

HITeC ANNUAL REPORT 2022

HITeC e.V. - an initiative of the Department of Computer Science
Faculty of Mathematics, Informatics and Natural Sciences
Universität Hamburg



Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

Hamburger Informatik Technologie-Center HITEC e.V.

Board of directors:

Prof. Dr. Tilo Böhmann, Prof. Dr. Winfried Lamersdorf,
Prof. Dr. Walid Maalej, Prof. Dr. Ricardo Usbeck

Management board:

Dr. Lothar Hotz

Vereinsregister Hamburg: VR 15499

Authors: Prof. Dr. Tilo Böhmann, Dr. Kai Brüssau, Dr. Thomas F. Düllmann, Prof. Dr. Paul Drews, Prof. Dr. Heiko Falk, Prof. Dr. Hannes Federrath, Wiebke Frauen, Dr. Rainer Herzog, Dr. André van Hoorn, Dr. Lothar Hotz, Ogeigha Koroyin, Prof. Dr. Winfried Lamersdorf, Jianzhi Lyu, Dr. Sven Magg, Prof. Dr. Walid Maalej, Dr. Benjamin Milde, Prof. Dr. Markus Nüttgens, Prof. Dr. Horst Oberquelle, Jan Reineke, Prof. Dr. Arno Rolf, Pascal Rost, Stephanie von Riegen, Prof. Dr. Thomas Schmidt, Prof. Dr. Ulrike Steffens, Prof. Dr. Ricardo Usbeck, Prof. Dr. Herbert Werner

Editorial and layout: Dr. Lothar Hotz

Hamburg, Mai 2023

TABLE OF CONTENTS

1. Overview	7
2. Projects of HITEC	10
2.1 IS - Intelligent Systems	11
2.1.1 Information Register - Portal for Implementation of the Transparency Law	11
2.1.2 3S - Schul-Support-Service for Hamburg Schools.....	12
2.1.3 DigitalPakt	13
2.1.4 UNEVIS - AI Systems for Marketing Content in the Automotive Industry	15
2.1.5 AI-VideoScouter - Automated Capture and Evaluation of a Complete Soccer Match based on Video Footage	16
2.1.6 ADAM - Autonomous Adapting Machines.....	16
2.1.7 Intelligent Traffic Infrastructure - SmartWalk.....	17
2.1.8 Intelligent Inspection System - aiSpecTo.....	18
2.1.9 Digital, Urban Production - Digitization of Local Value Networks.....	19
2.1.10 Tresor - Trustee Platform for Secure and Privacy-Protected Collection, Storage and Mediation of Mobile Device Data	20
2.1.11 EDIH for Urban Interconnected Supply and Value Ecosystems Hamburg (EDIH4UrbanSAVE)	21
2.1.12 Automatic AI-Integrated Dispatching for Universal Terminals (AKIDU)	21
2.1.13 AI Application Hub Plastic Packaging - Sustainable Circular Economy through Artificial Intelligence (KIOptiPack)	22
2.1.14 PESHAT - Portal for Philosophical and Hebrew Terminology	23
2.1.15 Matrikelportal Hamburg - Digitalization of Matriculation Registers from the Early History of the Universität Hamburg.....	24
2.1.16 Hamburg Professors Catalogue (HPK) - Integration of Geodata into the HPK and Extension of the Editor Workflow	25
2.1.17 Smart Tech-Tics - Development of a Smart Diagnostic System for Technical-tactical Analysis for Soccer Goalkeepers	27
2.1.18 VeriKAS - Verification of Learning AI Applications in the Aviation Sector	28
2.1.19 Green-Curri - Green-Potential-Screening for Curing Presses in the Tire Industry	28
2.1.20 Deep RL Framework.....	29
2.1.21 IMPA - Intelligent Media Production Assistant.....	30

2.1.22 3D-KIOB – Development of an Integrated Process for 3D Object Determination using AI Methods	30
2.1.23 EWIVIKIS - Development of an Intelligent Heat Cabin as a Tool for Vitality Measurement and Improvement based on an AI Recommendation System.....	31
2.1.24 EVASST - Development of a Value Stream Simulation Tool for the Process Industry	32
2.1.25 Cooperation with ARIC.....	33
2.1.26 AI Workshops.....	33
2.2 DSL – Distributed Systems Lab.....	34
2.2.1 Blockchain Projects.....	34
2.2.2 Smart City Projects.....	35
2.3 ITMC - IT-Management and Consulting.....	37
2.3.1 ITMC-Conference – Conference of the Informatics Course ITMC.....	37
2.3.2 Digital Excellence.....	37
2.3.3 CUDIT - Competence Centre Customer and User-Driven IT.....	38
2.3.4 Management of Digital Ecosystems.....	39
2.4 Business Information Systems.....	41
2.4.1 ITE - IT-Entrepreneurship.....	41
2.4.2 Exploring New Development Techniques for of Mobile Applications - an Example for the LPG Engine Technology "GasTronic ®"	42
2.5 Individual Projects.....	44
2.5.1 Lecture2Go/Subtitle2Go.....	44
2.5.2 Sensory Analysis of the Influence of the Terroir on Luxembourg Auxerrois and Chenin Blanc Wines	44
2.5.3 Data Protection Compliant Collection of Patient Data for Medical Research	46
2.5.4 Cooperation with „MINT Zukunft schaffen!“	46
2.5.5 Orientation in Digital Transformation - Understand Digitisation and Shape it Sustainably.....	46
2.5.6 Development of a new Computer-Assisted Tool for Drug Discovery.....	47
2.5.7 Geometric Databases for Protein-Ligand Complexes.....	47
2.5.8 RIOT Open Source Community Building	48
2.5.9 Data-driven and Networked Non-linear Predictive Control.....	48
2.5.10 DaFne – Platform Data Fusion Generator	49
2.5.11 Physics4DH: Exploring Potential of Algorithms and Methods from Physics for Digital Humanities	50
2.5.12 RoboCup-AG - Hamburg Bit-Bots	51





2.5.13 M-Lab - Teaching and Innovation Project	52
2.5.14 PoC Augmented Reality - Preparation of a Pressure Control Station.....	54
2.5.15 CoyPu – Cognitive Economy Intelligence - Platform for Resilience of Economic Ecosystems	55
2.5.16 OZG Implementation Project for Electronic Residence Registration (eWA)	56
2.5.17 SeaSchool	57
2.5.18 PerMoDiS - Performance Monitoring on Data-intensive Software	58
2.5.19 Memory Hierarchy Code Optimization	58
2.5.20 Efficient 3D Bin Packing based on Reinforcement Learning Method	60
2.5.21 Representation Expenses of the Department.....	60
2.5.22 Computer Science Orientation Unit.....	61
2.5.23 Business Information Technology Studies Orientation Unit.....	61
2.5.24 Hamburg Informatics Computer Museum.....	61
3. Outlook.....	63

1. OVERVIEW

HITeC is the research and technology transfer center of the Department of Computer Science at the Universität Hamburg. Due to its independent status, HITeC offers flexible and professional cooperation opportunities. HITeC solutions are based on the latest research results and provide advantages through innovative technologies.

HITeC is a registered, non-profit association supported by members of the Department of Computer Science at the Universität Hamburg. The association is linked to the Universität Hamburg by an agreement.

HITeC sees its main tasks in the:

-  Implementation of application-oriented research projects
-  Dissemination of application-oriented research results
-  Realization of seminars and workshops
-  Mediation of contacts between companies and students
-  Improvement of the practice-oriented education in the university
-  Support for business start-ups from the university
-  Education of students especially through including them in cooperation projects

In 2022, HITeC had six sponsoring members, these are companies and institutions that support HITeC. The number of active personal members of HITeC is more than 50.







HITeC's project volume in 2022 was approximately €4.6 million. The increased project volume was achieved, beside others, through the launch of several new projects.

HITeC conducts application-oriented research in the general field of Computer Science and research in the field of technology transfer. In contrast to basic research, application-oriented research is scientific Computer Science research whose results can be used directly in practice. On the one hand, the results of basic research are incorporated into cooperative projects; on the other hand, new questions for basic research arise through research on applications, which decisively further stimulates this research. Also known as Action Research, in which scientists go into the concrete, real conditions in practice in order to gain knowledge for further basic research this method. In addition, this way back into basic research (which essentially takes place at the university) is a very important part of the application-oriented research at HITeC, in order to fertilize this basic research in a completely new way, so that it can later find better application-relevant results for practice. As a further method, HITeC applies Design Science,

which considers the problem solution in real application-oriented settings through the development of artifacts such as prototypes or concepts.

Hence, application-oriented research at HITEC takes up the results of basic research at the Department of Computer Science and explores their possible applications in special application projects typically with partners.

Some selected projects and activities in 2022:

-  Projects in the area of cheminformatics, which study drug development in pharmaceutical research.
-  Projects in the area of optimization and monitoring:
 - Performance monitoring for data-intensive software
 - Code optimization for memory hierarchies
-  Several projects in the area of application of Artificial Intelligence methods:
 - Analysis of images, videos and streams for the creation of situation and action descriptions (including in sports, here also actions in training, traffic and landscape overflights) and the retrieval of media content,
 - New methods for explainable AI,
 - Planning systems for stacking goods using Reinforcement Learning.
-  Projects in the area of platform development:
 - Co-development of a platform for economic ecosystem resilience,
 - Co-development of a platform for synthetic data generation,
 - Design of a platform for urban production and local value networks,
 - Coordination of a European Digital Innovation Hub, for the targeted support of small and medium-sized enterprises, start-ups, and public administration.
-  Several projects in the field of eHumanities, which aim at the dissemination, collection, presentation, and long-term archiving of cultural objects, among others: Portal for Philosophical and Hebrew Terminology, Matriculation Portal.
-  Several projects in the field of digital transformation and digital literacy :
 - Scientific support in the digital transformation of the re-registration service/electronic residence registration,
 - Teaching of digital literacy competence through student seminars.



Furthermore smaller projects:

- with companies and research institutions from the Hamburg region as well as internationally,
- with schools to teach software development methods at an early stage.



Participation in a working group of start-up initiatives of all Hamburg universities as well as cooperation with ahoi.digital, ARIC, and Hamburg Innovation.

Publications of HITEC are listed on the websites of the university of the respective professors and project collaborators. An overview of project activities provides <https://hitec-hamburg.de>.

2. PROJECTS OF HITEC

The following sections provide a brief overview of the projects implemented in 2022. A summary of the activities in the respective project area precedes these project overviews.

HITeC focuses with project areas on sub-areas of computer science, which stand out due to special activities at HITeC, e.g., in the form of cooperation projects.

In addition to the projects listed, there were a number of smaller activities that are not mentioned here.

2.1 IS - INTELLIGENT SYSTEMS

The project area "Intelligent Systems" (IS) emerged from the "Laboratory for Artificial Intelligence", in which innovative methods of Artificial Intelligence have been developed and applied in cooperation with companies since its foundation in 1988. Characteristic for the work of IS is a scientifically founded and at the same time practice-oriented approach. The rich wealth of experience ranges from expert systems, configuration and diagnosis, monitoring and event recognition to machine learning (including deep learning and clustering), big data, knowledge discovery, image processing, and other current topics of Artificial Intelligence. IS offers the preparation of studies as well as prototype development in direct cooperation with companies. Furthermore, IS is often a partner in funded projects, especially in national and EU funding programs.

