

International Master of Science on Cyber Physical Systems "MS@CPS"

6.04.2021

INTERNATIONAL MASTER OF SCIENCE ON CYBER PHYSICAL SYSTEMS

IN THIS ISSUE

Master of Cyber Physical Systems **MS@CPS**

The International Master of Science on Cyber-Physical Systems (MS@CPS) provides a specialized and unified view of the industry-oriented research field, aiming to prepare the students to be highly skilled analyzer, designers, and developers of both the software and hardware aspects for various industry-related systems and applications in the context of CPS.

By enrolling in this program, the students will interact with people from several distinct countries, with diverse cultural backgrounds to promote globalization and technological development based on students' choices and expectations.

The ERASMUS PLUS Key Action 2 (capacity building in higher education) has funded the work reported herein; project reference number: 598750 - EPP-1-2018-1-DE-EPPKA2-CBHE-JP, which is gratefully acknowledged.

Co-funded by the
Erasmus+ Programme
of the European Union



For more information please visit:

Website:

<https://www.ms-cps.eu>

Facebook:

<https://www.facebook.com/MSCPS.EU>

LinkedIn:

<https://www.linkedin.com/company/mscps/>

- MS@CPS
- Consortium
- Zoom Meetings
- Workshops
- Events
- News
- Gallery
- Scientific Article on CPS fields



PROJECT INFORMATION

Number:

598750 - EPP-1-2018-1-DE-EPPKA2-
CBHE-JP

Key Action:

Cooperation for innovation and the
exchange of good practices –
Capacity Building in the field of
Higher Education



Consortium

University of
Hertfordshire **UH**



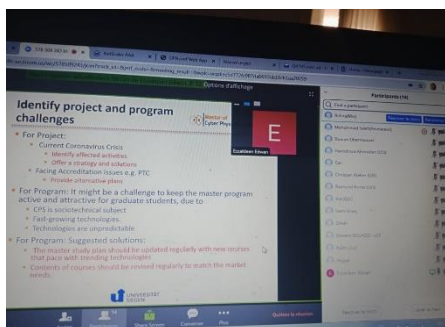
Institutions of the program countries include the University of Siegen in Germany, the leader of program. University of Hertfordshire in the UK, and the KTH Royal Institute of Technology in Sweden. Institutions from the partner countries include the German Jordan University and Tafila Technical University from Jordan, Carthage University and the



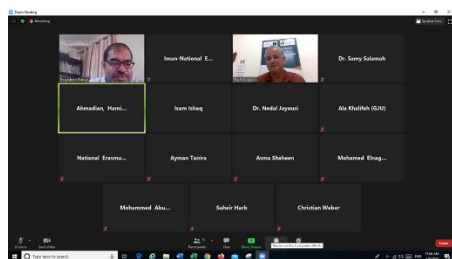
University of Sfax from Tunisia, as well as Al-Quds University and Palestine Technical College - Deir El-Balah from Palestine.



ZOOM MEETINGS

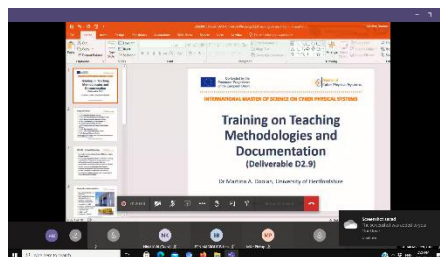


On Tuesday, 17.3.2020, the MS@CPS consortium held an online meeting instead of the scheduled face to face meeting because of imposed travel restrictions to limit Coronavirus (Covid-19) spread. The meeting discussed status, progress and planned activities in the project work packages. The meeting agenda lasted all full day and included presentations from the leaders of project Work Packages. All measures will be taken by the consortium partner universities to ensure a successful implementation of its tasks.



