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An Artificial Vision Prototype Based on Sensor Fusion For Mobile Robot's Obstacle Localization

ABSTRACT

Artificial vision systems can be defined as a mechatronic project. Designers of such systems should deal with electronic components such as cameras, a computer system to control the sensors and, finally, a mechanical part has a great influence on the project of the last two ones. When an artificial vision system is used in mobile robot's obstacle localization task, a single camera is not usually enough, compelling us to find ways to solve the problem. In this article, a solution based on sensor fusion to detect obstacles in front of a robot is presented in the form of a prototype. Mechanical aspects are discussed in order to demonstrate its impact on the computational module.

INTRODUCTION

Artificial vision for mobile autonomous robots is considered one of the most important tools. It is usually used in order to extract useful information from the environment in order to accomplish a localization task.

Many types of artificial vision system configuration can be provided with different computational performances according to the number of cameras used. A single camera system is certainly a low cost configuration, although in many applications, complete localization coordinates may not be achieved accurately. Two or more cameras should be more appropriate for the task of robot's obstacle localization. However, this kind of system usually requires a higher computational effort to extract obstacle spatial coordinates.

Sensor fusion using a single camera and distance sensors may provide an adequate solution. One important aspect of this type of solution is the property combination of the sensors involved. This consideration should be provided to the mechanical design in order to allow an efficient task-based method to build an artificial vision system that correctly infers the obstacle pose.

ASPECTS OF THE PROTOTYPE

The design of the system is based on the following modules: sensor data acquisition from a camera and infrared (IR) distance sensors, mechanical design and computational system.

After acquiring data from the sensors, a time window is defined, based on acquisition and feature extraction times. For the IR distance sensors, the only feature to be extracted is the distance that is obtained by a process of interpolation of the decimalized values given serially by each sensor. For each image frame from the camera, a set of pixels is sent. In order to extract features from the image achieved, a Support Vector Machine (SVM) classifier are applied.

Mechanical design has a great influence on the computational system. Disposal of sensors, width of the robot body and height of the robot are some examples of features that influence the calculation of object position in front of the robot.

Computational module is divided into 3 different submodules: data acquisition, obtaining data from sensor; feature extraction, extracting angle and distance of objects; sensor fusion, integrating, sensor data in a intelligent way, using Fuzzy logic.

At the end, the artificial vision system provides a tuple <object, angle, distance>, in each frame, to the navigation module, where decisions are made.

CONCLUSIONS

Tests demonstate that the solution provides a low computational cost. Also, the redundancy and complementarity obtained by the sensor fusion module offer, to the robotic unit, a more accurate information from the environment.

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