Autonomous Tennis Ball Picking Robot

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Abstract- *Over the years, research into robotics has yielded many applications in several sectors such as manufacturing, domestic and sports industries. This paper discusses the development of an autonomous tennis ball retriever robot for the sports sector. The robot was developed with the aim of saving the time and energy of the tennis player from manually collecting the tennis balls after training sessions. The developed autonomous robot is able to retrieve tennis balls by sweeping around the tennis court. The paper discusses the system configuration in terms of computer vision, me24chanical and controller subsystems, the navigation and system performance.*

Keywords- Robotics, sports sector, tennis court, computer vision, mechanical and controller subsystems.

I. INTRODUCTION

A machine can be defined as a semi or fully automated device that magnifies human physical and/or mental capabilities in performing one or more operations developed so as to ease the human life. To contribute in this field, we have decided to work for the development of the ball picking machine. This machine detects the ball and as per the location picks it up using image processing.

Tennis is one of the greatest sports of all time. Perfecting Tennis shots takes countless hours of practice with that comes inevitable chore of picking up hundreds of tennis balls scattered all over the court. Players & Coaches everywhere know the frustration & tediousness that goes into collecting balls during a practice session. That's why we need solution to help those players & coaches to save their time, so we have come up with a robot that will collect the balls that are scattered on the Tennis court.

The scattered balls are first caught by our camera attached to the robot. The image captured is processed through the software, once the ball is identified, extraction process begins, giving commands to the raspberry pi board and in turn the mechanical system, the robot moves in the direction of recognized ball and through the sweeping mechanism of acrylic sheet collects the ball. This process is repeated and the tennis balls lying on the tennis field are connected.

II. DESIGN

The objective of the model is to create a robot for collecting the tennis balls on the court so we have created the robot using a wooden plank of dimension of (40x20) cms,. The wooden sheet is of the same dimension to provide support to the system and hold the motors and wheels. This provides for stability and helps in keeping the system in an organized manner. The camera is mounted in the center of the front region, which is connected to the raspberry pi mounted behind with the 12V battery. The battery is connected to two L298 Board which helps in controlling and commanding the four wheels of the robot for movement and navigation, The other L298 board is connected to the battery and is used for the sweepers placed ahead to sweep the ball inside through rapid rotation of wooden sheet by the motor gear system. The front end has an inclined opening to help the ball come inside, the inclined piece is hard and is a few mm above the ground only. The software design is centered around coding in language python using open cv. The system is trained using CNN Module, we have images of 924 tennis balls in our database, once the camera recognizes a similar tennis ball through matching, the ball is processed in the system. The processing starts from first resizing the image, then blurring and various other such image processing techniques are used. The identification gives command to the motors to reach to the ball, once the ball is in exact sight of our robot, the sweeping machines begin and sweep the ball inside.

