europass

Andrea Helga Bernardi

Home : Via Andrea Cesalpino 35, 52100, Arezzo, Italy

Domicile : Via Andrea Costa 4/2, 40134, Bologna, Italy

Email: andreahelga.bernardi@unibo.it **Email:** ahcaterina@gmail.com

Phone: (+39) 3388539565

Website: https://www.unibo.it/sitoweb/andreahelga.bernardi

Date of birth: 16/06/1999 **Nationality:** Italian

WORK EXPERIENCE

[01/11/2024 – Current]

PhD in Automotive Engineering for Intelligent Mobility

Alma Mater Studiorum - Università di Bologna

City: Bologna | **Country:** Italy

Research Topic: Open-source technologies for AI-based HMIs in automotive applications

[01/06/2024 – 31/10/2024]

Research Fellow

Alma Mater Studiorum - Università di Bologna

City: Bologna | **Country:** Italy

Leveraging RISC-V for AI-based Enhanced Driver Security in ADAS Systems

[30/04/2023 – 01/06/2024]

Steward

Vivaevents

City: Bologna | **Country:** Italy

Typical tasks performed by stewards at the stadium and other events (exhibitions and concerts):

- Tickets and ID check;
- Pat-down;
- Security and maintaining order.

[03/2022 – 05/2022]

In-class technical support assistant and person in charge for an Italian course

Alma Mater Studiorum Università di Bologna

Address: Viale del Risorgimento 2, Bologna, Italy

Work performed as a student-collaboration activity (150 hours) at Unibo.

Technical support (audio and video) in classrooms for hybrid mode lessons (online&in-person).

Organization of Italian language lessons (basic level) in the afternoon for foreign students from the Faculty of Engineering and Architecture.

[07/2017 – 09/2017]

Electronic Technical Assistant

Bètica de Electronica

Address: Via Alberto Durero, Siviglia, Spain | **Business or sector:** Professional, scientific and technical activities

Work carried out as an ERASMUS project.

Installation of satellite dishes, antennas and decoders for MOVISTAR company, replacement of damaged components and orientation of satellite dishes at customers' homes.

EDUCATION AND TRAINING

[01/10/2024 – Current]

PhD in Automotive Engineering for Intelligent Mobility

Alma Mater Studiorum - Università di Bologna https://phd.unibo.it/ami/en

City: Bologna | | **Level in EQF:** EQF level 8

Open-source technologies for AI-based HMIs in automotive applications

[09/2021 – 03/2024]

Master in Electronic Engineering Cum Laude

Alma Mater Studiorum - University of Bologna https://corsi.unibo.it/2cycle/ElectronicEngineering

Address: Viale del Risorgimento, 2, 40136, Bologna, Italy | **Field(s) of study:** Information and Communication Technologies | **Final grade:** 110 Cum Laude | **Level in EQF:** EQF level 7 | **Thesis:** Smart Glasses as a Sensor Fusion Platform for Acquisition and Processing of ExG and Image Data

Specialized courses completed at the first year of Master's Degree:

- Biomedical Data and Signal Processing (Italian)

- Rehabilitation Bioengineering (Italian)

Specialized courses completed at the second year of Master's Degree:

- Cyber-Physical Systems Programming (English)

- Digital Architectures for Signal Processing (English)

- High Frequency Electronic Circuits (English)

- Biomedical Instrumentation (Italian)

The following projects have been developed:

- Activity Monitoring via IMU.

[Course: Rehabilitation Bioengineering - Italian]

Abstract: A semi-automatic system has been developed in MATLAB for the classification of various motor tasks. The project includes several stages: signal pre-processing (filtering), semi-automatic identification of instances, feature extraction and selection, classification.

- A safe communication system using OpenTitan: UART, ISR, AES .

[Course: Cyber Physical System Programming - English]

Establishing secure communication systems in terms of both hardware and software is a significant development within the OpenTitan Project realised by Google. In the context of this study, a secure communication system has been designed, using the AES cryptographic accelerator, UART communication protocol, and an Interrupt Service Routine (ISR) provided by the OpenTitan Chip to ensure secure data transmission between two entities.

The Master Thesis has been partially (3 months) conducted at the Integrated System Laboratory (IIS) ETH Zürich.