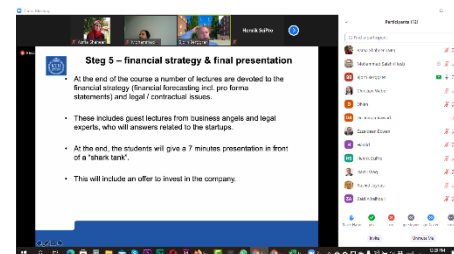
On the 7th of September 2020, a Virtual Advisory Meeting to the MS@CPS project, was carried out via the Zoom meeting by the NEO team headed by Dr. Nedal Jayousi, the Director of the National Erasmus+ Office - Palestine. The meeting has been held with the participation of all universities partners of the project, and the purpose of the Advisory Field Monitoring meeting is to learn about the activities realized and products developed so far, as well as to see if the project has met any problems in working and/or financial

implementation that can be discussed and solved. Dr. Ezzeldeen Edwan from Palestine Technical College-Deir El-Balah together with NEO Director / Dr. Nedal Jayousi opened the meeting and welcomed the participants and then presented a brief summary of the overall implementation of the project activities. Dr. Rashid Jayousi from Al-Quds university presented overall progress in the preparation work package. The team also discussed with NEO the issue of accreditation for the Master program as the main delivery of the project and reviewed with all partners the level of the project implementation, the status of work plans, and the major challenges of the project. The meeting ended with suggestions and recommendations posed by Dr. Jayousi to the project team to go ahead in this program.



A virtual training program of the MS@CPS project was concluded after two days, 14th and 15th of September 2020, of holding it. The training is organized by the University of Hertfordshire and was given via Microsoft Teams meeting and it was held with the participation of all partners of the project. The purpose of the training is to enhance capacities of partner universities in Cyber-Physical Systems education. Dr. Raimund Kirner and Dr. Martina Doolan from the university of Hertfordshire moderated the training. On the first day, Dr. Martina and Dr. Mick Walters presented about "Blended Learning Teaching Methodologies Through Using Technology to Enhance Collaborative

Learning" and "Lecture on Robotics" respectively. On the second day, Dr. Mike Pickup and Dr. Raimund Kirner presented about "Contemporary Issues Professional Ethical and Legal" and "Decision Making & Planning for Cyber-Physical Systems" respectively. The training closed with answering of questions the attendees by Dr. Martina Doolan and Dr. Raimund Kirner.



A virtual training program of the MS@CPS project was concluded after three days, 3rd, 4th, and 5th of November 2020, of holding it. The training was organized by the KTH Royal Institute of Technology, Stockholm, Sweden, and it was given via Zoom meeting. It was held with the participation of all partners of the project. The purpose of the training is to enhance the capacities of partner universities in Cyber-Physical Systems education with focus on entrepreneurship, industry-university collaboration, thesis evaluation and sustainability. Dr. Mohammad Saleh from the KTH moderated the training. On the first day, Dr. Cali Nuur and Dr. Victor Kordas presented presentations entitled "Industrial change including entrepreneurship" and "Infrastructure for support of research activities at KTH" respectively. On the second day, Dr. Henrik Hansson, Dr. Björn Berggren, and Dr. Victor Kordas presented presentations entitled "Quality assurance Thesis Management System", "New Venture Creation" and "Innovative Approaches to University- Industry Collaboration" respectively. On the third day, Dr. Urban Westergren, Dr. Cali Nuur, and

Dr. Donnie Sc Lygonis presented presentations entitled "Thesis and Evaluation process", "The transformation towards sustainability" and "Innovation Strategist & Business Coach" respectively.

WORKSHOPS



The team of MS@CPS at the higher Institute of Computer Science and Multimedia (ISIMS), University of Sfax held an internal workshop on the 4th of January 2020. The team discussed finalizing the accreditation application so the master program can be launched within the year 2020 as planned. It should be noted that the MS@CPS team at Sfax university is headed by Prof. Faiez Gargouri, the director of the higher Institute of Computer Science and Multimedia.

EVENTS

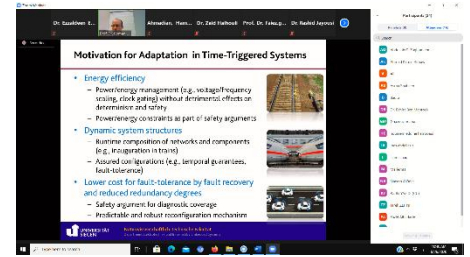


On the 17th of January 2020, the national Erasmus+ office of Tunisia represented by its coordinator Prof. Adel Alimi accompanied with the coordinator deputy Dr. Nesrine Baklouti conducted the first monitoring visit to the University of Sfax (USF) to evaluate the progress of the MS@CPS project. Prof. Faiez Gargouri the local coordinator of the

MS@CPS project at USF and the project's team presented the project status in preparation activities, curricula development and quality plan. Representatives from Carthage University were present as well. The discussions were very fruitful and Prof. Alimi praised the progress conducted so far. Representatives of the project leader, University of Siegen in Germany, presented the management status of the project. Other consortium partners participated in this meeting as well via video conference and presented their work progress. The dissemination activities and sustainability plan were presented by the representative of Palestine Technical College - Deir El-Balah, Palestine.



