

PART I: FACULTY SABBATICAL LEAVE COVER PAGE

Type of Award: Faculty Sabbatical Leave

Applicant Information:

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Date of initial appointment to full-time tenure-track faculty status: Fall 2019

Date(s) of previous sabbatical leave(s): N/A

Type(s) of previous sabbatical leave(s) (FDA or re-entry): N/A

Requested Leave Period: Fall 2025 OR Spring 2026 (1 semester)

Other Current FDA Award Applications: N/A

Title of Project: Research and Commercialization for Three Projects in Human-Computer Interaction (Eye tracking, Conversational agents, and Auction behavior)

Short Project Description (200 word max): This sabbatical proposal aims to enable the applicant to commit full-time to and advance the research, development, and commercialization of three ongoing, high-impact projects at the intersection of human behavior, machine intelligence, and data science: (1) eye-tracking technology for brain-vision coordination diagnosis and treatment, (2) conversational AI for mental health support, and (3) analysis of online auction behavior. As a result of the sabbatical, which will provide the opportunity to devote one entire semester to projects' tasks that require full-time commitment, the eye-tracking project will yield a deployable screening tool for remote neurological assessment, with potential to transform concussion management in sports, occupational health, and clinical care. The mental health project will produce clinically-validated chatbots that provide accessible, scalable support and assist provider decision-making, helping to address the global crisis in mental healthcare access. The auction analysis will generate novel insights into human economic behavior and inform the design of allocation mechanisms in domains from e-commerce to spectrum policy. Leveraging already-secured grants from the NSF and NIH, current proofs-of-concepts, and existing collaborations with organizations in the US and overseas, the sabbatical will enable major technical milestones, research outputs, and translational advances (e.g., partnerships, IP, applications).

Nicholas Caporusso

signature*

10/01/2024

date

* By typing your name or pasting your signature in the space provided you are allowing this application to be reviewed by the Faculty Benefits Committee for a possible award. The applicant is also aware that failure to comply with the instructions may result in this proposal not being reviewed.

PART II: PROPOSAL BODY

As a Tenure-Track Professor of Computer Science at Northern Kentucky University, the applicant's research has been focusing on the intersection of Human-Computer Interaction (HCI), machine learning, and behavioral analysis. Over the past years, the applicant created the HCILab (www.cprnhl.com/hcilab) and has been working alongside with students to develop three innovative projects with the potential for significant societal impact:

1. Eye tracking technology for assessing brain-vision coordination in potential concussion diagnosis

Eye tracking for concussion diagnosis has the potential to provide an objective, quantitative assessment tool for a prevalent health issue, especially in sports. Existing diagnosis methods are often subjective and require in-person evaluation by specialists. By enabling remote diagnosis using standard webcams, this technology could allow faster, more accessible screening. Initial prototypes have shown promise and the project has received grants from NKU, the NSF I-Corps program, a Kentucky Commercialization Ventures (KCV) IMPACT award, and the NIH through the KYNETIC program.

2. Conversational AI agents leveraging large language models (LLMs) to provide mental health support

Mental health is a growing global concern, with the COVID-19 pandemic further exacerbating the need for accessible support. Conversational AI chatbots powered by LLMs offer a scalable, low-cost complement to traditional therapy. They can provide 24/7 support, reduce stigma, and assist underserved populations. Partnerships with mental health organizations have been established to develop chatbots for specific needs like couples therapy, eldercare, and disability support. Further research is needed on ethical constraints, effectiveness validation, and integration with professional care. The project has secured funding from KCV, the NSF, and the NIH through the Mid-South Reach program.

3. Analysis of online auction data to understand human decision-making and economic behavior

Understanding human behavior in auctions provides insights applicable to fields like economics, psychology, and market design. The increasing prevalence of online auctions generates vast datasets that, combined with machine learning techniques, enable studying decision-making at an unprecedented scale. Access to data from a major platform with over 300,000 auctions and 1 billion interactions from 2018-2023 provides a unique opportunity for groundbreaking research. Initial analysis has been conducted but extensive work remains to fully leverage this data.

Each of these projects addresses a critical need and stands to generate important research outputs, practical solutions, and external funding opportunities. However, the applicant has reached a stage where focused effort through a sabbatical leave would enable major advancement and open new research opportunities and pursue commercialization of some of the outputs, per the ongoing collaboration with KCV.

