CM30229 - Room Circumnavigation using LEJOS

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Abstract

0.1 Introduction

The goal of this research is to see the effect of sensor loop times on the navigation capabilities of the rover while circumnavigating a room. The rover was built using parts from the LEGO Mindstorm NXJ kit. There were 3 sensors; a *Sonar*, *Light Sensor* and *Bump Sensor* (x3). Three motors were provided for movement and navigation.

To make informed decisions all of the sensors were used and the sonar was mounted on a pivot to allow for measurements in multiple directions, as shown in figure 1. To provide movement two driven wheels were used and a trolley wheel was placed at the back for stability.

During development a reactive approach was taken, using the subsumption architecture [Wooldridge, 2009] with emphasis on sensing using multiple layers of perception to allow for informed movement decisions. The use of the subsumption architecture was based on Brooks' theses that Intelligence is an emergent property of certain complex systems. [Brooks, 1991] During development this subsumption approach was added into the perception mechanism, during which the rover had to to decide on it's current situation.

Figure 1: Rover Head Sensor

0.2 Approach

The initial design of the rover was a simple reflex agent as described by Russell et al. [1995]. This took the sensor readings, and using transduction converted them to a proximity reading in every direction. This allowed to rover to react to a crash but when recovering from a crash the rover had no context. As a result I settled on Russell et al. [1995]'s model-based reflex agent. This allows the sensors to modify the state at individual rates, in the final design there were two sensing thread loops, operating at different tick rates, as shown in figure 2. One for the sonar which provided slow but accurate readings and one for the other sensors which provided almost instantaneous measurements.

All of the sensor readings were mixed and the closest reading was taken. This was especially important for the front sensor where 3 separate readings were taken from the bump, light and sonar sensor. To improve sensor quality 15 readings were taken every measurement and any reading more than two standard deviations away from the mean were thrown out, and the remainder of the readings were averaged.

Throughout the research the rover was shared with Ryan Cullen. In the first part of the coursework the rover resided in my house. I built the rover itself, optimising it's design over several iterations and created the perception system of the code. The software continuously modified proximity read-

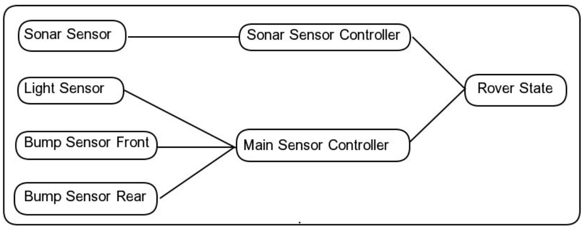

Figure 2: Final Perception Architecture

ings in the state, indicating how close the rover was to an object in all four cardinal directions. At this point the code was then forked by Ryan and we each developed our own action selection code based on the rover state.

0.3 Results

0.4 Discussion

0.5 Conclusion

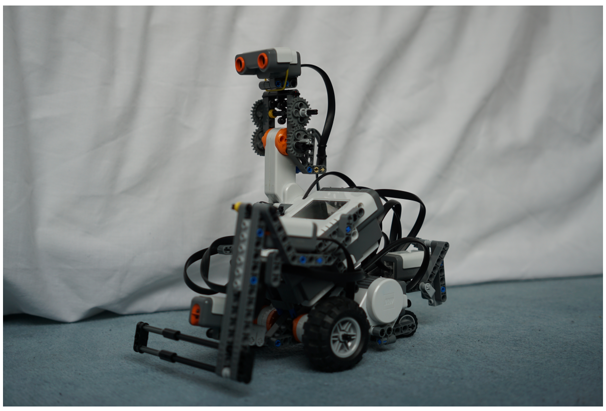

Figure 3: Stanley Rover

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