[09/2018 – 12/2021] **Bachelor in Electronic and Telecommunications Engineering**

Alma Mater Studiorum - University of Bologna https://corsi.unibo.it/1cycle/ElectronicsTelecommunications

Address: Viale del Risorgimento, 2, 40136, Bologna, Italy | | **Final grade:** 101 | **Level in EQF:** EQF level 6 | **Thesis:** Development of a microcontroller-wearable system based on MicroPython for the collection of images and EMG data in Hand Gesture Recognition (HGR).

Specialized courses completed at the third year of the Bachelor's Degree:

- Architectures and Programming of Electronic Systems (Italian)
- Bioengineering (Italian)
- Industrial Electronics (Italian)
- Electronic Measurements and Laborator (Italian)
- Internet of Things (IoT) (English)

[09/2013 – 07/2018] **Electrotechnical Technician**

State Industrial Technical Institute (ITIS) Galileo Galilei www.itis.arezzo.it

Address: Via Dino Menci,1 , 52100, Arezzo, Italy | **Field(s) of study:** Electronis and Electrotechnics | **Final grade:** 86 | **Level in EQF:** EQF level 4

LANGUAGE SKILLS

Mother tongue(s): Italian

Other language(s):

English

LISTENING B2 **READING** B2 **WRITING** B2

SPOKEN PRODUCTION B2 **SPOKEN INTERACTION** B2

Spanish

LISTENING A2 **READING** A2 **WRITING** A1

SPOKEN PRODUCTION A2 **SPOKEN INTERACTION** A2

Levels: A1 and A2: Basic user; B1 and B2: Independent user; C1 and C2: Proficient user

DIGITAL SKILLS

My Digital Skills

Microsoft Office

Word, Excel, PowerPoint, etc

Programming Language

C | MATLAB | Python | MicroPython | Linux (base) | System Verilog (base)

Application Software

ambiente MATLAB | Macchine Virtuali | LTspice (base) | AutoCAD (base)

DRIVING LICENCE

Motorbikes:	AM	03/2014 – 06/2028
Cars:	B	06/2018 – 06/2028

PUBLICATIONS

[2024] **GAPses: Versatile smart glasses for comfortable and fully-dry acquisition and parallel ultra-low-power processing of EEG and EOG**

Reference: Frey, S., Lucchini, M.A., Kartsch, V., Ingolfsson, T.M., Bernardi, A.H., Segessenmann, M., et al. (2024). GAPses. IEEE TRANSACTIONS ON BIOMEDICAL CIRCUITS AND SYSTEMS, PP, 1-11

Abstract:

Recent advancements in head-mounted wearable technology are revolutionizing the field of biopotential measurement, but the integration of these technologies into practical, user-friendly devices remains challenging due to issues with design intrusiveness, comfort, reliability, and data privacy. To address these challenges, this paper presents GAPSES, a novel smart glasses platform designed for unobtrusive, comfortable, and secure acquisition and processing of electroencephalography (EEG) and electrooculography (EOG) signals.We introduce a direct electrode-electronics interface within a sleek frame design, with custom fully dry soft electrodes to enhance comfort for long wear. The fully assembled glasses, including electronics, weigh 40 g and have a compact size of 160 mm × 145 mm. An integrated parallel ultra-low-power RISC-V processor (GAP9, Greenwaves Technologies) processes data at the edge, thereby eliminating the need for continuous data streaming through a wireless link, enhancing privacy, and increasing system reliability in adverse channel conditions. We demonstrate the broad applicability of the designed prototype through validation in a number of EEG-based interaction tasks, including alpha waves, steady-state visual evoked potential analysis, and motor movement classification. Furthermore, we demonstrate an EEG-based biometric subject recognition task, where we reach a sensitivity and specificity of 98.87% and 99.86% respectively, with only 8 EEG channels and an energy consumption per inference on the edge as low as 121 µJ. Moreover, in an EOG-based eye movement classification task, we reach an accuracy of 96.68% on 11 classes, resulting in an information transfer rate of 94.78 bit/min, which can be further increased to 161.43 bit/min by reducing the accuracy to 81.43%. The deployed implementation has an energy consumption of 40 µJ per inference and a total system power of only 12.4 mW, of which only 1.61% is used for classification, allowing for continuous operation of more than 22 h with a small 75 mAh battery.