IMPORTANCE

The proposed sabbatical projects address pressing issues with substantial potential for broad impact:

- Concussions are a major public health concern, with an estimated 1.6 to 3.8 million sports-related concussions annually in the U.S. alone. Misdiagnosis can have severe consequences, from impaired academic/work performance to increased risk of neurodegenerative disease. However, current diagnosis relies heavily on subjective symptom reports and brief in-person screenings that may miss subtle impairment. An objective, remotely accessible assessment tool using eye tracking could dramatically improve detection and monitoring, reducing the incidence and impact of undiagnosed concussions. Successful development would have applications in sports medicine, occupational health, and neurological care. By preventing undiagnosed concussions, the tool could save an estimated \$1 billion annually in healthcare costs.
- Mental health disorders affect over 20% of U.S. adults annually, with global cases rising during the pandemic. Treatment access is limited by provider shortages, cost, stigma and other barriers that disproportionately impact underserved groups. AI chatbots offer a promising complement to extend access and provide continuous support but require careful development to ensure safety and effectiveness. Thoughtful design in collaboration with mental health experts could create a powerful tool to fill gaps in care, provide low-barrier entry to support, assist provider-facing tasks, and reduce crisis escalation. Broad potential exists to ease the strain on mental health systems and improve well-being for millions. Also, this tool can bridge the mental health care gap in rural areas where providers are scarce.
- Understanding human behavior is foundational to fields from economics to public policy. Auction theory in particular has been influential, with impact on practices from strategic sourcing to radio spectrum allocation. The explosion of e-commerce and online auctions creates unprecedented opportunities to study decision-making and market dynamics at a massive scale through the lens of bid data. Access to a unique large-scale dataset enables exploration of behavioral phenomena like timing strategies, bidder collusion, and algorithmic bidding. Insights generated can inform the design of auction markets and allocation mechanisms in domains far beyond e-commerce. Advancing tools for analyzing auction data can also yield broader methodological applications.

The sabbatical would provide the applicant with opportunity to drive forward projects that, while already showing promise, require intensive work to refine, validate and scale up to their full potential for impact. The resulting progress in turn enables pursuing expanded funding and partnerships to magnify and sustain the ultimate scholarly and societal benefit. Furthermore, the sabbatical will enable two of the projects to secure technology transfer grants such as SBIR/STTR, which the applicant will pursue together with KCV and LaunchBlue.

GOALS

The overarching goal of the proposed sabbatical projects is to substantially advance the three lines of research. Specific goals for the projects are discussed below. The applicant and his teams at the HCIIlab have already made significant advancements in each of the three projects, establishing a strong foundation for further development. Through previous efforts, they have secured proof-of-concept prototypes, conducted initial data analyses, and established key collaborations with both academic and industry partners.

Eye Tracking for brain-vision coordination assessment and treatment

The primary goal of the sabbatical is to advance the research and development of a commercially viable tool for brain-vision coordination diagnosis. This project aims to refine algorithms, validate the diagnostic protocols, and develop a deployable screening tool. The ultimate objective is to create a widely accessible, scalable, and reliable product that can be used in diverse clinical and non-clinical settings. By leveraging the technology transfer process, the goal is to move from a research prototype to a market-ready product that can improve how concussions are diagnosed and managed. Technology transfer will play a crucial role in the commercialization phase of this project. The eye-tracking technology will undergo customer discovery, IP protection, and regulatory approval processes, positioning it for widespread use in sports, healthcare, and other fields requiring brain-vision assessments. Through collaboration with commercialization partners, including KCV and LaunchBlue, the project aims to secure additional funding and partnerships to bring the product to market. To this end, during the sabbatical, the applicant will work on the following tasks:

1. Refine algorithms for quantitative eye tracking metrics (fixation, smooth pursuit, saccades).
2. Expand the eye movement dataset through additional studies.
3. Validate diagnostic protocols on sports team and clinical populations.
4. Explore commercialization opportunities through the customer discovery process.
5. Develop a deployable screening tool prototype for field testing.

Conversational AI for mental health support

The primary goal of the sabbatical is to pilot the commercialization of scalable, clinically validated AI-driven chatbots that address specific mental health concerns. The pilot project will collaborate with established mental health organizations and clinical partners to ensure the chatbots deliver effective, safe, and ethical care. A successful pilot deployment will create the foundation for product scaling and commercialization through partnerships with mental health clinics, private practices, and public health institutions. This pilot will also prioritize technological refinements and ethical concerns. Through rigorous user studies and clinical validation, the project will focus on ensuring that these chatbots provide real-time, data-driven insights to therapists, improving clinical decision-making and enhancing patient outcomes. The pilot's success would

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open further commercialization opportunities. To this end, during the sabbatical, the applicant will work on the following tasks:

1. Fine-tune the existing language model currently used in the project.
2. Develop guardrails for safe and ethical operation in collaboration with experts.
3. Conduct user studies to evaluate effectiveness and identify refinements.
4. Pilot chatbot deployment through partner organizations.
5. Design provider-facing data visualization and summarization interface.
6. Analyze and publish results for AI in mental healthcare delivery.

Auction behavior analysis

Through this sabbatical, the applicant aims to advance the current status of the project through collaborative research, enabling partnerships with institutions that can contribute complementary expertise, particularly in behavioral economics, data analysis, and machine learning. A research collaboration has already been established with IMT, a prestigious PhD school in Lucca, Italy, where a partnership has already been established. This collaboration will provide access to interdisciplinary expertise, data sets, and new perspectives from leading European researchers. Working with IMT will enhance the project scope, strengthening the potential for high-impact, peer-reviewed publications. During the sabbatical, the applicant will work on the following tasks:

1. Expand the data infrastructure to enable multiple research groups to contribute to the analysis the auction datasets.
2. Develop machine learning models about bidding patterns and strategies.
3. Evaluate economic implications of the observed behavioral patterns.
4. Disseminate findings to relevant communities.

