ROBOSIX UPMC-CFA : RoboCup Team Description

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Abstract. This paper describes the Robosix team of the University Pierre and Marie Curie. The team is composed of five robots built inside the institute based on an omnidirectional motion system associated to a catadioptric sensor developped by the Laboratory of Instruments and System. The team started developping the robots during the year 1999 in prevision to participate to the RoboCup 2001, the team is partially composed by member of the French middle size team that participated to RoboCup98 in Paris. The robots computational system is based on a pc 104 card with a celeron 633Mhz running under a light version of Linux. The localization system relies on an assocation of multiagent panoramic vision system developped inside the LIS lab.

1 Introduction

Our research group started working on the RoboCup contest since the first edition of RoboCup in 1997 where we participated in the small size league. We consider Robocup to be a challenging competition as it is a good test plate-form to test new algorithm in distributed panoramic vision which is one of the main research subject at the Laboratoire des Instruments et System of the University Pierre and Marie Curie. A RobCup team needs several knowledge in different computer science domains, like networking, mechanical and eletrical engineering, computer vision and artificial intelligence. The team is the a consortium of different sections of the university and is composed of fifteen students from these differents fields and four advisors. Robosix is an association created to participate to the Robocup in different leagues, up to now Robosix handles both the small size and middle size activities, putting together the knowledge of both leagues. Most of the vision control and path planning algorithms are the same between both leagues. Following our particpation in the middle size competition in 1998 and our numerous participations in the the small size league our goal has always been particpating to this league as it presents problems more linked to distributed vision and intelligence that does not exist in the small size league and which is one of the main research subject of the research team. Our credo is to developp robots using unexpensive easy and very modulable components. This paper is organized as follows

2 Robots architecture

Fig. 1. Robosix middle size team

The robots architecture is based on an omnidirectional plate-form. All the robots have the same mechanical design. The robots computational system is based on a pc 104 card based on a celeron 633Mhz with 128Mb RAM and 32Mb of flash memory. The operating system is based on a linux Kernel taken from the Suze 7.1 version of linux that we lightened, the linux kernel is the 2.4 using the GlibC 2.2. The robots are size is $50 \times 50 \times 80$. The robots have a pneumatic shooting system and a roller like the one used in the small size league, we were waiting for a clarification of the rules before mounting it on the robots. An ST10 micro-controller handles the speed and control direction of the electrical motor. The electrical motor were given to us by MDP and are Maxon alimented under 48V. We also use wireless communication between the robots, we use a Cisco device running on the 2.4GHz frequency.

3 Vision System

The vision system of our robots is based on a catadioptric device developped in the laboratoire des Instruments et Systèmes and a colour card of 380 TV lines. We initially used the sensor we developped in 98 which desciption can be found in [3] and we finally used the one that we developped this year. The catadioptric system developped is under the process of being patented and then due to confidentiality we will not be able to give a scheme of it. The acquisition card is a pc-tv card which are the cheapest ones running under linux. The output signal of the camera is RGB. A color is defined as a three component vector containing the values for the red, green and blue color planes. A first stage is manually made where colors are selected, for each color we compute a mean and a standard deviation. We used a bettered version of RGB calibration to allow fast processing. The image is then filered, an image containing only the desired colors is generated. In a second time a second detection based on HSV color space is applied only on the detected zones to reduce computation. A scalar is assigned to each color corresponding to the objects seen, we obtain then a 8 bits images where for example the field is coded zero. A fast labelling algorithm is then applied giving for each detected region its gravity center and the number of pixels it contains. For more information concerning the labelling method, the reader can reffer to [1]. The same low-level image processing has been used succefully used by our small size team.

4 Path planning and localisation

Our panoramic device is sharply calibrated so that each robot can estimate the distance of each detected colour zone present in the image. From these 2D information a voronoi diagram is computed giving the best paths, then an A^* algorithm determines the best path to choose. The path planning is the same one of our small size team that we also used last year. The localisation algorithm of robots is the most complex part of the robot, it is based on the theory of distributed panoramic vision that our team is developping with the University of Wakayama for more information of these techniques the reader should refer to the paper [2]. The localisation is also based on a more local estimator based on the ICP algorithms, which use in the classical scheme of using a model of the field and matching it with the output of the vision system.

5 Behaviour

The behaviour of our robots is again partially based on the one we used last year in the small size league which proved to be quite efficient against agressive but also defensive teams, but this time we added to each robot a local behaviour giving a priority between what we call "reflex" behaviour and group actions, like passes, etc ... The behaviour of the robots is motivated by different flags corresponding to specific situations and robots positions after analysis of the situation. The field is cut into different zones each having a priority. The knowledge and the analysis of these flags gives an analysis of the situation of the game. Each robot according to its position, the position of other robots and the ball will have a specific behaviour. The behaviour is based on micro and macro orders. Each robot has simple behaviours each one corresponding to an action.

The robots use a prediction algorithm that gives the position of the ball and the opponents in the next two images. The behaviour of the robot varies according to situations for example if the team is winning or not.

6 Conclusion

In this paper, we have presented the Robosix team, its composition giving the headline of what has been developped. We are preparing this event since last year in parallel with our small size team that started from scratch last year. Up to now the robots are built and we are in the process of AI testing and distributed behaviour as we would like our robots to make passes and interact between them applying specific attack strategies. We wish within few years to see Robosix being able to particpate in all the Robocup leages as we think that this contest is a very good way to give students a better knowledge and specially introduce them to research. Like we did last year with our small size team, we will be participating to the German Open within few months as it showed last year (with the Dutch Open) to be a very good way to test the team to be fully ready for Seattle.

References

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