

COSY Research Areas and Current Thesis/Praktikum-Topics

 **Topic Info Meeting**

If you plan on doing your Bachelor's or Master's thesis/P1/P2 with COSY, we invite you visit the current semester's COSY seminar ([u:find link](#)):

- Wed. 10 Apr 2024 15:00-18:15 SR8 (1st floor)
- Wed. 08 May 2024 15:00-18:15 PC5 (2nd floor)
- Wed. 12 Jun 2024 15:00-18:15 SR8 (1st floor)

For an actual agreement on supervision, please attend the topic discussion session for WiSe 2024/2025:

When: TBD (October 2024)
Where: TBD

Please prepare yourself for this session:

- Read the topic descriptions and pick at least 2 topics that spark your interest
- Write down your associations and assumptions about the topics (e.g. your interests, research questions and methods that come to mind). Ideally, take a first look at the available literature.

The better your preparation, the greater the likelihood that we can optimally supervise you 😊

1. COSY Research Areas

Human-Computer Interaction (HCI)	Computer Networks and Alternative Social Media
• Human Factors and Interaction Design of ICTs • Usability, Usable Security, User Research, (Participatory) ideation and iterative prototyping • Social Computing, Technology and the cultural domain - "Culture over IP" • Ubiquitous and mobile HCI • Computer Supported Cooperative World - Social Computing /Social Informatics, Cooperative Systems	• Computer Networks --- design, operation, and use • Internet of Things, Internet of People • Decentralization • <u>NEW: Federated Online Social Networks (Fediverse and Mastodon)</u>
If you are interested in "Praktika" or Bachelor/Master-Theses in the Area of Human-Computer Interaction (HCI), please contact: Oliver Hödl (oliver.hoedl@univie.ac.at) Florian Güldenpfennig (florian.gueldenpfennig@univie.ac.at)	If you are interested in "Praktika" or Bachelor/Master-Theses in the Area of Networks and Network Security, please contact: Albert Rafetseder (albert.rafetseder@univie.ac.at) or Paul Fuxjäger (paul.fuxjaeger@univie.ac.at).

2. Current COSY-Thesis/Praktikum-Topics

- a. Topics with an HCI-related focus
 - Smart Subtitles App: Opera.Guru - available
 - EDDIE - European Distributed Data Infrastructure for Energy - available
 - User Interface Design for EDDIE <https://eddie.energy/> - assigned
 - Designing Tangible Interfaces and Interactive Systems with Lego bricks - available
 - Neue digitale Musikinstrumente und musikalische Interaktionsformen - available
 - Design Cards To Go Web App - available
 - STEAM Learning - Using music instruments for new learning concepts in STEM education - available
 - Digitalisierung im Ballsaal - available
 - Data Visualization on Small Displays - assigned
- b. Topics with a Network-related Focus
 - Federated Online Social Network Monitoring - available
 - Markdown Spreadsheets - available
 - Markdown for Questionnaires - available
 - Pure Data Software Engineering Best Practices - available
 - An open-source GVRP/GARP dissector for Wireshark - available
 - iLO Hacking - available
 - A Configurable Études Generator - assigned
 - IP networks with dynamically changing uplinks - available
 - A Calls-for-Papers Metadata System - available
 - A universal Smart Home API - vergeben
 - Fake Data Generator (Test-data API) - assigned
- c. Further Topics
 - Reverse Engineering a Quantum Computing Educational Toolkit - available

a. Topics with an HCI-related focus

Smart Subtitles App: Opera.Guru - available

Opera.Guru is an application suite to provide subtitles for live opera performances. (see www.opera.guru for details) The existing application contains a web-based frontend and smartphone app (Android/iOS) and a web-based CMS. The task of this thesis is to add new functionality and improve existing ones. The goal of this extension is to use the Opera.Guru application suite for events other than opera and to access new user groups as well as new application scenarios. Basic programming skills and knowledge with mobile, web and server applications are recommended. The work for this thesis will include a user study to evaluate the web app.

See the [project's website](#) for further information and finished theses about opera.guru.

If you're interested, please contact Peter Reichl (peter.reichl@univie.ac.at) and Oliver Hödl (oliver.hoedl@univie.ac.at) and describe why you are interested in the project and your prior experience.