The goal is not simply to incrementally extend prior work, but to leverage the focused sabbatical time for major advances that establish strong foundations for future growth, including the pursuit of commercialization opportunities in collaboration with NKU's ecosystem (e.g., NKU Foundation, KCV, and Blue North). Furthermore, the sabbatical offers an opportunity to build research partnerships, including with IMT, establish a leadership position in emerging interdisciplinary domains, build a strong platform for securing external funding, and create potential research and employment opportunities for NKU students.

URGENCY OF THE PROJECT

The rapid advancements in AI and their relevance in both research and commercialization creates a critical window of opportunity to bring the proposed projects to market, especially now that each project has reached a maturity level that makes it ready for deployment, testing, and commercialization. However, without dedicated full-time focus, the applicant becomes a bottleneck to their progress, as further advancements require constant oversight, collaboration, and refinement. By securing this sabbatical, the applicant can capitalize on the momentum of AI development and lead these projects to market at the optimal time.

PROCEDURES, TIMELINE, AND OUTCOMES

The sabbatical projects will be advanced through a combination of development work (data analysis, modeling, software development), research (eye tracking experiments, user testing with the chatbot, and secondary data analysis), and translational activities (prototype development, partner engagement, customer discovery and development). The activities will be organized as follows, will involve a total of 21 students who are currently part of the HCILab, and will be the opportunity to increase the number and scope of interdisciplinary research collaborations with other faculty and organizations. Each phase will produce the outcomes detailed below.

Eye Tracking for concussion diagnosis

- Product development (Months 1-2): Implement a deployable software tool for remote eye tracking and concussion screening using computer vision libraries and web technologies. Design an intuitive interface for test administration and result visualization. Conduct usability testing and iterate on design. Outcomes: beta version of the product deployed online.
- Data collection (Months 3-4): Conduct human subject experiments with 100+ participants on eye tracking protocols (fixation, smooth pursuit, free viewing of images/videos). Recruit from NKU and partner with local high school/college sports teams. Explore clinical validation with healthcare system partners. Outcomes: 100 users successfully enrolled in the platform and screened.
 - Dissemination (Months 4-5): Present findings at computer science and translational medicine conferences (e.g. ICML, AAN). Prepare peer-reviewed publications on methods and validation studies. Outcomes: 2 scholarly papers published in academic conferences or scientific journals.
 - Commercialization (Months 1-5): engage in customer discovery to identify IP protection and commercialization paths. Develop partnerships for field testing and pursue FDA approval. Outcomes: (1) provisional patent, (2) FDA Premarket Notification 510(k).

Conversational AI for mental health

- Language Model and prototype fine-tuning (Months 1-2): Adapt open-domain language models to mental health conversation using domain-specific datasets and human feedback. Develop prompts and datasets for target areas like cognitive behavioral therapy, motivational interviewing, and crisis counseling. Outcomes: beta version of the LLM released online.
- Initial user testing and refinement (Months 2-3): Conduct small-scale user studies with target populations (e.g. students, elderly) to evaluate chatbot effectiveness, engagement, and adherence. Gather qualitative feedback to identify limitations and refinement opportunities. Iterate on conversation design and user experience. Outcomes: system tested with 50 users.
- Pilot (Months 3-4): Pilot deployment with partner clinics and private practices. Evaluate impact on provider efficiency and patient outcomes. Outcomes: system tested with 500 users.

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- Scientific dissemination (Months 4-5): Present findings at AI and digital mental health conferences. Publish results and design principles in clinical psychology and machine learning venues. Outcomes: 2 scholarly papers published in academic conferences or scientific journals.
- Commercialization (Months 1-5): engage in customer discovery to identify commercialization paths. Develop partnerships for field testing and pursue translational/clinical research grants. Outcomes: (1) system deployed at 5 organizations.

Auction behavior analysis

- Establish collaborations for data analysis (Months 1-2): Identify expertise in behavior analysis from an external institution. Outcomes: collaboration with 1 external organization.
- Model development (Months 2-4): Train machine learning models (e.g. sequence prediction, clustering) to classify bidding strategies, detect anomalous behavior, and forecast price dynamics. Evaluate model performance and interpret key features driving predictions. Explore deep learning architectures for representation learning on raw bid sequences. Outcomes: preliminary model and data analysis
- Research dissemination (Months 1-5): Present methods and findings at computational social science and economics conferences. Publish papers in interdisciplinary data science and applied economics venues. Release analysis code and tools as open-source software for research community adoption. Outcomes: 2 scholarly papers published in academic conferences or scientific journals.