The team of MS@CPS at Palestine Technical College – Deir El-Balah (PTC) held a briefing day to present the cyber-physical systems (CPS) in an event that took place at the main meetings hall on the 27th of February 2020. The event is devoted for informing fifth year students at computer systems engineering department at PTC about the applications of CPS in different fields. At the end of the event the panel was opened for questions from the audience about the intended master program.



On Wednesday, 26.08.2020, the MS@CPS project partners held an online open info day about the master program. The event was moderated by Palestine Technical College - Deir El-Balah with the presence of all partners. Dr. Ezzaldeen Edwan welcomed all keynote speakers and attendees. The NEO Director, Dr. Nedal Jayousi, the guest speaker, launched the event and explained that the NEO office supports the Palestinian partners of CBHE projects in Palestine and he praised the excellent share they won this year. Dr. Jayousi encouraged the project's partners to sustain their work on the project during COVID-19 pandemic, as well as to work on getting accreditation as it lies within the priorities of the Palestinian Higher Education Strategic Plan. He encouraged the consortium to proceed with equipment purchase. The event included three consecutive sessions: the first session is "CPS in Academia" and it started with a talk given by Prof. Dr. Roman Obermaier about Dependable Embedded Real-Time Systems based on Time-Triggered Control. The second keynote speaker Prof. Raimund Kirner talked about Using SIL Arithmetic to Design Safe and Secure Cyber-physical Systems. The second session "CPS in Industry", started by Dr. Iyad AbuHadrour about turning an IoT idea into a proof of concept. Dr. Marwan Radi talked about the Industrial application of robotics and automation. In the last session, all consortium partners presented details

about the master's program at partner universities including a timeline of admission, admission criteria, features for study, teaching staff, study plan, and available scholarship and student support chances. During the event, the attendees raised a set of questions that were answered by the presenters.

NEWS



On the 9th of January 2020, the MS@CPS team at the university led by Prof. Faiez Gargouri presented the MS@CPS project master study plan and curriculum to the scientific council of the Higher Institute of Computer Science and Multimedia (ISIMS), University of Sfax. The study plan is now validated and approved which opens the door for next steps to get accreditation for program in Tunisia in-order to inaugurate the master program at the university of Sfax in the Fall of 2020 as planned.



On the 18th of January 2020, Prof. Faiez Gargouri the local coordinator of the MS@CPS project at the University of Sfax and the project's team member Dr. Nadia Bouassida participated in a live radio interview program at "radio Sfax" with Dr Hansen Trichili to present the MS@CPS project and the master

program in cyber physical systems at the university.



On the 16th of July 2020, the MS@CPS team at the higher Institute of Computer Science and Multimedia (ISIMS), University of Sfax held an information meeting targeting the teaching staff at the program. The team discussed teaching methods to be followed in the CPS master program which will be launched as planned in September.



The NEO Director, Dr. Nedal Jayousi opened the Info Day of CBHE EU Funded Project: International Master of Cyber Physical Systems. The Info Day was facilitated by Palestine Technical College - Deir El-Balah with the presence of International, Arab and Local partners and stakeholders. Dr. Jayousi participated in this event

among many activities of supporting and consolidating CBHE projects in Palestine. Dr. Jayousi encouraged the project stakeholders to sustain their work on the project during COVID-19 crisis, as well as to work on getting accreditation from Palestinian Accreditation and Quality Assurance Commission as this project ties with the priorities of the Palestinian Higher Education Strategic Plan.