EDDIE - European Distributed Data Infrastructure for Energy - available

There is an increasing need for energy-related technological innovation. Concerning computer science, more and more energy data-based services emerge within and beyond the energy sector, enabled by technological advance as well as the continuous revision of European legislation. COSY will be involved in the design, development and evaluation of new energy-related software services, which are data-driven and human-centred to target and support customers in the best possible way. Possible research activities for the resulting prototypes (e.g., smartphone apps, smart IoT devices) range from soft- and hardware development to user research to support the social acceptance of new energy technologies and increase participation of consumers in energy-related services.

If you're interested in this topic for your master thesis, bachelor thesis or practicum (P1, P2), please contact Oliver Hödl (oliver.hoedl@univie.ac.at) or Florian Güldenpfennig (florian.gueldenpfennig@univie.ac.at) and describe why you are interested in the topic and your prior experience.

User Interface Design for EDDIE <https://eddie.energy/> - assigned

We are looking for a committed student with an affinity for design or web design who would like to accompany the EDDIE project described above as part of a bachelor's or master's thesis or practicum with a focus on user interface design. In the described project a number of user interfaces will be created, for example, a market place for offering a variety of digital services. In order to contribute to the sustainable success of the project, the student should contribute to the design, analysis and evaluation of these interfaces. Interested persons should work independently and enjoy design: e.g. wireframes, user interface design guidelines, visual design.

If you're interested in this topic for your master thesis, bachelor thesis or practicum (P1, P2), please contact Florian Güldenpfennig (florian.gueldenpfennig@univie.ac.at) and describe why you are interested in the topic and your prior experience.

Designing Tangible Interfaces and Interactive Systems with Lego bricks - available

Bricks, in particular Lego, are - apart from being a toy - diversly and beneficially used because of their tangible and modular nature that offers a haptic experience and wideranging applicability, e.g., for design, creative thinking or idea finding. However, there is also rich potential to develop interactive brick-built models or turn pure tangible models into interactive systems. One particular useful example is [The Playel](#), which is a Lego Grand Piano turned into a fully MIDI-compliant keyboard. Working on this topic does not require any musical background or special electronic skills, but certainly interest in (re-)building Lego brick models, tinkering and embedded systems (e.g., Arduino, RaspberryPi).

If you're interested in this topic for your master thesis, bachelor thesis or practicum (P1, P2), please contact Oliver Hödl (oliver.hoedl@univie.ac.at) and describe why you are interested in the topic and your prior experience.

Neue digitale Musikinstrumente und musikalische Interaktionsformen - available

Die Elektrifizierung der Gitarre und der Synthesizer haben vor hundert bzw. fünfzig Jahren die Musik drastisch verändert. Heute sind es digitale und mobile Technologien aller Art von Smartphones, über Mikrocomputer bis hin zur Sensortechnik und künstlicher Intelligenz, die Musik, das Musikmachen und den Musikkonsum verändern. Dazu gehören neue digitale Musikinstrumente und Klangwelten genauso wie neue Interaktionsformen in der Live-Musik, die das Publikum mit den Musikern "vernetzen". Aufbauend auf unsere Forschungsprojekte *Breaking The Wall* (<https://www.piglab.org/breakingthewall>) und *Sparkling Instruments* (<http://www.piglab.org/sparkling-instruments>) sowie *Music Participation* (<http://www.musicparticipation.com/>) bieten sich viele Möglichkeiten für Bachelor- und Masterarbeiten sowie Praktika (P1 und P2) für alle Musik- und Computer-Interessierten.

Wenn Sie sich für dieses Thema im Rahmen Ihrer Bachelor- oder Masterarbeit oder auch Praktika (P1, P2) interessieren, informieren Sie sich bitte über die beiden oben genannten Projekte auf den jeweiligen Seiten und kontaktieren Sie Oliver Hödl (oliver.hoedl@univie.ac.at). Ergänzen Sie bitte in Ihrer Anfrage warum Sie dieses Thema interessiert, welchen Bereich Sie konkret untersuchen möchten und welche fachlichen Kenntnisse Sie dabei mitbringen.

Design Cards To Go Web App - available

Design or method cards are an approach to find inspiration and promote innovation, to think about user needs, behaviour and interaction, to seek for sustainability and to enable gamification and playfulness. The Design Cards To Go Web App (<https://designcards.cosy.univie.ac.at/>) is a web-based application to provide card sets online. Currently, the app implements the TMAP Design Cards for the design of technology-mediated audience participation in live music. This topic can be done as Bachelor thesis or Praktika (P1, P2).

If you're interested, please contact Oliver Hödl (oliver.hoedl@univie.ac.at) and describe why you are interested in the project and your prior experience.

