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SENSOR FUSION MODEL FOR LOW COST MOBILE ROBOT PLATFORM

A dissertation submitted to the
Department of Mechanical Engineering, University of Moratuwa
in partial fulfillment of the requirements for the
Degree of Master of Engineering



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DECLARATION

The work submitted in this dissertation is the result of my own investigation, except where otherwise stated.

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Abstract

This project investigates the general robots behavior, control and Multi-Sensor sensory fusion techniques using low cost Infra-red (IR) sensors, Sonar sensors (Ultrasonic sensors), Optical encoders and general-purpose Web camera specially CMUcam CMOS camera.

According to my literature survey I have found that current high – tech researches are going on by applying very expensive and sophisticated sensory devices such as, Stereo-Vision sensors, Laser scanners, High resolution CCD camera etc. along with embedded high speed Digital Signal Processor (DSP) systems. Due to above technical and financial restrictions facing with research as well as depth of expected research study to be performed; very complex and highly expensive components should have been eliminated and would not be illustrated further.

This project particularly based on sensory fusion with image processing techniques. The objective as well as motivation is, to build a low cost, optimal level resource consuming reliable sensory system for a robot. Relying only one sensor especially the time – of flight sensor (sonar) will probably cause problems such as, sonar sensors are limited in resolution, range and the size of the object they can detect, sensor value (from sonar) may not correspond to the actual distance of the object, cross talk, fore shorting and specula reflection.

Sensors sometimes can be complementary or redundant since it is necessary to make an appropriate selection of sensors when building the sensor suit for a mobile robot. For an example, Infra-Red (IR) can provide less-accurate range measurements compared to the ultrasonic sensors but IR sensors can provide a large number of measurements in a short time period; can easily be mounted on a scanner to provide panoramic view and sonar sensors are excellent for mobile robot applications when especially navigate through a room filled with obstacles. In many cases multiple sensor sources are better than single sensor reading. This led to the development of the sensor system architecture with sensory fusion techniques. Further, this permits more than one sensor making the sensory system more reliable and robust.

Typically the general architecture of the fusion sensor has been categorized into two; low-level fusion and high-level fusion. In this project, the architecture is developed based on action-oriented sensory fusion, in belief that multiple sensor reading can be fused and would give rise to certain behavior for mobile robot. And also Filtering techniques are employed to reduce the uncertainties in the line segment representation and Data / Image fusion.

Some of the issues in designing particular vision system for the robot, involves capturing and storing the entire image before starting the image analysis and to overcome some of general vision system issues, system has to be designed to extract visual information from the environment in Real-Time using an affordable 'off – the – shell' digital CMU cam color camera and embedded controller.

The final implementation and results were obtained by using Simrobot simulations and real low cost mobile platform was developed to certify the trialed simulations and implemented behaviors. It is discussed that complex situations such as emergency behavioral decision making, significantly deviates from expected once so that vision and image processing in real time make hardcore experience in low cost camera I had used and also uncertainty of sensor inputs truly make unexpected fusion results with noise addition as well.

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Content

	Page
<i>Introduction</i>	1
1.1 Uses of Robots	2
1.2 Characteristics of Robotics	2
1.3 Problems of Modern Robotics	3
1.3.1 Hardware	4
1.3.2 Software	4
1.3.3 Barrier to Entry	4
1.4 Why? Sensor Fusion	5
1.5 Sensor Modules for Perceptual Behaviors	6
1.5.1 Ranging Module	6
1.5.2 Machine Vision Operation	7
1.6 Implementation of Perceptual Behaviors	8
1.6.1 Obstacle-notification	8
1.6.2 Obstacle-detection	9
1.6.3 Landmark-detection	9
1.7 Development	9
1.8 The object in uncertain environment and identification or Avoiding	11
1.9 The proposed methodology	12
1.10 Structure of the Report	12
<i>Objectives and Methodology</i>	14
2.0 Main Objective:	14
2.2 Methodology :	15
2.2.1 Project methodology would be given as following steps:	15
2.2.2 Secondary Methodological aspects are illustrated as follows:	15
2.3 Hardware arrangement	15
2.4 Behavior Embodiments and Testing Results	16
2.5 Resource Requirement:	16

