Xalaquia II Project

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Abstract. Xalaquia II is a service robot that was created to innovate in the area of robotics to the environment. In this paper we discuss the operation of the robot as well as software and hardware that composes it. We will explain the algorithm that runs the robot and the way in which solves the problem of collecting garbage on a beach. The robot Xalaquia II is a service robot for research and innovation for Robotics-Environment for service improvement in outdoors. Competition in the category "IEEE Open" is an excellent opportunity to develop our research service robot traction on non-uniform terrain and obstacle avoidance. We have developed various techniques for efficient and effective implementation of the vision modules, detection, planning and execution.

Keywords: traction on sand, object detection, robot outdoors, avoidance of objects.

1 Introduction

Xalaquia II has participated in the "Mexican Robotics Tournament" (TMR) in which showed great ability to avoid obstacles and very good traction on a non-uniform field and sand. Xalaquia II uses vision modules, management, navigation and sensors in LabView©. In this service robot remained harvesting mechanism and improved traction system on two wheels. It makes use of a 720p camera, with which we have a better view of land and more functional. We have improved the reservoir system. We have some programming algorithms and critical points for decision making.

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Table 1 shows the relationship between the hardware and software that we used for our service robot.

Table 1. Description of the hardware and software

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>DESCRIPTION</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robot base</td>
<td>Aluminum</td>
<td>*Width: 0.5mm&lt;br&gt;*Size: 49x45 cm</td>
</tr>
<tr>
<td>8 wheels</td>
<td>4 wheels directly connected to motors, 4 of potency transmitted</td>
<td>5 in of diameter</td>
</tr>
<tr>
<td>2 Motors</td>
<td>Denso 730555-7030R and 730557-7030L</td>
<td>*3v-12v&lt;br&gt;*3A&lt;br&gt;*ø 44 mm&lt;br&gt;*Speed at 3 V: 30 r / min, at 12 V: 120 r / min</td>
</tr>
<tr>
<td>Motor controller</td>
<td>Pololu board Micro Maestro 6.</td>
<td>Control of position, acceleration, for 5 motors</td>
</tr>
<tr>
<td>1 battery</td>
<td>ENERCELL sealed lead-acid battery</td>
<td>*12V&lt;br&gt;*5Ah</td>
</tr>
<tr>
<td>camera</td>
<td>Logitech web cam USB</td>
<td>HD 720P</td>
</tr>
<tr>
<td>5 ultrasonic sensors</td>
<td>MAXSonar-EZ1</td>
<td>V-5v CD-2mA&lt;br&gt;range: 1m – 6 meters</td>
</tr>
<tr>
<td>Secondary motor</td>
<td>Servomotor opens the gate.</td>
<td>V-5v&lt;br&gt;5 Kg-cm</td>
</tr>
<tr>
<td>4 Chain</td>
<td>iron roller chain</td>
<td>1/4 in&lt;br&gt;100 links, 44 links</td>
</tr>
<tr>
<td>Computer</td>
<td>Pavilion dm 4 CORE i7</td>
<td>8 Gb of RAM</td>
</tr>
<tr>
<td>DEVELOPMENT SOFTWARE</td>
<td>Labview 2010</td>
<td>We used the following modules: Vision, Visa, Math Script and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>32 bits for Windows 7</td>
</tr>
</tbody>
</table>

Figure 1: Solidworks model, to construct all parts.
2 Control Architecture

Actions Xalaquia II plays mainly depend on four different environmental situations:

- Blue boundary.
- Obstacles (mannequin, beach chair, umbrella).
- Cans (garbage).
- Garbage depot.

In each case, certain entries will be received by either the webcam or the sensors and therefore the outputs will be sent to the motors, the broom or the dump gate.

Below is the diagram (Figure 2) in which is based the programming of Xalaquia II, with the different cases mentioned above.

Figure 2: General view of Control Architecture
Operating of the robot

One of the entrances to Xalaquia II is the image captured by the webcam and when it is received by the programming of the robot, it is compared with a template of different environmental colors: black for the garbage, red for the garbage depot and blue for the border.

Depending on the matches found by the program, will be the parameters sent to the motors, to the dump door or the broom and achieve the response of the robot.

On the other hand, to react with the case of the obstacles, we use the signals received by the sensors installed in the robot. Considering the values that they capture of the environment, other parameters will be sent to each of the motors for the robot can avoid them successfully. In Figure 3 we can see a connection diagram between devices (hardware) of the robot.

![Figure 3: General connection Xalaquia II](image)

![Figure 4: Real “Xalaquia II” Model](image)
3 Functional parts

Xalaquia II is organized into 4 different functional parts, which we decided to call “mechanisms”.

1. Traction

Xalaquia II has traction on the rear; is impulsed for two motors connected at the first axis, and this axis is connected to second axis, all through a chain system. Xalaquia II has 8 wheels organized in four pairs, creating four wider wheels, copying the structure of the wagons in the trailers, besides knowing the definition of pressure, if the area is greater pressure decreases, that fact help to increase the movement of Xalaquia II across the sand.

2. Collection

The mechanism of collection in Xalaquia II consists in a system with plastic bristles attached to a rotary axis, like a <<broom>>. This broom is Activated when the robot is in a relevant position, then it can drag the can into the container on the back.

3. Discharge

The design of the container allow slide the can until the end, again when Xalaquia II is in a relevant position, will active the tail gate, causing the cans fall into the tank.

4. Detection

The ultrasonic sensors give the position of the objects, and for consequence the position of the robot, wit this information, the robot avoid hitting objects, and will know in what position must activate the mechanisms, the camera detect the color of basic objects, the cans, the boundary, and the tank.

4 Conclusions

The paper presents the description of our service robot and some concepts of object detection and decision making to ensure the proper functioning of the robot. All programming is done in LabView 2011 and is right where we are making improvements to the operation of the robot based on our variables in the beach environment. We have presented an overview of the project "Xalaquia II" with the intention of making a support and history of the service robot.

5 Acknowledgment

We want to thank to the Mexican Robotics Federation (FMR) for the support provided to carry out this work and to attend the competition. Also at the “Universidad Popular Autónoma del Estado de Puebla” for the support and encouragement of technological development in the area of robotics outdoors.


6 References

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