VALUE OF THE PROJECT

Specifically, the work realized during the sabbatical and their outcomes will produce value as follows:

- Professional growth and status:
 - The focused time for research and development will substantially advance the applicant's expertise in emerging domains at the intersection of human behavior, machine intelligence, and data science. This positions the applicant as a leader and innovator in these high-impact fields.
 - Successful completion of the ambitious project goals and research outputs will build a strong case for future promotion to full professor.
- Teaching and students:
 - The projects directly relate to the applicant's teaching in human-computer interaction, machine learning, and behavioral analysis. Insights and examples from the cutting-edge work can enhance instruction and provide relevant case studies for the classroom.
 - Also, improved understanding of diagnostic technologies (eye tracking), intelligent systems (chatbots), and data-driven behavioral

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insights (auctions) will enrich the applicant's ability to guide and mentor student research projects in these domains.

- The applicant has secured funding to engage undergraduate research assistants in his research. Being able to commit full time to the projects will also result in improved mentorship opportunities for NKU students. Specifically, 21 NKU students will be involved in the activities of the projects, which will provide them with hands-on experience in the context of real-world projects.
- Scholarship and the scholarly community:
 - Each project advances an existing line of research and enables focused effort to achieve major milestones: eye tracking validation studies and a deployable screening tool; chatbot prototypes tested with mental health organizations; novel large-scale analysis of auction bidding behavior.
 - Dissemination plans through peer-reviewed publications and conference presentations will share the sabbatical's scholarly contributions and position the work to impact the broader research community.
- The University:
 - The high-impact sabbatical projects, especially successful development and potential commercialization of eye tracking and chatbot technologies, will raise NKU's profile as a source of innovative, translational research. This can lead to expanded research partnerships, media coverage, and attraction of students and faculty.
 - Two of the projects can directly benefit NKU: the eye-tracking system could be utilized by NKU athletes; the Conversational AI project could be distributed to NKU students and employees alongside current tools (e.g., TogetherAll)
- The non-academic community:
 - Each of the projects directly targets an audience of potential end-users beyond NKU and the academic community.
 - The eye tracking technology promises to make concussion screening more accessible to sports teams, employers, and healthcare providers, addressing a critical public health issue. Successful development positions it to benefit these communities.
 - Mental health chatbots can extend access to support for underserved populations and ease strain on overburdened mental health systems. Pilots with partner clinics enable refinement to serve real-world needs.
 - Auction data insights can inform the design of market mechanisms, with broad relevance to domains from e-commerce to resource allocation. Engaging with policymakers and platforms can guide applications to serve business and societal priorities.

BACKGROUND OF APPLICANT RELEVANT TO THIS PROJECT

The applicant has an extensive record of successfully completing complex projects across academia and industry. Key examples include:

- Leading a €1.5 million research project involving 8 partners as a researcher at the Polytechnic of Bari.
- Raising over \$500,000 in grants and increasing company staff by 160% as CEO of a start-up company.
- Managing government programs worth over €4 million and supervising hundreds of training initiatives as program manager at ARTI/Regional government of Apulia.

This track record demonstrates the applicant's ability to set and achieve ambitious goals on the scale of the proposed sabbatical projects. The projects already collected sufficient funding to support the proposed work and are at a development stage that makes them ready for technology transfer.

The applicant's research and teaching background is closely aligned with the proposed projects:

- Extensive research on human-computer interaction, machine learning, and behavioral analysis, with over 85 peer-reviewed publications.
- Leadership of the HCILab research group at NKU working on projects in eye tracking, conversational AI, and data analysis.
- The applicant recently received the Mid-Career Award by the Council on Undergraduate Research for his mentoring work.

In particular, the applicant's work leading the HCILab provides a strong foundation of preliminary results and collaborations to build upon during the sabbatical. Specifically, the HCILab will serve as a platform to recruit and work with students.

The applicant has a strong record of scholarly accomplishments relevant to the proposed projects:

- 85 peer-reviewed publications, including multiple best paper awards.
- Over \$1 million in research grants as PI or co-PI, from sources including the NSF, NIH, and industry.
- Extensive entrepreneurial experience, including co-founding 3 startups that successfully exited.
- Over 25 awards for research and innovation, including the Fulbright Scholarship, Marie Curie Fellowship, and MIT Technology Review Innovators Under 35.

OTHER SUPPORT, FUNDING, AND COMMITMENTS

Two of the projects already secured support and funding from organizations such as the NSF, NIH, and Kentucky Commercialization Ventures (KCV), which has enabled progress in research, development, and commercialization.