Head:



Lothar Hotz

2.1.1 Information Register - Portal for Implementation of the Transparency Law

The Hamburg Transparency Act came into force on October, 6th 2012. §1 states: "The purpose of this law is to protect the interests of the public through a comprehensive right to information. The information available to the authorities referred to in Article 2(3), while complying with the provisions of the protection of personal data, shall be made directly accessible to the public and to disseminate them in order to promote the formation of democratic opinion and wills and to monitor governance acts." Under §2 paragraph 3 almost all authorities are addressed. To implement this law, the financial authorities, HITEC, and partners designed and developed a web portal, the "Information Register" (Info-Reg). As essential functions thereby the collecting ("harvest"/"Harvesten") of existing documents and data from the authorities, the searchability from the Web portal and the machine access to the information objects are provided. This work belongs to the research areas "Open-Gov-Data" and semantic search.

In the project year 2022, HITEC supported the Department of Culture and Media of the city of Hamburg, as current partner, in its further development of the portal. For this purpose, concepts for the cooperation of developer and operation teams (DevOps) at different, partly public institutions were further developed on an organizational (e.g., cooperation processes) and technical level (e.g., for the cloud infrastructure). As special research topics, new deployment and test strategies, as well as the evolution of the software architecture module were continued.

Cooperation partners



Free and Hanseatic City of Hamburg, Department of Culture and Media,
State Archives Office



Dataport AÖR

Staff



Christian Bähnisch, Lothar Hotz, Björn Kulas, Melvyn Linke, Anja Richter

Link



<http://transparenz.hamburg.de>

2.1.2 3S - Schul-Support-Service for Hamburg Schools

The Schul-Support-Service (3S) is a cooperation between HITEC e.V., the Department of Computer Science at the Universität Hamburg, and the Hamburger Behörde für Schule und Berufsbildung (BSB). The goals of the cooperation are: the development of low-maintenance IT structures in the schools of Hamburg, the training of students, the implementation of research activities as well as the relief of teachers at general education schools in the elimination of malfunctions and the implementation of necessary maintenance work on the devices and networks used.

Within the framework of the cooperation, many projects are initiated and carried out in order to offer support to schools in the change of IT equipment, which is constantly changing and becoming more complex, because digitalisation is becoming increasingly relevant in teaching. Interdisciplinary perspectives are necessary in the analysis and (further) development of digital education concepts.

Examples of developments:





- Development of a concept suitable for schools for the distribution of software via the city network of the city of Hamburg to educational end devices: evaluation of a suitable tool, testing of the solution in the laboratory, documentation of the results and solutions.
 - Procedure: Configuration, provision and maintenance of the technical systems, development and implementation of processes based on the IT Infrastructure Library (ITIL) reference model, packaging of software (*.msi, *.mst).
 - Implementation: Distribution of packages with Baramundi. During the development of the solution, the special technical features of the educational network infrastructure, including the youth protection

filters and the need to set up policy-based routing from the schools to the data centre at Dataport, had to be taken into account in particular.



- Development of reusable software solutions (including script collections) to support IT infrastructure processes (e.g., solutions to a wide variety of problems in setting up the IT infrastructure in schools, solutions for installing WLAN tokens, solutions for configuring printers, solution for controlling clients, Call4Help to support fault messages).
- Development of sample images for easy installation and configuration of IT devices in schools.

In 2022, about 35 student and research assistants within the framework of the project successfully supervised 134 schools, and new concepts for school infrastructure development were developed and researched.

Cooperation partners

-  Hamburg Ministry of Education (Behörde für Schule und Berufsbildung (BSB)).
-  Universität Hamburg (UHH)
-  Hamburg University of Applied Sciences (Hochschule für Angewandte Wissenschaften (HAW))
-  State Institute for Teacher Training and School Development (Landesinstitut für Lehrerbildung und Schulentwicklung (LI Hamburg))

Staff

-  Wiebke Frauen, Marc Heydorn, Kai von Luck, Anja Richter, Arne Springborn, Zeynep Zengin and others
-  Approximately 30 students

Link

-  <https://www.3s-hamburg.de/>

2.1.3 DigitalPakt

The object of the project "Administration structure for IT end devices from the DigitalPakt (DigitalPakt I, II and IV)" is the development and establishment of a comprehensive and central support structure to support schools in the digital transformation through effective, comprehensive conceptual design and realisation of technical solutions for maintenance and administration of the end devices. Work in the project began in summer 2020 due to the urgency in the current crisis situation (Covid 19 pandemic).

Digitally supported teaching at Hamburg's schools and distance learning should be ensured by quickly providing ready-to-use devices for lending to pupils and teachers.

The Schul-Support-Service (3S) takes over the development of new technical solutions for these loan devices within the framework of the project:





- a) central technical support system for the devices of the DigitalPakt will be developed and implemented and
- b) the administration of the devices at participating schools will be carried out in order to obtain further starting points for the further development of support systems for IT infrastructures in schools. In doing so, Action Design Research is used as a scientific method for the design, development, implementation and evaluation of solutions for the establishment and operation of central support structures.

In 2022, 3S supported 125 schools with more than 13,600 devices from the DigitalPakt (notebooks, Surfaces, iPads) for set-up and maintenance.

The tasks in 2022 were mainly:

- Developing a set-up file for setting up the teachers' Surfaces: the file could be downloaded by the teacher from the secured 3S cloud. After executing the setup file, the certificate for the educational wireless network was created and the device connected to the baramundi server. Subsequently, the devices could be reached via the baramundi server and the desired software could be brought to the devices via the software distribution.
- Development of a stick solution that enables the data protection-compliant clean-up of devices that are to be quickly passed on again to other pupils
- Establishment of a 3S software kiosk for the teachers' Surfaces. Software can be obtained via this kiosk in self-service and installed by the teachers themselves.
- Set up, configure and play apps on the school iPads via Mobile Device Management.

Cooperation partners

-  Hamburg Ministry of Education (Behörde für Schule und Berufsbildung (BSB)).
-  Universität Hamburg (UHH)
-  Hamburg University of Applied Sciences (Hochschule für Angewandte Wissenschaften (HAW))
-  State Institute for Teacher Training and School Development (Landesinstitut für Lehrerbildung und Schulentwicklung (LI Hamburg))

Staff



Wiebke Frauen, Marc Heydorn, Zeynep Zengin, Kai von Luck, Anja Richter, Arne Springborn, and others



Aproximately 30 students

Link



<https://www.3s-hamburg.de/>

2.1.4 UNEVIS - AI Systems for Marketing Content in the Automotive Industry

HITeC started in May 2020 the project "AI Systems for REACT and SOLID" with the UNEVIS GmbH. In this project, development processes of large companies, especially in the automotive industry. In order to create representations of pro-products such as cars in glossy brochures for marketing purposes, these products are no longer these products are no longer photographed in the traditional way, but are instead from CAD descriptions and a suitable background image. However, this process product presentation today consists of a time-consuming and costly chain of error-prone and cost-intensive chain of error-prone conversion steps. HITeC supports supports UNEVIS in this project in the area of quality assurance - quality assurance (checking for consistency and completeness of data): In 2022, the work was limited to minor enhancements, improvements of the code structure as well as documentation.

- Uniform rendering of surfaces (to ensure a uniform rendering, different rendering different rendering engines require different configuration parameters, which often differ significantly in number and mode of action).
- Optically optimized fitting of background images, which emulate the 3D structures of background of background objects and enable parallax effects: During the project period, neural networks were created with artificially generated, realistic from city views, which contain perfect depth information in addition to the image information. also contain perfect depth information. These were generated or acquired by the in close consultation with the project partner. On the basis of this training data images with depth information in rectangular projection could be generated, with which a neural network was trained to determine depth information in a 360° view information in a 360° view could be determined.

The project is funded by the Innovations und Förderbank of Hamburg (IFB), the European Regional Development Fund (ERDF), and by the Freie und Hansestadt Hamburg.

Cooperation partners



Unevis GmbH

Staff



Christian Bähnisch, Rainer Herzog, Lothar Hotz, Gabriele Libardi, Sven Magg, Mohammad Ali Zamani

2.1.5 AI-VideoScouter - Automated Capture and Evaluation of a Complete Soccer Match based on Video Footage

The goal of the project is to capture automatically scouting data in soccer. This not only concerns the positions of players, but also events such as throw-ins or goals are to be automatically recognized and classified.

To implement the project, an interpretation system with three levels is used. The lowest level uses neural networks to provide detections based on either single or a short sequence of still images. The middle level enriches the detections into primitive events by combining different information from different detections.

At the highest level, a knowledge representation in the form of ontologies and a constraint system combine the information from the middle level into more complex actions. The constraint system helps to minimize false detections and to ensure an unambiguous interpretation of events.

The VideoScouter project aims to improve the efficiency and accuracy of data collection in professional sports and could help optimize tactical analysis of games and enable better decision making by coaches and players.

In 2022, the VideoScouter project worked on the further development of object recognition, hybrid architecture, and role recognition.

Kooperationspartner



WWE Media GmbH

Mitarbeiter/innen



Rainer Herzog, Lothar Hotz, Pascal Rost, Mohammad Zamani

2.1.6 ADAM - Autonomous Adapting Machines

In mechanical and plant engineering, there is the general challenge of achieving flexibility, to process changes in the requirements or operating conditions of a machine on site at the operators of the machine. The aim of the ADAM project was to deliver not





only a machine but also to deliver so-called autonomous agents. These agents have the task of monitoring the machine and, in the event of changes in requirements, to adapt the machine with the help of a digital twin. The machine together with the autonomous agent form the autonomous adapting machine.

In 2022, the final architecture for autonomous adapting machines was completed and aligned to the Demonstrator hardware and a concept for knowledge-based monitoring of such a machine was adapted. Furthermore, business models developed in the previous year were further developed with the partners.

The project belongs to the research area Industrie 4.0 and focused, particularly on the part of HITEC, on the following research topics: ontologies, constraints, modeling, and Asset Administration Shell (AAS).

The German Federal Ministry of Education and Research funds ADAM. The project was completed in August 2022.

Cooperation partners

-  Universität Hamburg
-  Encoway GmbH
-  Lenze SE
-  Remmert GmbH

Staff

-  Rainer Herzog, Alexander Pokahr, Stephanie von Riegen




2.1.7 Intelligent Traffic Infrastructure - SmartWalk

The aim of the "SmartWalk" project is to develop an intelligent traffic infrastructure with "smart" pedestrian crossings to protect vulnerable road users such as cyclists and pedestrians. The Smart Pedestrian Crosswalk (smart traffic sign) from the company Bercmann was enhanced by data protection-compliant camera technology from the company Natix to detect and track road users. The information was fed to a scene interpretation backend for the accumulation and detection of critical traffic situations.

These situations were modeled using an ontology. When the system detected a potentially dangerous traffic situation, a visual warning was triggered (road sign LEDs). The prototype was installed in Tartuu Estonia and the deployment was tested. In addition, the first possible steps for approval in Germany were identified. The data was published in the Mobilithek of the funding framework mFund.

SmartWalk was funded by Federal Ministry of Digital Affairs and Transport under mFund and successfully completed in September 2022.

Cooperation partners

-  NATIX GmbH Hamburg
-  Bercman SE Estland
-  Aric e.V. Hamburg (associated)

Staff

-  Lothar Hotz, Stephanie von Riegen, Jasper Gerwers

Link

-  <https://www.bmvi.de/SharedDocs/DE/Artikel/DG/mfund-projekte/smartwalk.html>

2.1.8 Intelligent Inspection System - aiSpecTo

The aim of the aiSpecTo project is the development of an intelligent inspection system for the aerial inspection of production pipelines. Pipelines are considered critical infrastructure and are therefore subject to special inspection obligations. The use of Artificial Intelligence (AI) and unmanned aerial vehicles (UAVs) in the field of pipeline inspection is a major challenge. Existing systems are capable of detecting and displaying material with a variety of sensors, but the complex evaluations, including hazard assessment, have so far be carried out only by trained personnel.