Link: https://ieeexplore.ieee.org/document/10713890

[2024] **Master's Thesis: Smart Glasses as a Sensor Fusion Platform for Acquisition and Processing of ExG and Image Data**

Supervisor: Prof. Davide Rossi

Co-supervisors: Prof. Simone Benatti, Pierangelo Maria Rapa, Sebastian Frey

Abstract:

The field of hand movements and grasp control has long faced challenges in replicating the natural movements of the human hand. A deeper understanding of such mechanisms is essential to enhance the functionality of wearable devices that can be used in multiple Human Machine Interface (HMI) applications. This necessitates an innovative approach beyond traditional methods that can mimic the complex interplay in hand movements. Although electrical muscle activity is commonly used in this field, images and eye movements provide important cues about a person's intention during hand gestures by offering visual context.

Smart glasses offer a promising platform for capturing electrooculograms (EOG) and images. They can also serve as an integration gateway for a Body Area Network, connecting with other biosensor nodes such as an electromyogram (EMG) device.

This thesis aims to develop a system consisting of a prototype for smart glasses with EOG sensors, an image acquisition board, and an EMG acquisition device. These data are wirelessly transmitted to a computer, which allows synchronization and processing.

The first part of the thesis consists of determining the optimal placement of EOG sensors on the glasses to balance accuracy and ensure robust signal acquisition with respect to traditional gelbased

methods. To achieve this, a glasses prototype integrating dry electrodes from Dätwyler, interfaced with the BioGAP platform, was developed and evaluated. An exploratory study involving 9-task eye movement classification, comparing this prototype with a conventional EOG setup, showed a promising 95% accuracy for the glasses prototype, close to the traditional setup's 96%.

The second part of the thesis involves utilizing the GAP9 Shield, a platform with a small camera and aWi-Fi shield for image transmission, and establishing a connection with BioGAP, guaranteeing synchronized communication with an average delay of 120 ms, comparable to the frame period of 166 ms.

Finally, a MobileNet V2 CNN model was adapted for binary image classification of open and closed hands, achieving an accuracy of 97%.

This master's thesis has been partially conducted at ETH Zürich.

[2021] **Bachelor's Thesis: Development of a microcontroller-wearable system based on MicroPython for the collection of images and EMG data in Hand Gesture Recognition.**

Supervisor: Prof. Davide Rossi

Co-supervisors: Dott. Manuele Rusci, Prof. Simone Benatti

Abstract:

Most recent wearable systems for gesture recognition use algorithms for analyzing biological data deriving from muscle activity. Concurrently, Computer Vision is increasingly active in this field, developing methods based on the collection and analysis of video and image of gestures. This

represents an additional source of information not only about the gesture itself but also about the surrounding environment, such as in the case of grasping objects.

This thesis aims to develop a low-power microcontroller-based wearable system for such applications. The microcontroller is integrated with a camera and electromyographic (EMG) sensors and it is programmed to acquire images and EMGs signals synchronously and continuously. The programming code is written in MicroPython, and after designing the system's software, its features and limitations were studied through tests with test-signals and single-EMGs signals. Hence, the correct reconstruction of the signal was verified starting from the acquisition of samples every millisecond followed by the integration with images. The resulting amount of available memory for data and image storage, as well as the associated timing for acquisition and saving, were evaluated. Good results were achieved with a total of one hundred images and a duration of the acquisition-phase of seven and a half seconds. Therefore, the study concluded with the collection of one hundred images and four different EMG signals during the execution of gestures and grasping objects with the hand.

PROJECTS

[03/06/2024 – 07/06/2024] **EFCL Summer School (Zürich)**

Participation in the EFCL Summer School in Zürich and completion of the course "Embedded AI for Biosignal Processing".

Lectures about: DNN and generic optimization concepts, NAS, Pruning and Quantization.

Hands-on sessions about Hand Gesture Recognition through EMG, which include:

- DNN creation and optimization (NAS, Pruning) on pre-collected dataset
- Personalized Dataset Acquisition
- Finetuning of the optimized DNNs on personalized data and Quantization
- Compilation and test of DNN models
- Real-time visualization of predicted gestures

[07/2017 – 09/2017] **Power Generation Project**

European internship program (ERASMUS) in Sevilla (Spain), including a Spanish course.

See the work experience section.

[04/2017 – 04/2017] **Energy Efficiency at Schneider Electric**

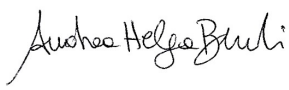
Project organized by Schneider Electric for technical high schools.

A 32-hour introductory course on energy efficiency occured in the branch of Stezzano (BG)

VOLUNTEERING

[10/10/2022 – 13/10/2022] **IEEE International Ultrasonics Symposium** Venezia (Centro Convegni)

Technical support at an IEEE conference.



30/01/2025

Andrea Helga Bernardi