Software Requirements Specification

BE Projects 2011-12

<Autonomous Security Guard Robot>

<Group 15>

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1Introduction

1.1 Abstract:

This document contains the description of specifications and functionalities of the ‘Autonomous Security Guard Robot'. The second section of the document contains the overall description of the product describing the factors that affect the product and its requirements. Section 3 of this document contains the details of the various functionalities of product along with description of the optimization constraints imposed on the design metrics to make the product more usable and friendly. The next two sections cover the quality of service and risk management perspectives.

1.2 References

a. “ Overall DescriptionIntelligent security robot fire detection system using adaptive sensory fusion method” - Luo, R.C.; Su, K.L.; Kuo Ho Tsai;

b. “A multiagent multisensor based real-time sensory control system for intelligent security robot” - Luo, R.C.; Su, K.L.; Kuo Ho Tsai

2 Overall Description

We'll be working on an autonomous security guard robot. Such robot should monitor and report the status of his guarding area, patrol inside a designated area and report intruders.

Product Perspective:-

This project is intended to be used as either a low cost alternative to human security personnel or as a supplement to in-place security of a company or organization. It can be used to establish a set of eyes and ears in a work or storage facility that can be accessed from outside of the facility and alert the proper authority if a situation was to arise. Being a monitoring device it would also serve as a deterrent to would be thieves.

Product Functions:-

The product functions as a simple autonomous security robot which identifies threat to a specific area. There are different aspects which determine when a threat is present and the details of its working are explained in the next section

User Characteristics: - The end-user interacting with the product is expected to be aware of the behaviour of Spark V. The end-user is also expected to be aware of the constraints on use cases of the product described in this document.

Constraints: -

The robot should detect intruders, walls and suspicious sounds, within a range of 3 meters. It should be a cost effective solution and replace the manual security system in

place. The robot should patrol on a flat land. The robot should run on battery for a minimum of 4 hours. The robot should avoid crashing to walls and stationary objects. Further, the maximum operating time for the robot to avoid the burning of its circuit should be determined with the manufacturers of Spark V. We are estimating it to be 4-6 hours. The robot will not be able to climb stairs or objects higher than the estimated and certain functionality will be clear after further tests in real-time. The maximum volume of the speakers should be set on 75% of full load to avoid damaging the speakers. The weight of the robot and hardware combined should be kept as low as possible to avoid damaging the motion wheel motors. The sound sensor can only detect loud noises.

Assumptions:-

The robot can work for 4 hours without the need to recharge its battery. The Sharp sensors will detect walls and blocking objects with a range of 3 – 80cm far from the robot. The minimum waiting time before changing direction of motion if nothing was detected is assumed at 7seconds. If the robot has detected something, the maximum delay between the detection and issuance of the sound alarm is 0.5 second (assumption). The minimum number of sensors to be mounted on the robot is 4 and maximum as per requirements and specifications mentioned by E-Yantra. & Spark V datasheet. The minimum number of wheels needed is 2 and maximum, if required, will need chassis redevelopment after approval from our mentor. The minimum number of DC motors needed is 2 and maximum upto 4 as determined by our mentor.

