AUTONOMOUS ROBOT GROOMER OF CANS - PROJECT DESCRIPTION TIME ROBOSOURCE

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Abstract— *This paper presents the solution team Robosource to the challenge of developing a robot to pick up soda cans in a sandy environment (beach) by category IEEE-Open in Event of Brazilian Symposium on Intelligent Automation (SBAI) 2013. For this, we developed a robotic chassis adapted for walking in sandy environments and also a computer vision system in order to locate the cans that was randomly placed in the beach environment simulated.*

Keywords— Robotics, beach cleaner, control, image processing and computer vision.

1 Introduction

The pollution on the beaches is configured as an old problem and it's difficult to solve, can be caused by several factors, be they natural or human: red tide, clusters of marine plants, dead animals, animal waste originated of place, and also by the effect of human activity, such as the accumulation of garbage, drainage and discharge of oil spills. Pollution of beaches cause serious damage to marine ecosystems occur, representing risks to human health, the fishing industry, and also affects tourism on the beach, connected directly to the local economy.

The countries of South America are mainly coastal, justifying conducting research towards environmental conservation and cleanup of natural heritage.

Moreover, substantial gains in tourism-based economy, being mostly related to these environments beaches in coastal cities.

Often cleaning environments tends to be a tedious and repetitive activity, also cite that for the human who performs this activity makes to be due to exposure to the harmful rays of the sun. To remedy this, nothing more appropriate to apply machinery to perform these types of activities. [1] It is worth noting that the *design* robot developed to meet the needs of the site where it is applied, thus, its structure must be strong to withstand possible to navigate without harm to the environment. This justifies the need for planning prior to the construction of the robot [3].

Strategies to offset on the environment should also be taken into account, since it is not interesting that a robot cleaner has not a good strategy for scanning the spot, and thus ineffective in activity [1, 2]. It is important to have a robot that performs cleanup of the place continuously, leaving no gaps dirty (not cleaned). For this, various methods can be used as based on swarms of robots, where cooperative and collaborative works are executed in order to meet the goal of optimally [4].

2 Objectives

The work presented here has as main objective to develop a fully autonomous robot that is able to collect cans of 350ml, randomly arranged in the competitive environment of circular shape with 5.5 m in diameter, filled with sand.

These cans represent the garbage to be collected by collectors robots, knowing that these robots must be able to divert also by obstacles of any system that fulfills this task. To capture mechanical cans, developed two mechanical arms parallel will be triggered whenever the algorithm camera robot programmed to realize that the garbage is in the range to be captured.

3 Development of Robot

3.1 Physical structure

The chassis used was the DAGU *Electronics* with the following characteristics (Figure 1).

- Name: Wild Thumper 6WD Chassis;
- Motors: 6xDC de 34:1 gear ratio;
- Dimensions: 420 x 300 x 130 mm;
- Weight: 2,7 kg;
- Capacity: 5,0 kg.

The choice of this chassis is justified by the fact that it has good performance in multi terrain because your wheels and flexible with a degree of freedom passive, allowing a better grip of the robot on uneven terrain.

In addition to the chassis structure, the robot also has other electronic and mechanical devices (Figure 2), as quoted below:

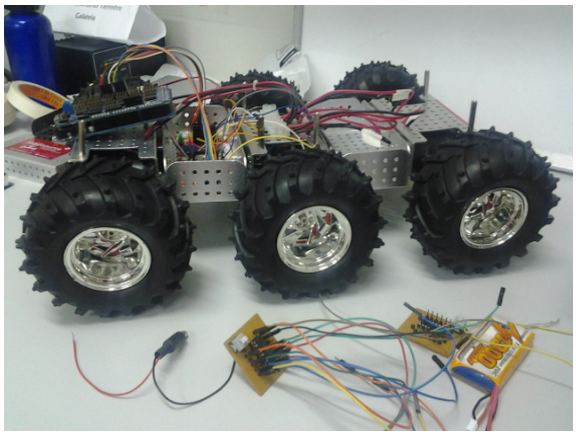

Figura 1: Initial prototype

- Camera;
- Computer;
- 5 ultrasonic modules;
- 1 mechanical arm with two degrees of freedom.

