Designing and Engineering a Smart Robot for Collecting and Arranging Badminton Shuttlecocks

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Badminton training is popular in China, but trainees often struggle with the tedious task of collecting and arranging scattered shuttlecocks during sessions. To overcome this, there is a need for robots that can automatically perform these tasks. This research involves designing a novel series of mechanical devices that can adapt to the unique shape and fragility of shuttlecocks. The robot can complete the entire process of sweeping, collecting, arranging, and packaging the shuttlecocks without stopping while in motion. Automation is achieved by using image recognition and path planning. The image recognition utilizes YOLO V3 models based on Darknet to recognize targets and a depth camera to make out their exact position. Construct a badminton court map based on location information, divided into large blocks of 3 meters by 3 meters and small blocks of 30 centimeters by 30 centimeters, for global and local path planning respectively. Reinforcement learning algorithm is used to decide the globally optimal path, while A* and DWA algorithms, which use efficiency as the cost function, are used for local path planning and dynamic obstacle avoidance. The system is deployed on the Raspberry Pi 4B board, using Ubuntu and ROS, with STM32 to steer the Mecanum wheels and the transfer and control motors. The final product can handle up to 60 shuttlecocks per minute and achieved a high accuracy and recall rate of image recognition. The path planning performs well in simulation environments. Although there is still room for improvement, this system offers an innovative and practical solution for automating shuttlecock collection and arrangement in badminton training courts.