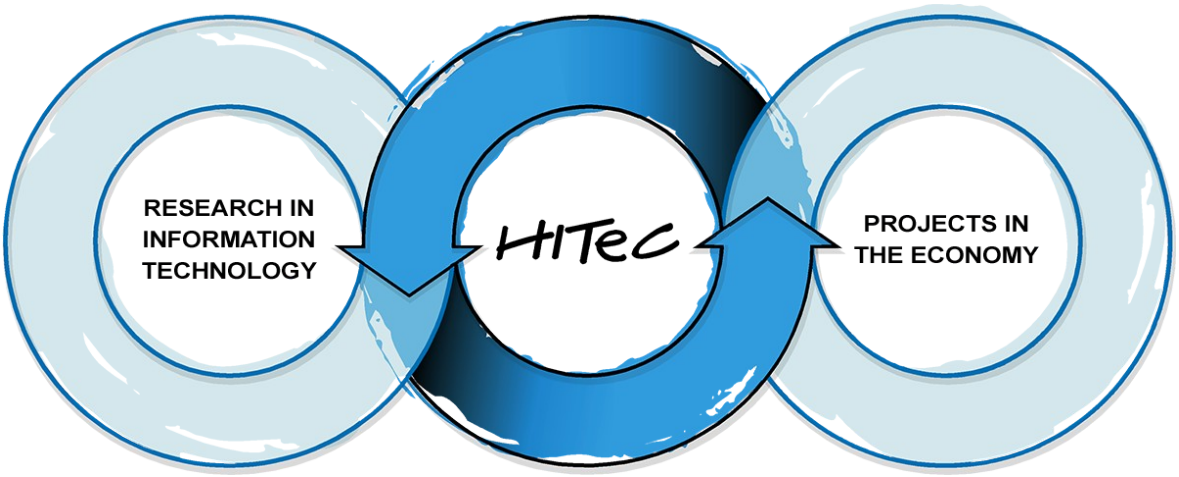
HAMBURGER INFORMATIK TECHNOLOGIE-CENTER



HITeC Annual Report 202

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

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Hamburger Informatik Technologie-Center HITeC e.V.

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Management board:

Dr. Lothar Hotz

Vereinsregister Hamburg: VR 15499

Authors: Dr. Tayfun Alpay, Prof. Dr. Tilo Böhmann, Marten Borchers, Prof. Dr. Paul Drews, Prof. Dr. Heiko Falk, Wiebke Frauen, Julia Hertel, Dr. Rainer Herzog, Prof. Dr. Ing. André van Hoorn, Dr. Lothar Hotz, Emir Kucevic, Prof. Dr. Winfried Lamersdorf, Jianzhi Lyu, Dr. Sven Magg, Prof. Dr. Walid Maalej, Prof. Dr. Markus Nüttgens, Prof. Dr. Matthias Rarey, Prof. Dr. Horst Oberquelle, Jan Reineke, Prof. Dr. Arno Rolf, Pascal Rost, Constantin von Brackel-Schmidt, Stephanie von Riegen, Prof. Dr. Ulrike Steffens, Prof. Dr. Jan Sudeika, Prof. Dr. Ricardo Usbeck

Editorial and layout: Dr. Lothar Hotz, Anja Haque

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1. OVERVIEW

HITeC is the research and technology transfer center of the Department of Computer Science at the University of 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 University of Hamburg. The association is linked to the University of Hamburg by an agreement.

HITeC sees its main tasks in the field of technology transfer for the Department of Computer Science at the University of Hamburg:

- 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 2023, HITeC had four sponsoring members, these are companies and institutions that support HITeC as well as the University of Hamburg and the Hamburg Chamber of Commerce. The number of active personal members of HITeC is more than 50 people.

HITeC's project volume in 2023 was approximately €3.9 million.

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 focused on scientific Computer Science research, with the objective of developing solutions that can be directly implemented in practice. On the one hand, the results of basic research are incorporated into collaborative projects; on the other hand, however, applied research also gives rise to new questions for basic research, which provide further inspiration for the latter. This is a method also referred to as *action research*, in which scientists engage directly with

concrete, real-life situations with the objective of gaining insights that can inform further basic research. This return to fundamental research (which is conducted primarily at the university level) represents a crucial aspect of HITeC's application-oriented research. It serves to enhance this fundamental research in a novel manner, thereby facilitating the generation of more practical and relevant outcomes. Another methodology employed at HITeC is design science, which examines problem-solving in authentic, application-oriented contexts through the creation of artifacts such as prototypes or conceptual models.

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, usually with partners.

In addition to application-oriented research projects, HITeC performs activities for the University of Hamburg (UHH) and the Department of Computer Science in particular:

- Supporting the development of technology transfer at UHH (e.g. the transfer agency) and in other departments by participating in internal workshops and discussions.
- Participation, networking and representation of technology transfer in the field of information and communication sciences at events of actors from public administration (e.g. Urban Data Hub) and business, e.g. Chamber of Commerce, Chamber of Trade, Digital Logistic Hub, as well as close cooperation with other associations (e.g. Artificial Intelligence Center e.V. (ARIC)) and universities (e.g. Helmut-Schmidt-Universität, Hafencity Universität (HCU), Nordakademie, Hochschule für angewandte Wissenschaften (HAW)).

Some selected projects and activities in 2023:

- The projects in the field of Chemistry Computer Science investigate the development of active ingredients and drugs in pharmaceutical research.
- The projects in the field of optimization and monitoring are as follows:
  - Performance monitoring for data-intensive software
  - Code optimization for memory hierarchies
- Several projects in the field of application of artificial intelligence meth ods:

- 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 flyovers) 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 the resilience of economic ecosystems
- Co-development of a platform for the generation of synthetic data
- 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
- Co-development of a platform to support emergency services in the event of severe weather using AI methods

Several projects in the field of eHumanities aimed at the dissemination, collection, presentation and long-term archiving of cultural objects, in cluding Portal for Philosophical and Hebrew Terminology, Matriculation Portal.

Several projects in the field of digital transformation and digital liter acy:

- Scientific support for the digital transformation of the re-registration service/electronic residence registration,
- Teaching digital literacy skills through student seminars,
- Design and implementation of a series of workshops for the use of Large Language Models, such as ChatGPT.

Further smaller projects:

- with companies and research institutions from the Hamburg region and internationally,
- with schools to teach software development methods at an early stage
- Participation in a working group of the start-up initiatives of all Hamburg universities and cooperation with ahoi.digital, ARIC and Hamburg Innovation.

Publications by HITeC are listed on the university websites of the respective professors and project members. An overview of project activities can be found at https://hitec-hamburg.de.

2. PROJECTS OF HITEC

The following sections provide a brief overview of the projects being worked on in 2023. This is preceded by a summary of the activities in each project area. HITeC focuses on sub-areas of computer science with project areas that are characterized by special activities at HITeC, also in the form of collaborative projects. In addition to the listed projects, there have been a large number of smaller activities that are not mentioned here.

2.1 IS – Intelligent Systems

The project area, designated "Intelligent Systems" (IS), originated from the "Laboratory for Artificial Intelligence." Since its establishment in 1988, the laboratory has been engaged in the development and application of innovative methods of artificial intelligence in collaboration with external partners. The work of IS is distinguished by an approach that is both scientifically rigorous and oriented towards practical objectives. The team's collective expertise encompasses a diverse range of areas, including expert systems, configuration and diagnosis, monitoring and event recognition, machine learning (encompassing deep learning, reinforcement learning, and clustering methods), big data, knowledge discovery, image processing (low-level and high-level techniques of image understanding), and other cutting-edge topics in artificial intelligence. IS provides the preparation of studies and the development of prototypes in direct cooperation with companies. Furthermore, IS frequently serves as a partner in funded projects, particularly in regional programs and in federal 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 2023 project year, HITeC provided support to the current partner, the Department of Culture and Media of the city of Hamburg, in the further development of the portal. To this end, the collaboration of developer and operations teams (DevOps) at

different institutions, some of which are public, was further developed at the organizational level (e.g., collaboration processes) and the technical level (e.g., cloud infrastructure). The deployment and test strategies, as well as the software architecture studies for the evolution of the system, were pursued as special research topics. The work was concluded in 2023.