3. Details

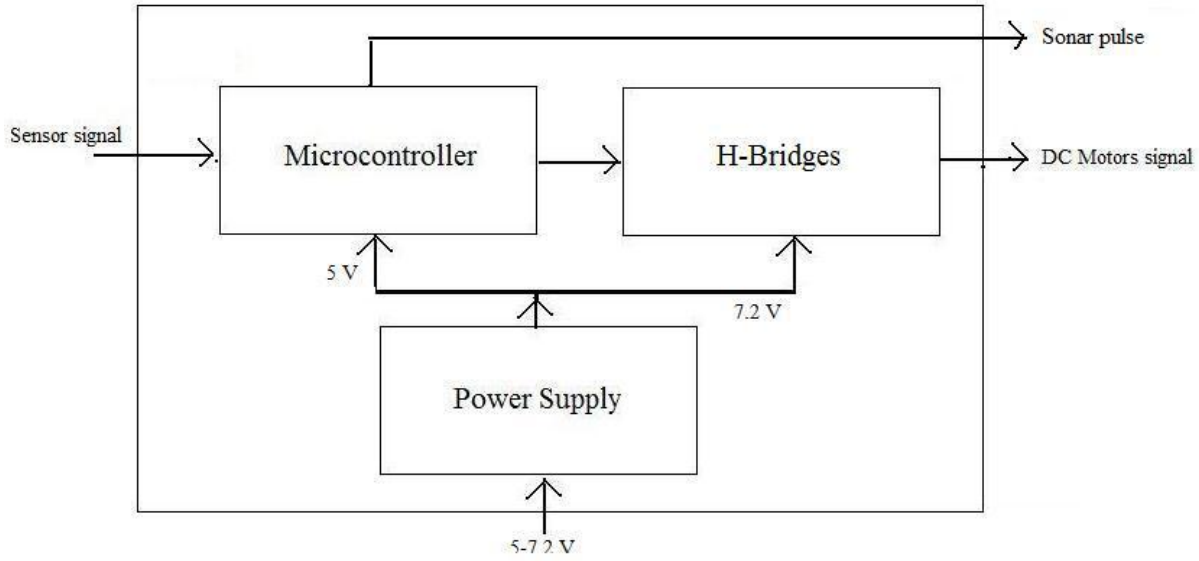
2.1 Functionality

Part A of Motion Control:-

Module	Motion control
Inputs	Sharp or Sonar based sensor output Passive Infrared sensor output Microphone sensor output 5 – 7.2 Volts input from batteries
Outputs	DC motors control signals to the H-bridges Sonar/Sharp sensor input

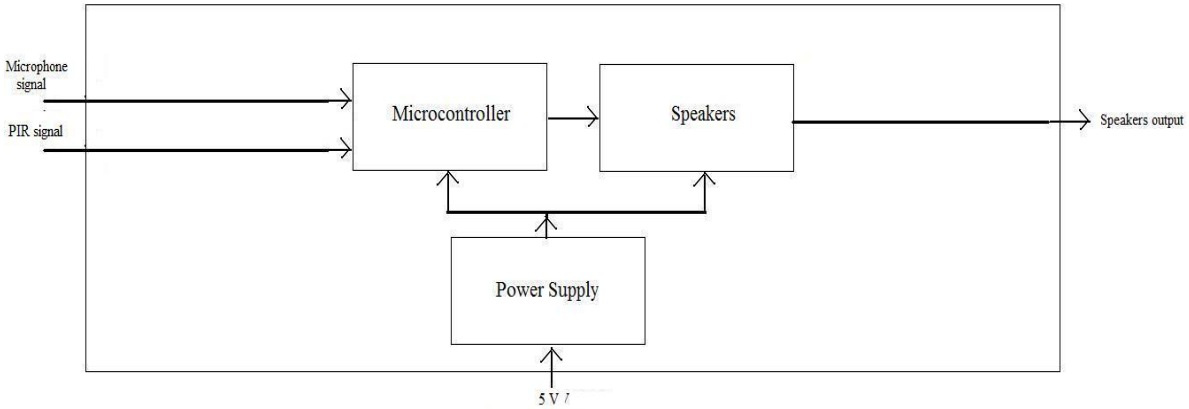
	Buzzer input
Functionality	Generates a pulse to the sharp based sensor and receives the sensor's bounced signal to determine where the robot should patrol or turn, senses for intruders and sounds, and outputs to the buzzer.

Part B (Motion Control Details): -



The microcontroller sends a pulse to the input of the Sharp/sonar sensor to generate and send an echo pulse through the air, the sensor waits for the signal to bounce back from the objects within its range; if something was detected, the outputs a TTL signal to the microcontroller in which is taken as an input by the microcontroller, then translated in terms of time and distance in the microcontroller. Then the microcontroller writes the proper signals to the H-bridge drivers to control the DC motors signal to turn or go forward.