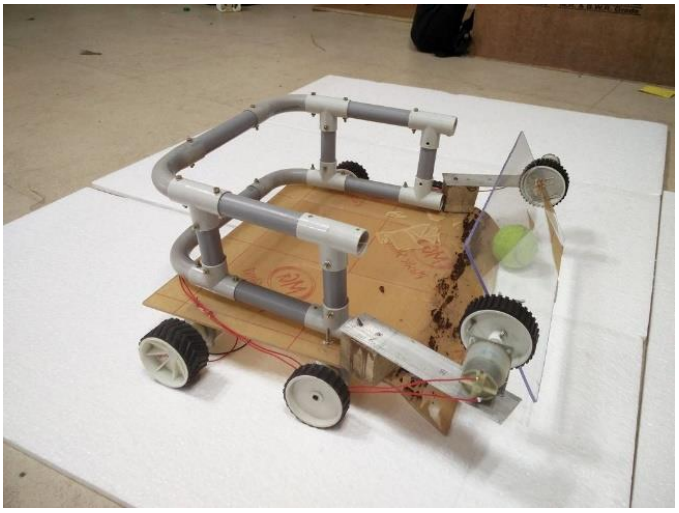

Fig 1. Structure of Autonomous Robot

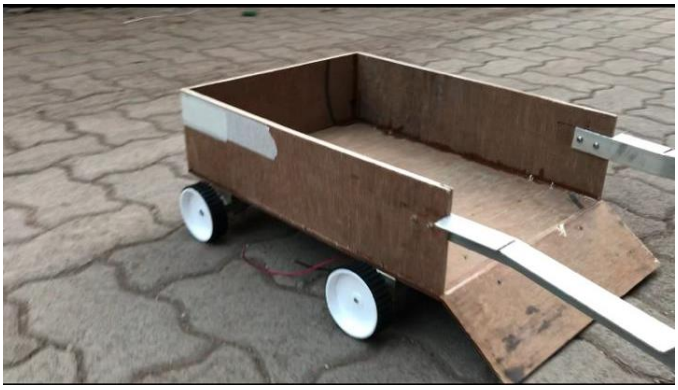

Fig 2. Hardware Setup

III. COMPONENTS

The various components used in the construction of the autonomous tennis ball collecting robots include

1.Wooden Planks
2.Wheels(6)
3.Motors(6)
4.Wire
5.Jumpers(15-20)
6.Tin plate(4cm width)(2 Nos)
7.Small cardboard
8.screw (20)
9.Motor Driver (L298N) (2)
10.Raspberry pi
11.Web cam
12.Li po battery(12 v)

Fig. 3 Rasberry Pi

Fig 4. LN298N

IV. PROPOSED METHODOLOGY

Logic for detecting a ball - Raspberry pi receives an image from webcam. We have set the image size to (450 X 300). The screen is considered as a cartesian coordinate with centre at the top left corner. It is coded to get coordinates of the centre of the ball. If x coordinate is in the range of 130 to 170 pin out 18 and 35 will be high while 16 and 37 will be low, this will make the bot to move forward. if x is less than 130 then the bot will have to move right for that pin 18 will 37 will be high while 16 and 35 will be low, this will make it move right. Similarly, pin commands are given for left movement. In an else case when no ball is detected a clockwise rotation is made by pin out for the right turn. The bot will rotate until it detects a ball. also set a 5 sec time limit for the bot to stop if it doesn't detect any ball.

Logic for collecting a ball – Once the image is extracted and the tennis ball is recognised, the raspberry Pi gives command to the L298 board which controls the navigation of the robot. The motors connected to the board and the battery start rotating, in turn which moves the wheels. Simultaneously, the sweeper starts rotating through the motor- shaft system. The sweeper consist of an acrylic sheet which swiftly swipes the ball through the inclined system inside the basket made by the card board box, it continues this process and collects balls.

V. FUTURE SCOPE

The present model has been trained with 920 images, the model can be trained more for higher accuracy. The model is made up of cardboard and can be made of good quality aesthetically sound material. The present robot is using sweeping tecnology, it can be updated to a mobile controlled robot, with ball springing mechanism with a larger capacity to collect balls. The future scope of the project is converting into a product and selling it to tennis clubs and academys so that the tiresome task of collecting balls and in turn wasting time to do so can be reduced. The app controlled, smart robot will be the want for all clubs.

VI. CONCLUSION

Our project aims to devise an easy-to-use lowest autonomous ball-picking device that helps pickup tennis balls over an enclosed tennis court area. The general idea is that this device will sweep through a tennis court in a smart fashion within a reasonable amount of time. The bot will be having an additional feature of cleaning a court while picking the ball hence reducing the efforts of the human. As keeping a human source for picking a ball will not be feasible too. This bot will

detect the ball and pick it from all over the tennis court in this way we will not lose any ball as well.

VII. RESULTS

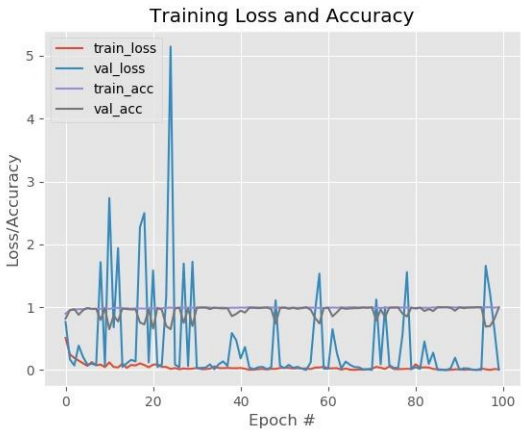

Fig5. Results of Epoch

Our autonomous ball picking robot is sucessfully able to identify tennis balls with high accuracy and in turn able to collect ball throigh our electric-mechanical system.

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