System Requirements Specification
CS-308 Project
Autonomous Defensive Robot

by
Harshvardhan Mandad 08005022 (TL)
Vinay Surana 08005031
Vivek Surana 08005030
Akhil Tak 08005029

Group 12

under guidance of
Prof. Kavi Arya

Department of Computer Science and Engineering
Indian Institute of Technology Bombay

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Abstract

We will make prototype for autonomous defensive robot(ADR) using FIREBIRD robot. ADR will detect enemies coming inside an Arena and will shoot them.
ADR takes image after shooting and confirms whether shoot is successful or not and take decisions accordingly. There is also another system which provides information(location and velocity) about enemies to ADR.

1 Introduction

Autonomous Defensive Robot(ADR) is proposed to get automatic defense around an Arena which can be a Military base. The robot has the capabilty to detect the enemies in the ground with some minimum height and to shoot them using laser gun which is then confirmed using camera mounted along with the laser gun in the Robot. Military or interested people can take ADR as basic defensive robot and can modify it for their use.

2 System Architecture

ADR will communicate to the system which is giving information about enemies.This system can be thought as a satellite which is taking images of arena continously and extracting relevant information from these images and then sending the information to ADR.(for making things simple in our case, this is a system with camera which is looking on arena from top and processing of images is done on computer).

Camera in front of ADR will takes images after shooting enemies to confirm that they are dead. For simplicity, in our case enemies are small balls and shooting mechanism contain firing laser on ball.

3 Proposed System Operation

1. **Detecting Enemies inside the Arena**

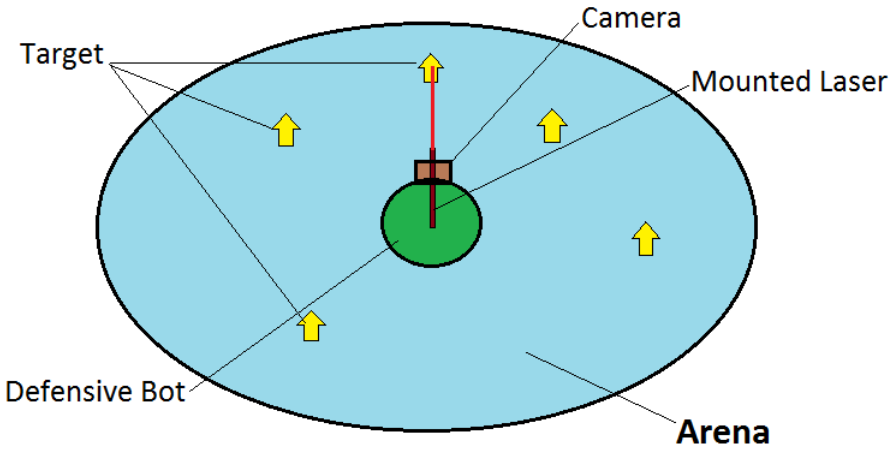

Figure 1: Detection from Top View(by Camera) of the Arena

- Enemies are assumed distinguishable from the arena.
- The camera in top will provide the location of enemies and their velocities can be infered by taking multiple snapshots of the arena.

2. **Deciding best order to shoot enemies** [1]
   Some Possible Algorithms :
   - Nearest radial distance enemy first
   - Nearest angular distance enemy first

   Depending upon the resources and configuration of the robot one of the above algorithms can be used.
3. **Confirming that the enemy is dead**

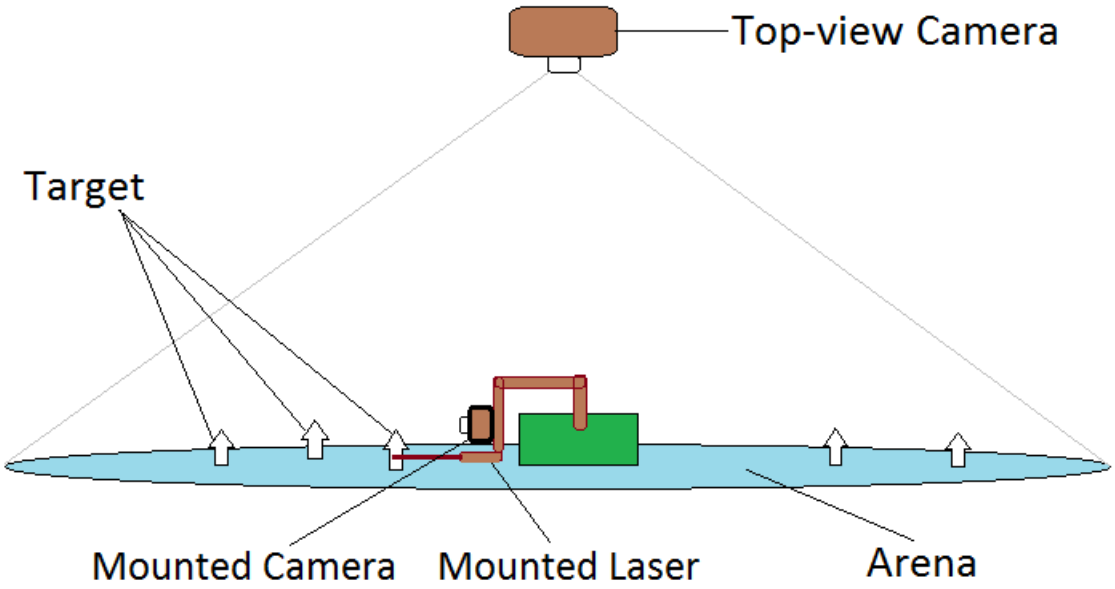

Figure 2: Side view of the arena showing detection of a direct hit

- Confirmed using front camera i.e. taking images and detecting laser dot on the enemy.

4 Work Division(tentative)

1. *Vinay Surana* : Imageprocessing
2. *Vivek Surana* : Algorithms and Calliberation
3. *Harshvardhan Mandad* : Imageprocessing
4. *Akhil Tak*: Algorithms and ServoMotor Mechanism

[1] If time permits.

5 Testing Plan

- Test Case 1:
  - Throw a ball randomly inside the arena with a constant speed.
  - Robot detects the incoming ball and shoots it with the laser.
  - Robot beeps on a perfect hit.
- Test Case 2:
  - Put some stationary balls inside the arena.
  - Robot will detect each ball one by one and shoots them with the laser.
  - Robot beeps on a perfect hit.

6 Requirements

- Hardware :
  1. One FIREBIRD robot
  2. Two Cameras
  3. Laser Gun
  4. Mechanism to mount Gun
  5. Servo motors for rotation mechanism
- Software :
  1. Matlab for image processing
  2. AVR Studio
- Arena Specification :
  1. Red rectangular arena with bot at the center.
  2. A camera mounted at the top.
- Enemy Specification :
  1. Will be a green color tennis ball.
- Detecting enemies on the arena :
  1. Will use mounted camera on top of the arena.
  2. After processing the image the system will send the absolute angle with respect to the zero of the servo motor.
- Shooting an enemy :
  1. After receiving the angle the bot will rotate the mounted laser gun in the direction of the enemy and shoot in a range of 10 degreees(to account for any error in calculation).
  2. Gun can rotate 360 degrees on the bot.
- Verifying a successful hit :
  1. Will be verified by the camera mounted on the bot along with the laser gun.
  2. A dot of the laser on the ball will imply successful hit.
  3. On successful hit, a buzzer will be sounded.