CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

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Project Number

S1010

Project Title

A Hand Dynamometer Controlled Computer Vision Based AI Robotic Navigation System for the Visually Impaired and Elderly

Abstract

Objectives

Parks, downtowns, malls, and stores are places we frequently visit in our daily lives for socializing, dining, shopping, etc. Out of the 7.5 billion global population, around 285 million individuals suffer from some form of visual impairment. The K9 was developed with the following feature-set in mind: provide user the ability to control the speed of the guide vehicle on a predetermined path, ability to detect & avoid obstacles and return to the path, ability to Identify multiple objects on the shelf of a mock-up store aisle, ability to provide audible feedback to the user based on signatures of the objects

Methods

The K-9 is based on the Arduino platform using an inexpensive computer vision camera on a servo-motor pan mechanism and a variety of sensors for capabilities. The low-cost cmuCam5 Pixy Cam computer vision camera is capable of recording signatures of objects by its hue, and this was used to detect pre-programmed objects. Ultrasonic sensors were used for hand dynamometer and obstacle avoidance, and the line follower for tracking around a store. The custom hand dynamometer allows the robot to change its speed based on the strength of one's grip. An option is provided for the user to use a flexible cable or a cane-like stick to connect the dynamometer to the vehicle. An emergency help button which triggers an SMS text was incorporated at the top of the device using an Arduino shield.

Results

A well-lighted grocery store based test environment was created with pegboards for aisles of the store, with plastic grocery items and electrical tape for the predefined path. Multiple tests were conducted with a blind individual as well as blindfolded individuals for navigation, object detection, and obstacle avoidance. K-9 s success rate was 96% for navigation, 75% for object detection, and 66% for obstacle avoidance with an average success rate of 79%.

Conclusions

The inclusion of a sophisticated computer vision camera with a cloud library would help tremendously in object identification. Future tests could also include leveraging multiple cameras for faster processing and incorporating voice feedback. From the results of the test data, as well as qualitative observations and learnings, one can conclude that an improved version of this product has very high potential to help guide visually impaired individuals around public venues.

Summary Statement

This project focuses on developing a hand dynamometer controlled robotic navigational aid leveraging computer vision for the visually impaired.

Help Received

I built, designed, and programmed the K9 on my own. My teacher provided guidance on the scientific process, and my parents supported me throughout.