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DEVELOPMENT OF ROBOTIC SWARMS FOR A SPORTS GAME

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ABSTRACT

There are myriad occasions where human inclusions in a situation can be replaced by a robot which does the same task with ease and in a shorter duration of time. With the advent of robotics in each and every field of life this is possible now. But in the field of sports, no such robotics has been associated. In-order to increase the efficiency of the team sports practicing and playing, the introduction of Swarm Robots makes a lot of difference to it. This paper introduces the Swarm Robots which can play the game of Badminton. This helps human players to practice as per their needs and requirements. This Swarms can also be used for search and resuce operation.

KEYWORDS: Swarm Robotics, Robominton, Embedded Robotics, Computer Vision, Path Planning

INTRODUCTION

The each and every day passing by, new records has started replacing old ones in the most of the games of sports. This is possible because of advancement in the instruments and equipments in the field of sports. This forces new age of players to train vigorously to perform well in the given game.

Use of robots can come to much useful in this fierce age of competition by helping players to practice properly and well in all the possible hard situations they are likely to encounter during the real game.

The use of Swarm robots comes very much useful in the case of team games like football, rugby, tennis, etc. This swarm robots helps in practicing a player individually and collectively for different conditions and situations they likely would encounter in the real game. This prepares them very hard for the actual game.

Here I have implement the Swarm robots in the game of Badminton. My Swarm bots were supposed to play well a doubles game of Badminton, with opposite to either humans or other bots, which they successfully had been able to do so.

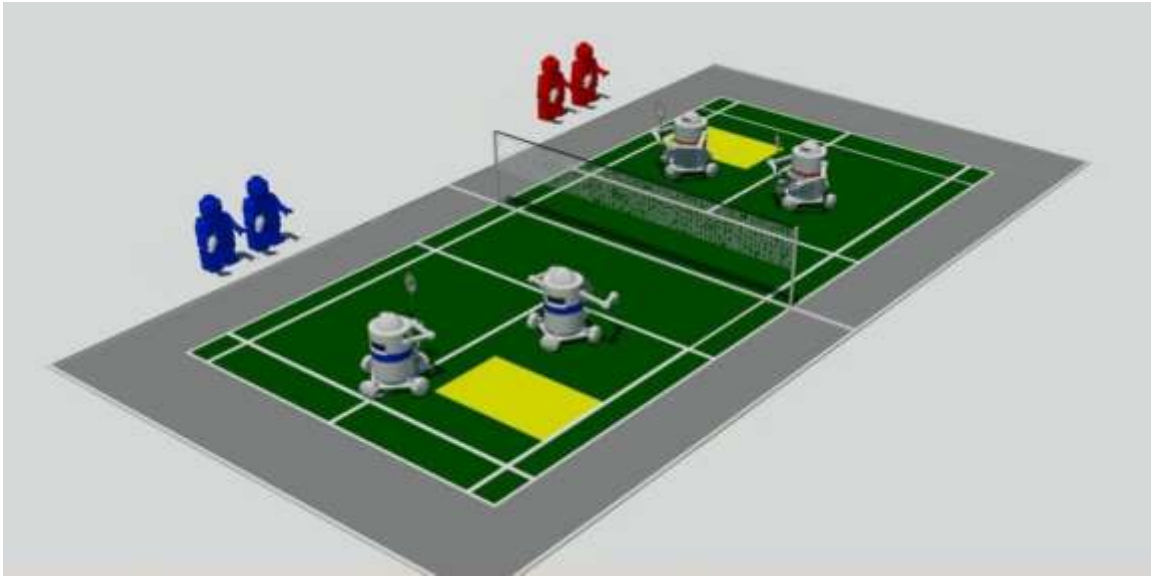

Fig.1: Robot game field for illustration purpose

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DESIGN SPECIFICATION

Mechanical Design:

Vertical Structure is used to construct the primary body structure of this robot. The reason for choosing vertical structure is that it sustains all the loads and stresses generated by different mechanisms like shuttlecock release mechanism, movement, etc. very well. This helps in the smooth operations of other mechanisms and doesn't weakens the structure.

Shuttlecock release Mechanism:

The foremost task of any badminton game is a 'Service'. Here the player is supposed to hit the shuttlecock which should go and land in the opponent area.

