



Bembelbots Frankfurt

ROBOCUP SPL TEAM AT GOETHE UNIVERSITY FRANKFURT
TEAMREPORT 2018

Tim Bohn¹, Sina Ditzel¹, Dipl.-Inf. Andreas Fürtig¹, Louis Glaser¹, Timm Hess¹, Hans-Joachim Hammer¹, Elena Knorr¹, Kyle Rinfreschi¹, Tim Schön¹, Jens-Michael Siegl¹, Stefanie Steiner¹, Felix Weiglhofer¹ and Philipp Wörner¹



¹Goethe University, Frankfurt, Germany

teamleader@bembelbots.de | www.bembelbots.de | github.com/Bembelbots

1 Team Information

The RoboCup team *Bembelbots* was founded in 2009 at the Goethe University Frankfurt (Main), Germany as a group fully organized by students. As there is no robotics group at the university, the team should help students to increase their experience in robotics, as well as programming skills in addition to the theoretical orientation of the computer science degree program of the university. The team does not have any constant financial resources, so a lot of resources are used to afford robot upgrades and additional hardware.

Currently 12 undergraduate students as well as one PHD student are working on the implementation of the framework for playing soccer. Team leader is Andreas Fürtig, a PhD student from the Electronic Design Methodology (EM) group at the Institute of Computer Science at Goethe University.

The team owns six Nao H25 v5 robots, as well as six old H21 v4 versions which are mainly used for demo purposes and public relations. The team is trying to buy at least one new Robot v6. Fig. 2 shows our current jerseys for the competitions.

2 Mixed Teams

The team *Bembelbots* will participate in the mixed team competition together with Team HTWK Leipzig. Since both teams share a lot of code together, this seems to be a good challenge to improve the team behavior. There will be some workshops and coding weeks to work together on current topics of research.



Figure 1: Team *Bembelbots* at the RoboCup German Open 2017 in Magdeburg, Germany.

3 Code Usage

The main goal of the team *Bembelbots* is to increase the programming skills, one major topic was to implement a framework from scratch rather than using frameworks from other teams. Over the years many framework iterations were implemented, resulting in a split architecture divided into two parts: the *backend* is optimized for the different hardware versions of the robot, since we have two different hardware versions. The *frontend* deals with cognition and motion tasks. Both parts are communicating through a shared memory, which can also be replaced by a software simulating actual hardware for testing purposes.

Nevertheless, some parts are used from other teams as well. First of all, the vision module from HTWK Leipzig¹ was really easy to include into our framework. The module is currently enhanced with an improvement in the detection of corners, as well as a new ball detector class, since the original version

¹<http://robocup.imn.htwk-leipzig.de/>



Figure 2: New Jerseys for the upcoming RoboCup season compared to the standard ones completing the traditional look of the NAO robots.

is only able to detect the old orange ball. Our first behavioral attempts were coded in a simple state machine approach, later replaced by the commonly used XABSL² language. Several drawbacks let us move further to the C-implementation published by B-Human³ which replaced the old Ruby implementation. Old behavior models could easily be reimplemented, communicating with our framework through a blackboard architecture. We’re currently working on a stand-alone behavior simulator, giving the opportunity to implement and test new behavior models, especially for new students joining the team.

In addition we are planning to replace our current walking motion with the walk included in the 2017 B-Human code release.

4 Past History

Table 1 lists the results from past events where the team *Bembelbots* participated. In 2018 the team wants to compete at the German Open in Magdeburg as well as the RoboCup in Canada. There are plans to join the unofficial workshops in Dortmund and Hamburg too. The FIAS BembelCup (see Section 5) will be held by the team like the past 3 years again in June.

5 Impact

Impact on the SPL As the team *Bembelbots* uses code from other teams, one main goal will be to improve these releases and help other teams. Additionally each new part of the framework is forced to be implemented without side effects and should

²The Extensible Agent Behavior Specification Language

³<http://www.b-human.de>

RoboCup European Open 2016 (Eindhoven)		
Bembelbots	Z-Knipsers	0:0
Bembelbots	Nao-Team HTWK	0:6
Bembelbots	GraceBand	0:1

RoboCup 2016 (Leipzig)		
Bembelbots	UPennalizers	0:0
Bembelbots	HULKs	0:2
Bembelbots	UCHile Robotics Team	0:5

RoboCup German Open 2017 (Magdeburg)		
Bembelbots	Luxembourg	0:2
Bembelbots	HULKs	0:1
Bembelbots	nomadZ	0:0
Bembelbots	SPQR	0:0

RoboCup 2017 (Japan)		
Bembelbots	Linkoping Humanoids	1:0
Bembelbots	Camellia Dragons	0:2
Bembelbots	NTURoboPAL	1:0
Bembelbots	UPennalizers	0:1
Bembelbots	JoiTech	0:0

Table 1: Game results of the Team Bembelbots since 2016

be runnable stand-alone, easing the publication and contribution process. We mainly focus on the following topics:

Framework One main goal is to provide a Framework structure which is easy to adopt by other teams. There are several plans to release our module based framework architecture with support for several other module releases of other teams like the vision module from HTWK. With this in mind, this will continue the SPL spirit and will help new teams to join the league.