In the project, by using different sensor systems, from AI-based algorithms for multi-sensor fusion, object recognition and tracking, change detection, and knowledge-based scene interpretation, a complex system for automating the inspection process will be designed.

Advanced research was conducted on potential hazard classes on the pipeline. Images from the aerial surveys of the test area were labeled for machine learning. An architecture was designed and interfaces between partners were specified. An API was provided to the partners for further processing of the detections. Thus, detections for scene interpretation can be processed in the so-called middle layer for scene interpretation and change detection. With the help of the middle layer, the detected objects are processed to events. In addition, a localization component was implemented to be able to locate objects within an image.

In 2022, HITeC focused especially on the research topics ontologies, constraints, and modeling.

The idea for the project arose within the framework of the innovation network MOWAI - mobility with Artificial Intelligence, which is funded by the Central Innovation Program for SMEs (ZIM).

Cooperation partners

-  AeroDCS GmbH
-  Speenlab GmbH
-  Digpro Technologies AB Schweden

Staff

-  Rainer Herzog, Jasper Gerwers, Lothar Hotz, Stephanie von Riegen

Link

-  <https://www.bmvi.de/SharedDocs/DE/Artikel/DG/mfund-projekte/smartwalk.html>

2.1.9 Digital, Urban Production - Digitization of Local Value Networks

Within the framework of the project, a novel form of local production is to be established in the Hamburg metropolitan region, This is to be geared to the local production of individualized, globally developed products. The product (focused on furniture) can be customized by the customer. A platform is to support from the product development phase to production and delivery through a continuous digital value creation process with innovative technologies. The products are manufactured locally by regional craftsmen and small or medium-sized production companies.

As a cooperation partner, HITEC carries out scientific implementation consulting. Joint working sessions are held in which HITEC reflects results and work processes, gives expert feedback, and gives advices on further development. One focus was the support in developing a methodology for requirements and technology analysis, as well as in the implementation of the analysis of technology potential and assessment, which was supported by an extensive literature research.

First prototypical work was carried out regarding a classification based on text and image data of furniture, as well as the production planning.

The project is funded by the Center for Digitization and Technology Research of the German Armed Forces (DTEC.bw).

Cooperation partners

-  Helmut-Schmidt-Universität Hamburg
-  Unity AG

Staff



Stephanie von Riegen, Lothar Hotz, Michael Variola, Emad Aghajanzadeh

Link



<https://dtecbw.de/home/forschung/hsu/projekt-urbane-produktion>

2.1.10 Tresor - Trustee Platform for Secure and Privacy-Protected Collection, Storage and Mediation of Mobile Device Data

The collection of data on mobile devices and with whom it is shared by app providers, for example, is hardly comprehensible for users today. The value of data has also increased considerably in recent years, but the sphere of influence that data providers have on their data has not. In the funded project Tresor, a data trust approach is to be developed within the next three years in order to align the conflicting interests of the users of mobile devices and the data users. This is to be achieved by cryptographically secured and privacy-protecting collection of data through a data trustee app and an associated central and data-saving trustee component.

The focus of HITEC was to design use cases, gather requirements, and design initial aspects of a governance structure. A special focus in this year was on technical and organizational processes of data allocation, as well as the consideration of possible operator forms of a data trustee and the responsibilities of all parties involved.

The project has been funded by the German Federal Ministry of Education and Research since March 2022 within the framework of Digital Transformation in Education Science and Research..

Cooperation partners



Universität Hamburg



Umlaut Solutions GmbH

Staff



Stephanie von Riegen, Ogeigha Koroyin, Jan Reineke

Link



<https://tresor-projekt.de>






2.1.11 EDIH for Urban Interconnected Supply and Value Ecosystems Hamburg (EDIH4UrbanSAVE)

The EU-funded project EDIH4UrbanSAVE is a European Digital Innovation Hub (EDIH) with a focus on the Hamburg metropolitan region. EDIH4UrbanSAVE is one of more than hundred EDIHs in the EU. With the help of the Hubs, the EU wants to support small and medium-sized enterprises as well as public authorities in responding to digital challenges for becoming more and more competitive. In addition to expertise, support is also to be provided with targeted experiments, proof of concepts or financing advice.

HITeC as coordinator has planned the project launch and performed initial management work.

The EU as part of the Digital Europe program and the Hamburgische Investitions- und Förderbank (IFB Hamburg) fund EDIH4UrbanSAVE.


Cooperation partners

-  Hamburg University of Technology (Technische Universität Hamburg)
-  Hamburg University of Applied Sciences (Hochschule für Angewandte Wissenschaften (HAW))
-  Chamber of Crafts Hamburg (Handwerkskammer Hamburg)
-  Digital Hub Logistics
-  Artificial Intelligence Center Hamburg (ARIC)

Staff

-  Stephanie von Riegen, Kai Himstedt, Daniel Speck

Link

-  <https://edih-hamburg.de>



2.1.12 Automatic AI-Integrated Dispatching for Universal Terminals (AKIDU)

The AKIDU research project is intended to contribute to an increase in the competitiveness of German seaports through significant system development for the storage and handling of rolling cargo. The overarching objective of the project is to tap into the new possibilities of digitization and AI in the application area of non-standardized RoRo goods in order to increase the handling performance of the port terminal. Approaches to digitalization are in data acquisition and storage, but also in the area of loading planning of ships and simulation of the entire terminal operations, in order to reschedule the inflow of vehicles and goods in addition to reschedule in case of postponements or failures of ships, thus, making optimal use of the limited storage space at the terminal.

The focus of the work regarding measurement, weighing, damage detection and resulting recommendations for action is on RoRo cargo or non-standardized project cargo. In the sub-project 3D measurement and identification of goods by means of AI, HITeC will, among other things, specify the sensor technology for measurement, as well as design and develop machine learning methods for the classification of goods, attachments and damage based on the sensor data.

The German Federal Ministry of Digital Affairs and Transport as part of IHATEC (Innovative Port Technologies) fund AKIDU.


Cooperation partners

-  akquinet port consulting GmbH (apc)
-  Unikai Lagerei- und Speditionsgesellschaft mbH

Staff

-  Rainer Herzog, Pascal Rost, Christian Bähnisch, Lothar Hotz

Link

-  <https://www.innovativehafentechnologien.de/staatssekretaerin-henkel-ueberreicht-ihatec-ii-foerderbescheide/>

2.1.13 AI Application Hub Plastic Packaging - Sustainable Circular Economy through Artificial Intelligence (KIOptiPack)

The research project KIOptiPack is designed to optimize AI-based plastic packaging with recycled content. Together with the partner project K3I-Cycling, which serves the AI-supported optimization of the recycling of plastic packaging, the projects form the "AI Application Hub Plastic Packaging - Sustainable Circular Economy through Artificial Intelligence", in which the circular economy, which has so far only taken place to some extent, is to be optimized through a more sustainable design of the value chain of plastic packaging. In doing so, methods of AI from design and production to closing the loop are tested in concrete use cases and brought into application.

The focus of HITeC's activities in 2022 was initially on a well-founded analysis of the current situation in the packaging industry. The analysis covered the various plastics technologies used, packaging and the recycling technologies currently in use.

Furthermore, HITeC examined the possibilities of synergy effects with other research projects in which HITeC was or is involved, e.g., with the European Digital Innovation Hub (EDIH).

The German Federal Ministry of Education and Research funds KIOptiPack.

Cooperation partners



Artificial Intelligence Center Hamburg (ARIC)



And about 40 more partners (see link)

Staff



Rainer Herzog

Link



<https://www.ivv.fraunhofer.de/de/presseinformationen/bmbf-foerdermassnahme-ki-anwendungshub-kunststoffverpackungen.html>

2.1.14 PESHAT - Portal for Philosophical and Hebrew Terminology

Up until Spring 2016, HITeC helped transfer an existing web application for philosophical and scientific Hebrew terminology over to the content-repository application “My-CoRe”. By means of this transfer, a permanent application was created, aimed to last throughout the project term of “PESHAT in context” and beyond.

At the end of 2019, the German Research Foundation (DFG) extended for the “PESHAT in Context” project another three years after an extensive review. In collaboration with HITeC, a number of improvements and extensions were planned, especially in the area of Digital Humanities, which were implemented by the end of 2022.

In 2022, the further developments of the web application started in the previous year were continued, continuously tested and finalized largely. This includes

- the work from the research area "Digital Humanities", specifically the cooperation with the Mispar project¹ in which a jointly usable interface for automated data exchange was conceived and implemented,
- as well as the integration of a large part of the terminology and explanations from the book "A Concise Dictionary of Novel Medical and General Hebrew Terminology from the Middle Ages" by Gerrit Bos (ISBN 9789004398658).

For the latter, the PESHAT application was extended so that static texts from external sources could be semi-automatically added to the dataset. Additionally, work continued to open up the PESHAT database for the general public in terms of the "dissemination" aspect of the Digital Humanities, making it searchable (even by automated web crawlers) and implementing various new, particularly clear search and overview functions,

¹ <http://mispar.ethz.ch/>

which allows interested scientists to research Hebrew lemmas, their linguistic roots, and corresponding definitions, even without an account.

The HITEC staff acted as interdisciplinary mediators in close cooperation with all participating scientists, provided assistance on practical and theoretical questions of informatics and helped to promote standardized data exchange using machine-processable formats between the portals and resources.

At the end of 2022, the "PESHAT" project was extended by the DFG for a further, final project phase, which will run until the end of 2025.

Cooperation partners



Institute for Jewish Philosophy and Religion at the Universität Hamburg

Staff



Pascal Rost, Lothar Hotz

Link



<https://www.peshat.org/>

2.1.15 Matrikelportal Hamburg - Digitalization of Matriculation Registers from the Early History of the Universität Hamburg

For this project, in the context of the anniversary "100 years Universität Hamburg" in early 2019, the matriculation registers that were passed down from the center for the History of the University were digitalized, presented on a website and made searchable. The matriculation registers span from the beginnings of the Universität Hamburg in the year 1919 to the year 1935. The technical implementation of the corresponding website and repository of the digital copies were implemented with the content-repository system "MyCoRe". The project was extended at the end of 2019 with the aim of also digitizing the students' matriculation cards over the aforementioned period and integrating them into the matriculation portal. The role of HITEC in both parts of the project was not only the technical implementation, but above all the cooperative, interdisciplinary development of suitable structures for storing the metadata with regard to publication, long-term archiving and subsequent use in the sense of the "FAIR data" principles of the research area of research data management.

The web-portal "Matrikelportal Hamburg" was successfully completed in time for Hamburg's university anniversary in 2019. Even before the project was completed, the staff of the University Archives approached us to plan an extension of the matriculation portal under the heading "Matriculation Cards". In addition to the matriculation books,

the so-called "matriculation cards" are now to be digitized and displayed on the matriculation portal. The digitized matriculation books are to be linked with the matriculation cards in a meaningful way. In doing so, the students of the matriculation records from the books are to be linked with the students recorded on the matriculation cards, while duplicates needed to be avoided. The technical fundamentals and the practical and theoretical assistance of HITEC for the extension of the matriculation portal with matriculation cards was completed at the end of 2020. However, due to the time-consuming work, specifically the creation of high-quality digital copies of the matriculation cards and the acquisition of their metadata, the publication of the enhancements had been delayed. The final publication was carried out in the third quarter of 2022.