PTC participates in Erasmus+ (info day)



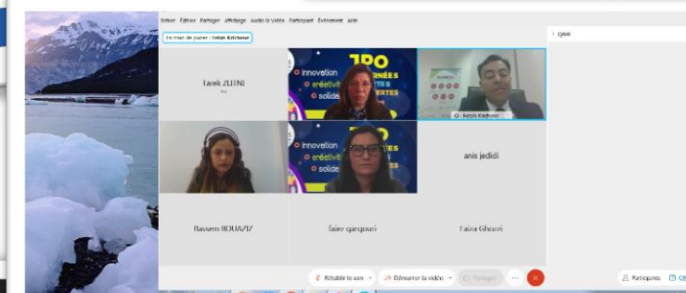
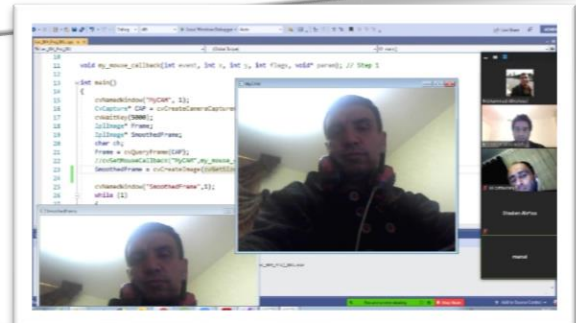
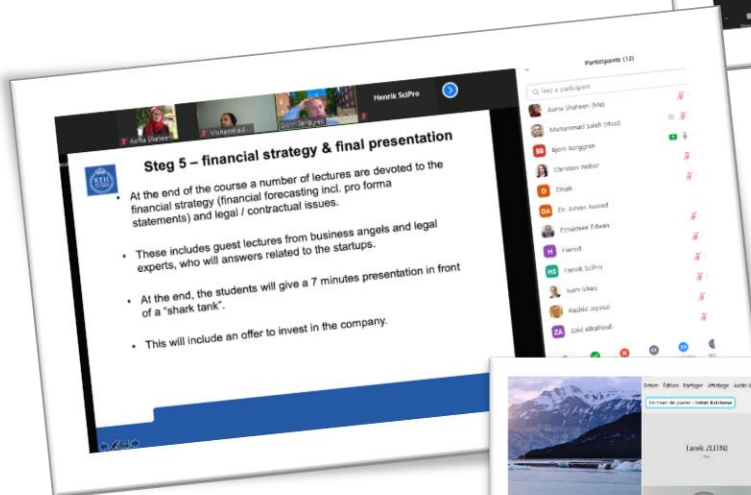
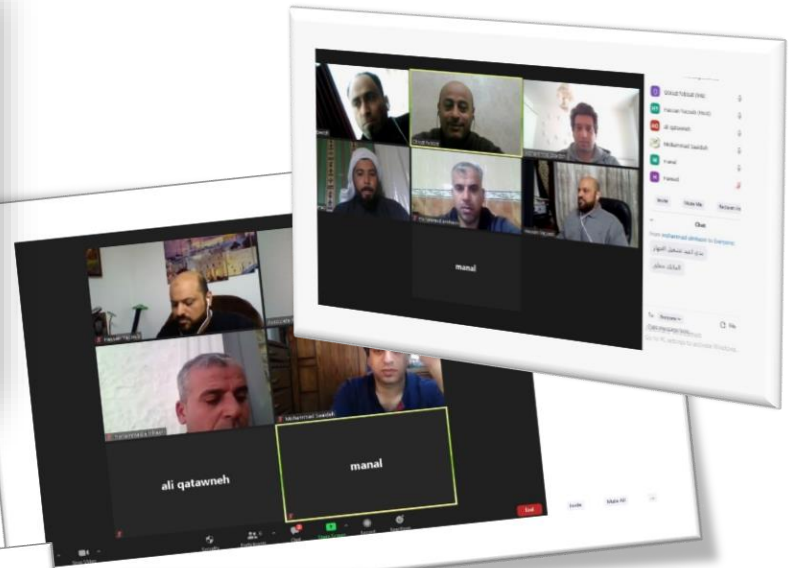
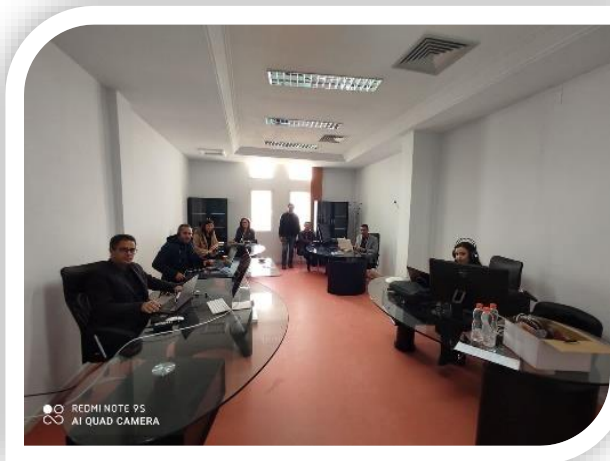
On Wednesday, November 25th, 2020, under the auspices of H.E the Minister of Higher Education and Scientific Research, Dr. Mamoud Abu Mouis, and with the occasional presence of the EU Representative in Jerusalem Mr. Sven Kuhn von Burgsdorff, and Dr. Nedal Jayousi the Representative of the Palestinian – European Cooperation Mission for Higher Education (Erasmus+), the Information Day in Palestine took place with more than 350 participants attending from both West Bank and Gaza Strip.

