VBASR: The Vision System
Vision Based Autonomous Security Robot

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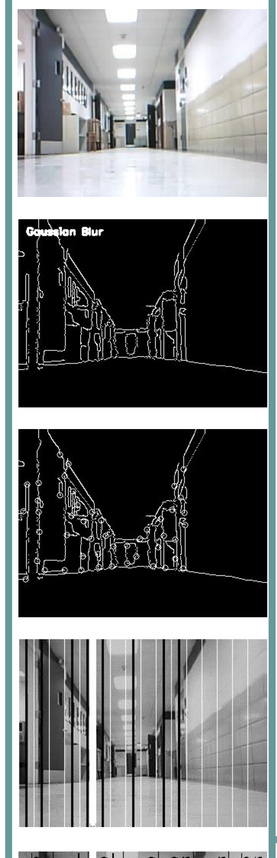
Abstract

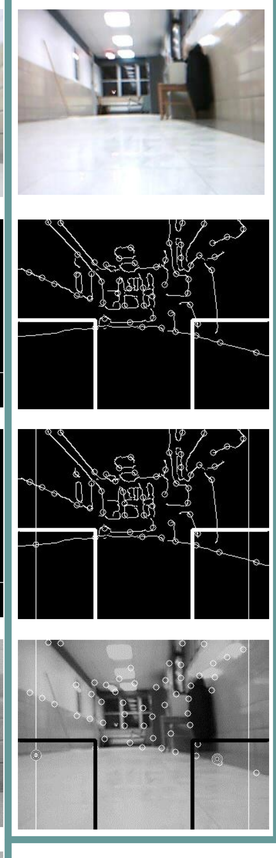
The goal of this project is to develop a computer vision system that enables a robot to navigate the hallways of Bradley University's engineering building using a generic webcam as the only sensor. Using OpenCV2.0 programmed in C++, three algorithms were developed to identify the center of the hallway and guide the robot in the correct direction. The first uses vertical lines, the second uses the trapezoidal shape formed by the corners of the floors and walls, and the third utilizes the color differentiation between the floor and walls. Test data indicates that none of these algorithms is singularly sufficient; however, combining their results they can identify the direction a robot must turn to remain in the center of the hallway with 96.6% accuracy.