Cooperation partners



Archive of the Universität Hamburg

Staff



Rainer Herzog, Lothar Hotz, Pascal Rost, Arne Springborn

Link



<https://www.matrikelportal.uni-hamburg.de/>

2.1.16 Hamburg Professors Catalogue (HPK) - Integration of Geodata into the HPK and Extension of the Editor Workflow

Commissioned by the Arbeitsstelle für Universitätsgeschichte (department for the history of the Universität Hamburg), this project produced a comprehensive catalog of former professors at the Universität Hamburg (HPK) and made accessible to the public via a website. The HPK covers a period from 1919 to the present day and, in addition to a multifaceted search function, also provides an efficient content management system for editors of the catalog. The application was implemented using the content repository system "MyCoRe" and was based on the professors catalog of the Universität Rostock².

After the website was published in January 2017, the application was taken over by the Archive of the Universität Hamburg for further editorial support and continuation. In the middle of 2020 the responsible persons of the HPK approached us to discuss a number of enhancements for the catalog. In joint work, concepts were developed how the

² <http://cpr.uni-rostock.de/>

desired improvements and new functions could be integrated into the existing application in a technically and graphically meaningful way. As a result, this new, cooperative project, emerged.

The focus of the extension of the HPK in the course of this project is the integration of standardized geodata (concretely: geo-coordinates or geo-identification numbers) into the existing data stock as well as the presentation of the same on the website. For this purpose, the workflows of the editors of the portal are to be adapted and the corresponding editor functionalities are to be extended so that the geodata relating to different stations in the life of the professors can be found and entered easily and precisely. In order to relieve the editors, standardized geodata from external sources will be automatically collected and added to the existing data stock based on the already existing location information. This data will then be used to display the stations in life of the professors in an interactive and dynamic world map specially developed for this application.

The project was started in the spring of 2021 and, in addition to the extensive maintenance work in the course of a major version update, the basic functionalities for the automatic enrichment of the existing data with standardized geo-identification numbers were implemented during the course of the year. Originally, it was planned to use the geo-identification numbers of the portal "GOV" (Place Database of the Association for Computerized Genealogy³). However, in the third quarter of 2021 it was decided to work with the data of the portal Portals "Wikidata"⁴ instead. Likewise, at the end of the year 2021, a prototype for an interactive world map was implemented, in which the professors of the HPK can be displayed with the help of the geodata. All enhancements have been in a testing and adaptation phase since the end of 2021. The release of the new functions in HPK are planned for the second quarter of 2023.

Cooperation partners



Archive of the Universität Hamburg

Staff



Lothar Hotz, Pascal Rost

Link



<https://www.hpk.uni-hamburg.de/>

³ <http://wiki-de.genealogy.net/GOV>

⁴ <https://www.wikidata.org>

2.1.17 Smart Tech-Tics - Development of a Smart Diagnostic System for Technical-tactical Analysis for Soccer Goalkeepers

The goal of the "Smart Tech-Tics" project, which is set to run until the first quarter of 2025, is to develop a novel diagnostic system for the training of football goalkeepers. This system should capture the tactical behaviour of the goalkeeper in real-time (positioning and timing) while simultaneously analysing information on relevant movement techniques (basic position, running paths, jumping techniques) of the goalkeeper. The movement techniques of the goalkeeper should be recorded using body-worn sensors, with a combination of inertial and pressure sensors planned. The location and timing information of the ball and other field players should be calculated from a video stream using machine learning techniques that are synchronized with the sensor data. An AR and VR analysis software to be developed should provide comprehensive technical and tactical evaluations to the trainer.

Since the project began in mid-2022, the employees of HITeC have been working closely with the sports scientists from the Westfälische Wilhelms-Universität Münster. An optimal camera and tripod system was determined to obtain suitable data for the planned ML algorithms. Suitable positions for the camera to capture the desired data were also investigated, and an appropriate marking scheme was developed for the key points of the playing field. In the process, the films and photos collected in initial tests were then tested for their ability to recognize players (goalkeeper, shooter), and the ball using object recognition algorithms. Additionally, algorithms for the perspective transformation of the playing field based on the keypoint markings were also tested.

The R&D cooperation project is funded by the "Central Innovation Program for SMEs" (ZIM) of the German Federal Ministry of Economics and Climate Protection (BMWK).

Cooperation partners

-  GeBioM Gesellschaft für Biomechanik Münster mbH
-  LAVAlabs Moving Images GmbH & Co. KG
-  Westfälische Wilhelms-Universität Münster
-  iotis GmbH

Staff

-  Pascal Rost, Rainer Herzog, Lothar Hotz

Link

-  <https://www.portalderrwirtschaft.de/pressemitteilung/366848/durch-live-analyse-zum-super-torwart.html>

2.1.18 VeriKAS - Verification of Learning AI Applications in the Aviation Sector

The overall goal of VeriKAS is to develop proposals for certification processes of neural AI methods and to demonstrate the feasibility and usefulness of these proposals. All methods will be demonstrated using two use cases: emergency landing site selection of a drone and anomaly detection in aircraft interiors. In VeriKAS, HITEC focuses in particular on black-box testing and collaborates with the Universität Hamburg on methods to explain reinforcement learning.

In 2022, an automated modular neural network testing framework could be implemented that tests a given neural network for robustness against unseen data by various methods (standard metrics, adversarial attacks, data augmentation at test time) and automatically summarizes the results as reports. In addition, various extensions to reward decomposition within a reinforcement learning (RL) scenario have been investigated that can be used to explain trained RL agents. Together with all partners, parallel work is being done to use all findings in a certification process. For this purpose, the two use cases will be integrated into currently proposed processes in order to test their feasibility.

The project is funded by the German Federal Ministry of Economics and Climate Protection (BMWK) under the Aviation Research Program.

Cooperation partners



Center for Applied Aeronautics Research, Hamburg



Hs2 Engineering, Ulm



Knowledge Technology, Department of Computer Science, Universität Hamburg

Staff



Sven Magg, Thilo Freyen, Ramin Farkondeh, Jessica Kick, Mohammad Ali Zamani

2.1.19 Green-Curri - Green-Potential-Screening for Curing Presses in the Tire Industry

Harburg-Freudenberger Maschinenbau GmbH (HF Group), in cooperation with HITEC, is conducting a feasibility study to set up an intelligently networked monitoring and diagnostics module for condition-based real-time monitoring of highly productive manufacturing plants in the tire industry in order to identify and measure ecological and economic savings potential. During the project, the following objectives were defined and investigated: increasing machine performance and availability, ensuring

quality, and reducing energy consumption. These objectives have also been confirmed as relevant by customers through a survey. All objectives could be estimated quantitatively by a prototypically developed digital application for condition monitoring. HITeC investigated the possible prediction of cycle times of a press. For this purpose, data from a test press were examined and subsequently predicted using a neural model, i.e., the running time of the individual machine steps was determined from machine parameters and recipe information (tire parameters). This prediction can then be used as a basis for various other applications that address the aforementioned goals. For example, maintenance can be predicted if cycle times deviate from the prediction, including the affected components. Likewise, run times can be optimized, thereby reducing downtimes and energy consumption. The potential improvements identified are now being jointly implemented in a research and development project.

The Hamburgische Investitions- und Förderbank (IFB Hamburg) funds the project within the framework of the "Program[s] for Innovation" (PROFI).

Cooperation partners



Harburg-Freudenberger Maschinenbau GmbH (HF Group), Harburg

Staff



Sven Magg, Elif Alkac, Lothar Hotz

2.1.20 Deep RL Framework

This project was to transform an existing reinforcement learning software framework from an early phase of a DLR research project into a more elaborated science-oriented state, so that the exploration of new biologically oriented algorithms is accelerated. To this end, existing frameworks were to be used and integrated as far as possible and, in particular, the implementation and documentation of series of experiments was to be simplified. In the course of the project, the already existing framework was revised and improved from a software engineering point of view. Subsequently, the experiment pipeline was revised and improved, especially the automatic documentation.

HITeC staff performed the work in close cooperation with staff from the Universität Hamburg. This resulted in a substantial extension and improvement of the framework. This included documentation of the source code for better future use, extensive testing of the framework and elimination of bugs found, and improvement of interfaces to other software frameworks and benchmarks.

Cooperation partners



Manfred Eppe, Universität Hamburg

Staff



Thilo Freyen, Elif Alkac, Sven Magg

2.1.21 IMPA - Intelligent Media Production Assistant

The intelligent media production assistant (IMPA) is intended to enable media companies to conduct intuitive searches and material research on audiovisual media. Using reference material, IMPA is to generate a collection of material in the form of a video timeline as the search result. One of the main aspects of the project was the content-based search in videos, which allows editors to find relevant video material in a few steps and represents a major advance over simple keyword searches in video descriptions.

The prototype developed in 2021 based on CLIP (Contrastive Language-Image Pre-Training) was extensively tested by HITeC on project partner data in 2022. In addition, various search mechanisms were implemented to find matching video clips by combining words and phrases (short description of the features searched for) and to refine them by further textual or even video-based input (e.g., "similar to this video"). A detailed user study was then conducted in the second half of the year, involving professional prospective users from various fields. The study measured both quantitatively and qualitatively which features were used, how often and when in the process, and what role each component of IMPA played for users. The results found were then further confirmed through interviews. The results of this study are to be published in 2023.

The Hamburgische Investitions- und Förderbank (IFB Hamburg) funds the project within the framework of the "Program[s] for Innovation" (PROFI).

Cooperation partners



Nachtblau GmbH, Hamburg

Staff



Tayfun Alpay, Jessica Kick, Jonas Kuntzer, Sven Magg, Mohammad Ali Zamani, Daniel Speck

2.1.22 3D-KIOB – Development of an Integrated Process for 3D Object Determination using AI Methods

In September 2021, HITeC started the project "3D-KIOB" together with LUVIS AI GmbH and LUIS Technology GmbH. The goal of the project is the development of an integrated prototype for the visual recognition of known objects, as well as their exact position

and orientation in 3D space. To this end, 2022 research is being conducted into how CAD models can be used to generate artificial photorealistic data, which will serve as the basis for AI algorithms from the current research fields of image processing and so-called "pose estimation". In order to enable real-time outdoor recognition with depth cameras using vehicle systems, we are also investigating how traditional algorithms can be accelerated so that they can be accommodated on a specially developed integrated system. The resulting prototype should be able to quickly detect objects, separate them from the background (segmentation), and calculate the orientation of the object (distance and rotation to the camera).

By the summer of 2022, it was possible to develop a prototype for this, mainly on synthetically generated data, which can separate objects from the background ("segment") and recognize their orientation in space. Due to current developments on the market, the project was terminated prematurely in 2022.

The Hamburgische Investitions- und Förderbank (IFB Hamburg) funds the project within the framework of the "Program[s] for Innovation" (PROFI).

Cooperation partners



LUVIS AI GmbH, Hamburg



LUIS Technology GmbH, Hamburg

Staff



Tayfun Alpay, Elif Alkaç, Gabriele Libardi

2.1.23 EWIVIKIS - Development of an Intelligent Heat Cabin as a Tool for Vitality Measurement and Improvement based on an AI Recommendation System

Since July 2022, HITeC has been working together with Clearlight Saunas Europe GmbH (Clearlight) and the Ilmenau University of Technology (TU Ilmenau) in a research capacity on the sub-project "Classification and prediction using federated machine learning" as part of the "EWIVIKIS" project.

The goal of the project is the development of an intelligent thermal cabin. The use and application conditions of a new generation of heat cabins, as well as a new evaluation and prediction system to be developed, are to be researched. Health and vital parameters are to be recorded and measured during the heat application by means of suitable measuring sensors, considering external influences. After the preprocessing of these measurement data, a neural network is to be trained with the help of data protection-compliant, federated machine learning methods as part of the research question addressed by HITeC. Derived from this, qualified and individualized recommendations for

actions computed by an AI recommendation system are to be generated in the future in order to be able to improve personal vitality.