Dr. Ezzaldeen Edwan presented a short video about the impact of the MS@CPS project at Palestine Technical college - Deir El-Balah and at Palestinian society.

<https://www.youtube.com/watch?v=g1AYhRIZ0vE>



Gallery from online Teaching of MS@CPS



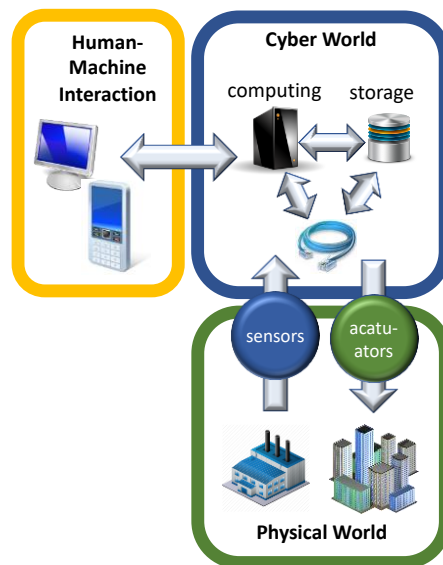
Scientific Article on CPS fields

Smooth Degradation of Cyber-Physical Systems in the Presence of Faults

Computers have become the most successful tool in the history of mankind.

The first transistor-based computers have only been built in the early 1950s, and within the next 70 years the advancement of computer technology has changed human societies tremendously. From interactive devices operated by humans, computers soon have morphed into so-called embedded systems, controlling mechanical and electrical devices, for example, the Apollo Guidance Computer in 1965. With the advancement in telecommunication technology and networking, computer systems have become increasingly interconnected, enabling large-scale distributed systems where embedded control is only a part of it. For this new paradigm of networked embedded systems, the name cyber-physical systems (CPS) has been coined [1]. With the emergence of CPS another technology has evolved, the so-called Internet-of-Things (IoT), which is about the deployment of smart objects or "things", interacting with other smart objects or systems [2]. Application domains of CPS have a tendency to continuously grow in scope with the advancement of technology. For example, the Global Positioning System (GPS) has started in 1973 as a satellite-based radionavigation system in 1973. From GPS numerous derived applications have emerged, with one of very high impact being satellite navigation, allowing the navigation with electronic maps. With the advent of artificial intelligence this evolved further into autonomous vehicles, having computers as drivers or pilots of vehicles. Even before the advent of autonomous vehicles, vehicles using satellite navigation have started to report back their traffic data, which creates a global view of real-time traffic, allowing to provide traffic control on a large-scale level. CPS applications tend to grow

continuously, with every advancement in the different technological areas. As a further example, the global connectivity with the internet allows CPS systems to operate beyond distance limitations. CPS have become the backbone for different areas of critical infrastructure, for example, the power grid. With CPS operating on such a global scale on critical infrastructure, it is also very important to build those systems with resilience against different causes of faults [3]. Failures of subsystems must not allow to bring down the whole system, as this could have catastrophic consequences in case of critical infrastructures.



At the University of Hertfordshire, we have developed an approach to provide smooth degradation for CPS in case of faults [4,5]. Subsystems of CPS typically provide services of different criticality. Providing resilience against faults is the goal. However, once so many resources have failed that not all services can be maintained at their full quality of service, a systematic approach to lower the

service quality provided by the system is needed. The basic assumption we have is that the tasks implementing a service can be deployed on different computing elements. And instead of just dropping services so long till the remaining computing capacity can deal with the remaining computing load, we use a more graceful way of system degradation. The very basic idea is that in order to have completely stiff timing requirements for a task, like real-time deadline and task period, we allow for a tolerance range for each task [4]. The tolerance range represents the magnitude of safety margins accompanied within a task during the system design phase; these margins correspond to a utility range that represents the value of the task to the overall system [4].