Eye Tracking for concussion diagnosis

- 2022 – UAccel (N/A)
- 2022 – VentureWell E-Teams (\$5,000)
- 2022 – NKU Institute for Health Innovation (\$3,000)
- 2022 – NKU FDA Project grant (\$5,000)
- 2023 – KCV Impact Award (\$9,000)
- 2024 – NSF I-Corps (\$50,000)
- 2024 – NIH KYNETIC (\$48,000)

Conversational AI for mental health

- 2023 – KCV Impact Award (\$9,000)
- 2023 – NKU Institute for Health Innovation (\$3,000)
- 2024 – NKU FDA Project grant (\$5,000) – in progress
- 2024 – UAccel (N/A)
- 2024 – Kentucky Academy of Science (\$5,000)
- 2024 – Mid-South Reach Hub (\$48,000)

PART III: APPENDICES

1. VITA
2. PREVIOUS FACULTY DEVELOPMENT AWARDS (FDA)

Education

- **PhD in Computer Science and Engineering** at Institutions, Market, Technologies (IMT) - Institute for Advanced Studies (Italy). Thesis title: *Issues, Challenges and Practices in Advancing Pervasive Human-Computer Interaction for People with Combined Hearing and Vision Impairments*. Dec 2012.
- Fulbright Certificate in **Technology Entrepreneurship** at Santa Clara University (Santa Clara, CA, US). Jun 2011.
- **MS in Computer Science (Magna cum Laude)** with specialization in Interactive systems at University of Bari (Italy). Thesis title: *Multimodal Feedback for Portable Brain-Computer Interfaces*. Mar 2007.
- **BS in Informatics and Digital Communication (Magna cum Laude)** at University of Bari (Italy). Thesis title: *System for enabling deafblind people to communicate using the Malossi method*. Jul 2004.

Work experience (selected list)

Tenure-Track Assistant Professor of Computer Science at Northern Kentucky University (Highland Heights, KY - US) Aug '19 - present day

- Director of the Bachelor's degree Program in Applied Software Engineering
- Course coordinator of INF286 - Introduction to Web Development
- Instructor of 7 graduate- and undergraduate-level courses on campus and online
- Instructor of 2 Honors College courses
- Representative of the College of Informatics in the University Research Council
- Raised 20k USD in research grants for working with undergraduate students
- Raised 70k USD in grants for international projects

Tenure-Track Assistant Professor of Informatics at Fort Hays State University (Hays, KS - US)

Aug '17 - May '19

- Taught 9 graduate-level courses on campus and online
- Published 16 peer-reviewed conference papers with students and faculty
- Nominated to 7 and received 5 best faculty awards
- Received Entrepreneurship Faculty Fellow Award
- Secured stage 1 for a 650k USD grant from the National Institute of Standards and Technology
- Secured 2 Undergraduate Research Experience Grants on Augmented/Mixed Reality and Computer Vision (10k USD)
- Secured an Open Textbook Grant (3k USD)
- Organized "Kansas start-up" and the "Faulkner challenge", and awarded 10k+ USD in grants

Marie Skłodowska Curie Experienced Researcher at the University of Salford (Manchester, UK)

May '17 - Oct '17

- Helped revise Intellectual Property strategy and technology transfer pipeline
- Supervised grant applications (550k GBP total) for the Defence Science and Technology Laboratory
- Contributed to a 12mIn GBP application for a Research hub in robotics and automation
- Completed course on Robot Operating Systems

Researcher and teaching adjunct at Polytechnic of Bari (Bari, Italy)

May '15 - May '17

- Responsible for 1,5mIn EUR project involving 8 partners
- Published 9 papers, including 1 best paper award
- Supervised 2 magna cum laude master theses and 1 bachelor thesis

Co-founder & CEO at INTACT srl (Bari, Italy)

May '13 - Dec '16

- Raised 500k EUR in grants and increased company staff by 160%
- Led to profitability in 18 months, increased revenues by 185% after 1 year
- Managed 12 people with different backgrounds in 3 company departments
- Sold Intellectual Property to an acquirer and exited the company.

List of Selected Publications since 2017

1. N.C., J.Zhou, Y.Tao, B.Thaman, T.Cao, A.Oassey, A.Shrestha, *A Machine Learning Dataset and Pipeline for Web-based Gaze Tracking* submitted in August 2022 to the Journal of Universal Computer Science (JUCS).
2. B.Thaman, T.Cao, A.Aossey, A.Shrestha, N.C., *Evaluating the Correlation of Gaze and Mouse Interaction*, submitted in August 2022 to the Journal of Information Systems Applied Research (JISAR)
3. B.Thaman, T.Cao, A.Aossey, A.Shrestha, N.C., *Analysis of Research and User Experience with Eye-Tracking Technology*, submitted in August 2022 to the Advances in Science, Technology and Engineering Systems Journal (ASTESJ)
4. N.C., *An Improved PIN Input Method for the Visually Impaired*, to appear in the 44th International IEEE Convention on Information, Communication, and Electronic Technology, 2021. <https://bit.ly/3gyQP7M>
5. J. Niehaus, N.C., *An Infrastructure for Integrated Temperature Monitoring and Social Tracking*, to appear in the 44th International IEEE Convention on Information, Communication, and Electronic Technology, 2021. <https://bit.ly/3BtxahR>
6. J.Walden, N.C., L.Atnafu, *A Chatbot for Teaching Secure Programming*, to appear in the Proceedings of the 2022 International Conference of the Information Systems & Computing Academic Professionals | Education Special Interest Group (EDSIGCON + CONISAR 2022)
7. B.Thaman, T.Cao, N.C., *Face Mask Detection using Mediapipe Facemesh*, to appear in the Proceedings of the 45th International Conference on Information, Communication, and Electronic Technology (MiPro 2022)

