1. **INTRODUCTION**

Problem solving in complex domains require multiple agents, dynamic environment and the need for adaptive learning from the environment. Cooperative centralized multirobot learning is an active research area involving multiple learning entities controlled by a single central governmenting body to learn optimal solutions for an overall system. Robotic football is such a complex task. The paper proposes the task of minor football tactics for development of such a cooperative system. The project will aim to analyze the cooperative learning in various practical conditions so as to come up with a optimal collaborative tactics.

* 1. **Background**

The field of distributed robotics has its origins in the late 1980s, when several researchers began investigating issues in multiple mobile robot systems. The problem of efficient multirobot coordination has risen to the forefront of robotics research in recent years. Interest in this problem is motivated by the wide range of application domains demanding multirobot solutions. In general, multirobot coordination strategies assume either a centralized approach, where a single robot/agent plans for the group, or a distributed approach, where each robot is responsible for its own planning. The key advantage of centralized approaches is that they can produce globally optimal plans. Robot football has been taken as a benchmark for collectively intelligent systems and is an active part of research.

* 1. **Problem Statement**

Robots have been a major part of different solutions to well-known problems. Innumerable intelligent approaches have been applied to solve a vast majority of problems in the world. What has been recently realized through the inspiration of various biological flocks is that a larger number of robots can solve more distributed problems more efficiently.

Football, being such a cooperative sector, is a curious sector to be solved and optimized using robotics. Therefore, the project will intend to apply and use various algorithms to implement the real-life football tactics in the robotics domain.

* 1. **Objectives**

The main objective of the project will be to construct a squad of robots which will be able to cooperatively solve dynamic problems of football like cooperatively getting the ball into the net and strikers versus defender problem. The overall objectives of the project can be enumerated as:

* Solve well known football objectives by mutual cooperation
* Track the robots, terrain and the obstacles using centralized image processing systems
* Detect and avoid obstacles
* Implement collective intelligence algorithms.
  1. **Scope of the Project**

The project is scalable to various applications like coordinated exploration and detection of threats in an environment, garbage collection and disposal. It can be used for most of the works done by a single robot but is able to solve the problem faster. Since the project uses a centralized system, it will be able to control an arbitrary number of cheap robots.

1. **METHODOLOGY**
   1. **System Operation Overview**

The system consists of multiple bare-boned mobile robots equipped with just the minimal sensors required for their local actions. A powerful central computer will be used to inspect, collect and correct the global pose of the whole environment(the robots, the ball and the objective locations).

* 1. **Hardware Aspects**

In the hardware portion, the system consists of multiple bare-boned mobile robots equipped with just the minimal amount of necessary sensors to keep the cost low. Besides that, the system will also consist of a powerful central computer for the inspection of the system. The centralized computer will also act to correction of various sensor errors from the robot and provide a means to use the powerful algorithm requiring high amount of processing power to solve the collaborative problem.

Arduino has been proposed to be used as the controller for the robot due to its superior hardware compatibility and ease of use. Besides that, a Raspberry Pi might also be used if the computational need is so high that the Arduino might be unable to solve it.

Sensors in the robots consist of IMU for pose detection and remote transmission module for communication.

The central computer is proposed to be equipped with a low quality camera to track the global pose of the environment.

**figure 2.2.1:** Working Hierarchy of the system

**figure 2.2.2:** Structure of each individual robots

* 1. **Software Aspects**

The Software Aspects of the project will include various modules of software codes written in the Python Programming Language for the central computer and Arduino-C Programming Language for the mobile robot. The modules include nodes for Pose Detection(Image Processing), Inverse Kinematic Path Planning and Pose Prediction.

**figure 2.3.1:** Software parts of the project

1. **PROJECT REQUIREMENTS**
   1. **Software Requirements:**

* Text Editor
* Python Programming Language Interpreter
* Compiler Toolchain
* git Version Control Software
* Github
* Proteus Professional
* Fritzing
* Arduino IDE
* Various Algorithm toolkits
* Open-Source Libraries
  1. **Hardware Requirements:**
* DC Motors **x6**
* Dual-Bridge Motor Driver Modules **x3**
* Arduino **x3**
* IMU **x3**
* Central PC **x1**
* Camera **x1**

1. **EXPECTED OUTCOME**

The project expects to be able to design and develop a system of multiple robots which is able to collectively optimize the solution to the game of football. The system primarily will be expected to be able to track a ball and collectively guide it to the specified area of the field.

1. **REFERENCES**

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