Cooperation partners

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

Project management

- Lothar Hotz

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 University of 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 digitalization 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 center 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 2023, 137 schools were successfully supervised by about 35 student and research assistants within the framework of the project, 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))

Project management

- Wiebke Frauen

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 comprehen-

sive and central support structure to support schools in the digital transformation through effective, comprehensive conceptual design and realization 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) will take over the development of new technical solutions for these loan devices within the framework of the project: A) 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 2023, 3S supported 122 schools with more than 13,700 devices from the DigitalPakt (notebooks, Surfaces, iPads) for set-up and maintenance.

The tasks in 2023 were mainly:

- Further development of a stick solution that enables the data protection-compliant cleaning of devices that are to be quickly passed on to other pupils or teachers.
- Expansion of the offer by setting up a 3S software kiosk for the teachers‘ Surfaces: Software can be obtained via this kiosk in self-service and installed by the teachers themselfs.
- Development of solutions to facilitate the transition from loaned devices for the use of individual use by a single user at home to school devices with sole use in schools by multiple users.
- Further development of Call4Help tool, a self-developed tool which allows school contacts to create their own tickets directly from the device with all relevant data on the affected end device at 3S

Cooperation partners

- Hamburg Ministry of Education (Behörde für Schule und Berufsbildung (BSB))
- Universität Hamburg (UHH)

Project management

- Wiebke Frauen

Link

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

2.1.4 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 2023, the VideoScouter project worked on further improvements of object recognition, the constraint-based interpretation of situations which are difficult to recognize, and enhancements of player tracking.

The project is funded by the Hamburgische Investitions- und Förderbank (IFB Hamburg).

Cooperation partners

- WWE Media GmbH

Project management

- Rainer Herzog

2.1.5 Intelligent Inspection System – aiSpecTo

The aim of the aiSpecTo project is to develop an intelligent inspection system for flying over production pipelines. Pipelines are considered critical infrastructure and are therefore subject to a special inspection obligation. The use of artificial intelligence

(AI) and unmanned aerial vehicles (UAVs) in remote sensing can reduce costs, streamline inspections and enable dangerous situations to be identified at an early stage.

In 2023, the work of HITeC focused in particular on the following topics:

In order to correctly assess the hazard potential along a pipeline, the exact position of object detections in real coordinates is important. For this reason, an additional localization module was designed and implemented for the system, which uses the information provided and the camera/drone metadata to localize detections in the image.

In addition, approaches for generating synthetic image data were tested, as the aerial survey alone could not generate sufficient training data for all object classes. The aim was to falsify existing object data sets by making changes (mirroring, scaling, adding image noise, etc.) and thus expand the existing amount of training data. The approach "POSEIDON: A Data Augmentation Tool for Small Object Detection Datasets in Maritime Environments" by [Ruiz-Ponze2023] was integrated.

Integration and validation work was also carried out on the overall system.

The idea for the project was developed as part 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

Project management

- Stephanie von Riegen

Link

- https://www.mowai.net/projekte/aispecto

2.1.6 Digital, Urban Production - Digitization of Local Value Networks

In this project, a new form of local furniture production is to be established in the Hamburg metropolitan region, which focuses on local production by local craftsmen of individualized, globally developed products. A platform will provide support from the product development phase through to production and delivery via an end-to-end digital value creation process.

As a cooperation partner, HITeC provides scientific implementation advice. Joint working sessions are held in which results and work processes are reflected upon, expert feedback is provided and advice is given on platform development.

In 2023, in addition to implementation consulting, the focus of work was on the development of a planner that finds all possible work plans for a product from the partial work steps of the local craftsmen. The planner translates the planning problem into a graph structure and uses a backward search algorithm to find all solutions. Furthermore, it is possible to visualize the solutions, compare them according to different criteria and it extends the concept of planning to scheduling, i.e. it also provides detailed schedules for the solutions.

The project is funded by the Bundeswehr Centre for Digitalization and Technology Research (DTEC.bw).

Cooperation partners

- Helmut-Schmidt-Universität Hamburg
- Unity AG
- P&M Agentur Software and Consulting GmbH

Project management

- Stephanie von Riegen

Link

- https://dtecbw.de/home/forschung/hsu/projekt-urbane-produktion, https://productionnextdoor.de

2.1.7 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 to users these days. The value of data has also increased considerably in recent years, but the data providers' control over their data has not. In the funded Tresor project, a data trust model is to be developed over the next three years in order to align the conflicting interests of mobile device users and data users. The aim is to enable cryptographically secured and privacy-protecting data collection through a data trust app and an associated central and data-saving trust component.

The focus of HITeC in 2023 was the further development of a governance structure for data trustees. Possible contract types were identified and samples examined. Roles and responsibilities in the data trust ecosystem have been described.

Legal innovations such as the Data Act or the Data Governance Act were examined with regard to their implications for the data trustee. Possible incentive systems were examined to support the acceptance and continuous use of the data trustee.

The project has been funded by the Federal Ministry of Education and Research since March 2022 as part of Digital Change in Education, Science and Research.

Cooperation partners

- Universität Hamburg
- Umlaut Solutions GmbH, now Accenture Dienstleistungen GmbH

Project management

- Stephanie von Riegen

Link

- https://tresor-projekt.de

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

The EDIH4UrbanSAVE project, funded by the EU and the City of Hamburg, is a European Digital Innovation Hub (EDIH) with a focus on the Hamburg metropolitan region. With the help of the EDIH, the EU wants to support small and medium-sized enterprises and start-ups (SMEs) as well as public authorities (PSOs) in responding to digital challenges and becoming more competitive.

In 2023, the particular focus was on the development of services, i.e. formats for SMEs and PSOs. Workshops, training sessions, advisory documents and surveys were designed on the topics of further training, "Test before Invest", financing and funding advice, as well as networking. A number of services have already been offered or implemented in the reporting period. In particular, the "Use Case Development" and "Joint Proof of Concept" services from the "Test before Invest" area were in demand at HITeC.

The year 2023 was also characterized by the establishment of a Research Computing Infrastructure (RCI) in the project. This SLURM cluster system with CPU and GPU servers is offered to EDIH customers for the secure execution of computationally in-

tensive experiments. In addition, an application for typical AI use cases was developed to make it easier for RCI users to get started with the experiments.

Cooperation partners

- Hamburg University of Technology (TUHH)
- Hamburg University of Applied Sciences (HAW)
- Chamber of Crafts Hamburg (Handwerkskammer Hamburg)
- Digital Hub Logistics and Commerce
- Artificial Intelligence Center Hamburg (ARIC)

Project management

- Stephanie von Riegen

Link

- https://edih-hamburg.de

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

The AKIDU research project aims to increase the competitiveness of German seaports through improved digitalization and the use of AI by significantly improving processes for the storage and handling of non-standardized cargo.

During the reporting period, HITeC investigated various methods for obtaining 3D information and ultimately decided in favor of using 3D cameras. Different configurations of 3D cameras were tested experimentally in terms of number and position, the output of which was to be merged into a single point cloud to represent even large goods such as complete lorries. The camera configurations were modelled in the 3D graphics software Blender.

