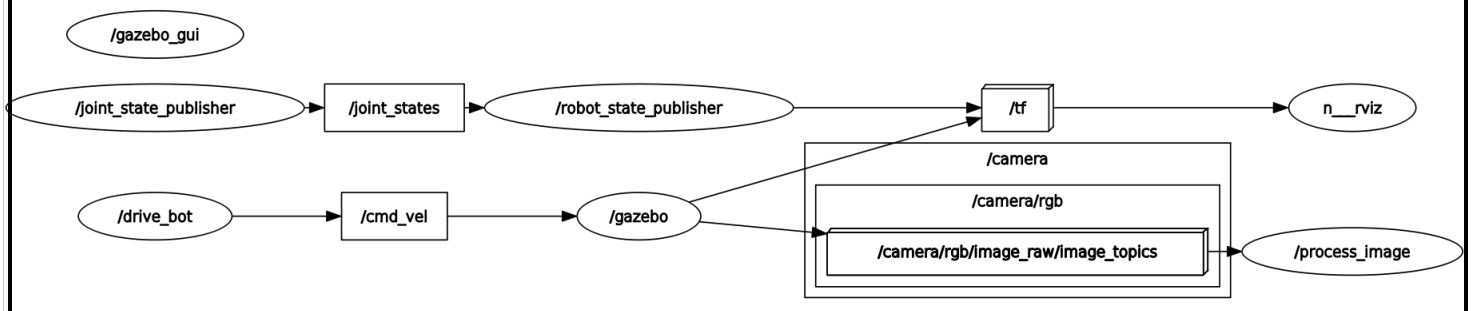


Image of Robot:



RQT GRAPH



Conclusion

Finally the Robot detected the white ball and tracked it, The velocity results of linear and angular along all axes i.e., X, Y, Z showed in the terminal, and if the white coloured ball is kept in camera view of the robot, then the robot detect it and start chasing it, Hence the robot working perfectly.