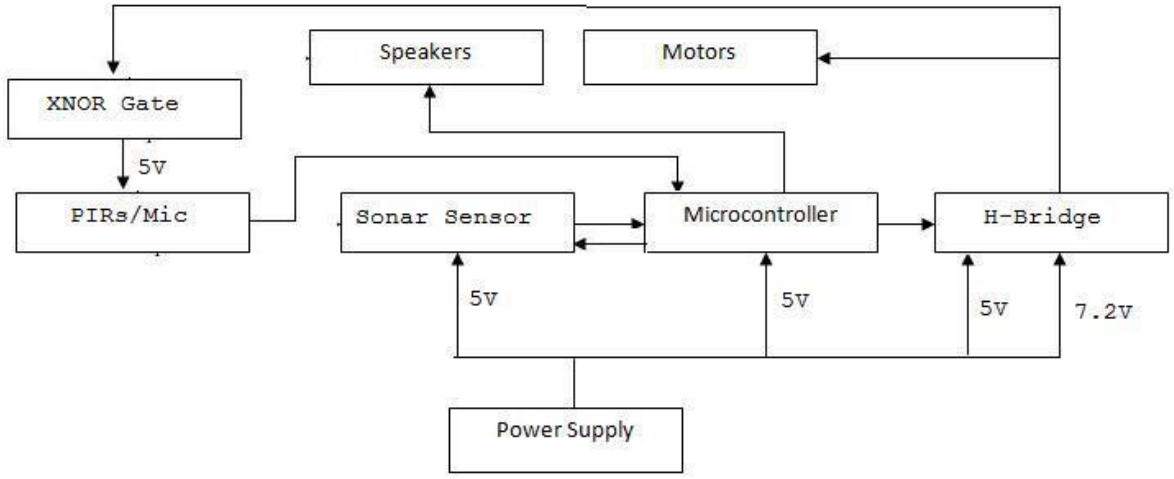
Part C (Sensor Control)



Module	Sensor control
Inputs	Microphone output 2.5 V peak PIR output of 3.3 V

	5V power from battery
Outputs	Speaker signal
Functionality	The microcontroller receives input signals from the microphone, and the PIR sensors and outputs through the speakers a loud output sound

FINAL WORKING BLOCK: -



2.2 Supportability

The software for our security guard robot will be written in C. We have used Keil uVision 4 to develop and compile our code.

1. All the functions and function calls will have prefix 'asgr_'
2. All variables will have names depending on the function.
3. Further Supportability will be compatible with the Spark V platform and will be in association with the Software Manual of Spark V.

2.3 Design Constraints

1. The maximum operating time for the robot to avoid the burning of its circuit is 6 hours.
2. The robot will not be able to climb stairs or objects higher than 0.5 foot.
3. The maximum volume of the speakers should be set on 75% of full load to avoid damaging the speakers.
4. The weight of the robot should be less than the maximum load tolerance as determined by specifications of motors and chassis if built for 4 wheels.
5. The sound sensor can only detect loud noises.

2.4 On-line User Documentation and Help System Requirements

Any queries regarding the project – related to concept, implemented algorithms, code or anything else for that matter can be posted at the forum: http://www.e-yantra.org/ci/downloads

2.5 Interfaces

There will be 3 Interfaces

1. **Face Recognition System**: A face recognition system for determining whether authorized or unauthorized personnel are intruding. This interface will be implemented after discussions with our E-Yantra mentor and after further reading of Hardware Manual of Spark V platform.

2. **Fire & Smoke Sensors**: Will be introduced for enhancement of already existing functionality.

   **** The above interface includes proper hardware and software integration as determined by our mentor at IIT-Bombay and our internal project guide. Face recognition will include camera (hardware) and proper MATLAB code (software) which will be developed and debugged in real-time. GSM module is a communication interface.**

3. Quality Control

a. Test Data

1. This sentry/patrol robot operates mainly in an indoor environment.

2. It navigates on a flat horizontal surface, which limits its outdoor usage.

3. Because it is used indoors and possibly in office buildings or homes, the robot may have several obstacles in its way such as furniture and possibly humans.