STEAM Learning - Using music instruments for new learning concepts in STEM education - available

STEAM is an acronym that combines STEM fields (Science, Technology, Engineering and Maths) with arts and humanities (the "A" in STEAM). The topics around STEAM learning can be hardware-focused such as in the research project *Sparkling Instruments* (<http://www.piglab.org/sparkling-instruments>) or software-based. In any way you are working on the development and evaluation of novel concepts for STEAM learning in the context of our research project in this area.

If you're interested, please contact Oliver Hödl (oliver.hoedl@univie.ac.at) and describe why you are interested in the project and your prior experience.

Digitalisierung im Ballsaal - available

Die Wiener Ballsaison ist nicht nur einzigartig und ein besonderes Erlebnis für alle Besucher, sondern auch ein wichtiger Faktor für den Tourismus, die Wirtschaft und das Image der Stadt Wien. Egal ob auf großen oder kleinen Bällen, im Vordergrund stehen Musik, Tanz und Unterhaltung in eleganter Atmosphäre. Doch auch in den Ballsaal hat auch nach über hundert Jahren die digitale Technik Einzug gehalten. Seien es die Smartphones der Besucher, große Bildschirme auf den Gängen, komplexe Lichtshows oder Barcode-Scanner am Eingang statt der herkömmlichen Eintrittskarte. Die Ballbesucher tanzen und unterhalten sich nicht mehr ausschließlich, sondern posten die schönsten Eindrücke online in diversen sozialen Medien. Am Charakter eines Balles selbst hat sich nun nicht viel geändert. Aber die Möglichkeiten zur Kommunikation, Interaktion und letztendlich Unterhaltung in diesem Rahmen sind mehr geworden. Das wirft unmittelbar Fragen auf: Wie können digitale Systeme im Rahmen eines Balles genutzt oder weiterentwickelt werden und welchen Bedarf gibt es? Die konkreten Fragestellungen für eine Abschlussarbeit in diesem Themenkomplex sind vielseitig und können sowohl technischer als auch gestalterischer Natur sein.

Wenn Sie sich für dieses Thema im Rahmen Ihrer Bachelor- oder Masterarbeit oder auch Praktika interessieren, kontaktieren Sie bitte Oliver Hödl (oliver.hoedl@univie.ac.at) und ergänzen Sie warum Sie dieses Thema interessiert, welchen Bereich Sie konkret untersuchen möchten und welche fachlichen Kenntnisse Sie dabei mitbringen.

Data Visualization on Small Displays - assigned

The objective of this Praktikum or Bachelor's Thesis is to explore how sensor readings, such as energy data, can be displayed on small devices (e.g., 240 x 240 pixels) to offer users interesting information on small gadgets in their daily lives.

The topic may also be expanded into a master's thesis if applicable.

Programming microcontrollers using the Arduino IDE and relevant display libraries will be essential for this project.

If you are interested in this topic, please contact florian.gueldenpfennig@univie.ac.at

b. Topics with a Network-related Focus

Federated Online Social Network Monitoring - available

The Mastodon network - currently around 1.5 million monthly active accounts on +10000 servers - is regarded as **the most successful alternative online social network** yet:

<https://joinmastodon.org>

Unlike Twitter, Facebook, Instagram, TikTok - this service is NOT based on manipulative strategies like targeted advertising and algorithmic outrage maximisation - which are posing imminent threats to democracies worldwide - and for this reason, the network keeps evolving rapidly.

However, its decentralized nature creates exciting challenges for monitoring "network health".

Your task is to:

1. Conduct research on the current state-of-the-art in monitoring of federated network statistics (e.g. nr. of posts per instance over time, blocking events, outages...)
2. Apply *your insights and ingenuity* to help improving the situation, e.g.
 - a. Aggregation of publicly available statistical data (via mastodon server APIs)
 - b. Setup a public monitoring service directory, similar to these:
 - i. <https://instances.social/list/advanced#lang=&allowed=&prohibited=&min-users=&max-users=>
 - ii. <https://fedidb.org>
 - c. Propose new ideas on "how to measure network health" of a federated online social network

Further reading: <https://fediverse.party/en/mastodon>

Further watching: "The State of the Federation, with Mastodon's Eugen Rochko" <https://flipboard.video/w/CTBu4HusskGTuPBahqm6WY>

Further watching: "Die rosarote Brille des Fediverse" https://media.ccc.de/v/rc3-857362-die_rosarote_brille_des_fediverse

If you are interested in the future of online social networking systems (democratically legitimised moderation and algorithms + resistance against spam, censorship, denial-of-service...) then this topic may be something for you 😊

If you're interested, please contact Paul Fuxjäger (paul.fuxjaeger@univie.ac.at).

