Team Description Paper 2023 - Bembelbots

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1 Team Information

The RoboCup Standard Platform League team *Bembelbots* was founded in 2009 and is affiliated with the Department of Computer Science at Goethe University Frankfurt (Main), Germany. One of team's main goals is to provide students of computer science with an opportunity to practice hands-on programming skills in the field of robotics. Currently, ten students and alumni of computer science at Goethe University Frankfurt work on the implementation of our framework for playing soccer.

The group is fully organized by students, and the team leader is Jens Siegl. The team's website can be found at www.bembelbots.de, and you can reach the team per mail via contact@bembelbots.de

2 Code Usage

Most of our framework was written from scratch by members of the team *Bembelbots*. Nevertheless, we use some code from other teams.

We use the vision and walk modules of the team *HTWK Robots*.[3] The vision module has been enhanced with the detection of corners, as well as our own object classifiers for the ball, penalty marks, and robot feet (for further details see [1]). The walk published by *HTWK Robots* has been integrated into our own modular motion engine as a submodule.

Our behavior is implemented using CABSL, the standalone C-implementation of XABSL published by B-Human.[4] The behavior is implemented as a module in our framework that communicates with our framework through a message-passing system.

3 Own Contribution

The team *Bembelbots* has developed their framework from scratch. The current framework features a modular motion engine, that schedules and executes motions. The CABSL behavior can be compiled independently and tested using a 2D simulator.

[3] https://htwk-robots.de/
[4] https://github.com/bhuman/cabsl

Our work in the past year has focused on two main research projects: the modularization of our framework and a new robot detection.

In our previous blackboard-like framework, any parallelization and synchronization had to be done by hand, as there was no explicit dependency management. This was very error-prone and made it hard to fully utilize the NAO v6 platform. We solved this by replacing our framework with a message-passing system. Modules only declare their inputs and outputs. Dependencies are resolved based on these descriptions and modules can run in parallel based on the dependency graph without any further effort required by the module author. Our new approach also guarantees that modules can be run standalone. This will allow us to cover entire modules with automated tests.

In cooperation with *HTWK Robots*, we worked on a new robot detection using the YOLO v3 architecture. We expect this new robot detection to help us further avoid player-pushing and provide a more stable basis for path planning, which is one of the next projects we plan to implement. Unlike our previous robot detection, which operated on the results of our ball detection, this new one has its own pipeline. The training data we used is a combination of simulated data, which we have previously shown to yield good results in the context of the SPL [2], and of labeled NAO v6 top cam images.

4 Past History

4.1 German Open 2019

The *Bembelbots* achieved 7th place at the German Open 2019. The results from Round Robin Pool A are as follows:

Table 1. Results from Round Robin Pool A at German Open 2019

B-Human	Nao Devils	Berlin	GF	GA	GD	Points	Rank
0:7	0:4	0:4	0	15	-15	0	4

4.2 RoboCup 2019

The *Bembelbots* achieved 5th place overall in the *Champions Cup* of the main SPL competition at RoboCup 2019, as well as a second place as part of *Team Team*, together with *HTWK Robots*, in the *Mixed Team* challenge.

The results from the individual challenges are:

Table 2. RoboCup 2019 main competition

Game	Home	Away	Score
Challenge Shield 1	SPQR	Bembelbots	1:1
Challenge Shield 2	Bembelbots	MiPal	6:0
Challenge Shield 3	SABANA Herons	Bembelbots	0:3
Champions Cup Play-In	NTU RoboPAL	Bembelbots	1:6
Champions Cup 1	HULKs	Bembelbots	3:1
Champions Cup 2	rUNSWift	Bembelbots	7:0
Champions Cup 3	HULKs	Bembelbots	3:1
Champions Cup Play-In	Berlin United	Bembelbots	1:1 (0:0) *
Champions Cup Quarterfinals	B-Human	Bembelbots	10:0

* Decided by coin flip after penalty shootout

Table 3. RoboCup 2019 Mixed Team challenge

Game	Home	Away	Score
Round Robin 1	B&B	Team Team	1:1
Round Robin 2	Devil SMASH	Team Team	1:2
Round Robin 3	SwiftArk	Team Team	1:3
Round Robin 3	Team Team	SPQR-Starkit	4:0
Finals	B&B	Team Team	0:0 (3:2)

4.3 RoboCup 2021

The *Bembelbots* achieved 5th place overall of the SPL competitions at RoboCup 2021. The results from the individual challenges are:

Table 4. Results from individual competitions at RoboCup 2021

Challenge	Ranking
Obstacle Avoidance Challenge	7
Passing Challenge	3
1 vs. 1 Challenge	5
Autonomous Callibration Challenge	5
Overall	20

4.4 German Open Replacement Event (GORE) 2022

Overall, team *Bembelbots* ranked 4th at GORE 2022.