<i>Literature Review</i>	17
3.0 Introduction	17
3.1 Sensors	17
3.1.1 Sensor Classification.....	18
3.1.2 Active Sensors	18
3.1.3 Passive Sensors	24
3.2 Sensor Fusion.....	29
3.2.1 What is Sensor Fusion?.....	29
3.2.2 Sensor Fusion Considerations.....	30
3.2.3 Sensor Technology Development	31
3.2.4 Internal State Sensors.....	31
3.3 External Navigation Sensors.....	32
3.4 Sensor Interpretation Algorithms– why it is so hard	33
3.4.1 Better quality of sensors.....	33
3.4.2 Better sensor models	34
3.4.3 Better data fusion methods.....	34
<i>System Component Selection and Design</i>	35
4.1 Vision System	35
4.1.1 Illumination.....	35
4.1.2 Image Acquisition.....	35
4.1.3 Image information.....	36
4.2 Supporting Libraries	40
4.3 Vision Algorithm	42
4.5 Deventec SRF04 series Ultrasonic Sonar Range Finder.....	45
4.5.1 The Microcontroller and serial data transmission.....	46
4.5.2 Validation Methodology for Sonar Sensor	48
4.6 Infrared sensors	49
<i>Implementation</i>	51
5.0 Sensor Fusion.....	51
5.1 Common data fusion methods	52
5.2 Motivation for Sensor Fusion	53
5.2.1 Sensor Fusion Architectures	53

5.2.2 Behavior-Based Robotics and Sensor Fusion	56
5.3 Robotic Sensor Fusion Studies	59
5.3.1 Sensor Fusion Effects Architecture	60
5.3.2 Sensor Fusion in a Time-Triggered Network	62
5.3.3 Just-in-Time Sensor Fusion	63
5.3.4 Neural Network Sensor Fusion.....	63
5.4 Sensor Fusion Algorithm	64
5.4.1 The Intelligent Sensor Fusion Algorithm for Object Identification (Sub System)...	66
5.4.2 Fuzzy Logic Application.....	66
5.4.3 Combining with image information.....	70
5.4.4 The New Input Array and Neural Network Classifier.....	70
5.5 The Intelligent Sensor Fusion Algorithm for Object Avoidance and Navigation Era.....	71
5.5.1 Vision information Processing.....	73
5.5.2 Behavior Acquisition by Fusing Sonar and Vision.....	73
5.5.3 Basics of Reinforcement Learning.....	73
5.5.4 Construction of State Space	74
5.6 Estimation of Robot's Position Using Wheel Encoder System.....	76
5.6.1 Theoretical background	77
5.6.2 Implementation	78
5.7 Miscellaneous Existing Developments of Multi Sensor Data Fusion	79
5.7.1 Theory on the selection of Kalman-filter-based multi-sensor data fusion methods .	79
5.7.2 Open Problems - the big questions	80
<i>Results & Discussion</i>	83
6.1 Sensor fusion for Object Identification scenario	83
6.1.1 The Classifier with Data by Both Sensors without Filtering	83
6.1.2 The Classifier with Fusion of Data by Both Sensors with Filtering.....	85
6.2 Sensor Fusion for Navigation Behavior with avoiding obstacle	86
6.3 The Simulation Results form the Robot Navigation.....	88
6.4 Alternative Test Results on Estimation of Robot's Position.....	89
6.4 Discussion	91
<i>Conclusions</i>	92
7.0 Conclusions.....	92

7.1 Recommendation for Future Work	94
<i>References</i>	96
Appendix A	115
Appendix B	112
Appendix C	115
Appendix D	117
Appendix E	122

List of Figures

Figure 1.1: Flowchart of project development process.....	10
Figure 3.1: Scanning Laser Range Finder.....	18
Figure 3.2: Basic Structured Light Setup.....	20
Figure 3.3: An Earlier Ultrasonic Range Finder.....	21
Figure 3.4: IR Sensor (A), Ultrasonic Sensor (B), and Servo (C).....	22
Figure 3.5: Schematic Diagrams of the Ranging Module and its Beam Coverage.	23
Figure 3.6: Schematic Diagrams of the Typical Angles of the Ranging Module.....	23
Figure 3.7: Two-Track Incremental Encoder Disc	25
Figure 3.8: Vision System Components	26
Figure 3.9: CCD Camera	27
Figure 3.10: The microcontroller board mated with the CMOS camera.	27
Figure 3.11: Detail of the assembled microcontroller board	27
Figure 3.12: Computer Vision Process	28
Figure 4.9: Image preprocessing stages of Images for Object Identification Case	36
Figure 4.10: Image preprocessing stages of Images for Object Avoidance and Navigation.....	36
Figure 4.11: primitive objects used in the Test and Research	37
Figure 4.12: Histogram based thresholding.....	38
Figure 4.13: Camera Frame and preprocessed Image.....	40
Figure 4.14: CMOS camera and Parameters.....	41
Figure 4.15: CMOS camera and Parameters in schematic representation.....	41