Furthermore, goods were to be identified and localized on the terminal with the help of a drone. Optical markers in the form of data matrix tags were initially used for identification; these could be identified on the drone's camera images and localized with the help of the drone's GPS information. Different flight altitudes, different tag sizes and recognition under unfavorable viewing angles and lighting conditions were investigated.

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

Project management

- Rainer Herzog

Link

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

2.1.10 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 2023 was the organization and realization of several AI workshops for the project partners. This is intended to increase transparency with regard to different AI approaches and objectives between the individual research partners and the exchange of experiences and opportunities to help optimize AI-supported research within the project. Furthermore, with the help of the workshops and its own ongoing knowledge building, HITeC was able to design the first parameters regarding the requirements for a demonstrator that is intended to demonstrate the recyclability of polyolefins (i.e. PE-HD and PP), whereby the recyclate is to be obtained from end-user waste. Recycling of this type of plastic waste (PCR) currently only takes place to a very limited extent.

The German Federal Ministry of Education and Research funds KIOptiPack.

Cooperation partners

- Artificial Intelligence Center Hamburg (ARIC)
- And about 40 more partners (see link)

Project management

- Rainer Herzog

Link

- https://www.ivv.fraunhofer.de/de/presseinformationen/bmbf-foerdermasssnahme-ki-anwendungshub-kunststoffverpackungen.html

2.1.11 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 "MyCoRe". 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. 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.

In 2023, a major internal restructuring of the data model was implemented as part of the final project phase, which had been planned for a long time and was necessary for further work on the web application. At the same time, the infrastructure was created to be able to transfer the content of further volumes of the author and project partner Gerrit Bos as so-called "internal entries" into the database of "PESHAT in Context", which was successfully carried out. For this purpose, the front end of the web application for displaying such entries was also significantly expanded so that, among other things, various volumes can be selected and the content searched.

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.

Cooperation partners

- Institute for Jewish Philosophy and Religion at the Universität Hamburg

Project management

- Pascal Rost

Link

https://www.peshat.org/

2.1.12 Hamburg Professor 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 professor's catalogue of the Universität Rostock.[1]

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 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

[1] http://cpr.uni-rostock.de/

the geo-identification numbers of the portal "GOV" (Place Database of the Association for Computerized Genealogy[2]). However, in the third quarter of 2021 it was decided to work with the data of the portal Portals "Wikidata"[3] 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 2024.

Cooperation partners

- Archive of the Universität Hamburg

Project management

- Pascal Rost

Link

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

2.1.13 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 behavior of the goalkeeper in real-time (positioning and timing) while simultaneously analyzing 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.

In the 2023 project year, the HITeC team started collecting data and implementing the annotation and training pipeline for an original ball detection model. In addition, a prototype was developed to calculate the 2D and 3D coordinates of the goalkeeper, the shooters and the ball from one or more cameras. Furthermore, suitable camera positions were determined for this project and the appropriate hardware was selected, purchased and tested.

[2] http://wiki-de.genealogy.net/GOV
[3] https://www.wikidata.org/

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

Project management

- Pascal Rost

Link

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

2.1.14 MUGI – Music and Gender on the Internet – Restoration of Multimedia Presentations

The internet portal MUGI is an online encyclopedia of the Hamburg University of Music and Performing Arts (HfMT) that has existed since 2003 and deals with research questions in the field of musicological gender studies and makes them publicly accessible. Due to an increasing lack of maintainability, MUGI could only be hosted in a "frozen", i.e. static, state since April 2019 and was at risk of being taken offline in the near future. Over 17 years of research work would then have been lost.

In the period from 2020 to 2021, the MUGI internet portal and the existing research data were secured for the long term in collaboration with HITeC and transferred to a maintenance-friendly web framework based on the repository web framework "MyCoRe". In addition to the encyclopaedia entries, which include very detailed biographies, the research results of the MUGI portal also include various multimedia presentations by different authors in various formats, some of which are no longer supported (for example "Flash" and "RealPlayer"). The preservation and partial restoration of these presentations could not be carried out during the project period at the time; instead, corresponding theoretical action plans were drawn up in which possible different preservation methods were explored and tested.

In the course of the "MUGI - Restoration of Multimedia Presentations" project, which was launched and successfully completed in 2023, the theoretical concepts for action were put into practice and 22 of the original 23 multimedia presentations were pre-

served, restored and partially modernized so that they can be called up and played back or viewed and used in modern web browsers.

The restored multimedia presentations have been on the MUGI test server and in the hands of the editors of the MUGI internet portal since the fourth quarter of 2023. Publication will take place once the presentations have been finalized, partially reviewed and approved by the original creators.

Cooperation partner

- HfMT Hamburg, Redaktion MUGI

Project management

- Pascal Rost

Link

- https://mugi.hfmt-hamburg.de/

2.1.15 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 University of Hamburg on methods to explain reinforcement learning. In 2023, the work on reward decomposition was further investigated within a reinforcement learning (RL) scenario. One focus was on the detailed evaluation of the RD² framework, which promised to find reward components without them being predefined. It was shown that the approach does not work and the results from the publication could not be reproduced. Furthermore, general problems with this approach were also identified. At the same time, great progress was made in the area of deep metric learning and a new type of clustering algorithm was developed that can generate test data sets with different levels of difficulty based on the embeddings generated. Together with all partners, work also continued on using all findings in a certification process. To this end, the necessary documents for a certification process were developed iteratively over the course of the year. The project is funded by the Federal Ministry of Economics and Climate Protection (BMWK) as part of the aviation research program.

Cooperation partners

- Center for Applied Aeronautics Research, Hamburg
- Hs2 Engineering, Ulm

- Knowledge Technology, Department of Computer Science, Universität Hamburg

Project management

- Sven Magg

2.1.16 Digital-Curri – Digital Condition Monitoring and Maintenance Recommendations for Tire Heating Presses for Economic and Ecological Optimization

In collaboration with HITeC, Harburg-Freudenberger Maschinenbau GmbH (HF Group) is carrying out a project to develop an intelligently networked monitoring and diagnostics module for the condition-based real-time monitoring of highly productive manufacturing systems in the tire industry, in order to identify and measure ecological and economic savings potential. The project aims to increase machine performance and availability, ensure quality and reduce energy consumption. The work of HITeC in this project includes the research and development of AI models for the prediction of cycle times, the prediction of energy consumption, and the prediction of possible errors based on those. The results of the models are to be incorporated into a cloud-based application HF-Explore to plan repair times, optimize energy consumption and reduce waste. In 2023, HITeC has already evaluated prototype models on test data and implemented the connection to the cloud application. These are now to be tested on end customer data and further optimized. Digital Curri is funded by the Hamburg Investment and Development Bank (IFB Hamburg) as part of the "Program for Innovation" (PROFI).

Cooperation partners

- Harburg-Freudenberger Maschinenbau GmbH (HF Group), Harburg

Project management

- Sven Magg

2.1.17 SciLabRL – Scientific Lab for Reinforcement Learning

In this project, an existing reinforcement learning (RL) software framework from an earlier collaboration project was further developed and improved on behalf of the TU Harburg. SciLabRL is a software framework for the scientific investigation of modern RL methods that is specifically aimed at researchers. Together with HITeC, the framework was updated, tested and improved. In particular, the implementation of the RL algorithms was restructured to simplify their use, the test environments for robot

simulations were improved and the data visualization was revised. The documentation and software tests were also improved and updated. The project ran for three months and was successfully completed at the end of the year.