In 2022, the use cases for the intelligent heat cabin were analyzed and an initial overall architecture was outlined. At the same time, the implementation of the interfaces of a first prototype for federated learning was started.

The "Central Innovation Program for SMEs" (ZIM) of the German Federal Ministry of Economics and Climate Protection (BMWK) funds the R&D cooperation project.

Cooperation partners



Clearlight Saunas Europe GmbH



Technische Universität Ilmenau

Staff



Elif Alkaç, Tayfun Alpay, Lothar Hotz

2.1.24 EVASST - Development of a Value Stream Simulation Tool for the Process Industry

The innovation project EVASST has set itself the goal of using an automated (parameterized) simulation model of the customer's value stream network (from raw material to goods delivery), which is determined from real data, to check the impact of desired/possible changes at high speed without having to change the production itself. For this purpose, an image of the customer's value stream (production & logistics) is determined as a simulation model by an iterative optimization procedure of the model parameters, which can then be used by the customer for the simulation of various scenarios. The simulation model created and optimized in this way represents the customer's production network running in reality with all its behavioral characteristics. HITeC provides expertise in the area of network optimization for this project. In particular, both the simulation model will be optimized to represent the real measured performance indicators and the simulated process itself will be optimized to show possible (regarding different indicators) improved operations. To achieve this, different optimization methods will be iteratively evaluated and adapted.

The Hamburgische Investitions- und Förderbank (IFB Hamburg) funds the project within the framework of the "Program[s] for Innovation" (PROFI).

Cooperation partners



Data Lighthouse GmbH, Hamburg

Staff



Michael Variola, Sven Magg

2.1.25 Cooperation with ARIC

HITeC co-founded the Artificial Intelligence Center Hamburg e.V. (ARIC) in September 2019. ARIC's mission is to bring topics from the field of Artificial Intelligence (AI) into the economy and society. ARIC develops formats such as networking events, workshops, use case identification, and project initiation with HITeC. In the reporting period, HITeC conducted internal and publicly accessible AI workshops with the support of ARIC.

Cooperation partners



Artificial Intelligence Center Hamburg e.V.

Staff



Lothar Hotz, Sven Magg, Mohammad Zamani

2.1.26 AI Workshops

Following requests by projects partner and companies, HITeC has started to offer a series of AI Workshops to teach the basics of AI and especially neural network implementation. The workshops cover a wide area, starting with basic concepts of Machine Learning, all the way to Hyperparameter Optimization with Bayesian Optimization. After a successful start with a 3-session workshop on Image Processing with Convolutional Neural Networks (CNNs) and Hyper parameter Optimization with BOHB, a series of 5 workshops was offered on a regular basis. The workshops will be further improved and offered as tailored workshops for companies for specific topics.

Staff



Sven Magg, Mohammad Ali Zamani, Lothar Hotz

2.2 DSL – DISTRIBUTED SYSTEMS LAB

The project area "Distributed Systems Lab" (DSL) cooperates closely with research in the area of "Distributed Systems" (Verteilte Systeme, VSYS) of the Department of Computer Science at Universität Hamburg. It cooperates mainly with industrial partners that are active in the area of distributed information and communication systems and their applications. Current activities focus on concepts and prototype implementation of innovative system software for, e.g., the field of "Service-Oriented Computing" (SOC), operational procedures, and processes (Business Work-flows) as well as the coordination of autonomous and mobile services and processes (including social media) as well as cloud and sensor-based distributed services. Technologies used include related software development techniques as well as those of blockchain or self-organization (autonomous computing) as well as sensor-based applications – e.g., in areas such as the "Internet of Things" (IoT) or "Smart Cities".

Head:



Winfried Lamersdorf

Link



<https://vsis-www.informatik.uni-hamburg.de/>

2.2.1 Blockchain Projects

Prior project partners for DSL activities in the area of "Blockchain" were the Hamburg-based companies Ponton and PPI AG. Corresponding projects have been carried out aiming at analyzing and evaluating existing blockchain technologies, finding respective advantages and disadvantages of such a technology, and evaluating it practically. Respective prototypes of blockchain applications in the insurance industry have been designed, built, and evaluated jointly with PPI AG. In another former project together with the Hamburg-based company Ponton, Blockchain Technologies have been developed and applied in the area of energy management in the framework of the projects „Energy-“ and "Gridchain".

In 2020 and 2021, HITEC DSL was engaged in another Blockchain project together with „Lufthansa Industrie Solutions“ (LHIND), Hamburg sponsored by "Hamburgische Investitions- und Förderbank" (IFB Hamburg) in its „Program for Innovation (PROFI) – Modul PROFi Environment Transfer“. Here, innovative Blockchain technologies were applied to logistics applications in form of a realization study which included concepts and a prototypical realization (and evaluation) of an open freight market „Future Transport Hamburg“ (FTH).

In a feasibility study, LHIND and HITEC evaluated jointly, how a Blockchain-based open market place for freight can be realized both technically as well as economically. Main thematic focus was to minimize trips of trucks with empty cargo beds by optimizing the coordination of freight-supply and freight-demand. The corresponding pilot study laid the ground for a subsequent establishment of an open provider-neutral freight exchange based on blockchain technology. Through an open plug-in architecture, service providers were, thus, enabled to offer and provide additional services on the freight exchange. So, in addition to prototypical development and usage simulation, this feasibility study also focused on ecological (i.e. carbon reduction) and legal aspects.

In the study, HITEC DSL provided support mainly in the areas of system architecture and topics related to decentralized marketplaces, blockchains, and distributed ledger technologies.

Cooperation partner



Lufthansa Industrie Solutions (LHIND), Hamburg

Staff






Wolf Posdorfer, Heiko Bornholdt, Philipp Kisters, Winfried Lamersdorf

2.2.2 Smart City Projects

Other ongoing HITEC DSL projects in the area of distributed system software concentrate on support for "Smart Cities", i.e., sensor-based system components, which are designed, developed, and used for networked applications in the area of intelligent and "smart" cities. This is also the focus of the project "Smart Networks for Urban Citizens' Participation" (SANE) which is carried out as part of the "ahoi.digital" digitalization initiative carried out by the city of Hamburg together with partners from Universität Hamburg and Hamburg University of Applied Sciences. Main goal is to open up new opportunities for citizen participation (citizen science/ education) by, among other things, providing, disseminating, analyzing and sharing diverse (e.g., environmental) data for citizens and institutions. Technical challenges include the integration of large amounts of data from heterogeneous sensors and devices as well as network-based distributed analysis and processing of information with additional guarantees for security, resilience, privacy and trust. At all levels, such issues are particularly important for acceptance and use of the combined information space and, thus, represent a unique selling point of the results achieved using this approach.

Cooperation partners

-  AG „Computer Networks“ (NET) sowie „IT-Sicherheit und Sicherheitsmanagement“, FB Informatik, Universität Hamburg (Prof. Dr.-Ing. Matthias Fischer et al.)
-  AG „Distributed Operating Systems“ (DOS), FB Informatik, Universität Hamburg (Jun.-Prof. Dr. Jannick Edinger et al.)
-  AG „Internet Technologies“ (inet), HAW Hamburg (Prof. Dr. Thomas Schmidt et al.)

Staff

-  Heiko Bornholdt, Philipp, Kisters, Winfried Lamersdorf

Link

-  <https://sane.city>

2.3 ITMC - IT-MANAGEMENT AND CONSULTING

The ITMC project area works in close cooperation with the corresponding research area at the university, which conducts research on service systems engineering and IT management. Current focal points are the transformation of companies with AI, regulatory aspects of digital ecosystems, and approaches to continuous service innovation.

Head:



Tilo Böhmann

Project Manager:



Paul Drews

Links:



<https://www.inf.uni-hamburg.de/inst/ab/itmc/home.html>



<https://www.inf.uni-hamburg.de/inst/ab/itmc/research/themes.html>

2.3.1 ITMC-Conference – Conference of the Informatics Course ITMC

Students of the Master's program IT Management and Consulting (ITMC) regularly organize exchange formats between IT business, science and students. These can be, e.g., lectures, workshops, panels as well as networking formats for students, prospective students and alumni of the ITMC program.

Staff



Many students of the ITMC course

Link:



<https://www.inf.uni-hamburg.de/de/inst/ab/itmc/studies/prospects/conference.html>

2.3.2 Digital Excellence

Companies in all industries face the challenge of digital transformation. Driven by the far-reaching impact of IT, IT megatrends, digital start-ups, and international competition, enterprises have to develop and implement suitable strategies. So far, however, the direction of this transformation is unclear. In the first project, "Digital Excellence", we explored together with Sopra Steria from 2014 to 2015 the dimensions of this transformation goal. The results of this cross-industry study were published in various forms: The main report "Digital Excellence: An Inventory of the Digitization of German Companies and Public Authorities" ("Digitale Exzellenz: Eine Bestandsaufnahme zur

Digitalisierung deutscher Unternehmen und Behörden“) was published in summer 2015.

From 2015 to 2016, we conducted a qualitative-empirical follow-up study on "data-driven agility“. In this study, we examined this dimension of the digital excellence model in depth. The results were published in November 2016.

In 2018, the series of studies on digital excellence continued. The focus of the study published at the beginning of 2019 is the topic "Digital Platform Management". Expert interviews and a survey were conducted in a qualitative and quantitative empirical project. The study provides a systematization of digital platforms as well as an overview of the current challenges and initiatives for digital platforms in companies and public authorities. Since 2020, conceptual work for the continuation of the work was carried out, e.g., as continuous monitoring of platforms and digital ecosystems.

Cooperation partners:



Sopra Steria SE

Staff



Linda Becker, Tilo Böhmman, Paul Drews, Martje Feddersen, Mathias Kerkhoff, Corvin Meyer-Blankart, Katharina Schuh, Alena Störmer, Andreas Zolnowski

Link



<https://www.soprasteria.de/digitale-exzellenz>

2.3.3 CUDIT - Competence Centre Customer and User-Driven IT

Companies are facing the challenge of increasing requirements with regard to the IT support offered for their services, because employees and customers are projecting their expectations with regard to the use of digital services across companies and industries.

Customers expect digitally available offers and services. Employees expect the best possible support for personal information management at the workplace. As a result of the digital transformation, IT expertise in specialist departments is growing. As a result of these challenges, IT in many companies must be further developed into "Customer and User Driven IT" (CUDIT), which can better respond to the increased needs and expectations of internal and external stakeholders.

The competence center CUDIT takes up the challenges of the companies and organizes and realizes application-oriented research in this field. The participating companies

(partners), the Universität Hamburg and HITEC have an interest in jointly researching the challenges and possible measures for CUDIT.

Possible further developments can lie in the investigation of continuous innovation processes as well as in methods, tools, and organizational models for this.

Cooperation partners



Beiersdorf Shared Services GmbH



Hamburg Port Authority AöR

Staff



Tilo Böhmann, Paul Drews, Corvin Meyer-Blankart, Ingrid Schirmer,
Jöran Tesse

2.3.4 Management of Digital Ecosystems

The starting point for this collaboration is the increasing proliferation and networking of digital services, especially in the healthcare sector. Healthcare players face the challenge of opening up to a variety of new partnerships on the one hand to enable competitive user experiences and promote digital innovations. On the other hand, networking entails significant risks.

Networking partners in turn use other digital services. As a result, data flows in such highly networked and dynamically evolving digital ecosystems are difficult to keep track of. Individual examples show that critical personal data can diffuse in such ecosystems, presumably without any particular intention. This may be the - presumably unintended - consequence of using cloud-based tools to support the development and operation of smartphone apps in the context of application performance management or user activity tracking. Even very granular functionality, such as two-factor authentication or street name completion in address fields, can be easily implemented today using external services. The decision to integrate such services can be in the hands of a single software developer. Existing methods and tools for analyzing and assessing partnership relationships insufficiently address this level of networking complexity and dynamics.