Markdown Spreadsheets - available

Markdown is a simple text formatting method that translates to HTML and other formats easily. Extensions exist to add table formatting to Markdown as well. In this project, you devise a method to augment Markdown with spreadsheet functionality. That is, your Markdown version should understand simple formulas, cell references etc., much like LibreOffice Calc, Gnumeric, or Excel do, and be able to calculate formula values.

Outcomes of this project may include:

- A syntax definition for Markdown Spreadsheets, both for formulas and formatting, and a simple, user-friendly serialization format which might include a preview of pre-computed values
- A command-line program that takes a Markdown Spreadsheet, calculates all cell values, and outputs the result in a configurable format (e.g. as a Markdown Table)
- An interactive, perhaps web-based editor with live updates

If you're interested, please contact Albert Rafetseder (albert.rafetseder@univie.ac.at)

Markdown for Questionnaires - available

(For some context of Markdown, see above :-)

The plan for this topic is:

1. Develop a syntax that extends Markdown to allow for a simple, text-based description of questionnaire elements such as checkboxes, lists to choose from, percentage sliders, and free-text fields.
2. Devise a way to render such source files to HTML forms, potentially implemented as a web-based editor with live preview, and
3. Connect them with existing Web survey software such as LimeSurvey.

The topic includes a survey and comparison of existing tools and literature on (online) surveying, a usable implementation, and a qualitative evaluation with prospective users of the technology.

If you're interested, please contact Albert Rafetseder (albert.rafetseder@univie.ac.at)

Pure Data Software Engineering Best Practices - available

Pure Data is a visual language for multimedia computing. Pure Data programs, usually called "patches", may use various software engineering techniques such as modularization to achieve better readability, reusability, and maintainability. There exist some established patterns. Yet, there is little introductory literature on them. In this project, you research the existing material such as public patches and libraries, Pure Data's own documentation system and included examples, and your own experience creating programs in this (and other) programming language(s). The outcome of the project is a set of well-documented worked examples of good software engineering practices in Pure Data.

Participation and research intervention in our current course [Network-based Communication Ecosystems](#) is possible – you are invited to **include our students in your research**. We can also connect you with the **international community** of Pure Data users and developers for further investigation.

If you're interested, please contact Albert Rafetseder (albert.rafetseder@univie.ac.at)

An open-source GVRP/GARP dissector for Wireshark - available

Wireshark is a renowned measurement and analysis software for computer networks. Its dissector library is large, yet lower-layer protocols such as GARP and GVRP (protocols for configuration management between switches in LANs) are only partially implemented, do not appear to be tested, lack documentation, etc. Your task in this project is to assess the state of GARP / GVRP / GMRP protocol support in Wireshark through experiments, and extend the implementation and documentation to support the use cases that you identify as most relevant.

For this project, you will **work with practical network equipment** such as switches and wiretaps, as well as **write software in C**, and glue code in other languages.

If you're interested, please contact Albert Rafetseder (albert.rafetseder@univie.ac.at)

iLO Hacking - available

Server hardware includes management interfaces to remote-control the hardware and BIOS of a server even if the main operating system or hypervisor becomes inaccessible through usual means such as ssh. For this, a fully separate embedded system is built into the server. It provides its own firmware and operating system, RAM, storage, a separate physical Ethernet port, and low-level access to the running server hardware (e.g. fan and power supply status) and software (e.g. main memory of the server).

Little is known about the actual software comprising these management interfaces, although (mostly-informal) investigations have been conducted, e.g. [1](#), [2](#), [3](#), [4](#), [5](#), [6](#), [7](#), [8](#), [9](#), [10](#), [11](#). Feel free to research other projects, useful search terms include iLO, IPMI, iDRAC, LOM, OOB, BMC...

In this project, you aim to expand and formalize this knowledge by trying out existing and developing new methods of analyzing and modifying firmware of management interfaces. A distant goal could be a fully free and open-source operating system, e.g. based on OpenWrt, for a management controller. **We have multiple HP servers from different generations at our disposal** for hardware analysis and hacking.

If you're interested, please contact Albert Rafetseder (albert.rafetseder@univie.ac.at)

A Configurable Études Generator - assigned

Études are musical pieces designed as practice materials for perfecting particular musical skills (Wikipedia). The skills to be perfected can differ (in difficulty and category) from étude to étude, and are different between instruments, players, and also dimensions of musical content (melody, harmony, rhythm). Develop a sufficiently generic, configurable generator for études that outputs études of choosable difficulty. For this, define a system that encodes the difficulty of a task to be studied, and transformations that assess the difficulty of combinations of study tasks appropriately.

