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Robot companion for rehabilitation

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Introduction

We started out this project as an extension of our original project, which was to create a jumping robot that could transverse various types of terrain. Upon examination, we decided to extend the jumping robot's capabilities to be a companion robot that could assist in various tasks.

Looking into potential applications for a "robot companion," we came upon the issue of patient rehabilitation, which required staff dedicated to the monitoring of the patient for hours on time. Hence, we decided to refine the robot we had to cater to the requirements of physical rehabilitation patients.

This design thus aims to track the progress of the patient's movements and act as a companion that cheers him on upon completion of key exercises within his sessions.

Methodology

Our original robot model consisted of a platform driven by two motors; it housed a spring- loaded mechanism that winds up and releases upon remote radio control. The robot runs off an Arduino Romeo board that accommodates RC connectors.

This initial prototype had a jumping height of about 20 cm and has a jumping angle of 45 degrees approximately. It normally accomplishes its jump in less than 5 seconds.

The redesign aimed to reduce the weight of the robot to achieve a higher jump height, while strengthening the overall structure of the platform. To that end, we swapped to a smaller Arduino board (Arduino UNO) and the spring platform.

We attached a Pixy camera system that would both track the intended patient and determine obstacles that require jumping to overcome. The Pixy camera is able to track coloured objects and by placing a colour code on a patients' leg and colour code on the stairs. The robot equipped with 2 Pixy cameras will be able to differentiate the patient and the stairs with their respective unique colour codes autonomously.

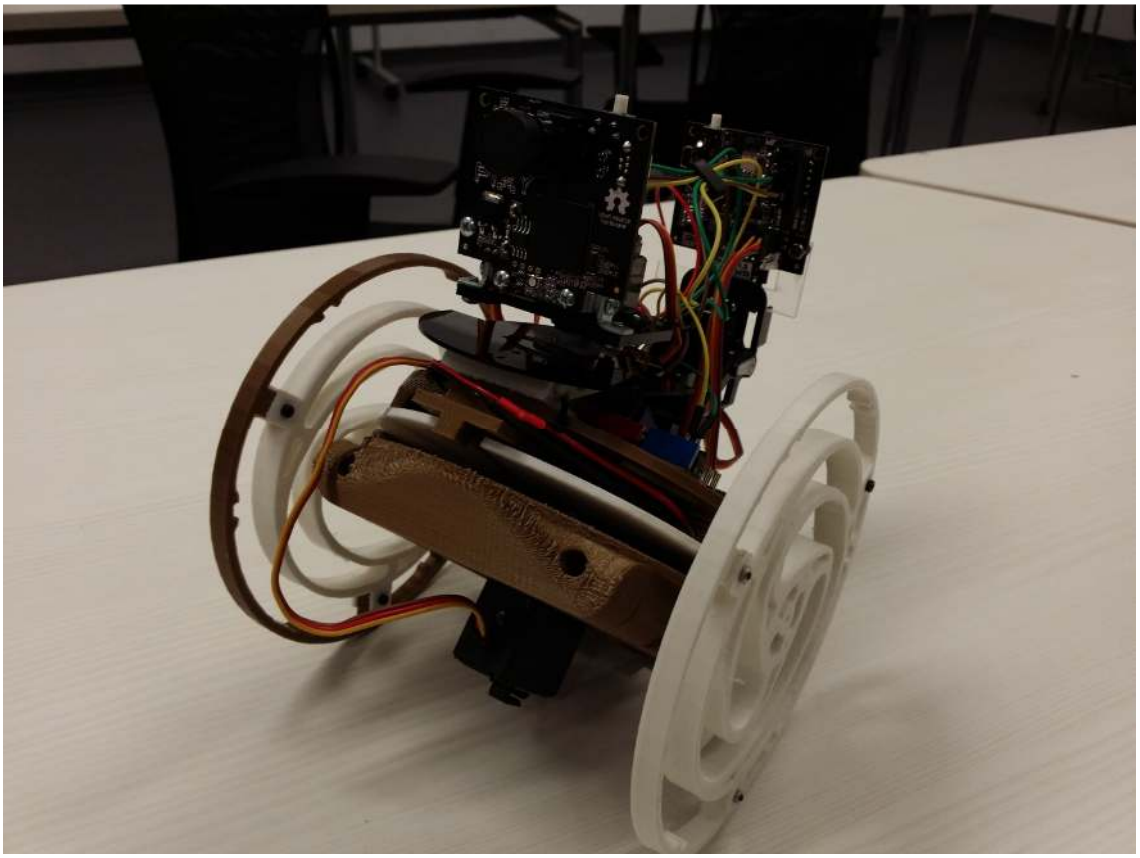

Fig 1 – Robot Prototype

The control algorithm for the robot is as follows (Briefly)

If there is not stair objects on the rear camera, the robot will continue to track the patient. The front camera is equipped with pan and tilt servos to align the center of the camera to the object it tracks. If it detects a stair object, it will compare the distance between the patient and the stairs. (Using the size of the colour code)

If the stairs is closer to the robot than the patient, it will track the stairs and attempt to scale it, while keeping track of the distance of the patient. When the patient comes into close proximity, the robot will then jump and scale the next step.

Encouraging the Patient

For simplicity, we will first begin with installing a LED screen as a display mechanism to show encouragement, as well as a mp3 module to play a sound clip with encouraging statements like "Doing great! Keep up the great work!".

Conclusion

We have completed both the tracking sub–system and jumping sub–systems and will be working towards integrating these two sub–systems into a single robot. Also, we will work on further refining our control algorithm and move onto using OpenCV as a computer vision platform to allow the robot to track patients more accurately.

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