4. The robot is designed to handle obstacles based on proximity.

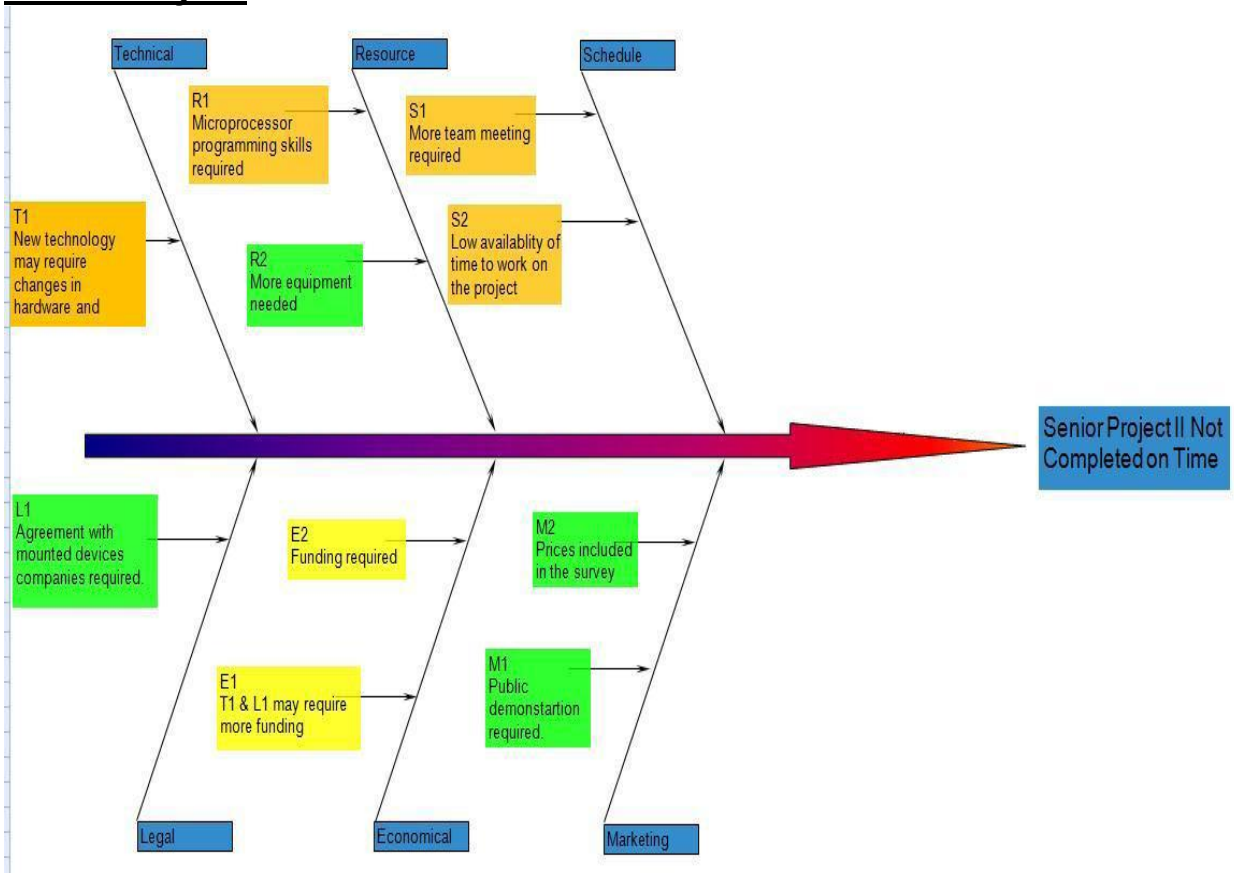
5. It is foreseeable that this robot, since it is autonomous, operates without any human present to issue instructions to it.

6. For this reason it is capable of patrolling in an area while giving feedback to the user in terms of alarms if someone was detected, but not requiring feedback during its operation.

7. The robot has set of goals to accomplish which have been preprogrammed into it.

5. Risk Management

Part A:-
Risk Analysis



		Liklihood of Occurance			Legend
		Very Likely	Possible	Unlikely	
Undesireable Outcomes	Class IV			S2	Catastrophic
	Class III		R1		Severe
	Class II	S1, T1			Moderate
	Class I	E1, E2	R2,M2	M1,L1	Low

Actions	
M1,M2,R2,L1	None
E1, E2	Funds provided by team members and possibly more financial support from their parents
R1,T1,S1,S2	Designate all team membors to solve the problem
	Continue process