For this 'Service' phase, the robot is equipped with a unique Shuttlecock release mechanism. This unique mechanism uses the universal CAM-FOLLOWER mechanism to release the shuttlecock stacked in the robot. This facilitates the game to continue without any interpret.

Fig. 2.3 : Shuttlecock Release Mechanism

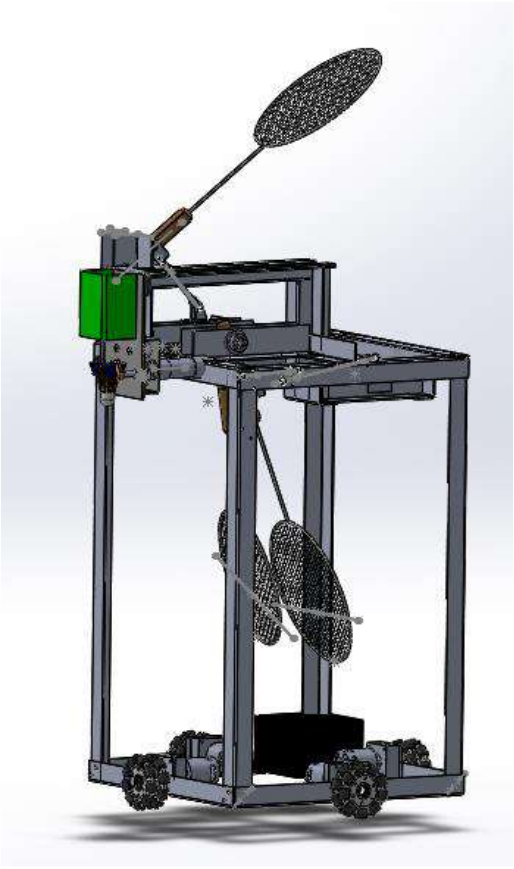

Fig 2.1: Final Robot Design Modelling

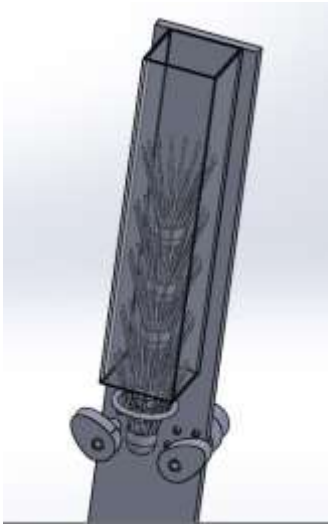

Fig 2.2: Shuttlecock Release Mechanism Modelling

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Locomotion:

This robots runs on double aluminum Omniwheels, for easy movement in all the direction. The use of Ominwheels facilitates easy and swift motion of the robots making them competent for playing in real time.

The Omniwheels requires huge power to be operated and hence high toqure motors are used. Still the problem arises is of power consumption. The on-board electronics is operated by AVR and PIC based Microcontrollers and so to drive this much powerful motors, motor drivers are used.

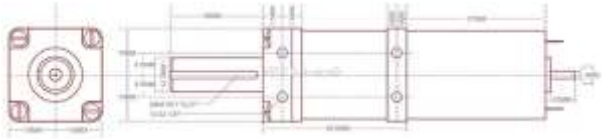

Fig 2.4: Schematic of motor

Electonics Design

The robots are governed by a very powerful on-board Microcontorllers based on AVR and PIC architecture. The main purpose of using Microcontroller is to give autonomy to the robots. Moreover, microcontrollers provides real-time processing of different peripheral devices and thereby instructing the robot to make real time decision.

To make robots completely autonomous, a series of different sensors like proximity sensor, etc. were use to fetch the on-field data. This data helped robots to get surrounding information and thereby helped them to function well.

For the communication of data between different robots and program compiling unit, the Bluetooth 3.0 2.4GHz channel is used. Moreover the actuators are operated manually with the help of PS2 game controller.

All the communication channels, on-board sensors, PS2 controllers, and actuators were interfaced with the microcontroller unit.

Mechanism Operation:

The Service, Shuttlecock release mechanism and shuttlecock hitting mechanisms are all operated by using Pneumatic drive.

The use of Pneumatic facilitates powerful and fast operation. Here the standard pneumatic cylinders from different vendors like Janatics and Festo are used with accompanying pneumatic components. Entire pneumatic circuit is placed on-board with pneumatic tank storing required compressed air in them.