Three Parallel Algorithms

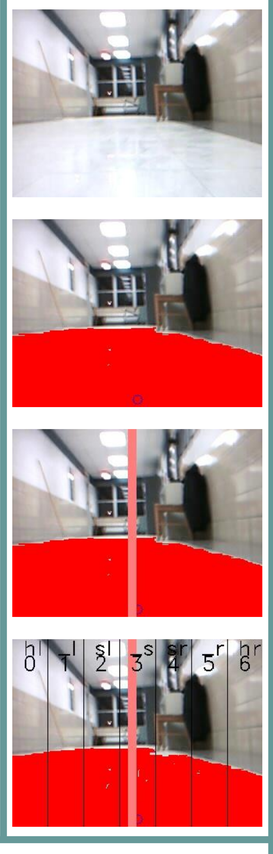
Lines



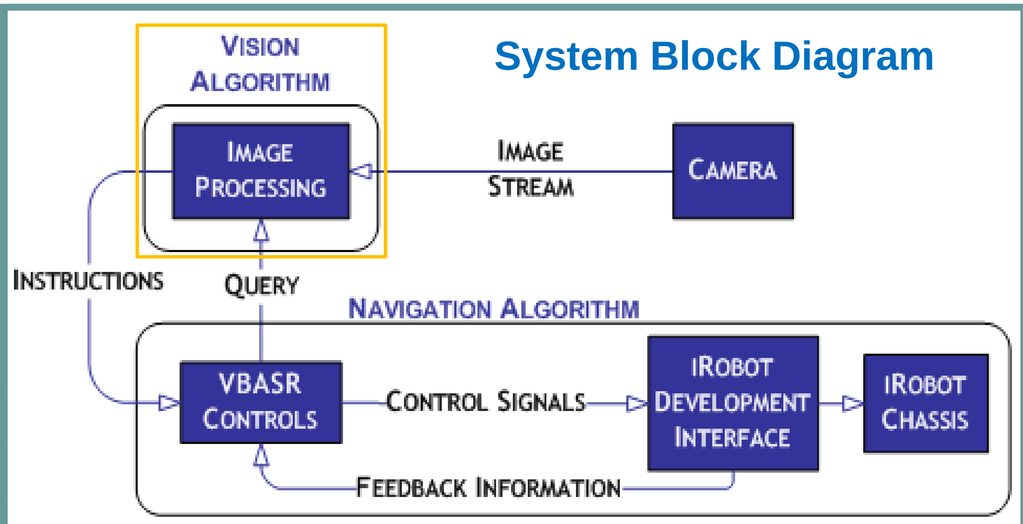
Corners



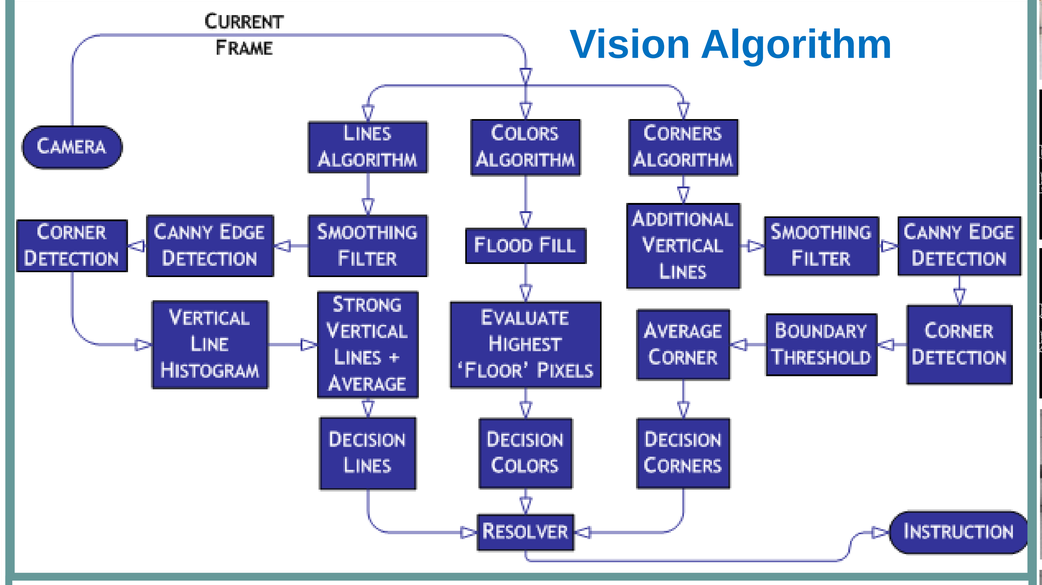
Colors



System Block Diagram



Vision Algorithm

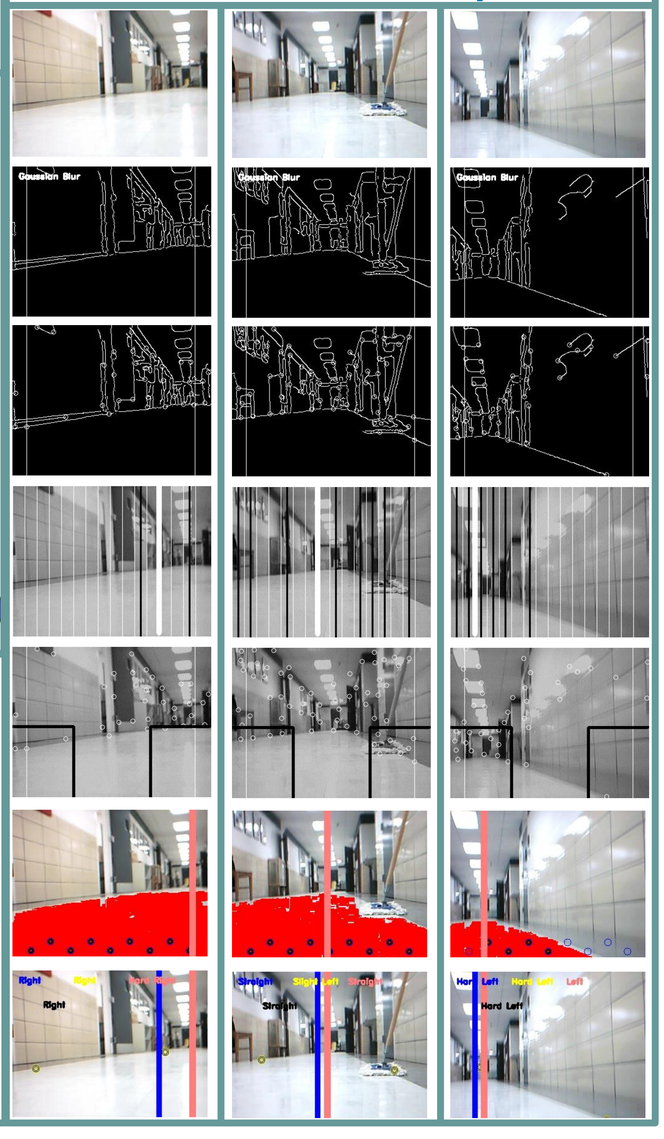


The Platform

VBASR is focused on machine vision

- Software
  - Microsoft Robotics Developers Studio
  - Microsoft Visual Studio 2008 (C++)
  - OpenCV 2.0 (C++)
- Hardware
  - Generic Webcam
  - iRobot Create chassis
  - Onboard Computer

Final VBASR Examples



Final Results

- Data set of 300+ images
- 96.6% 0verall accuracy rate
- Colors algorithm performs best
  - Other algorithms contribute
- Promising Results
  - Webcam mounted
  - iRobot manually controlled
- Autonomous navigation capable

	Lines	Corners	Colors	Resolved
Hard Left	33.3	13.3	93.3	93.3
Left	87.9	55.2	93.1	100.0
Slight Left	97.1	28.6	91.4	94.3
Straight	96.4	48.2	96.4	98.2
Slight Right	97.6	29.3	92.7	100.0
Right	57.1	46.9	96.9	95.9
Hard Right	26.3	21.1	100.0	94.7
Totals	70.8	34.7	94.8	96.6

BRADLEY UNIVERSITY

NORTHROP GRUMMAN