Cooperation partners

- Manfred Eppe, Universität Hamburg

Project management

- Sven Magg

2.1.18 IMPA – Intelligent Media Production Assistant

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

The project was successfully completed in March 2023. Together with nachtblau GmbH, the results of the user study were published in the Information Retrieval Journal. In addition, a prototype was developed that enables the search for entire scripts, where video suggestions are made for individual text modules and arranged in a timeline. The project goals were thus all achieved and are available for nachtblau's mediaLoopster tool. The project was funded by the Hamburg Investment and Development Bank (IFB Hamburg) as part of the "Program[s] for Innovation" (PROFI).

Cooperation partners

- nachtblau GmbH, Hamburg

Project management

- Tayfun Alpay

2.1.19 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 recommendations for actions are to be generated in the future in order to be able to improve personal vitality.

In 2023, based on the evaluations of the sensors at the TU Ilmenau, a user study was carried out in which some initial data could be collected: participants had sauna sessions at home over the course of several weeks using a specially developed IoT device and a smart ring. Various data such as heart rate, temperature etc. were collected with the intention of studying (and in the final step predicting) the effects of different sauna behavior on the body.

A continuation with a larger number of participants and a final evaluation of the user study are planned for 2024, as well as a long-term study on the effects of sauna functions on vital parameters.

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

Project management

- Tayfun Alpay

2.1.20 EVASST – Development of a Value Stream Simulation Tool for the Process Industry

The innovation project "Development of a Value Stream Simulation Tool for the Process Industry – EVASST" aims to create an automated, parameterized simulation model of the customer's value stream network, spanning from raw materials to goods delivery. This model, derived from real data, will allow for rapid assessment of the effects of desired or potential changes without necessitating alterations to the actual production process.

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. In 2023, HITeC developed and evaluated an optimizer based on artificial evolution that uses the simulation to find optimal scheduling decisions and thus maximize/minimize specified KPIs. Extensions for more complex scenarios (inclusion of workforce scheduling, load balancing, etc.) have been examined and various approaches tested. The project is funded by the Hamburgische Investitions- und Förderbank (IFB Hamburg) within the framework of the "Program[s] for Innovation" (PROFI).

Cooperation partners

Data Lighthouse GmbH, Hamburg

Project management

Sven Magg

2.1.21 RESCUE-MATE: Dynamic Situation Generation and Support for Emergency Services in complex Crisis Situations

Since October 2023, HITeC has been one of 25 partners involved in the research and development project RESCUE “Dynamic situational awareness and support for rescue workers in complex crisis situations (RESCUE-MATE)”.

The aim of the RESCUE-MATE project is to develop a system for effective support of rescue workers in complex crises based on artificial intelligence (AI). A dynamic situation overview should be generated with the continuous integration of real-time data, allowing rescue workers to quickly orientate and assess the situation in the event of a crisis. A possible once-in-a-century flood in Hamburg serves as a central case study.

The HITeC sub-project “homogeneous data structures and hybrid AI methods to supplement BOS situation images” aims at the intelligent processing and preparation of various available data streams. The focus of research is on data integration for social media (vocabularies/ontologies), event detection from social media and transcriptions of TETRA radio, classification of sensor data, and scene interpretations from images and videos. All information should flow into a common, dynamic situation picture.

So far in 2023, the project has started with an analysis of the use cases and with the requirements engineering.

The research and development project RESCUE-MATE is funded by the Federal Ministry of Education and Research (BMBF) in the “Research for Civil Security” program.

Cooperation partners

- University of Hamburg - Department of Computer Science
- Absolute Software GmbH
- Artificial Intelligence Center Hamburg (ARIC) e. V. (associated)
- Free and Hanseatic City of Hamburg - Ministry of the Interior and Sport
- Federal Agency for Technical Relief (THW)
- BRH/Rettungshundestaffel Hamburg und Harburg e.V. (associated)
- German Red Cross (associated)
- Deutsche Telekom AG (associated)
- DLRG LV Hamburg e.V. (associated)
- EuroCommand GmbH
- Pinneberg Volunteer Fire Brigade (associated)
- HafenCity University Hamburg - Professorship Digital City Science
- Hamburg Aviation (associated)
- Hamburg Port Authority AöR
- Hamburg Informatics Technology Center (HITeC) e.V.
- Hanseatic Aviation Solutions GmbH
- Hamburg University of Applied Sciences
- Innovation contact point (associated)
- State Office for Geoinformation and Surveying (associated)
- State Office for Roads, Bridges and Waters (LSBG)
- Lufthansa Industry Solutions AS GmbH (associated)
- LV Hamburg e.V. (associated)

- NMS new mobility solutions GmbH (associated)
- Stadtreinigung Hamburg (associated)
- UAM-InnoRegion-SH (associated)

Project management

- Tayfun Alpay, Ricardo Usbeck

Link

- https://www.rescue-mate.de/

2.1.22 Cooperation with ARIC

In September 2019, HITeC co-founded the Artificial Intelligence Center Hamburg e.V. (ARIC). The mission of ARIC is to facilitate the integration of topics from the field of artificial intelligence into business and society. Formats such as networking events, workshops, use case identification, and project initiation are developed in collaboration with HITeC. During the reporting period, HITeC conducted internal and publicly accessible AI workshops, in addition to project initiation activities with the support of ARIC.

Cooperation partners

- Artificial Intelligence Center Hamburg e.V.

Project management

- Lothar Hotz

2.1.23 AI Workshops

In response to requests from project partners and external companies, HITeC has initiated a series of AI workshops designed to provide an introduction to the fundamental principles of AI, with a particular focus on neural networks. The workshops encompass a comprehensive range of topics, from fundamental concepts in machine learning to advanced techniques such as hyperparameter optimization with Bayesian Optimization. Following the favorable reception of a three-session workshop on image processing with Convolutional Neural Networks (CNNs) and hyperparameter optimization with BOHB, a regular series of five workshops was subsequently offered. Subsequent enhancements will be made to the workshops, which will also be offered in a bespoke format to companies.

Project management

Sven Magg

2.2 DSL – Distributed Systems Lab

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

Head:

Winfried Lamersdorf

Link

https://vsis-www.informatik.uni-hamburg.de/vsys/

2.2.1 Blockchain Projects

Prior project partners for DSL activities in the area of distributed “Blockchain” technology 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 addition, 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 have been 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).

Cooperation partner

- Lufthansa Industrie Solutions (LHIND), Hamburg

Project management

- Wolf Posdorfer

2.2.2 Smart City Projects

Other ongoing HITeC DSL projects in the area of distributed system software concentrate on support for networked data-intensive distributed "Smart City" applications, 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 Hamburg University and Hamburg University of Applied Sciences. Main goal is here to open up new opportunities for citizen participation (citizen science/ education) by, among other things, providing, disseminating, analyzing and sharing a wide diversity of (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.

After having proposed, prototyped, as well as evaluated and published respective concepts and applications, this project shall finish by end of 2024 with two remaining PhD dissertations which arose out of the respective project context.

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.)

Project management

- Winfried Lamersdorf

Link

- https://sane.city

2.3 ITMC - IT-Management and Consulting

The ITMC project area maintains a close collaborative relationship with the corresponding department at the university, which engages in research activities pertaining to service systems engineering and IT management. The current focal points of the project are the transformation of companies through the application of artificial intelligence, the regulatory aspects of digital ecosystems, and approaches to continuous service innovation.