Research area and question: Platform economy: How can the governance of actors in meshed platforms be realized? Privacy and data protection: How can user data in meshed ecosystems be used in a reliable and privacy-preserving way? Service systems: How can services be designed, integrated, and controlled to operate with the dynamic assistance of additional actors?

Cooperation partner



German Health Insurer







Stuff:



Tilo Böhmann, Martin Semmann, Christian Kurtz

2.4 BUSINESS INFORMATION SYSTEMS

The project area Business Information Systems at HITeC deals with topics at the interface between computer science and business administration. The focus is on topics that can be researched in an application- and practice-oriented way in the sense of a design-oriented business informatics. A special concern of the department, however, is not only the execution of application and practice-oriented research projects, but also the transfer into practice up to the spin-off of companies, which transform current research results into marketable products and services. The transfer takes place via the heads involved. Topics and activities in the field of transfer are among others:

-  Business process management and IT support for business processes
-  Productivity of services through IT
-  Hybrid value creation through product service systems
-  Usability of business management systems
-  IT support for auditing tasks (auditing, internal audit)
-  Standardization projects at the German Institute for Standardization (Deutsches Institut für Normung)

Head:

-  Markus Nüttgens

2.4.1 ITE - IT-Entrepreneurship

Together with the Hamburg Research Center for Information Systems (HARCIS) at the Universität Hamburg, the IT-Entrepreneurship program for undergraduate students is offered every summer semester. Topics from the field of IT-based start-up management are dealt with in multiple perspectives. The course run in the summer semester of 2022 was dedicated to innovative solutions in the context of sustainability management.

Contents of the course are:


- Economic significance of start-ups for the economy and society
- basic concepts of start-up management (founding ABC)
- methodical approaches to the development and implementation of ideas and innovations in IT-based products and services (including Design Thinking)
- critical success factors for technology-oriented and knowledge-intensive start-ups (opportunities and risks)
- Forms of financing and participation for company founders and risk / capital providers (investors, business angels, promotional banks, etc.)

- Process models and best practices for IT-based business start-up and consolidation (case studies and guest lectures)
- Creation and evaluation of business plans (business plan competition)
- Presentation of a business idea to an expert jury

Hereby the following aims are pursued:

- Knowledge of the theoretical foundations of IT-oriented start-ups
- Knowledge of founding from a regional, national, and international perspective
- Learn the basics of digital business models and innovations and how to translate them into IT-based products and services
- Applying a systematic and scientifically sound approach for establishing and consolidating young IT-oriented companies
- Case study-based preparation of a business plan
- Presentation of a business idea in a compact pitch

Contributors to the 2022 ITE round included representatives from:

-  Transferagentur of the Universität Hamburg
-  Hamburg Innovation
-  TUTECH
-  HITeC
-  Neuhaus Partners
-  IFB Hamburg
-  Taxdoo
-  eBlocker Open Source
-  Entrepreneurs from the metropolitan region

Staff

-  Marc Frerichs, Markus Nüttgens

Link

-  <https://www.bwl.uni-hamburg.de/harcis/03-lehre/bachelor/it-entrepreneurship.html>

2.4.2 Exploring New Development Techniques for of Mobile Applications - an Example for the LPG Engine Technology "GasTronic ®"

With the hydraulic gas system, Direct GasTec GmbH is setting new standards in the field of LPG systems, so that even vehicles with state-of-the-art direct-injection petrol engines can be expanded by the lower-emission LPG mode. In order to provide the end user and car workshops with a modern and user-friendly operation and maintenance

of the LPG system, a mobile application is being developed in cooperation with HITEC, which connects via Bluetooth to the LPG system installed in a vehicle. The app is primarily used by the end user to control and monitor their gas system. The service workshops are supported in the initial set-up and maintenance of the gas system. Furthermore, the app can be used to find cheap gas stations in the area. In addition to the app, a web-based administration environment is being developed, which can be used to maintain the configurations and software of the gas systems as well as user and technician master data.

The project explores new ways of software development, especially the development of mobile applications. The methodology is agile Scrum and prototyping is used to develop mock-ups and prototypes. There was also a strong focus on usability and open-source technologies. The project evaluates methods and technologies as well as a framework concept for "additive software production."

Cooperation partners



Direct GasTec GmbH

Staff



Marc Frerichs, Markus Nüttgens, Frank Rump

Link



<https://www.bwl.uni-hamburg.de/harcis/03-lehre/bachelor/it-entrepreneurship.html>

2.5 INDIVIDUAL PROJECTS

2.5.1 Lecture2Go/Subtitle2Go

Subtitle2Go is an open source solution for the generation of automatic subtitles for videos. For German speech recognition, the basis is the open source solution for training German speech recognition models⁵ developed at the Language Technology department, which was also significantly improved in this project. The models are trained with the speech recognition toolkit Kaldi and now achieve a low word error rate, since large amounts of data of up to 1700 hours of speech are used for training. In addition to speech recognition, we created models for punctuation reconstruction and developed algorithms to segment the subtitles at appropriate points. An English version of the subtitle pipeline is also the subject of current development, as well as an improvement of punctuation reconstruction through new models.

A particular challenge of this project is the correct recognition of lecture-relevant keywords and technical terms, which are rare in normal speech but have a higher probability in lecture videos. For the subtitling of English videos, there is the additional challenge that the speakers may have a German accent and are not native speakers, which usually worsens recognition results. Accordingly, the subject of research is also how this can be improved.

Subtitle2Go is available as open source including all necessary models.

Cooperation partner



Universität Hamburg

Staff



Robert Geislinger, Benjamin Milde

Link



<https://github.com/uhh-lt/subtitle2go>

2.5.2 Sensory Analysis of the Influence of the Terroir on Luxembourg Auxerrois and Chenin Blanc Wines

The project considers the evaluation of the impact of viticultural practices on the sensory properties of Pinot Gris and Chardonnay wines of the Appellation d'origine protégée (AOP) region Moselle Luxembourgeoise. For this aim, the project examines how

⁵ <https://github.com/uhh-lt/kaldi-tuda-de>

wine styles of different AOP Moselle Luxembourgeoise quality classes can be differentiated between, by selected viticultural measures. These examinations are conducted considering the change of climatic conditions, which also have a significant effect on grape vine phenology, cluster health, and wine typicity. Because of climate change, analyses of the future risk potential of viticulture in Luxembourg is equally important, in order to develop and test viticultural adaptation strategies for an economically sustainable viticulture.

The VinoManAOP project aims at fostering and sustainably ensuring the economic success of viticulture within the AOP region Moselle Luxembourgeoise, in the face of climate change.

For this, different working packages were defined, containing the following aspects:

- Development of models for the simulation of the vine phenology, of the development of grape maturity, and of the yield, and the application of these models,
- Testing of targeted viticultural measures to control yield, wine quality, and wine style,
- Examination for finding the optimal harvest date and harvest method,
- Examination of viticultural measures for adaptation to climate change, and
- Testing ways of differentiation for wine styles within the AOP-Region Moselle Luxembourgeoise via viticultural measures.

Within the reporting period of the year 2022, nine Pinot Gris wines of the vintages 2019 and 2020 each, underwent sensory evaluation in a Quantitative Descriptive Analysis, conducted by a group of trained panellists at Hamburg University of Applied Sciences. The wines to be examined were micro-vinified under standardized conditions. They varied regarding the grape yield, and regarding the harvest date.

Cooperation partners



Luxembourg Institute of Science and Technology (LIST), Belveaux, Luxembourg



Institute Viti-Vinicole, Remich, Luxembourg



University of applied sciences (Hochschule für angewandte Wissenschaften), Hamburg

Staff





Andrea Bauer


2.5.3 Data Protection Compliant Collection of Patient Data for Medical Research

The project IDOMENEO, carried out by the department for vascular medicine of the University Medical Center Eppendorf (UKE), evaluates the success of treatments for peripheral arterial disease (PAD) patients. The required data is gathered in a centralized platform, which is implemented in collaboration with HITEC. The platform utilizes innovative techniques from the fields of cryptography and privacy by design to safeguard sensitive medical data while providing this data for medical research.

Cooperation partners

-  University Medical Center Eppendorf (UKE)
-  Barmer GEK

Staff

-  Hannes Federrath, Tobias Müller, Tom Petersen

2.5.4 Cooperation with „MINT Zukunft schaffen!“

HITEC e.V. is supporting the digital workflows of „MINT Zukunft schaffen!“. The German initiative „MINT Zukunft schaffen!“ aims to fire students with enthusiasm for Mathematics, Informatics, Natural Sciences and Technology (MINT). Best schools in Germany and German schools abroad are awarded by „MINT Zukunft schaffen!“ with the signs „Digitale Schule“ und „MINT-freundliche Schule“.

Cooperation partners

-  MINT Zukunft schaffen! e.V.

Staff

-  Hannes Federrath

2.5.5 Orientation in Digital Transformation - Understand Digitisation and Shape it Sustainably

The project wants to bring together different disciplines in order to understand digitisation and shape it sustainably. We want to strengthen the judgement and orientation of students, for whom there is hardly any time left today in the shortness of every day university life. The expectation is to strengthen judgment and orientation for students of (business) computer science, for which there is hardly any time left in today's short-winded university routine. That's why we press the technologies with their registered

values (Digitisation in context), the challenges, opportunities, consequences, and sustainable realisation by value- and interest-oriented design. We call this Digital Literacy. During the reporting period, this platform was further developed and new concepts for the further dissemination of the topic to the business community were elaborated. In the reporting period, this platform was further developed and new concepts for the further dissemination of the topic in the economy were elaborated. Furthermore, HITEC continued to support the Mikropolis project within the framework of DDLitLab.

Stuff



Lothar Hotz, Mathias Kerkhoff, Arno Rolf

Link



<https://mikropolis.org>

2.5.6 Development of a new Computer-Assisted Tool for Drug Discovery

In the project "Development of a new computational tool for drug discovery", the Computational Molecular Design group (AMD, Prof. Rarey) is cooperating with the company Beiersdorf AG in the field of bio- and cheminformatics. The aim of the project is to develop a code prototype that generates new molecules via generative machine learning based on gene signatures. Generative models such as GANs (Generative Adversarial Networks) are already described several times in the literature for generating molecules. Within the framework of the project, various methods were reimplemented and evaluated for their suitability in the research context of the project partner.

Cooperation partners



Beiersdorf AG

Staff



Tobias Harren

2.5.7 Geometric Databases for Protein-Ligand Complexes

In the project "Geometric Databases for Protein-Ligand Complexes", the Computational Molecular Design group (AMD, Prof. Rarey) is cooperating with the company Astra-Zeneca (Mölndal, SE) in the field of pharmaceutical research and drug development. The aim of the project is to develop a version for internal use based on the GeoMine technology developed at the ZBH. In addition, the GeoMine database technology will be extended to include protein-ligand complexes from public resources as well as from internal holdings, provided that all structures are made available in the valid PDB format.

Furthermore, a GeoMine frontend will be developed and deployed to provide access to the database via a web server. The frontend will allow uploading or retrieving a PDB structure for query generation and execution, browsing and refining results, and downloading selected complexes in table or PDB format.

The GeoMine frontend will be able to be installed on internal servers via a Docker container or a similar commonly agreed infrastructure. It will be accessible via standard web browsers in current versions (Firefox, Chrome). In 2022, many technical foundations were laid for this project, in particular an adaptation of the software to Docker technology took place..