The pressure of compressed air required is calculated by examining the necessary force requirement and swiftness. And based on this calculation different air tanks and cylinders wth varying capacity are selected.

This pneumatics circuits employs different pneumatic actuators supported by solenoid valves which are operated by digital signals generated by Microcontroller core.

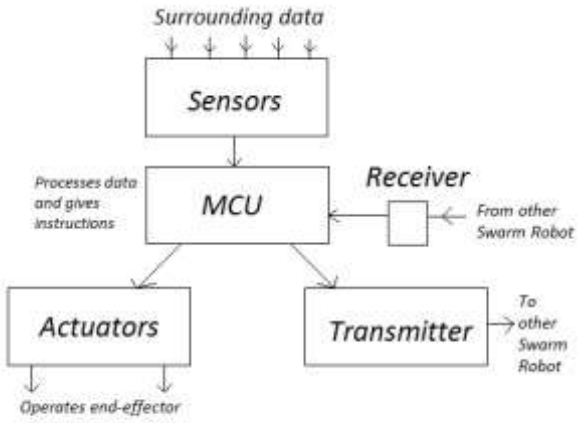

Fig 3.1: Logic process flow diagram

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Swarm Mechanism

This robots are pre-programed in Matlab (openCV with image processing can also be implemented) to work according to its team mates.

The Matlab program is structured such that it continuously monitors the data received from the other swarm robots, through Bluetooth connection, to determine the position and its operation as hitting robot or service robot.

In-order to run such a large software, a laptop was used. The program continuously monitors the data and then instructs the robot MCU to position itself. Once the MCU gets position and role, the on-board sensors accurate role with the help of colored zones and white lines. Once it gets positioned at it places an external operators actuatess the Pneumatic cylinder with the help of PS2 controller interfaced with the robot.

Due to limitation of on-board microcontroller based unit to perform all the task from Service to hitting back shuttlecock and movement all at the same time, much of the Swarm algorithm is being processed by a program developed in Matlab which suns on a laptop. Furthermore, because of using low-end peripherals, it was making robots to function very slowly and unable to return the serve in time. In-order to avoid this problem without losing the swarm operation, the end-effector actuation control was given to the manual operations, which reduced burden on both the program and on-board microcontoller. This was done by interfacing a PS2 controller with the robot.

All this implementation made it possible to run a robot effectively playing the game side-by-side.

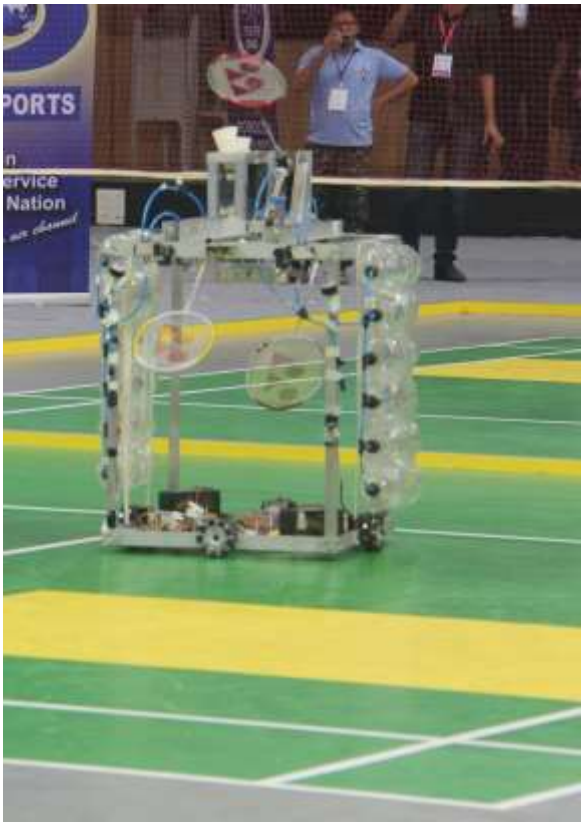

Fig. 4.1: Swarm Robot Working Prototype

CONCLUSION

All in a nutshell, this Swarm Robots can be used effectively to play any group sports without or with humans.

Apart from the field of sports, this Swarm robots can be used for search or rescue operation in case of any calamites like severe fire or earthquakes, with little modification.

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