Head

- Tilo Böhmann

Project Management

- 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 enrolled in the IT Management and Consulting (ITMC) Master's degree program facilitate interactions between the IT industry, academic institutions, and fellow students. Such events may include, for instance, lectures delivered by experts in the field, workshops, panel discussions, and networking opportunities for students, prospective students, and alumni of the ITMC degree program.

Project Management

- Many students of the ITMC course

Link

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

2.3.2 CUDIT - Competence Centre Customer and User-Driven IT

In the contemporary business environment, organizations are confronted with the imperative of enhancing their information technology (IT) support infrastructure to meet the evolving demands of their employees and customers. The proliferation of digital services across industries has precipitated a surge in expectations regarding the utilization of these services.

In the contemporary business environment, customers anticipate the availability of digitally accessible offerings and services. Similarly, employees expect comprehensive support for personal information management in the workplace. The digital transformation is intensifying the demand for IT expertise within specialized departments. Consequently, the IT function in many companies must evolve into a more customer- and user-centric approach, or "Customer and User Driven IT" (CUDIT), to better align with the heightened needs and expectations of both internal and external stakeholders.

The CUDIT competence center addresses the challenges faced by companies and is responsible for organizing and implementing application-oriented research in this field. The participating companies (partners), the University of Hamburg, and HITeC have a vested interest in jointly researching the challenges and potential measures for CUDIT.

Further developments may be pursued through the investigation of continuous innovation processes and the development of methods, tools, and organizational models for this.

Cooperation partners

- Beiersdorf Shared Services GmbH
- Hamburg Port Authority AöR

Project Management

- Tilo Böhmann, Paul Drews

2.3.3 Prompt-a-thon

The Prompt-a-thon® is an interactive training format based on a hack-a-thon, in which individuals work collaboratively over a period of time to develop a solution to an idea or challenge. However, in contrast to the independent writing of code or the construction of hardware, the Prompt-a-thon® is concerned with the utilization of Generative AI (e.g., Copilot or ChatGPT for text and program code, or MidJourney for images) to obtain responses that are then employed in the development of a solution. It is an accessible introduction to generative AI for individuals with varying degrees of expertise. Concurrently, its multifaceted applications render it an optimal point of entry for pilots or the introduction of generative AI in organizational contexts, facilitating connections and fostering mutual learning. A preliminary introduction provides an overview of the fundamental concepts and establishes a common vocabulary for discussing the applications of generative AI. The implementation of the Prompt-a-

thons® entails the collection of research data, which are utilized to examine the utilization of generative AI systems in scenarios wherein intricate problems are solved. This renders the format optimal for investigating human-AI collaboration, particularly in a team context. Prompt-a-thons® can be scheduled upon request, with prices contingent upon the focus of the requesting organization.

Cooperation partners

- Universität Hamburg

Staff

- Constantin von Brackel-Schmidt, Emir Kucevic

Selection of References

- Otto Group
- Hermes
- Techniker Krankenkasse
- AMAG Group
- Prosoz
- BPC AG
- IHK
- Hacker School
- Hamburger Verwaltung

Link

- https://prompt-a-thon.eu/

2.4 Business Information Systems

The Information Systems project area at HITeC encompasses research topics situated at the nexus between information technology and business administration. The emphasis is on subject matter that can be investigated through an application- and practice-oriented approach, in alignment with the principles of design-oriented business informatics. Nevertheless, the department's primary objective is not merely the implementation of research projects oriented towards application and practice, but also the transfer of these projects into practical applications. This transfer includes the establishment of companies that transform current research results into marketable products and services. The transfer occurs through the agency of the minds involved. The transfer area encompasses a range of topics and activities, including:

- Productivity of services through IT
- Hybrid value creation through product-service systems
- Usability of business management systems
- Development of innovative service apps
- Standardization projects at the German Institute for Standardization

Head:

Markus Nüttgens

2.4.1 ITE - IT-Entrepreneurship

In collaboration with the Hamburg Research Center for Information Systems (HARCIS) at the University of Hamburg, the IT Entrepreneurship course is offered each summer semester for Bachelor of Science students. The course addresses a range of topics related to the management of technology-based startups from diverse perspectives. The course, which was held during the summer semester of 2023, was dedicated to the exploration of innovative solutions within the context of sustainability management.

- The course covers the following topics:
- economic significance of start-ups for the economy and society
- basic terms of start-up management (start-up 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, development banks, etc.)
- Process models and best practices for IT-based business start-ups and consolidation (case studies and guest lectures)
- Preparation and evaluation of business plans (business plan competition)
- Presentation of a business idea in front of an expert jury

The following objectives are pursued:

- Knowledge of the theoretical foundations of IT-oriented start-ups
- Knowledge of the start-up sector from a regional, national and international perspective
- Learning the basics of digital business models and innovations and their implementation in IT-based products and services
- Application of a systematic and scientifically proven procedure for founding and consolidating young IT-oriented companies
- Case study-based creation of a business plan
- Presentation of a business idea in a compact pitch

Cooperation partners

- Contributors to the 2022 ITE round included representatives from:
- Transferagentur of the Universität Hamburg
- Hamburg Innovation
- TUTECH
- Raakwark Kaptaal
- IFB Hamburg
- Taxdoo
- eBlocker Open Source
- Entrepreneurs from the metropolitan region

Project management

- Markus Nüttgens

Link

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

2.5 INDIVIDUAL PROJECTS

2.5.1 Digital Sociological Discourse Analysis of Knowledge (D-WISE): Multi-modal analyses of meaning in grounded theory-guided research processes

The BMBF-funded joint project D-WISE (2021-2024) sought to investigate the potential applications, circumstances, and methods of integrating digital humanities techniques into qualitative discourse-analytical knowledge production. The consideration of multi-modality and the modeling of plurality of meaning were of equal importance to the epistemological reflection and further development of hermeneutic methodology. To address this research need, D-WISE developed novel analytical methods for the utilization of contextualized embedding representations and a comprehensive prototypical working environment, the Digital Analysis Tool Suite (DATS), as a digital support for socio-logical discourse analyses (WDA).

The work conducted within the D-WISE project was undertaken in close collaboration between members of the Computer Science and Empirical Cultural Studies departments at Universität Hamburg. In 2023, the project's emphasis shifted to the technical implementation and testing of the jointly developed tools in DATS, as well as the dissemination of findings derived from the respective subject areas. Another area of focus was the preparation for the integration of machine learning components. In the future, these will facilitate an interactive and reciprocal process in DATS, whereby users interact with machine-generated suggestions. The machine learning will be continuously improved on the basis of their decisions.

DATS will be made available as open source software.

Cooperation partner

- Universität Hamburg

Project management

- Prof. Dr. Chris Biemann, Prof. Dr. Gertraud Koch

Link

- https://www.dwise.uni-hamburg.de/
- https://github.com/uhh-lt/dats

2.5.2 Orientation in the digital transformation – understanding digitalization and shaping it sustainably

The project group at the Department of Computer Science at the University of Hamburg is dedicated to the synthesis of knowledge from disparate disciplines with the objective of enhancing comprehension of and developing sustainable strategies for navigating the digital age. It is anticipated that this will enhance the capacity for critical thinking and decision-making for students of (business) informatics, a skill that is often overlooked in the context of the condensed nature of modern university life. Consequently, our attention is directed towards the technologies and the values they embody (digitalization in context), the challenges, opportunities, and consequences, as well as the sustainable implementation of desirable outcomes through value- and interest-oriented design (design in context). This is what we refer to as digital literacy. One tangible manifestation of this conceptual framework is the Mikropolis.org platform, which serves as a public forum for showcasing student-led contributions on digital literacy. During the reporting period, the platform underwent further development, and new concepts for the dissemination of the topic in the business world were devised. Additionally, HITeC provided assistance to the Mikropolis project as part of DDLitLab.