Cooperation partners



AstraZeneca

Staff



Konrad Diedrich, Joel Graef

2.5.8 RIOT Open Source Community Building

RIOT, the friendly operating system for the IoT, was co-founded by HAW Hamburg with FU Berlin and INRIA Paris in 2013 and since then has evolved to a global, open source ecosystem. In addition to technical advancement, we manage the large open source community. In this year, the yearly community meeting called RIOT summit, which brings together RIOTers from industry and academia, makers and freelancers, application designers and core system developers, was held in Hamburg in September. With about 80 on-site participants from three continents, this (still) hybrid event could resume the tradition of two intense days of presentations, discussion, work-group meetings, and social interaction.

Cooperation partners



Ericsson, Zühlke, Huawei, u.a.

Staff



Thomas C. Schmidt, Matthias Wählisch

2.5.9 Data-driven and Networked Non-linear Predictive Control

The aim of the project is to develop and test nonlinear predictive control strategies for networked applications as well as for applications with data-driven models. In recent years, new methods for fast nonlinear predictive control have been developed at the Institute for Control Technology (IRT) of the TUHH, which are based on a quasi-LPV

model of the nonlinear controlled system. These methods are to be further developed for use in the above-mentioned applications.

Cooperation partners



IAV GmbH, Berlin

Stuff



Herbert Werner

2.5.10 DaFne – Platform Data Fusion Generator

The generation of synthetic data, usually in addition to existing data, is of great importance in the research and development of AI methods where data is not available in sufficient quantity or does not contain certain features, such as rarely occurring anomalies. Although some approaches to data generation already exist in science, the practical usability of these methods is often severely limited, as they are optimized for a specific context (e.g., use case, AI model) to ensure the corresponding data quality. The application of the obtained results then remains limited to the chosen context and thus low in its impact.

The goal of the DaFne project outlined here is to significantly and systematically improve the usability of data generation methods for AI researchers and developers in the context of developing an innovative flexible platform for data generation through three closely coordinated contributions:






- Developing flexible methods for improved data generation that lead to robust models and can be used in additional application areas.
- Development of assured and verifiable quality criteria for the generated data, which allow a reliable use in AI applications.
- Systematic parameterization of data generation methods to extend their applicability.

Both the developed methods and the platform will be evaluated in the project based on concrete use cases in the application domain of smart cities.


The project can be assigned to the research area of Artificial Intelligence and focuses in particular on the topic of data synthesis and the consideration of suitable platform architectures.

The German Federal Ministry of Education and Research funds the project DaFne.


Cooperation partners

-  Hafencity Universität Hamburg
-  Forschungszentrum L3S (Leibniz Universität Hannover)
-  Technische Universität Dresden, Center for Interdisciplinary Digital Sciences (CIDS)
-  Sopra Steria SE
-  Ströer SE & Co. KGaA

Staff

-  Ulrike Steffens, Pamela Kunert, Eric Eichholz, Kübra Tokuc, Tom Krause, Mareile Beernink, Sebastian Gedigk

Link

-  <https://dafne.informatik.uni-hamburg.de>

2.5.11 Physics4DH: Exploring Potential of Algorithms and Methods from Physics for Digital Humanities

The goal of the project is to explore the potential of algorithms and theoretical backgrounds from physics for the Digital Humanities (DH). DH is an interdisciplinary field of research between different areas of the humanities and/or social sciences and computer science.

A special role in DH is played by archiving and researching cultural heritage artifacts using methods not only from computer science, but also from other natural sciences such as physics, chemistry, and biology. Such methods allow not only the preservation and conservation of cultural heritage, but also a better understanding of authenticity, origin, historical, geographical and social background, as well as the techniques used for the production of the objects.

The natural sciences offer tools that have great potential for the preservation and study of cultural heritage through non-destructive or mini-mal invasive techniques, and in combination with IT tools. Due to the complicated theoretical background, tools from the physical sciences (e.g.), are usually used by end users as a black box. Also, the presentation of research results only mentions the use of such tools but does not explain why exactly the particular methods were chosen, what parameters were exactly set and why. This has a devastating impact on the replicability of results and overall sustainability (cf. FAIR principles) of the research.

In this project, we are investigating methods from physics that are re-relevant to DH approaches, particularly in the area of digital cultural heritage. We intend to develop a

set of learning materials that explain algorithms and methods from physics in a simple and understandable way for humanities scholars. As a result of the project, we aim to create a website on GitHub that will serve as a platform for integrating, structuring, and explaining the theoretical background and potential of research methods from physics that are relevant to DH approaches.

The following results were achieved during the reporting period:

- Current literature on physics applied to cultural heritage projects was collected. The research focus is on non-destructive or minimally invasive research techniques - laser technologies, nuclear methods, and visualization.
- A template for explanatory materials and a structure for the thesaurus of terms to be developed were defined.
- A set of learning materials explaining non-destructive research techniques from physics used in DH was further developed.
- Work has begun to develop the website as a platform with explanatory materials.

The Volkswagenstiftung funds the project.

Stuff



Cristina Vertan, Nataliya Martynyuk

2.5.12 RoboCup-AG - Hamburg Bit-Bots

The student working group "Hamburg Bit-Bots" has been participating in the international science competition RoboCup since 2012. The competition aims at advancing research in Robotics. The rules of the RoboCup football leagues are continuously increased to meet the proposed goal to beat the human world champion team by the middle of this century. The competitions are a place to share knowledge and compare approaches while providing an incentive for further development.

The Hamburg Bit-Bots compete in the Humanoid Kid-Size League. Since 2012, they have qualified every year for the World Championship. Additionally, the team participated in multiple GermanOpen and IranOpen tournaments. Due to the pandemic, the world championship was held via simulation. The team achieved the third place in this competition and the first place in the simulated BrazilOpen tournament.

Besides their participation in the competitions, the team has become the university's flagship student project. Therefore they are typically participating in different public events. Unfortunately, this was not possible this year due to the pandemic.

Since 2015, the members of the team have made twelve scientific publications. In 2021, three theses that resulted from work in the RoboCup AG were completed successfully. Furthermore, eight former members of the team are now working at universities, five of them at the Universität Hamburg. The group's research focus lies in the integration of many complex systems in the field of humanoid robotics.

Cooperation partners



RoboCup AG „Hamburg Bit-Bots“

Staff



Jasper Güldenstein, viele Studierende

Link



<https://bit-bots.de/>

2.5.13 M-Lab - Teaching and Innovation Project

Within the learning and innovation project “M-Lab”, Bachelor and Master students have the opportunity to develop smartphone apps and services using the newest technologies, working in small teams (4-7 members) for real clients from the industry with real deadlines. The students experience software engineering technology and methods, such as for example object-oriented analysis or design and implementation of mobile applications. Furthermore, they gain experience in teamwork, project management and communication with clients.

Within the Client-Acceptance-Test concluding the project, the students present their applications for mobile devices such as smartphones and tablets. All the developed apps come with a poster, a product video, a website, and a live presentation by the responsible students.






The students received the project with great enthusiasm. This year’s focus was also mainly on AI for Mobile Applications. The technology transfer and innovation management is ensured in the course of the companion HITeC project. This mainly includes the professional communication with the practice partners, ensuring that something useful for them is created, as well as the documentation, integration and delivery (as these are not part of the teaching).

Cooperation partners (practice partners) and results:


1. **Aromatico:** The app built for Aromatico brings the coffee buying experience directly into the hands of coffee enthusiasts. The app acts as a companion to the Aromatico website, allowing for searching, filtering, selecting, and purchasing Aromatico coffee products. The app does much more, however, including Artificial Reality (AR) support for the complex coffee machines, an AR “see this machine in my kitchen” experience before buying expensive coffee machines, and a customer reward program built around continuous purchases and experimenting with buying coffee from countries all over the world.
2. **Hamburg Wasser:** The app built for Hamburg Wasser elevates the “weather app” experience to a whole new level with historical and real-time information on flood areas, active floods, and issues with the Hamburg water infrastructure. Hamburg Wasser collects and utilizes flood data in the Hamburg area, and these insights are now available to the broader public through this app. Additionally, the app has an engagement system designed to encourage users to report water infrastructure issues, with a reward structure built in. The app also features weather information, as to give a holistic perspective on weather, floods, and water infrastructure information.
3. **imbus:** The app built for imbus turns a normal company conference experience into a fully-involved people-first event. With the Crowds app, attendees pitch their workshop ideas and vote for their favorites, building a conference schedule around their own interests. The app supports and enhances the experience of meeting new people as it tracks your encounters as Huddles, remembering who you met and the innovation you captured during that time. Finally, the app presents you with memory quizzes to help solidify your memory of the people you met, the ideas you discussed, and the business connections you need.
4. **Telekom:** The app built for Telekom creates a new perspective on meeting people and discussing topics: chaos mode. Imagine that with a simple tap and hold, you could be connected with anyone in the world. From there you share and discuss your thoughts on any topic you choose. When you lift up your finger, the call is immediately ended and the experience is over. Still interested? Just hold down your finger again and be instantly connected to another person again. Instant connection, brought to you by the communications API provided by Telekom.
5. **UHH Speech Therapy:** The app built for UHH Speech Therapy opens up the possibility to assess and get feedback on speech impediments in real time. The primary purpose of the app is to support researchers who assess these issues, and streamline their process from study to results. The app is built on existing ideas around speech pathology and nomenclature; furthermore, the app goes a step further and

presents new ideas on how to label and adjust data using novel and intuitive UI elements. The app serves as more than just a scientific instrument though, it can also be used as a tool to perform simple tests, and get immediate feedback on a user's speech abilities.



Cooperation partners (practice partners)

-  Aromatico
-  Hamburg Wasser:
-  imbus AG
-  Telekom
-  Universität Hamburg (UHH)

Staff

-  Prof. Dr. Walid Maalej, Lloyd Montgomery, Tim Puhlfürß, Dr. Wolf Posdorfer, Abir Bouraffa, Volodymyr Biryuk, Aref El-Maarawi Tefur

Link

-  <https://mast.informatik.uni-hamburg.de/mlab/>
-  <https://www.youtube.com/@appliedsoftwaretechnologyp4945/videos>

2.5.14 PoC Augmented Reality - Preparation of a Pressure Control Station

This project investigates the possibilities offered by augmented reality (AR) to support technicians in the inspection of facilities of the local gas provider, Hamburger Gasnetz. In an iterative user-centered process, we identified requirements and developed a corresponding prototype together with various stakeholders, especially technical staff as potential end-users. We derived potential use cases, e.g., the interactive and three-dimensional visualization of installed components, and the digitization of forms in AR to facilitate the inspection process. Furthermore, additional data for display in AR was reviewed, such as the spatial representation of underground pipelines. Moreover, the suitability of different interaction methods was investigated.

The project is assigned to the research area of human-computer interaction and focuses on a practical use case of AR in an industrial context. Through the user-centered research approach, the project's goal is to develop a helpful AR system to support workers during the inspection in the facilities of the gas provider. Furthermore, we aim to gain generalizable knowledge regarding requirements and potentials of AR for inspection processes.

Cooperation partners

-  Gasnetz Hamburg

Staff



Jenny Gabel, Julia Hertel, Lucie Kruse, Frank Steinicke

2.5.15 CoyPu – Cognitive Economy Intelligence - Platform for Resilience of Economic Ecosystems

The project "Cognitive Economy Intelligence - Platform for Resilience of Economic Ecosystems" - CoyPu started in June 2021. It is funded in the "Innovation Competition Artificial Intelligence Intelligenz (BMWK)"⁶.

