4 Stooges

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1 Introduction

The 4 STOOGES are a small sized ROBOCUP team, which grew out of the ALL BOTZ, a team which competed previously at ROBOCUP-99 and ROBOCUP-00.

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 itself.

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 second year that the 4 STOOGES entered the ROBOCUP competition.

In 2001, the main improvement has been the use of demosaicing to quadruple the resolution of the image capture to 160x120 without increasing the processing overhead.

This demosaicing performed extremely. The robots constantly were able to recognize the ball at distances up to 50cm.

2 Team Development

Team Leader: Jacky Baltes
Team Members:

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

Matthew Painter
- Uni. of Auckland
- New Zealand
- Student
- attended

Andrew Thomson
- Uni. of Auckland
- New Zealand
- Student
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Peter Yu-shan Cheng
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A. Birk, S. Coradeschi, and S. Tadokoro (Eds.): RoboCup 2001, LNAI 2377, pp. 559–562, 2002.

3 Hardware Platform

In 2001, we redesigned the hardware platform. Instead of toy cars with Ackerman steering, we used a differential drive design. However, true to the spirit of the 4 Stooges and All Botz, we used cheap components. The driving mechanism is based on a twin gear box available from Tamiya, which can be bought for less than $20.00.

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.

Fig. 1. An image of one of the robots of the 4 Stooges. The Eyebot controller is mounted on the top.

Using the standard RoBios developed by Thomas Braunl, the CMOS camera provides a 80x60 image with 24 bit colour information at a maximum of three frames per second. The colour information is not very good, since the camera uses a cheap Bayer RGB pattern [2].

In 2000, we developed a new image capture routine which was able to capture images at up to 30 frames per second [1].

In 2001, we used demosaicing to quadruple the resolution of the camera. Our demosaicing technique is described elsewhere in this book in more detail. The main idea is to infer missing colour information from the Bayer pattern.

4 World Model

Localization of the robots is a difficult problem for the local vision teams in the RoboCup small sized league. Other leagues 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. If it can not see the ball, it moves back towards the home position in the center of the goal, 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 second 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 second time this year. The games between the local vision teams have significantly improved from last year. Our robots were able to see the ball consistently if it was less than 50cm away.

This improvement has been mainly due to the improved resolution and speed of our image capture routines. Instead of looking for four or less pixels (the size of the ball in x 80x60 image), we are now looking for 16 pixels. This means that we are much less susceptible to noise in the image.

Current development for the 4 Stooges centers around improved team play. We plan to add wireless communication to our robots so that they can communicate during the game.

References

1. Jacky Baltes. 4 stooges. In Peter Stone, Tucker Balch, and Gerhard Kraetszchmar, editors, *RoboCup-2000: Robot Soccer World Cup IV*, pages 519–522. Springer Verlag, Berlin, 2001.
2. Bryce E. Bayer. Color imaging array. U.S. Patent 3,971,065.