8. D.Ferman, N.C., *The Role of Social Media during the COVID-19 Pandemic*, to appear in the 13th International Conference on Applied Human Factors and Ergonomics (AHFE 2022)
9. B.Thaman, T.Cao, N.C., *A Landmark Detection and Iris Prediction Dataset for Gaze Tracking Research*, to appear in the Proceedings of the 7th International Conference on Human Interaction and Emerging Technologies (IHET 2022)
10. N.Samuel, N.C., *A systematic assessment of the impact of the pandemic on academic and scientific conferences*, to appear in the 13th International Conference on Applied Human Factors and Ergonomics (AHFE 2022)
11. B.Thaman, T.Cao, N.C., *Improving Eye-Tracking using RGB Cameras for Large-Scale Human-Machine Applications*, to appear in the 5th International Conference on Intelligent Human Systems Integration: Integrating People and Intelligent Systems (IHSI 2022)
12. T. Farber, L. Christen, N.C., *Incorporating Human Factors in Solutions for Pandemics*, to appear in 12th International Conference on Applied Human Factors and Ergonomics, 2021. <https://bit.ly/2UNzfoU>
13. L. Christen, T. Farber, N.C., *Face Masks as Awareness and Engagement Platforms*, to appear in 12th International Conference on Applied Human Factors and Ergonomics, 2021. <https://bit.ly/3Dk2HEm>
14. J.Clark, N.C., *A Dedicated Platform for Health-Safety Reviews*, to appear in 12th International Conference on Applied Human Factors and Ergonomics, 2021. <https://bit.ly/2XQfluA>
15. N.C., K.Zhang, G.Carlson, *Using Eye-tracking to Study the Authenticity of Images Produced by Generative Adversarial Networks*, in 2nd International Conference on Electrical, Communication and Computer Engineering (ICECCE), 2020. <https://bit.ly/3ixTCg3>
16. A.Miller, J.Miller, N.C., *Enhancing Webpage Navigation with a Novel Scrollbar*, in 11th International Conference on Usability & User Experience, 2020. <https://bit.ly/2XRKN8W>
17. A.Peralta, N.C., *The Impact of Social Media in Military Recruiting*, in 11th International Conference on Social & Occupational Ergonomics, 2020. <https://bit.ly/33SiJWY>
18. J.Esparza, N.C., *Addressing Human Factors in the Design of Cyber Hygiene Self-Assessment Tools*, in 6th International Conference on Human Factors in Cybersecurity, 2020. <https://bit.ly/2PIBDav>
19. A.Legleiter, N.C., *Flat-Design Icon Sets: a Case for Universal Meanings?*, in 11th International Conference on Usability & User Experience, 2020. <https://bit.ly/33TRSd0>
20. N.Elleman, N.C., *A Platform for Tracking Teacher-Student Interaction*, in 6th International Conference on Human Factors in Training, Education, and Learning Sciences, 2020. <https://bit.ly/3gWIYPO>
21. N.C., *Deepfakes for the Good: a Beneficial Application of Contentious Artificial Intelligence Technology*, in 3rd International Conference on Human Factors in Artificial Intelligence and Social Computing, 2020. <https://bit.ly/33PMQOI>
22. N.C., N.Elleman, S.Cho, *Interface Digital Twins: Rendering Physical Devices Accessible to People who are Blind*, in 43rd International Convention on Information, Communication and Electronic Technology, 2020. <https://bit.ly/3BdsKLz>
23. N.C., *An Experiential Learning Approach to Research Methods in Computer Science based on SMART Goals*, in 43rd International Convention on Information, Communication and Electronic Technology, 2020. <https://bit.ly/2PYDZIP>
24. S.Cho, T.Farber, C.Schultz, N.C., M.Song, *SMILE: Smart Module Integration for IoT Programming Logic and Environment*, in 20th IEEE International Conference On Electro Information Technology, 2020. <https://bit.ly/3ahcpcC>
25. N.C., N.Elleman, S.Cho, I.Perilli, *A Digital Platform for Improving Accessibility in Physical User Interfaces*, in 6th IEEE International Conference on Information Management, 2020. <https://bit.ly/3ajhOzS>
26. S.Li, N.C., *Investigating Transparency and Accountability in User Interfaces for Data Visualization: a Case Study on Crowdfunding*, in International Conference on Human Interaction & Emerging Technologies, 2019. <https://bit.ly/2GDppfd>
27. N.C., K.Zhang, G.Carlson, D.Patchin, D.Jachetta, N.Vaughn, S.Romeiser, *User Discrimination of Content Produced by Generative Adversarial Networks*, in International Conference on Human Interaction & Emerging Technologies, 2019. <https://bit.ly/2YB4j78>
28. N.C., A.Walters, D.Patchin, N.Vaughn, D.Jachetta, S.Romeiser, M.Ding, *Comparative User Experience Analysis of Pervasive Wearable Technology*, in 3rd International Conference on Human Factors and Wearable Technologies, 2019. <https://bit.ly/2KeZv2l>
29. N.C., T.Helms, P.Zhang, *A Meta-Language Approach for Machine Learning*, in 2nd International Conference on Human Factors in Artificial Intelligence and Social Computing, 2019. <https://bit.ly/2Ov4i52>
30. T.Fandakly, N.C., *Beyond Passwords: Enforcing Username Security as the First Line of Defense*, in 8th International Conference on Human Factors in Cybersecurity, 2019. <https://bit.ly/2ytd0FY>
31. M.Stainbrook, N.C., *Comparative Evaluation of Security and Convenience Trade-offs in Password Generation Aiding Systems*, in 8th International Conference on Human Factors in Cybersecurity, 2019. <https://bit.ly/2Gzns3l>
32. N.C., G.Carlson, M.Ding, P.Zhang, *Immersive Virtual Reality beyond Available Physical Space*, in 8th International Conference on Human Factors in Game Design and Virtual Environments, 2019. <https://bit.ly/2YB4kYK>
33. N.C., *An Interactive Device for Reducing Risk of Infusion Therapy and Blood Transfusions*, in 8th International Conference on Human Factors and Ergonomics in Healthcare and Medical Devices, 2019. <https://bit.ly/2ytc98e>
34. N.C., K. Udenze, A. Imaji, S. Romeiser, Y. Cui, Y. Li, *Accessibility Evaluation of Automated Vending Machines*, in 4th International Conference on Design for Inclusion, 2019. <https://bit.ly/336Ysu3>
35. X.Xiao, N.C., *Comparative Evaluation of Cyber Migration Factors in the Current Social Media Landscape*, in IEEE International Symposium on Social Networks and Applications, 2018. <https://goo.gl/QdJvFQ>
36. M.Clarke, G.Carlson, N.C., C.Jacobs, *Filmmaking without a Frame - Virtual Reality and 360 Degree Video*, in 72nd Annual Conference of the University Film and Video Association, 2018.
37. G.Carlson, M.Clarke, N.C., A.Perez, C.Jacobs, M.Ding *Best of Both Worlds: Combining 360 Video and Augmented Reality for Understanding and Creating Narrative*, in Digital Frontiers conference, 2018.
38. N.C., L.Biasi, G.Cinquelpalmi, V.Bevilacqua, *An Immersive Environment for Experiential Training and Remote Control in Hazardous Industrial Tasks*, in 9th Intl Conf. on Human Factors and Wearable Technologies, 2018. <https://goo.gl/roiqw2>
39. N.C., M.Ding, M.Clarke, G.Carlson, V.Bevilacqua, G.F.Trotta, *Analysis of the Relationship between Content and Interaction in the Usability Design of 360° Videos*, in 9th Intl Conf. on Usability and User Experience, 2018. <https://goo.gl/FnZm7w>