In an increasingly interconnected corporate world, the company-specific parameters that are relevant from the perspective of crisis management are in very complex relationships and dynamic interactions with a wide range of external factors (e.g., location, customers, competition, suppliers, personnel market, legal and social context). The CoyPu project addresses these complex economic challenges in crisis situations with an intelligent platform for integrating, structuring, networking, analyzing and evaluating heterogeneous data from economic value networks as well as from the industry environment and social context.

HITeC's mission is to explore and develop synergies between knowledge graphs and machine learning methods (hybrid AI). The focus is on geospatial and temporal data or data streams as well as time-dependent, graph-based AI methods and their application to event detection problems.

In 2022, HITeC worked on the implementation of its AI modules for temporal and geospatial event extraction and event detection, as well as a question answering module. Data sets required for this were analyzed and created. Furthermore, a suitable ontology was developed and integrated into the central CoyPu ontology. Scientific publications were successfully presented at relevant conferences. The completion milestone at the half of the project was reached.

Cooperation partners



Institut für Angewandte Informatik e.V. (INFAI)



Forschungszentrum L3S, Leibniz Universität Hannover (L3S)



Leibniz Informationszentrum Technik und Naturwissenschaften (TIB)



Deutsches Institut für Wirtschaftsforschung (DIW)



eccenca GmbH



DATEV eG

⁶ siehe auch https://www.digitale-technologien.de/DT/Navigation/DE/ProgrammeProjekte/AktuelleTechnologieprogramme/Kuenstliche_Intelligenz/ki.html



Implisense GmbH



Siemens AG



Infineon Technologies AG



Selbstregulierung Informationswirtschaft e.V. (SRIW)

Staff



Rudy Garrido, Philip Heider, Junbo Huang, Longquan Jiang, Angelie Kraft, Jan Reineke, Julius Schulz, Najeebullah Shams, Shaista Shabbir, Ricardo Usbeck, Xi Yan

Link



<https://www.coypu.org/>

2.5.16 OZG Implementation Project for Electronic Residence Registration (eWA)

The Free and Hanseatic City of Hamburg (FHH) - Senate Chancellery is continuing the project eWA - electronic residence registration for the implementation of the OZG project electronic residence registration. The online service electronic residence registration (German: eWA) enables citizens to register their residence digitally and to digitally update the address on the identity document, e.g., via the NFC interface of the mobile phone.

The process envisages that the users uniquely authenticate themselves via eID, registers the new residence and then updates the ID document with the help of the Ausweis-App2 and the dedicated writing service (eID-server with write access) in the background via the NFC interface of the mobile phone or a card reader. The introduction and successful operation of this online service thus represents an important building block in the implementation and spread of the use of the eID for a variety of other online/digital administrative services.



Since September 2022, an MVP of the online service eWA has been successfully rolled out and operated as a pilot in the Hanseatic City of Hamburg. Parallel to this, the further development of the eWA product is being driven forward with a view to EfA capability (EfA: one-for-all principle, the nationwide roll-out of the service in other municipalities is planned) and an expansion of the target group as well as optimization of the process.

HITeC is continuing to accompany and evaluate the project scientifically with regard to security aspects, digital transformation aspects, and software development strategy aspects within the framework of the further development of the pilot project towards a rollout-ready product in public administration with heterogeneous stakeholders.

The research work lies in the research areas:

- Secure IT systems
- Digital transformation
- Software development strategies (heterogeneous DevOps processes)

Cooperation partners

-  Amt für IT und Digitalisierung/ Office for IT and Digitization (ITD)
-  Freie und Hansestadt Hamburg/ Free and Hanseatic City of Hamburg (FHH) – Senatskanzlei

Staff

-  Fabian Burmeister, Mathias Fischer, Lothar Hotz, Ogeigha Koroyin, Ingrid Schirmer, August See

Link

-  <https://www.wohnsitzanmeldung.de/>

2.5.17 SeaSchool

The SeaSchool project will develop and evaluate a concept to give students a realistic picture of the roles, tasks and skills of software engineers and software architects. Programming, which is often one of the first - even daunting - associations with computer science, is only a small area of software engineering.

The strategic goal of the project is to inspire more students to pursue careers in IT/MINT. SeaSchool addresses the social problem of the shortage of IT specialists. In particular, the project aims to inspire students who have not yet considered an IT focus due to prejudices regarding the job description - this applies especially to female students.

The core of the concept is a class-wide workshop with students in the 9th or 10th grade. Based on a real problem for which the development of a software system is to be planned, the students gain practical experience and are thus introduced to the methods and processes of software engineering and software architecture.

In 2022, workshops were held at two high schools, each with about 100 students. Reports and photos of the workshops can be found on the project website. Further workshops are already in the planning phase.

Cooperation partners

-  Gymnasium Oberalster Hamburg



Europaschule Aldegrevener-Gymnasium Soest

Staff



André van Hoorn, Thomas F. Düllmann, Sebastian Frank, wiss. Mitarbeiter:innen, Studenten:innen

Link



<https://www.hitec-hamburg.de/seaschool/>

2.5.18 PerMoDiS - Performance Monitoring on Data-intensive Software

In the PerMoDiS (Performance Monitoring on Data-intensive Software) project, research is being conducted in cooperation with Huawei on Application Performance Monitoring (APM) for AI-based software systems (e.g., software services for image recognition).

The project started in April 2022. HITEC is contributing its expertise in APM and dynamic software analysis.

In 2022, the first phase was successfully completed in the form of a literature review and a first prototype of a tool for dynamic analysis focusing on the collection of relevant performance metrics using a demonstrator. In the next steps, the tool prototype will be further extended, e.g., regarding automatic performance problem diagnosis.

Kooperationspartner



Huawei

Mitarbeiter/innen



André van Hoorn, Thomas F. Düllmann

2.5.19 Memory Hierarchy Code Optimization

Modern real-time embedded systems are required to fulfill stringent constraints in terms of execution times, energy consumption, code size, etc. Such systems are frequently equipped with sophisticated memory subsystems, featuring, among others, Flash memories, caches, tightly-coupled scratchpad memories (SPM), DMA engines, etc.

In general, memory allocation for such elaborate architectures is a complex optimization problem to address. In the real-time community, the static assignment of memory objects to memories and address spaces typically is prevalent due to its inherent timing predictability. But this might lead to sub-optimal memory usage because of the lacking

flexibility to adapt the memory allocation to the program's current state during execution.

Dynamic memory allocation has been investigated in the past only for reasonably limited architectures. Moreover, the overhead imposed due to the copying of memory objects within the memory hierarchy is modeled accurately only in some rare cases. Lastly, until now, only dynamic memory allocation-based single-objective optimizations are considered.

Therefore, this project exploits compiler-based dynamic memory management for architectures with sophisticated memory hierarchies to design timing-, energy-, and code size-efficient programs.

To handle such multi-objective optimizations, project year 1 focused on the development of a generic model for compiler-level dynamic memory allocation. This model supports Flash memories, caches, SPMs, and DMA. The assignment of memory objects to different memory addresses is done by combining liveness analysis with integer-linear programming or heuristic approaches. Dynamically moving instructions and data within the memory hierarchy comes with extra overheads in terms of execution times, energy consumption, and code size. For this reason, the compiler infrastructure used within this project has been extended by precise analyses of these overheads. Furthermore, the compiler's code generation stage has to apply various code transformations, depending on when and where memory objects reside in the memory hierarchy, when memory contents are dynamically moved, and whether this dynamic movement is done by the CPU or a DMA engine.

All these models, analyses and code transformations have been realized successfully. First experiments have demonstrated the usefulness of the developed techniques, a first dynamic memory allocation optimizing execution time and energy consumption produces solutions of equal quality than the current state of research in static memory allocation.

This project addresses the research area of safety-critical embedded systems and focusses on exploiting memory hierarchies in order to trade execution times with energy consumption and code size. Here, the project specifically addresses dynamic memory allocation.

Kooperationspartner



NXP Semiconductors, CTO Office Hamburg

Mitarbeiter/innen



Shashank Jadhav

2.5.20 Efficient 3D Bin Packing based on Reinforcement Learning Method

Efficient 3D bin packing is the key to improving logistics turnover efficiency, and it is a difficult problem. The core task includes planning the placement position of each box in a container and finding the optimal stack shape to maximize the space utilization of the container. The project will focus on

1. The proposed method should be based on reinforcement learning.
2. The items to pick up will be in different sizes.
3. The item should be picked up sequentially and immediately, without buffering or readjusting.

The proposed algorithm should be validated by industrial applications, and the space utilization should reach 70%.

In 2022, HITeC focused on the project start and a comprehensive literature review on this topic was conducted. At the same time, the results of one state-of-the-art baseline have been reproduced. For the next step, HITeC will build a simulator and develop an advanced reinforcement learning algorithm.

Kooperationspartner



Mech-Mind Robotics GmbH

Mitarbeiter/innen



Jianzhi Lyu

2.5.21 Representation Expenses of the Department

In close cooperation with the Department of Computer Science, HITeC regularly supports scientific research and teaching events of the department, such as colloquia or closed conferences.

Cooperation partners



Department of Computer Science at the Universität Hamburg

Staff



Professorships of the Department of Computer Science

2.5.22 Computer Science Orientation Unit

In close cooperation with the Department of Computer Science and in particular through the committed cooperation of many students of computer science, HITEC regularly organizes the Orientation Unit Computer Science.

Cooperation partners



Department of Computer Science at the Universität Hamburg



Student Council of Computer Science at the Universität Hamburg

Staff



Many students in the field of computer science

2.5.23 Business Information Technology Studies Orientation Unit

In close cooperation with many students of the bachelor and master degree courses Information Systems and the master course IT Management & -Consulting HITEC regularly organizes the orientation for the Information Systems and ITMC courses.

Cooperation partners



Department of Informatics at the Universität Hamburg



The Universität Hamburg's student association of Information Systems and ITMC

Staff



Many students in the field of Information Systems and ITMC

2.5.24 Hamburg Informatics Computer Museum

Since his retirement, Prof. Dr. Horst Oberquelle has built up a computer museum in the Department of Computer Science at the university. The museum highlights an interesting selection of groundbreaking inventions from the beginnings of mechanical computing, desktop and pocket calculators, hardware from Konrad Zuse to mainframes, the development of workstation systems, and home computers to large and smallest portable computers. Visitors can explore the rich history of computing and witness the evolution of technology firsthand. Data transmission from the Morse code machine to teleprinters and telephones to smartphones, writing and printing from the mechanical typewriter to the laser printer, and the development of storage media are also featured. Many devices will be demonstrated live. A special aspect is the importance of innovation and design in Apple computers and the development of interaction techniques in mice, joysticks, trackballs and other input devices.

The Computer Museum reaches out to alumni clubs, schools, and the public in addition to faculty members. Prof. Oberquelle offers tours on a regular basis. In 2022, open houses had to be cancelled due to Corona; however, tours were held again with a total of 250 participants. Through support of a technology-enthusiastic guest, various other old computers could be reactivated. In particular, early works of the computer art pioneer Herbert W. Fanke could be revived.

The museum is financed almost exclusively by donations and gifts and would like to thank HITeC for their support in acquiring interesting exhibits and materials.

Staff



Horst Oberquelle

Link



<https://www.inf.uni-hamburg.de/home/about/museum.html>

3. OUTLOOK

As a guiding theme, HITEC is involved in research and technology transfer projects in the field of digitization of urban tasks, digital transformation in economy and society, secure distributed systems as well as the application of Artificial Intelligence in enterprises. This is intended to bundle current and future projects in this field and to increase the visibility of HITEC.

In 2023, projects will continue to be carried out and advanced with research institutions, authorities, and industry, especially in the EDIH4UrbanSAVE project. In particular, further projects are planned in the area of Artificial Intelligence, also in cooperation with ARIC, as well as in the area of secure, data protection-friendly system developments.