Figure 4.16a: Grayscale Conversion of Objects	42
Figure 4.17 Result after selecting Red layer.....	42
Figure 4.18 Edge Map.....	43
Figure 4.19 All Ellipses	43
Figure 4.20 Most prominent ellipse	44
Figure 4.21: Schematic diagram of tested platform.....	44
Figure 4.22: Deventec SRF04 series Ultrasonic Sonar Range Finder.....	45
Figure 4.23: The beam pattern of the SRF04.....	46
Figure 4.24: PIC16F877A Microcontroller pin arrangement	47
Figure 4.25: Interfacing Sonar Module to host computer.....	47
Figure 4.26: An Example of Sonar Sensor Information Collection.....	48
Figure 4.27: Block diagram of the Microcontroller and PC communication	49
Figure 4.29: Sharp GP2D02 distance output (left) and sensing range (right).	50
Figure 4.30: Robot with basic sensor elements and their propagation directions	50
Figure 5.1: Block diagram of sensor fusion and multisensor integration.....	53
Figure 5.2: Sensor Fusion I/O Modes	54
Figure 5.3: Sensor Fusion & Behavior Fusion.....	58
Figure 5.4: How percepts are combined in sensor fusion.....	59
Figure 5.5: How percepts are combined in sensor fusion.....	60
Figure 5.6: How percepts are combined in sensor fusion.....	60
Figure 5.7: Cognitive model of sensing used in SFX.....	61
Figure 5.8: The similar appearance of different objects	65
Figure 5.9: Fuzzy membership functions.....	66
Figure 5.10: Fuzzy membership functions for premise parameters.....	67
Figure 5.11: Fuzzy membership functions for consequent parameters	67
Figure 5.12: Block diagram of a fuzzy inference system	68
Figure 5.13: Untrained membership functions of the antecedent.....	69
Figure 5.14: Untrained membership functions of the consequent	69
Figure 5.15: The Tsukamoto type fuzzy inference system.....	69
Figure 5.16: The new input array.....	70
Figure 5.17: The Classifier with proposed sensor fusion algorithm.....	71
Figure 5.18: Integrated overview of the System schematic presentation	72
Figure 5.19: States discriminated by the visual sensor.....	73

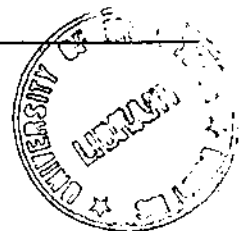


Figure 5.20: Sensory Region and Discriminating method.....	75
Figure 5.21 :(a) Positions of A & B wheels with encoders	77
Figure 5.23: Block Diagram of the Robot	78
Figure 5.24: GUI – Configuration Window & GUI – Path Displaying Window.....	79
Figure 6.1: The classifier architecture with both data without filtering	83
Figure 6.2: Network error graph with sensors without filtering	84
Figure 6.3: Illustration of Filtering Mechanism.....	85
Figure 6.5: Robot Navigate with vision sensor attached	86
Figure 6.6: (a) Sub environmental sonar distance patterns.....	87
Figure 6.7: Target reaching behavior in computer simulation.....	87
Figure 6.8: Robot simulation results.....	88
Figure 6.9: GUI for Map and Navigation viewer	89
Figure 6.10: Path settings of robot to be navigated	90
Figure 6.11: GUI – Path Displaying Window	90
Figure D1: Current flow through the H-bridge circuit.....	117
Figure D.2: PWM motor input examples.....	118
Figure D.3: Input to the motor control circuit.....	119
Figure D.4: RS232 Logic Levels.....	119
Figure D.5: Block diagram of motor driven circuit	120
Figure D.6: PWM signal routing according to directional bit	120
Figure D.7: Final appearance of the motor control circuit.....	121
Figure D.8: Robot step responses for various PWM values	121