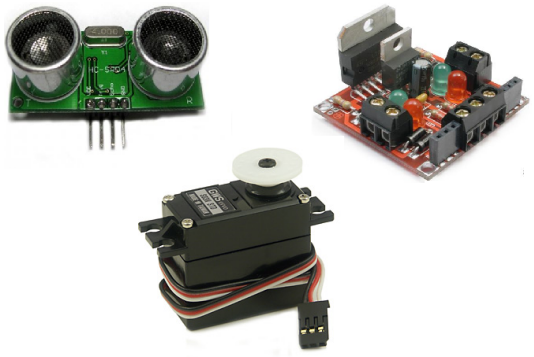

Figura 2: Some devices used: ultrasonic sensor, motor driver and servomotor.

3.2 Computer vision system

In order to locate and capture only the garbage with predetermined characteristics to the challenge, we applied a methodology wedding based image indexing pixels of the current frame to the desired frame, using the API of OpenCV with C++. Its operation is simple and works as follows.

Initially, the desired object (trash) is photographed in various possible positions and then these images are stored. As the garbage is black, it is possible that the robot confuse other objects of the same color and size as also rubbish. As the challenge there will be another kind of black object, then that is no problem.

For each pixel is been choose the current camera frame, there is a horizontal and vertical scan in search of similarity with previously stored images. This scan is limited by a constant tolerance pixels.

In the Figure 3 have the scheme of two frames: a previously recorded image (desired) and image imitated by the algorithm, according to the similarities found in current frame camera. We see that the constant used was 5 pixels, as for pixel 4, there was horizontal displacement of 5 to each side counting central pixel. Thus, the algorithm will mimic the drawing where to find similarity of pixels.

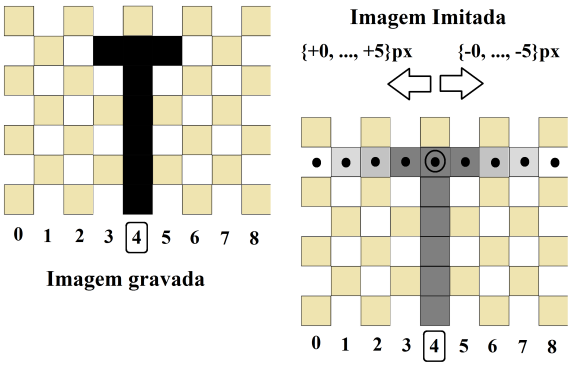

Figura 3: Algorithms developed to search (scan) of similarity horizontally. Search to the left, starting from the pixel 4-0, and seeks to right starting pixel 4-8.

If all the current frame has similarity over 50 % of the stored images, the object considered as recognized that distance, then activating the mechanical arm of the capture system of waste.

In Figure 4 we have the perception of image similarity at 40 % approximately. Note that the image imitated (right) was partially similar to the desired image (left) that was initially stored to be compared to the camera frames. It is also noticed that the background image was imitated almost entirely due the background of image be stopped, which does not happen with the person in front of the camera, which naturally moves, causing some mismatches of pixels to be married.

Figura 4: Algorithm of imitation of an image, detecting similarity of approximately 40 %: desired image (left) and image imitated by the algorithm (right).

4 Experiments and results

4.1 Initial tests

The first tests were made ??on the robot: engine run, test obstacle avoidance, acceleration and braking (Figure 5).

Figura 5: Robot used, testing its obstacle detection in an environment with many people moving.

As for vision tests, we detect some elements such as faces, bottles and other materials (Figure 6 and Figure 7).

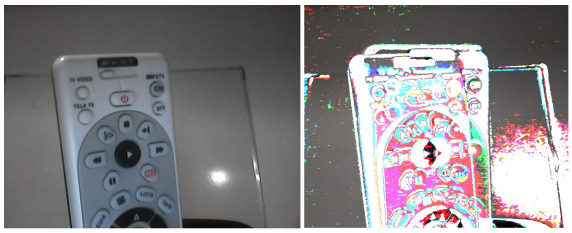

Figura 6: Test imitation image: desired image (left) and imitated image (right).

Figura 7: Perception test image at different positions (lying bottle and bottle standing).

4.2 Results

In terms of computer vision tests were performed pattern recognition with small variations of rotation and proportion.

Using the methodology of view created for this challenge, there was good results, but sometimes the image processing methodology that has been time consuming due to the complexity of the search in each frame of the camera capturing the delay in generating waste. But that was bypassed optimizing search algorithms random for each frame.

The robot was tested thoroughly as the movement and deviation plots similar to the challenge of achieving satisfactory results.

5 Conclusions

The set of hardware developed is versatile and meets the systems used, the proposed requirements are met and the difficulties were resolved or mitigated in large part of the time, the tests on the physical structure had efficiency particularly for the obstacle avoidance of objects both mobile namely static and also its good resourcefulness in sandy soils.

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