Project management

Arno Rolf

Link

https://mikropolis.org

2.5.3 Development of a new computer-aided tool for the discovery of active substances

In the project "Development of a new computer-aided tool for the discovery of active substances," the Algorithmic Molecular Design (AMD, Prof. Rarey) working group is engaged in a collaborative endeavor with Beiersdorf AG in the domain of bioinformatics and cheminformatics. The objective of the project is to develop a code prototype that generates new molecules using generative machine learning based on gene signatures. Generative models, such as GANs (Generative Adversarial Networks), have been previously described in the literature for the generation of molecules. As part of the project, various methods were reimplemented and evaluated for their suitability in the research context of the project partner. The project will run until Q1/2023.

Cooperation partner

Beiersdorf AG

Project management

- Tobias Harren

2.5.4 DaFne - Data Fusion Generator Platform

The DaFne project focuses on the synthesis of tabular data, as well as the utilization of the developed generation and evaluation algorithms on an intuitively operable platform.

For this purpose, different machine learning models for generating tabular and time-series data have been tested, and metrics for evaluating the synthetic data have been implemented.

The architecture for the platform was finalized, and development of the frontend and backend was advanced, so that a functional prototype can be created by early 2024.

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

Project management

- Pamela Kunert

Link

- https://platform.dafne-project.org/

2.5.5 Physics4DH: Exploring potential of algorithms and methods from Physics for Digital Humanities

The objective of this project is to investigate the potential of algorithms and theoretical backgrounds derived from the field of physics for application in the digital humanities (DH). Digital humanities (DH) are an interdisciplinary field of research that draws upon insights from different areas of the humanities and social sciences, as well as computer science.

The archiving and research of cultural heritage artefacts using methods drawn not only from computer science but also from other natural sciences, including physics, chemistry and biology, occupies a distinctive position within the field of digital humanities. Such methods facilitate not only the preservation and conservation of cultural heritage, but also a more nuanced understanding of the authenticity, provenance, historical, geographical and social context, and the techniques employed in the production of the objects. The natural sciences offer a range of tools that, when used in conjunction with IT tools and non-destructive or minimally invasive techniques, have significant potential for the preservation and study of cultural heritage. The intricate theoretical framework of these tools often renders them inaccessible to end users, who typically interact with them as a black box. Furthermore, the presentation of research results merely mentions the utilization of such tools, without elucidating the rationale behind the specific methodologies employed, the precise parameters set, and the underlying motivations. This has a detrimental impact on the replicability of results and the overall sustainability of research (cf. FAIR principles).

In this project, we investigate methods from physics that are relevant for DH approaches, especially in the field of digital cultural heritage. The objective is to develop a set of learning materials that explain algorithms and methods from physics in a simple and accessible manner for scholars in the humanities. The project will culminate in the creation of a website on GitHub that will serve as a platform for integrating, structuring and explaining the theoretical background and potential applications of research methods from physics relevant to digital humanities (DH) approaches.

The following outcomes were attained during the reporting period:

- A review of the current literature on the application of physics to cultural heritage projects was conducted. The research focus is on non-destructive or minimally invasive research techniques, including 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 to explain non-destructive physics research techniques used in DH has been further developed.

Project management

Cristina Vertan

2.5.6 RoboCup-AG - Hamburg Bit-Bots

The RoboCup working group, operating under the designation "Hamburg Bit-Bots," has been engaged in the international scientific competition RoboCup since 2012. The competition is designed to facilitate the advancement of robotics. The objective is to utilize incremental problems within the RoboCup soccer leagues in order to guarantee that human-like robots are able to operate at the level of professional soccer players by the year 2050. The competitions provide a forum for the exchange and comparison of results, as well as incentives for further development. The Hamburg Bit-Bots participate in the Humanoid Kid-Sized League.

The team has qualified for the World Championship on an annual basis since 2012. Additionally, the team has participated in numerous German Open events in Magdeburg and several Iran Open tournaments in Tehran.

In consequence of the pandemic, the World Championship was conducted via simulation this year. The team attained the third-place ranking. Moreover, the team achieved the highest ranking, namely first place, in the simulated Brazil Open tournament.

In addition to its involvement in competitive events and scientific research, the team has also become a prominent figure within the university, frequently participating in public events such as the Day of Knowledge. However, due to the ongoing pandemic, these events have unfortunately been canceled this year.

Since 2015, members of the working group have successfully published twelve peer-reviewed scientific papers. The fact that eight former members are currently employed at a university, five of them at the University of Hamburg, demonstrates that the working group has effectively served as a conduit for the advancement of scientific knowledge.

The group's research is primarily focused on the integration of numerous complex subsystems in the field of humanoid robotics.

Cooperation partner

RoboCup AG „Hamburg Bit-Bots"

Project management

Jasper Güldenstein

Link

https://bit-bots.de/

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 AstraZeneca (Mölndal, SE) in the field of pharmaceutical research and drug development. The aim of the project is to develop a protein structure database system 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 resources, 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 GeoMine backend and frontend were each installed via a Docker container on internal servers or on a cloud infrastructure. After initial tests, remaining work was carried out to fully integrate the software into the project partner's infrastructure so that the project could be successfully completed in mid 2023.

Cooperation partner

AstraZeneca

Project management

Konrad Diedrich

Link

https://proteins.plus/geomine

2.5.8 M-Lab 2023/2024 (Innovation and Technology Transfer Teaching)

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 (4-6 members) for real clients from the industry with real deadlines.

The students can experience software engineering technology and methods. Furthermore, they gain experience in teamwork, project management and communication with clients.

HITeC supports the student-industry collaboration projects with a special focus on knowledge and technology transfer. It ensures that the projects are relevant in practice, support teams on practice and industry-related issues and ensures the transferability of the results.

Cooperation partners (practice partners) and results:

European XFEL:

The European XFEL scientific facility wanted an app that employees and guests could use to send feedback to the company. One use case, for example, is that scientists visiting the company to carry out an experiment can use the app to report whether the experiment went well or whether process-related problems occurred. The M-Lab student team has developed a mobile app for the users and a web application for the application administrators. The team paid particularly attention to multimodal input options for feedback by voice, text and image, as well as semi-automated processing of the input.

Habinator:

The start-up Habinator sells an app that can be used to document personal "habits" on a daily basis in order to motivate people to carry out certain activities in their daily routine. Examples include walking a certain number of steps per day or meditating once a day. The company needed an innovative further development of the existing app in order differentiate itself from other apps on the market. The M-Lab student team developed a mobile app that allows users to record their habits via text and voice in a guided dialog and then receive motivational incentives to pursue the activities they have entered.

Hochbahn AG:

Hochbahn would like to improve accessibility in the HVV public transport network. They wanted an app that implements innovative concepts, for example to support visually impaired people on the subway. The M-Lab student team has developed a mobile app that looks similar to the existing HVV app, but specializes in accessibility. The benefits of the app include the fact that visually impaired users can use the app to scan a departure board on the subway track in order to be informed about the next departures, "click" a route guidance via a tidy user interface or alternatively use the smartphone's voice assistant and operate the app elements via "VoiceOver" support.

Signed Media:

The media production company Signed Media manages several YouTube channels to play out video content for their clients. The company wanted an application that would allow employees to monitor the performance of YouTube videos and channels and receive innovative ideas for new videos. The M-Lab student team developed a mobile app that can compare the performance of multiple channels or videos and analyze currently popular YouTube videos to suggest better keywords for existing videos or ideas for new videos to users.

