4 Stooges

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1 Introduction

The 4 Stooges are a small sized RoboCup team, which grew out of the All Botz who competed at RoboCup-99.

One of the main differences is that the 4 Stooges are a team of fully autonomous robots. All sensors, actuators, and power supply (CMOS camera, and battery) as well as all processing is housed on the robot.

The localization, path planning, and task planning problems for local vision teams are more difficult than those for global vision robots. However, an autonomous robot is more realistic for applications outside of the RoboCup domain. Therefore, the development of robust solutions to the above mentioned problems is very important to drive the development of practical mobile robotics.

This was the first year that the 4 Stooges entered the RoboCup competition. Most of the development was on the design of a mobile robotics platform and the image processing of the robots. The main contribution was the development of a new image capture routine which allows significantly higher framerates (30 fps as opposed to 5 fps) than the original one.

2 Team Development

Team Leader: Jacky Baltes
Team Members:

Jacky Baltes
- Uni. of Auckland
- New Zealand
- Team Leader
- attended

Gary Henson
- Uni. of Auckland
- New Zealand
- Student
- attended

Andrew Thomson
- Uni. of Auckland
- New Zealand
- Student
- attended

Weidong Xu
- Uni. of Auckland
- New Zealand
- Technician
- could not attended

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P. Stone, T. Balch, and G. Kraetzschmar (Eds.): RoboCup 2000, LNAI 2019, pp. 519-522, 2001.

3 Hardware Platform

The 4 Stooges use last year's mechanical platform of the All Botz, the old but reliable Tamtech toy cars. However, the 4 Stooges added local control and local vision resulting in a fully autonomous robotic system.

The cars are controlled by an Eyebot controller. The Eyebot controller is a MC68332 processor based controller, developed by Prof. Thomas Bräunl from the University of Western Australia.

The Eyebot controller includes a parallel interfaces, a serial interface, A/D converters and 12 servo control outputs and two motor control circuits. It also provides an interface for the Radiometrix serial transceiver. The biggest advantage for small robotics projects is that a CMOS camera is available for the controller. The Eyebot controller also comes with some libraries for image capture and processing.

The CMOS camera provides a 80x60 image with 24 bit colour information. The colour information is not very good, since the camera uses a cheap Bayer RGB pattern. The image sensor has 160 rows. The odd rows provide red and green and the even rows return green and blue colour information.

Since our mobile platforms can not turn on the spot and since we do not have dead reckoning sensors in our robots, we decided to add a pan servo on the robot. Using this servo, the field of view of the robot is extended in the horizontal direction. Figure 1 is an image one of the 4 Stooges.

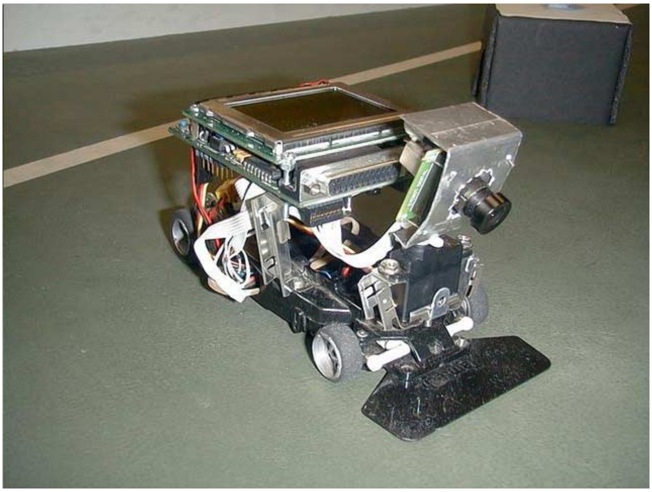

Fig. 1. An image of one of the robots of the 4 Stooges. The Eyebot controller is mounted on the top. The pan servo and the camera are mounted on the front of the robot.

4 World Model

Localization of the robots is a difficult problem for the local vision teams in the RoboCup small sized league. Other teams using local vision added special corner or side markers to make localization easier. Since the small sized league is intended mainly for global vision teams, it does not make any such concessions.

The only two distinguishing features in the domain are the two goals on either side of the playing field. The problem is that the 4 Stooges are not able to see the goals in most positions.

Since the 4 Stooges do not have shaft encoders, they can not use dead reckoning for the periods where the robots are not able to observe the goals. Instead, the 4 Stooges use the walls to recailbrate their relative short term motion. Note that by observing the wall, only the orientation angle can be accurately determined.

The 4 Stooges recailbrate their orientation whenever they are able to observe a goal. The orientation is updated using the relative change of orientation from walls and lines on the field. If no feature can be detected by the robot, a "best guess" of the motion of the robot is used.

5 Skills

The code for the field players is almost identical. The only difference is their home position. The team strategy employed by the 4 Stooges uses one defense player, a left striker, and a right striker.

The goal keeper starts out on the goal line and attempts to stay on this line as much as possible. It uses a simple feed forward control to keep the goalie between the ball and the goal. It it can not see the ball, it moves back towards the home position, since this provides it with the best view of the playing field.

The strikers always approach the ball if they can see it. If a striker can see the goal and the ball, it will attempt to shoot at the goal (if the direct line through the ball points at the goal) or will try and maneuver itself behind the ball. If the robot can not see the goal, but has recently recalibrated its orientation, it will use this information to either kick the ball into the opponent's direction (if it is facing the opponent's goal) or to dribble the ball (if it is facing its own goal). In all cases, it attempts to keep the ball away from the opposition.

6 Special Team Features

The original Eyebot controller was limited to five frames per second, because of the large interrupt latency for each byte transferred.

The 4 Stooges changed the camera interface routine to use a carefully timed polling and were able to increase the frame rate to 30 frames per second. Since the source code for the Eyebot BIOS is not freely available, we had to disassemble the BIOS and "hack" the BIOS to support the higher frame rate.

Another features of the 4 Stooges was that a lot of the image processing code was based on the video server of the All Botz, a global vision team also from the University of Auckland.

7 Conclusion

This year was the first year that the 4 Stooges entered the competition. Clearly, a local vision team is solving a more challenging problem than a global vision team. It comes therefore as no surprise that the 4 Stooges were not competitive against their global vision opponents.

Of more interest to the 4 Stooges were the results of the local vision derby which was held for the first time this year. The games between the local vision teams were boring. Most of the time, the robots had trouble finding the ball. In case of the 4 Stooges, this was due to the poor camera mounting as well as the poor quality images returned from the CMOS camera.

One lesson that we learned from the competition was the camera mounting was not useful. To recognize the ball even at comparatively close distances (about 50cm), the camera had to be mounted at such an angle that balls that were really close to the robot were not recognized anymore.

We changed the mounting of the camera to look straight ahead. This will allow us to see the ball when it is close to the robot.

One of the main research directions of this work is the development of efficient role assignment for multiple agent systems. Therefore, we will add communication between robots for next year's competition.