Funding (selected list)

- 2021: Department of State - US-Italy Mission grant, 60.000 USD
- 2019: Student/Faculty Development award, 4.500 USD
- 2019: Summer Project Research Grant, 6.000 USD
- 2018: Entrepreneurship Faculty Fellows on Digital Matchmaking, 4.000 USD
- 2018: Undergraduate Research Experience Grant on Wearable eye tracking, 5.000 USD
- 2018: NIST, EQUIPS, 750.000 USD (awarded phase 1)
- 2018: InnoNetwork, T-Care, 1.250.000 EUR
- 2018: InnoLabs, EpiC, 650.000 EUR
- 2017: Undergraduate Research Experience Grant on Immersive Video, 5.000 USD
- 2017: Verso Technologies (Equity), 180.000 EUR
- 2017: Start&Go, Verso Technologies, 380.000 EUR
- 2015: InnovateUK, dbGLOVE, 120.000 GBP
- 2015: Sisal Pay GoBeyond, dbGLOVE, 50.000 EUR
- 2014: Berlin IoT, dbGLOVE, 50.000 EUR
- 2013: InnoLabs, SmartEnergy, 650.000 EUR
- 2013: InnoLabs, Carehub, 420.000 EUR
- 2012: European Regional Development Fund - European Commission, Laboratori dal Basso, 2,400.000 EUR
- 2012: Valore Assoluto, dbGLOVE, 120.000 EUR
- 2009: Principi Attivi - dbGLOVE, 25.000 EUR

Awards (selected list)

