A GOLF BALL PICKING ROBOT DESIGN AND DEVELOPMENT

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ABSTRACT

The golf ball picking task is a daily that requires human intensive labor. This document presents the hardware developing process of an autonomous golf ball picking robot which aims to efficiently perform this task. It has a maintenance capacity of a 25,000 m^2 practice field. Compared to a similar device in the market this robot has twice the maximum speed and three times more container capacity.

INTRODUCTION

Golf sport is an ever increasing industry and many golf courses and practice fields are being built all over the world to meet the growing demand in golf playing (Golfe, F.P.d, 2011). There are about 30000 golf practice fields, of which 18000 are located in USA and Canada. In some countries the golf industry represents more than 15% of Tourism GNP (Turismo de Portugal, i.,2007). Golf practice fields are well suited for players to train their ball strike skills, and thus, there are hundreds of balls being thrown every day in such places. In a typical practice field, about 10,000 balls have to be picked up every day (Golfe, F.P.d, 2011). This picking task is a tedious and dangerous one (Pacheco, L., 2008, Ribeiro F. 2007). The ball reaches a speed of about 238 Km/h. A golf ball weights about 45 g and hits the ground at about 76.4 km/h.

A robust, light and low cost autonomous robot for commercial purposes in safety improvement of golf ball picking task, to substitute the tedious, painful and dangerous man work and also to reduce costs in golf practice fields' maintenance. This work follows the previous study (Pacheco, L., 2008, Ribeiro F. 2007, De Looze, 1995) where a first prototype was built to prove the concept functionality. The main initial constraints were: final price lower than 12,000€; collecting rate of about 10,000 balls/day; robot cover material resistant to ball impact, oxidation and corrosion.

RESULTS AND CONCLUSIONS

The structure (fig. 1) was made compatible with currently commercially available gangs (disks that pick up golf balls). A set of 34 polyethylene disks with a diameter of 29.4 cm each, were mounted on a steel axle. The gang is attached to the front structure and has two degrees of freedom (horizontal and vertical movements). Since the disks rotate as the robot moves, the balls are collected into the basket. The maximum width is 1.65 m. The whole structure (mechanical chassis, motors, batteries, wheels and gang) weighs 130 kg and it is prepared to push up to 200 kg. Its capacity is about 1200 balls which means extra 54 kg.

The robot was submitted to some practical tests performed on a practice field [fig. 2]. It climbed a 22° slope terrain. The maximum speed was 8 km/h, which is higher than the average buggy operation speed (5 km/h). The full container capacity is over 1,200 golf balls and the maximum turning angle is 45°.

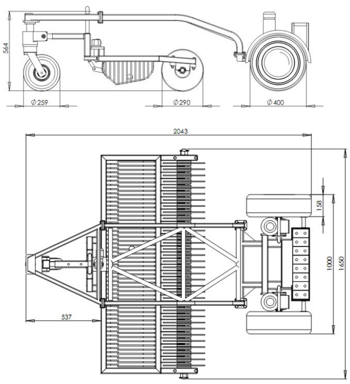

Figure 1 – Technical Drawing

Fig.2 – Golf Ball Picker Robot Prototype

The average power consumption of the whole system is 1,600 W. The first test log file revealed that the maximum temperature registered was 65°C which is well below the cut-off temperature (100°C). The robot takes 140 min to completely sweep a 25,000 m2 field at average speed of 7.2 km/h (2 m/s). Considering a case in which 1,200 balls are evenly distributed over the field, it would collect them all in 140 min. Operating 8 h/day it can run 57.6 km which represents covering 3.4 times the total area. Further work include implementing efficient path planning to minimize the energy consumption, by minimizing the distance travelled and maximizing the collecting ratio (balls/h).

There is a patent pending (Portuguese Patent 103 807, and United States under assessment, Patent on 30 September 2010: US-2010-0250024-A1).

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