Team Description Paper 2024 - 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 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*.[1] 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.[2] 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.

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[1] https://htwk-robots.de/
[2] https://github.com/bhuman/cabsl

Our current framework is based on a modular architecture 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. This approach also guarantees that modules can be run standalone. This will allow us to cover entire modules with automated tests.

Over the course of the past year, we have extended our framework to include logging capabilities. All messages passed between modules can now be logged, as long as a serialization for each message type is defined. In combination with newly developed tools, we aim to achieve full replay capabilities and better analysis.

Additionally we have continued to work on our vision pipeline. Our previously developed robot detection has been integrated into our framework, with current efforts directed at using its results more effectively, for example, in path planning. Future work on our vision pipeline will aim to improve our ball detection and include the detection of other objects, such as penalty marks and goalposts.

4   Past History

4.1   RoboCup 2021

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

Table 1. 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

4.2   German Open Replacement Event (GORE) 2022

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

Table 2. Overall Results at GORE 2022

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

Table 3. 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

4.3 RoboCup 2022

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

Table 4. 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 5. 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 6. 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

4.4   German Open Replacement Event (GORE) 2023

Overall, team *Bembelbots* ranked 7th at GORE 2023.

Table 7. Overall Results at GORE 2023

Points	BHN	Goal Difference	Summed Score
3	68	-26	3:29

Table 8. Individual game results at GORE 2023

Round Number	Home	Away	Score
1	Bembelbots	HULKs	0:2
2	Nao Devils	Bembelbots	4:0
3	Naova	Bembelbots	0:0
4	Bembelbots	NomadZ	2:1
5	HTWK	Bembelbots	7:1
6	B-Human	Bembelbots	10:0
Quarterfinals	HTWK	Bembelbots	5:0

4.5   RoboCup 2023

Team *Bembelbots* achieved 8th place at the RoboCup 2023 Champions Cup, and 9th place at the technical challenges.

Table 9. Individual game results at RoboCup 2023

Round Number	Home	Away	Score
1	Berlin United	Bembelbots	0:2
2	Bembelbots	NomadZ	2:2
3	Bembelbots	HULKs	0:2
4	Bembelbots	HTWK Robots	0:7
5	Bembelbots	rUNSWift	0:3
6	Nao Devils	Bembelbots	2:0
Quarterfinals	B-Human	Bembelbots	10:0

The overall results of the technical challenges are:

Table 10. 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 11. 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 2024, the team plans to take part in the RoboCup German Open in Kassel.

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.[3]

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.[4] 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.

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

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

References

1. Bembelbots. 2020. "Bembelbots Team Research Report for RoboCup 2019." Accessed February 06, 2023. 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).