If you're interested, please contact Albert Rafetseder (albert.rafetseder@univie.ac.at)

IP networks with dynamically changing uplinks - available

Routing and upstream/downstream traffic flows in IP networks have certain protocol and time constraints for working correctly. This project investigates challenges and opportunities opened up by making the network's uplink change dynamically, e.g. attach to a different address block while traffic flows are still active. What happens to current-day applications in situations like these? What protocol adaptations are required to lessen the impact of uplink dynamics? What timescales are reasonable for reconvergence? (Etc.)

If you're interested, please contact Albert Rafetseder (albert.rafetseder@univie.ac.at)

A Calls-for-Papers Metadata System - available

Academic work includes presenting one's research results to the community at conferences and in printed publications. Unfortunately, the dissemination of conference dates, times, places etc. through calls-for-papers happens in an ad-hoc manner, e.g. by e-mail or on websites.

Your task is to design a metadata system for conference organizers that encodes deadlines, keywords, tracks, formats, roles and so on in a structured, machine- and human-readable form and includes interfaces for both professional conference management systems and end-user calendar software. You design both the format for data exchange, and the distributed, federated system architecture that provides a simple implementation path for interested parties (servers and clients).

Further reading: <https://github.com/rtholmes/conf-data> (a system to encode data for use during conferences), <http://www.rssboard.org/rss-specification>, <https://tools.ietf.org/html/rfc5545> (iCal)

If you're interested, please contact Albert Rafetseder (albert.rafetseder@univie.ac.at)

A universal Smart Home API - vergeben

The Smart Home communication protocol environment is heavily fragmented and many standards compete for integration. Thus, interoperability and unified control are not possible in most cases.

Your task is to:

1. Research the most widely used Smart Home communication standards and the corresponding APIs
2. Design and Develop an API to cover all identified use cases/API calls from all of the aforementioned standard

Your Project should be implemented in a lightweight language such as MicroPython. Experience programming for microcontrollers (Arduino, ESP, NodeMCU) would be a plus.

Fake Data Generator (Test-data API) - assigned

Design brief in short: **Write a RESTful API that outputs data previously stored in a CSV file!**

Data is recognized as an essential 'raw material' of the future, and it's no secret that many modern applications are extremely data-intensive. For development purposes and user studies, having access to synthetic data of any kind can be quite beneficial.

The task for the Praktikum, Bachelor's, or Master's Thesis is to develop a web application that primarily fulfills the following requirements:

- The user uploads a CSV file (or a JSON file, XML, etc.) with prepared data into the application. This could include, for example, recordings of stock market data and time-stamps. However, it could be anything like energy consumption, energy costs, or whatever is relevant.
- Through an API, the user should then be able to access and download this data.
- Only data that pertains to the past should be provided. That is, if the CSV file contains stock prices from 2022 to 2025, the API should deliver only those values that correspond to past dates, up to and including the current moment.
- If the topic is treated within the scope of a Master's Thesis, we must conceive of even more meaningful tasks, such as an integrated random data generator.

Motivation: If one wanted to develop another application (not part of the Praktikum/Bachelor's/Master's Thesis) that, for example, deals with stock prices, then the API of the Fake Data Generator should provide the data for this app, thereby enabling tests to determine how well the app functions, etc.

Technology: We prefer Django, but we are flexible.

If you're interested, please contact Florian Güldenpfennig (florian.gueldenpfennig@univie.ac.at)

c. Further Topics

Reverse Engineering a Quantum Computing Educational Toolkit - available

In unserer Forschungsgruppe entsteht derzeit ein neues Teaching Lab zum Thema "Quantum Computing", das in einem ersten Schritt mit Equipment des Startups <https://phasespacecomputing.com/> betrieben wird. In dieser Arbeit soll untersucht werden, inwieweit der dort gewählte Ansatz, Quantengatter mit Hilfe klassischer Schaltungen zu emulieren, im Sinne eines "Reverse Engineering" reproduziert und ausgebaut werden kann. Hierzu benötigen Sie ein grundsätzliches Verständnis der Eigenschaften von Quantenschaltungen sowie ausgeprägte praktische Fähigkeiten und Geschick im Bereich Hardwarebau, ausserdem viel Selbständigkeit und Fantasie.

If you're interested, please contact Peter Reichl (peter.reichl@univie.ac.at)