We use the relation between tolerance range and utility range to determine the run-time adaptation capability of a task in case of run-time failure [5]. This relation formulates a utility function that exploits the safety margins of each task according to its value using an Integer Linear Programming optimization technique to allow graceful degradation for the overall system utility by optimising the utility of individual tasks. The special feature of this approach is that it allows to degrade even higher critical tasks in order to keep some other lower criticality tasks still running. For the applicability of our approach in the industry, we integrate it to Safety Integrity Levels (SIL) defined in IEC 61508 using the Criticality Arithmetic concept [6]. Criticality arithmetic is the application of using multiple redundant independent implementations of lower integrity level components to obtain a higher integrity level component. The integration of this approach to safety standards in system development can provide benefits in terms of both reduced development time and reduced development cost without tampering with the required level of assurance for the functional safety of systems components. gradation of Cyber-Physical Systems in the Presence of Faults.

References

- [1] E. A. Lee and S. Seshia. Introduction to Embedded Systems - A Cyber-Physical Systems Approach. Lee and Seshia, 2nd edition, 2015.
- [2] H. Kopetz. Real-Time Systems - Design Principles for Distributed Embedded Applications. Springer, 2nd edition, 2011. ISBN: 978-1-4419-8236-0.
- [3] A. Avizienis, J.-C. Laprie, B. Randell, and C. Landwehr. Basic concepts and taxonomy of dependable and secure computing. IEEE Transactions on Dependable and Secure Computing, 1(1):11–33, Jan. - Mar. 2004.
- [4] R. Kirner. A uniform model for tolerance-based real-time computing. In Proc. 17th IEEE Int'l Symposium on Object/Component/Service-oriented Real-Time Distributed Computing, pages 9–16, Reno, Nevada, USA, June 2014.
- [5] S. Iacovelli, R. Kirner, and C. Menon. ATMP: An adaptive tolerance-based mixed-criticality protocol for multi-core systems. In Proc. 13th International Symposium on Industrial Embedded Systems (SIES'18), Graz, Austria, June 2018.
- [6] S. Fadlelseed, R. Kirner, C. Menon and S. Iacovelli. ATMP-CA: Optimising Mixed-Criticality Systems Considering Criticality Arithmetic. In Proc. 17th IEEE Int'l Symposium on Object/Component/Service-oriented Real-Time Distributed Computing, Daegu, South Korea, June 20

AUTHORS



Dr. Raimund Kirner,

Dr. Raimund Kirner holds a position as Reader of Cyber-physical Systems at the University of Hertfordshire. He is the Head of the Algorithms Research Group and Director of the Cyber Security Center at the University of Hertfordshire. He has received his PhD from the TU Vienna in 2003. Raimund Kirner has published numerous journal and conference papers and received two patents. His research is on cyber-physical systems and their security aspects. He has been principal investigator of numerous national and European research projects.



M.Sc. Sajid Fadlelseed

Sajid Fadlelseed: He received the MSc in Computer Science (specialisation in Advanced Computer Science) at the University of Hertfordshire (United Kingdom) in 2017. He is currently working towards his PhD in computer science at the University of Hertfordshire. His current work focuses on mixed-criticality scheduling and his main interests are real-time embedded systems, fault-tolerance, NoC architectures and mixed-criticality systems. Sajid is sponsored by National University, Sudan. Besides his Ph.D. studies, he is serving as a member of the Research and Development Program (RDP) at the University of Hertfordshire.

Project Leader

The consortium is led by the University of Siegen in Germany. The University of Siegen has a long running experience of combining embedded systems, as the overarching concept for CPS, knowledge management and intelligent systems, to continuously utilize the intersection for research and teaching throughout the master's degree domains of computer science and electrical engineering. In consideration of the implemented best practices at the University of Siegen, a jointly developed pedagogy is in focus of the MS@CPS master program.



Hamidreza Ahmadian
Chair for Embedded Systems
 Hölderlinstr. 3,
 Building E, Room 008
 57076 Siegen
 Germany
 Email: hamidreza.ahmadian@uni-siegen.de