Table 5. Overall Results at GORE 2022

Points	BHZ	Goal Difference	Summed Score
9	65	-11	14:25

Table 6. Individual game results at GORE 2022

Round Number	Home	Away	Score
1	Bembelbots	SPQR	2:0
2	rUNSWift	Bembelbots	1:0
3	-	-	-
4	Bembelbots	R-ZWEI-KICKERS	3:0
5	B-Human	Bembelbots	9:0
6	Bembelbots	HULKs	6:0
Quarterfinals	Bembelbots	Nao Devils	2:1
Semifinals	B-Human	Bembelbots	10:0
Finals	Bembelbots	RoboEireann	2:4

4.5 RoboCup 2022

Team *Bembelbots* achieved 7th place at the RoboCup 2022 main competition, and 5th place at the technical challenges.

Table 7. Individual game results at RoboCup 2022

Round Number	Home	Away	Score
1	Bembelbots	SPQR	3:0
2	Nao Devils	Bembelbots	4:0
3	HTWK Robots	Bembelbots	7:0
4	UT Austin Villa	Bembelbots	1:1
5	Bembelbots	Naova	3:0
Quarterfinals	HTWK Robots	Bembelbots	8:0

The overall results of the technical challenges are:

Table 8. Results of technical challenges at RoboCup 2022

Challenge	Points	Rank
Visual Referee Challenge	10	4
7 vs. 7 Challenge	-	3

The individual game results for the 7 vs. 7 Challenge are as follows:

Table 9. 7 vs. 7 Challenge at RoboCup 2022

Home	Away	Score
B-Human	Bembelbots	7:0
Nao Devils	Bembelbots	2:1
Bembelbots	SPQR Team	2:1

4.6 Future Participation

Prior to the RoboCup main competition in July 2023, the team plans to take part in the German Open Replacement Event (GORE).

5 Impact

The team *Bembelbots* contributes to the SPL with their own framework. Apart from that, our latest contribution has been a Webots controller that implements the LoLa interface for Nao V6, which can be found on the team's GitHub account.[5]

In the context of our university/community, one of the team's main goals is to provide an opportunity for students of computer science to gain experience in programming and in the field of robotics. All members, especially new ones, are encouraged to contribute to the team's software and are supported by more senior team members. Also, several members of the *Bembelbots* have written degree theses related to the team's work.[6] Team members also acquire important soft skills, such as teamwork, project and time management, as well as organizational skills.

The team organizes informational events for prospective new members at the start of each semester (April and October). The team also regularly shares information about their activities, and thus about the RoboCup initiative, in lectures, the learning center of the Department of Computer Science, and via a mailing list reaching all students of the department.

At the "Night of Science," a yearly event at Goethe University Frankfurt, the team has previously organized the BembelCup, a small tournament of four competing SPL teams. The *Bembelbots* also regularly contribute to events of Goethe University by presenting their activities at a booth, for example at events meant to encourage high school students to study computer science.

References

1. Bembelbots. 2020. "Bembelbots Team Research Report for RoboCup 2019." Accessed February 06, 2023. https://bembelbots.de/publications/.

[5] https://github.com/Bembelbots

[6] A list of degree theses written in the context of the activities of the *Bembelbots* can be found at https://bembelbots.de/publications/

2. Hess, T., Mundt, M., Weis, T., Ramesh, V.: Large-scale stochastic scene generation and semantic annotation for deep convolutional neural network training in RoboCup SPL. In: Akiyama, H., Obst, O., Sammut, C., Tonidandel, F. (eds.) ROBOCUP 2017, Robot World Cup XXI, pp. 33–44. Springer, Cham (2018).