Cooperation partners (Practice partners):

- European XFEL
- Habinator
- Hochbahn AG
- Signed Media
- Universität Hamburg (UHH)

Project management

- Prof. Dr. Walid Maalej

Link

- M-Lab website: https://mast.informatik.uni-hamburg.de/mlab/
- Youtube playlist / Trailer: https://www.youtube.com/playlist?list=PLhVzhgTBKDOBzliTY9qBO_g3t5xIitX-E

2.5.9 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 have already identified requirements and developed a 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. Building upon this, we are analyzing which modalities are suitable for allowing users to interact with the system. For example, users could use voice commands, touch virtual elements with their hands, or use their eye gaze to perform inputs.

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 the use of AR for inspection processes, with a special focus on how human could interact with such AR systems.

Cooperation partner

- Gasnetz Hamburg GmbH

Project management

Julia Hertel

2.5.10 CoyPu – Cognitive Economy Intelligence - Platform for the 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)“[4].

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 2023, HITeC was able to contribute to a significant further development of the CoyPu ecosystem in collaboration with the consortium partners. HITeC's core contributions touched on various AI focal points of the project. In the field of automatic knowledge extraction, modules for recognizing and reading events from unstructured data sources were further developed and benchmark data sets were created to evaluate the extraction algorithms. The resulting event knowledge bases were integrated into the CoyPu knowledge graph. Furthermore, AI methods for event deduplication were evaluated and expanded. Developed question-answering modules were revised and benchmarking approaches for the automated evaluation of the corresponding algorithms were designed, implemented and published in accordance with the FAIR principles. In addition to fine-tuning, methods for the synergetic use of large language models (LLMs) were also developed in the area of question answering. In 2023, HITeC also thoroughly evaluated the project's core ontology and submitted suggestions for

[4] See also:
https://www.digitale-technologien.de/DT/Navigation/DE/ProgrammeProjekte/AktuelleTechnologieprogramme/Kuenstliche_Intelligenz/ki.html

improvement to the consortium. As a further step towards ensuring the data quality of the CoyPu knowledge graph, work was carried out on procedures for the automatic creation of rule sets based on the Shapes Constraint Language (SHACL). In addition, scientific publications were successfully presented at relevant conferences and expanded upon in several theses.

The project is funded by the Federal Ministry for Economic Affairs and Climate Protection.

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
- Implisense GmbH
- Siemens AG
- Infineon Technologies AG
- Selbstregulierung Informationswirtschaft e.V. (SRIW)

Project management

- Ricardo Usbeck

Link

- https://www.coypu.org/

2.5.11 WiBUmo – Scientific monitoring of the implementation of the online service “online re-registration”

The Free and Hanseatic City of Hamburg (FHH) - Senate Chancellery is pursuing the eWA (electronic residence registration) project, which is intended to facilitate the implementation of the OZG (electronic residence registration) project. The online service, electronic residence registration (eWA), provides citizens with the ability to register their residence digitally and to update the address on their ID document, for instance, via the NFC interface of their cell phone.

The process entails the user authenticating themselves via eID, registering their new place of residence, and then updating the ID document through the AusweisApp2 and the dedicated writing service (eID server with write access) in the background via the cell phone's NFC interface or a card reader. The introduction and successful operation of this online service, therefore, represents a significant milestone in the implementation and dissemination of the use of the eID for a variety of other online/digital administrative services.

A minimum viable product (MVP) of the eWA online service has been successfully implemented and operated as a pilot in the Hanseatic City of Hamburg since September 2022. Concurrently, the eWA product is undergoing further development with regard to EfA capability (EfA: one-for-all principle; the nationwide rollout of the service in other municipalities is planned) and an expansion of the target group, as well as optimization of the process.

HITeC will continue to monitor and assess the project from a scientific perspective, with a focus on security, digital transformation, and software development strategy. This is part of the ongoing effort to develop the pilot project into a rollout-capable product in public administration with diverse stakeholders.

The research scope encompasses the following areas:

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

Cooperation partners

- Amt für IT und Digitalisierung (ITD)
- Freie und Hansestadt Hamburg (FHH) - Senatskanzlei

Project management

- Ogeigha Koroyin

Link

- https://www.wohnsitzanmeldung.de/

2.5.12 SeaSchool – Software Engineering and Architecture in School

As part of the SeaSchool project, a concept is being developed and evaluated to give students a realistic picture of the roles, tasks, and skills of software engineers and

software architects. Programming is often one of the first - even scary - associations with computer science, but it is only a tiny area of software engineering.

The project's strategic goal is to get more pupils interested in careers in the IT/MINT sector. SeaSchool addresses the social problem of the shortage of IT specialists. In particular, we aim to make all pupils, including those who have not yet considered an IT focus due to prejudices regarding the job profile — especially females — feel valued, considered, and enthusiastic about the topic.

The core component of the concept is a cross-class workshop with students in the 9th or 10th grade of secondary school (Gymnasium). These workshops are not just theoretical exercises, but real-world problem-solving sessions. By engaging in a real-life 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.

After initial workshops in 2022, a workshop was held at the Europaschule Aldegrever-Gymnasium in Soest in 2023 with around 100 pupils.

Reports and photos of the SeaSchool workshops are on the project website. Further workshops are already in the planning phase.

Cooperation partners

- Gymnasium Oberalster Hamburg
- Europaschule Aldegrever-Gymnasium Soest

Project management

- André van Hoorn

Link

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

2.5.13 PerMoDiS - Performance Monitoring on Data-intensive Software

Application Performance Monitoring (APM) comprises methods, techniques, and tools for collecting performance data from software systems and gaining insights into their performance-relevant behavior—including analyzing performance-related problems. While APM is being increasingly adopted, especially in cloud environments, no full-fledged solutions exist for service-based AI-enabled software systems. However, AI-enabled software applications add a new level of complexity and pose a critical point in an application, so they should not be a blind spot in terms of APM.

The project, conducted from 2022 to mid-2023, investigated the potential of APM within service-based AI-enabled software systems using open-source software and standards. The focus was on collecting and using the required metrics for further analysis in the context of problem analysis, i.e., detection and diagnosis.

Our research began with a comprehensive study of the state-of-the-art and the requirements for monitoring the performance of service-based AI-enabled software systems. We focused on concerns, metrics, and current limitations concerning open-source APM tools and practices. Armed with these insights, we designed and implemented a prototype to support the interactive metrics analysis, particularly the interactive detection and diagnosis of performance problems. The prototype is designed as an interactive analysis notebook. To demonstrate the practical application of our prototype, we used an image recognition demonstrator application as a use-case scenario. We then conducted exploratory load test experiments to study the effectiveness of our approach.

Cooperation partner

Huawei

Project management

André van Hoorn

2.5.14 Memory Hierarchy Code Optimization

Modern real-time embedded systems can face strict timing, energy, and code size constraints depending on the underlying application. Dynamic memory allocation is a compiler-level optimization that can be used to exploit embedded system's memory hierarchy to optimize for such constraints. In the past, single-objective dynamic memory allocation for reasonably limited architectures have been the focus of the research. Optimizing for a single objective can lead to worsening of other program properties, for example, minimizing Worst-Case Execution Time (WCET) can negatively impact energy consumption of a program and vice versa.

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 2 focused on developing multi-objective optimizations in the context of dynamic memory allocation at the compiler level. The dynamic memory allocation model, liveness analysis, and address assignment algorithm developed during the first year of the project was combined to

define a multi-objective optimization problem, where WCET and energy consumption were the minimization objectives. The multi-objective optimization problem was solved using two metaheuristic algorithms – Flower Pollination Algorithm (FPA) and Strength Pareto Evolutionary Algorithm (SPEA).

