Abstract

Robots are critical assets used extensively in manufacturing, health care, aerospace industry including space exploration. The industry is in great need of qualified professionals that can meet the demand of the ever-changing technologies and latest innovation. Robot perception is greatly researched and appealing to both commercial application and military war theaters. Image and video capture via cell phone camera and VEX sensors provides in-depth knowledge about the concept of image processing at the middle school classroom level. This study examined the performance of VEX sensors and an iPhone6 camera as an introduction to robots perception to middle school students. VEX line followers, ultrasonic rangefinders, and an iPhone camera were used to perform object recognition and conduct robot navigation within a classroom robotics competition field setting.

Research question: How to increase the knowledge base of middle schools students to build an intelligent robot capable of video and image processing?

Research Objectives

This research focuses on the study of robot navigation and perception. It is made possible by the Research Experience for Teachers (RET) program sponsored by Texas A&M University's ETID Department. in which secondary educators engage in research and curriculum development with faculty mentors.

Research focus areas:

1. Design and build a robot that will perform within the constrains specified in classroom competition guidelines.
2. Mount and program VEX sensors to create robot mobility in a robotics classroom competition.
3. Capture video using an iPhone6 mounted on a VEX robot.
4. Install, build and use openCV in MacOSX 10.10.3.
5. Install and configure CMake in XCode.
6. Set up Xcode 6.3.2 to work with OpenCV libraries.
7. Use an application built with XCode to store, execute, and process video and image inputs.
8. Train the application to recognize objects against predefined image repository.

The key objective is to provide middle school graduates the building blocks for robot perception that will allow students to engage and instigate them to learn and innovate further in field of Cognitive Robotics.

http://etidweb.tamu.edu/hsieh/ResExp-Teachers

Methodology

Equipments:

- VEX classroom kit
- Line follower sensors kit
- Ultrasonic rangefinder sensor
- iPhone 6
- MacBook pro

Design:

Robot design specifications: chassis capable of navigating a 10 feet by 10 feet field without being trapped by obstacles. Robot measures must not exceed 18 inches by 18inches.

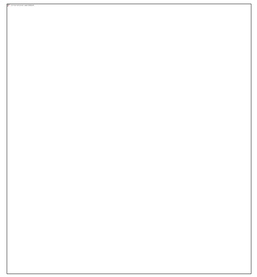
Sensors mount: sensors must be mounted so that they will facilitate the robot to follow a path and avoid obstacles.

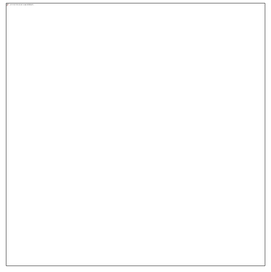
Camera mount: camera must be mounted at a level that will capture objects on the field, cell phone top must be mounted no higher than 14 inches.

Procedure:

The first step was to build a robot following the specifications to ensure it would perform on the field based on parametric requirements. Second, line followers were strategically mounted following competition field specifications. Sensors were programmed and tested on the field. Image 1 shows the first trial using the sensors kit.

Image 1 (to the right)
This image shows the first prototype robot with the line follower sensors kit mounted and being tested for the first time.

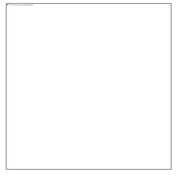




The third step was to mount, program and adjust the ultrasonic rangefinder to avoid collision in the field.

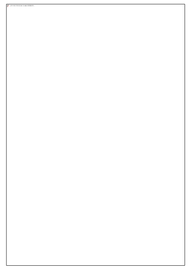
Image 2 (to the left) shows the ultrasonic range finder sensor performing successfully on first trial test.

The fourth step was to program and adjust sensors to ensure the robot would travel autonomously from point A to point B following a path and avoiding obstacles.



The iPhone camera was used to capture data (i.e. video images) and data processing algorithm was used to recognize the obstacles on the robotics field based on pre-defined image repository. Once the master repository was build, the iPhone camera was able to detect and recognize objects on the field.

Image 3 (to the right) shows the app recognizing an object and preparing data for training.



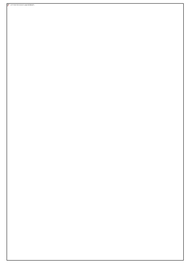


Image 4 (to the left) shows the iPhone camera detecting and recognizing the obstacle on the field.

Results and Conclusions

Results:

VEX sensors passed tests at first trial. Sensors provided robot mobility according to programmed goals. The integration of sensors as an aid to capture video using a cell phone camera mounted on a robot was successfully tested.

Conclusion:

Learning how to design, build, and program robots provides students with advanced professional building skills, motivates and prepares them to pursue careers in the STEM field.

Future Research:

Programming and video processing require SDK, a system that manages the build process in an operating system, and supporting library integration knowledge. It requires computer engineering skills and a timeline that is beyond the scope of this research timetable. Research recommends developing the vision portion of robot perception research to be implemented at senior high school or college level as separate software skill that incorporates video and image processing tools and techniques. Future research in this area will provide improved curriculum for **Cognitive Robotics Building Skills.**

References

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