Vision One dominating problem in the current rule change, the detection of the new ball, needs to be improved. For this, a convolutional net approach based on simulated data was proposed [10] and published in the RoboCup17 Proceedings. A dataset containing a huge amount of simulated images, as well as the simulating framework itself is available on our Github Account⁴. Further advancement in vision will be focused on object detection refinement, including close-range (bottom-camera) robot detection aiming to develop a camera driven anti-pushing measurement.

Whistle Detection We created a stand-alone toolchain to detect the whistle automatically,

⁴<https://github.com/Bembelbots>

given the possibility to tune the parameters offline by capture samples during the competitions. The software can be found at our public github repository.

Motion We use a modular motion engine. This allows us to easily modify existing motions as well as integrate new motions. Additionally, we are able to test individual motions during runtime and if necessary calibrate them.



Figure 3: Team members at the *Phoenix Contract Robotics Cup* in Cologne.



Figure 4: Audience at Night of Science in Frankfurt 2017.

Impact on the University Besides the official RoboCup competitions (see results in Table 1) the team *Bembelbots* also participates in different other unofficial workshops, competitions and fairs. The team is well connected to other teams, joining events like the "E-Mobility Play Day" in Austria or the RoHOW in Hamburg. The team frequently joins events of the university, pushing the public relation effort of the computer science department. Per annum several talks are held in schools around increasing the enthusiasm for robotics. Since 2012 the team *Bembelbots* organizes the FIAS BembelCup in line with the "Night of Science"



Figure 5: The FIAS BembelCup 2017 trophy in Frankfurt.

event, a public event showing different aspects of science, technology, engineering and mathematic study paths offered at the Goethe university in Frankfurt. This small tournament of four competing teams is one of the final tests for the RoboCup, as it is temporally located nearby.

6 Other

The RoboCup Team Bembelbots is located inside the Joint Robotics Lab (JRL) at the Computer Science Institute of the Goethe University Frankfurt. It offers much more than the soccer playing robots. The JRL tries to help the students to realize their own projects and supports them with hardware, knowledge and access to our laboratory. Driving robots, drones, microcontrollers, a 3D-printer: there is much to discover...

Team publications

It's possible to write your thesis on the topic of RoboCup at the Goethe University. Several works have been published in the last years. Together with the new bachelor arrangements in 2014, it's possible to earn credit points for the work at the Bembelbots project, which hopefully will increase the number of active team members in the future. The team also held a talk at the Robocup Symposium in Nagoya, Japan 2017 [10].

Here is a list of already finished bachelor and diploma theses:

1. Rohnfeld, Erik (2010): Reinforcement Learning zum Lernen eines Schusses auf dem Nao-Roboter, Bachelor thesis at Goethe-University, Frankfurt

2. Jäger, Moritz (2010): Entwicklung eines automatisierten Verfahrens zur Optimierung der Laufbewegung des Nao Roboters, Bachelor thesis at Goethe-University, Frankfurt
3. Fürtig, Andreas (2011): Farbklassifizierung für humanoide Roboter im RoboCup Umfeld, Diploma thesis at Goethe-University, Frankfurt
4. Weis, Tobias (2011): Selbstlokalisierung für humanoide Roboter im RoboCup Umfeld, Diploma thesis at Goethe-University, Frankfurt
5. Becker, Christian (2013): Linienbasierte Featuredetektion und Positionstracking durch Voronoi-Diagramme in einer symmetrischen Umgebung, Diploma thesis at Goethe-University, Frankfurt
6. Ruscher, Gerhard (2013): Entwurf und Realisierung eines Frameworkes zur Bewegungsplanung eines Humanoiden Roboters, Diploma thesis at Goethe-University, Frankfurt
7. Ditzel, Sina (2016): Selbstlokalisierung des Nao-Roboters im RoboCup mittels Partikel Filter, Bachelor thesis at Goethe-University, Frankfurt
8. Hess, Timm (2016): Training convolutional neural networks on virtual examples for object classification in the RoboCup-environment, Bachelor thesis at Goethe-University, Frankfurt
9. Brast, Jonathan Cyriax (2017): NAO Body Control and Motion Framework for RoboCup, Bachelor thesis at Goethe University, Frankfurt
10. T. Hess, M. Mundt, T. Weis and V. Ramesh (2017): "Large-scale Stochastic Scene Generation and Semantic Annotation for Deep Convolutional, Neural Network Training in the RoboCup SPL", In: RoboCup 2017: Robot World Cup XXI, LNAI. Springer