The compiler infrastructure is also extended to support DMA engine and a so-called DMA Call Placement Optimization (DCPO) was developed that tries to find optimal places within the code to place DMA calls that initiate the dynamic allocation of code fragments during runtime. DMA model, DMA analysis, and DCPO were combined with dynamic allocation based multi-objective optimization to perform DMA aware optimization.

All these models and optimizations have been realized successfully and evaluations have been conducted to demonstrate the usefulness of the developed techniques. The proposed techniques have produced better quality solutions compared to the state-of-the-art single- and multi-objective static- and dynamic-memory allocation techniques.

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.

Cooperation partner

NXP Semiconductors, CTO Office Hamburg

Project management

Heiko Falk

2.5.15 Efficient 3D-Bin-Packung based on Reinforcement Learning Method

Online bin packing, where items arrive sequentially and must be immediately placed, contrasts with the offline approach where all items are known in advance. Traditional heuristics often struggle with long computation times and suboptimal solutions, while deep reinforcement learning (DRL) promises global optima through explorative learning and real-time, sensor-based decision-making, showcasing its efficiency and optimality.

We utilized NVIDIA's Isaac Sim for our simulation environment, featuring a UR5 robotic arm and a conveyor belt, to train our DRL algorithms. Our work focused on replicating and fine-tuning two recent algorithms, achieving up to 80.1% space utilization in various scenarios, highlighting the benefits of DRL in dynamic, real-world applications. Further improvements on one algorithm showed potential for even

higher efficiency, underlining the significant impact of item selection strategies on overall performance.

Our findings indicate the substantial influence of decision tree construction and soft constraint methods on performance. Future work will explore advanced integration of prior information and the synergistic application of differentiable optimization with DRL for safer, more generalizable solutions.

Cooperation partner

Mech-Mind Robotics GmbH

Project management

Jianwei Zhang

2.5.16 Data-driven Solutions for the Smart City Hamburg (D2S2C Hamburg)

In the Data-driven Solutions for the Smart City Hamburg (D2S2C Hamburg) project, students from the MIN faculty have the opportunity to work on and learn with various challenges in groups in a practical environment and develop innovative prototypes with the help of future-oriented technologies. The focus is on the proof of concept, which should be achieved through the use of new technologies such as artificial intelligence and machine learning, as well as scientific methods. The students are supported by lecturers and various experts from the cooperation partner - Hamburger Hochbahn AG - which provides data and information for this purpose and is part of the agile development process. In 2023, 20 students worked on four challenges or used cases that dealt with identifying hazard spots in public road traffic, the AI-based analysis of sustainability reports, stakeholder management, and the analysis of weather-related incidents in public transport.

In line with the mentioned challenges, research questions such as

- "How can hazard locations and accident hotspots for bus transport in Hamburg be identified automatically using operational and geotechnical data?",
- "How can the sustainability reports of public transport companies be evaluated automatically to support the comparison and the development of measures? ",
- "How can relevant stakeholders be automatically identified using web crawlers and large language models and relevant information extracted to support participation processes?",
- "What are the weather-related causes of disruption in public transport operations, and what factors are they dependent on?",

- "How can findings about causes support the planning of measures to safeguard public transport in the context of climate change?"

and other answers.

Cooperation partners

- Hamburger Hochbahn AG (HOCHBAHN)
- Universität Hamburg (UHH)

Project management

- Marten Borchers

Link

- https://urbanplanning.informatik.uni-hamburg.de/IS4UrbanPlanning/d2s2c/overview.xhtml
- https://www.hochbahn.de/de

2.5.17 Intelligent Distributed Computing

This project supports research at the intersection of „Intelligent Systems“ and „Distributed Computing“.

Intelligent Computing covers a hybrid palette of methods, techniques and their applications ranging from classical artificial intelligence, information and data sciences, multi-agent technologies or computational intelligence to more recent trends such as swarm intelligence.

Distributed Computing develops methods and technology to build complex computational systems composed of collaborating software components scattered across diverse computational elements, including advanced topics from edge/cloud computing or social/cyber-physical trust and security.

A central application domain are cyber-physical systems (CPS) like: intelligent energy systems, adaptive production systems, flexible transportation systems, smart city applications, etc.

The main activity in 2023 has been the organisation of the 16th International Symposium on Intelligent Distributed Computing (IDC'23), which was held from 13th – 15th September 2023 at the Hamburg University of Applied Sciences (HAW Hamburg). More details can be found at the conference web site: http://idc2023.cc4e.de.

This project is categorized into the project area „Distributed Systems Lab“ (DSL); in fact, it is equally connected to the area „Intelligent Systems“ (IS) as this project operates in in the intersection of both.

Kooperationspartner

- Forschungs- und Transferzentrum „Smart Systems“ (FTZ SMSY) der Fakultät Technik und Informatik an der HAW Hamburg. https://smsy.haw-hamburg.de

Projektleitung

- Michael Köhler-Bußmeier, Wolfgang Renz, Jan Sudeika

Link

- http://idc2023.cc4e.de

2.5.18 Emerging Trend Detector: Innovative AI tool for aligning production and development processes with emerging trends in markets with different dynamics

The project "Emerging Trend Detector: Innovative AI tool for aligning production and development processes with 'emerging trends' in markets with different dynamics" started in mid-2023 and is funded by the BMWK as part of the "Central Innovation Program for SMEs" program. Globalization and digitalization are leading to increased networking of different markets, which presents companies with the challenge of aligning their products and services not only with the requirements of the target market, but also with overarching market trends from different industries. Current methods such as market research analyses and keyword-based trend scouting, supported by AI tools, are already in use. However, the actual identification and derivation of influential trends remains the preserve of human specialists.

The Institute for Management and Economic Research (IMWF) is addressing this need and is planning to develop an AI-based "Emerging Trend Detector" in collaboration with HITeC. The aim of the project is to dynamically model market and trend developments on the basis of freely available communication data. This enables the early identification of market dynamics and trends so that customized product and strategy developments can be made in a timely manner.

As initial steps, HITeC received United Nations related Environment Sustainable Goals (ESG) data from the partner, analysed and labeled it with appropriate classes. The team at HITeC applied Large Language Models (LLMs) on the classification tasks and

presented their results. Consequently, initial steps have also been taken on the development of Topic Models, where a batch of data has been shared by the partners.

Kooperationspartner

- IMWF Institut für Management- und Wirtschaftsforschung GmbH

Projektleitung

- Ricardo Usbeck

2.5.19 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

2.5.20 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

2.5.21 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

2.5.22 Hamburg Informatics Computer Museum

Since his retirement, Prof. Dr. Horst Oberquelle has set up a computer museum in the university's Department of Computer Science. The museum displays an interesting selection of pioneering inventions from the beginnings of mechanical computing to desktop and pocket calculators, hardware from Konrad Zuse to mainframe computers, the development of workstation systems and home computers to large and small portable computers. Data transmission from the Morse key 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 covered. Many devices are demonstrated live. A special aspect is the importance of innovation and design in Apple computers and the development of interaction technologies in mice, joysticks, trackballs and other input devices.

In addition to members of the department, the Computer Museum is also open to alumni associations, schools and the general public. Prof. Oberquelle regularly offers guided tours. In 2023, guided tours took place again with over 400 participants. With the help of a guest with a passion for technology, various other old computers were again reactivated. In particular, early works by computer art pioneer Herbert W. Fanke were revived.

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

Project management

- 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 2024, projects will continue to be carried out and advanced with research institutions, authorities, and industry. 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. In particular, the transfer activities of Universität Hamburg will be supported in 2024.