- 2021: Best paper award at the 1st Conference in Human Factors in Disease Control and Pandemic Prevention
- 2020: Best paper award at the 6th International Conference on Information Management
- 2019: "Pilot Award" Nomination as best faculty at Fort Hays State University
- 2019: "University Outstanding Scholar Award" at Fort Hays State University
- 2019: "1st prize Faculty Research Award" at SACAD
- 2019: "Entrepreneurship Faculty Fellows Award" at Fort Hays State University
- 2018: "Pilot Award Nomination as best faculty
- 2018: "Fischli's Excellence in Higher Education Award" at Fort Hays State University
- 2018: "Faculty of the year Service award" at Fort Hays State University
- 2018: "Graduate School's Outstanding Research Mentor" at Fort Hays State University
- 2018: 1st place at "Innovation Party" start-up competition
- 2017: Best paper award at the International Conf. on Applied Human Factors and Ergonomics
- 2017: Marie Curie Fellowship
- 2016: Best paper award at the International Conf. on Recent Trends in Image Processing & Pattern Recognition
- 2016: 1st prize at the "Make to care" challenge as best start-up
- 2016: 1st prize at "Heroes - meet in Maratea" as best start-up
- 2016: 1st prize at "Charité Venture Summit" as best technology for healthcare
- 2015: 1st prize at "Cuore digitale" as best technology with social impact
- 2015: 1st prize at "GoBeyond" as best start-up
- 2015: 1st prize at "InnovateUK" as best wearable technology for accessibility
- 2015: MIT Technology Review - Italian chapter - "Innovators Under 35" award
- 2015: 1st prize at "Internet of Things accelerate Berlin" as best IoT start-up
- 2014: 1st prize at Job&Orienta as best innovation project
- 2014: 1st prize at AlternAttiva as best school innovation project
- 2014: 5th place winner at Future in Research (1250 applications)
- 2014: 1st prize at Focus innovation prize in media and communication
- 2014: 1st prize at Lamarck Prize for INTACT srl
- 2014: 2nd prize at Lamarck Prize for IVE360 - Immersive Video Experience
- 2013: Mario Tchou award for best PhD dissertation by AICA
- 2012: 1st place at Valore Assoluto by Camera di Commercio di Bari
- 2011: L'innovazione tecnologica per la gestione del rischio in sanità by Gutenberg - Healthcare safety
- 2011: 1st prize at James Dyson Award - Italian edition
- 2010: Fulbright scholarship from the United States Department of State, Bureau of Educational and Cultural Affairs
- 2009: 1st place at Principi Attivi as best technology with social impact (1600 applicants)
- 2008: Best thesis award by CINEAS
- 2008: Best master thesis award by AICA

PREVIOUS FDA AWARDS

Summer 2020: Summer Fellowship, 6.000 USD

The Fellowship supported research on a system that can improve the accessibility of User Interface (UI) of physical devices (e.g., vending, ticketing, and ATM machines, as well as appliances) to render them usable to individuals with disabilities, with specific regard to blind and deaf-blind people.

Specifically, the project focused on creating a system for implementing an Interactive Digital Twin, that is, a digital replica of the product user interface (e.g., touchscreen displays, keypads, knobs, and buttons) on users' smartphones, so that individuals can leverage the accessibility features of their phone (i.e., text-to-speech) to be able to easily navigate the interface and understand how to use the vending machine. The project accomplished its main objective, achieving a working prototype that has been tested in a laboratory environment and is ready to be implemented in real-world scenarios. Moreover, the team rendered the solution affordable and immediately adoptable without requiring any changes to current devices.

The work has been realized in the context of a collaboration with a network of international partners and has resulted in two publications in international peer-reviewed scientific conferences, of which one has received a best paper award. Furthermore, the summer fellowship has created the opportunity to involve one NKU faculty and two NKU students in undergraduate research (including one UR-STEM project).

The Summer Fellowship supported a research project focusing on improving the accessibility of physical devices, with specific regard to publicly available vending machines, to people who are blind. Instead of requiring major changes to the physical interface of eVending, the goal of the project is to develop an interconnected platform that enables individuals who are blind to use their smartphone to easily download and access a digital replica of the user interface of the device. By doing this, they can navigate the options using the text-to-speech features, receive instructions and feedback on how to make their selection, and complete their task on the physical device (and, in the future, or on their smartphone).

We introduced the concept of Interface Digital Twin, that is, a completely digital replica of a User Interface specifically designed to exactly mimic the form, layout, and workflow of a physical device, product, or object (e.g., a device or a paper document) to render it accessible and help users learn it. IDTs aim at supporting multi-modal interaction via tactile icons and audible feedback without requiring a dedicated or external physical device. In addition to reproducing the original UI, the primary purpose of IDTs is to provide an additional information and interaction layer that improves usability and accessibility (e.g., by helping the user locate controls using vibration patterns and by translating visual labels in

audible form) and adds user customization. As a result, its layout and features are aimed at supporting alternative multi-modal content that results in a more effective interaction with the associated object or device. By doing this, they can build a mental model of the configuration of the physical interface of the actual device and learn how to operate it.

Publications:

- N.Caporusso, N.Elleman, S.Cho, Interface Digital Twins: Rendering Physical Devices Accessible to People who are Blind, in 43rd International Convention on Information, Communication and Electronic Technology, 2020. Full text: <https://bit.ly/3BdsKLz>
- N.Caporusso, N.Elleman, S.Cho, I.Perilli, A Digital Platform for Improving Accessibility in Physical User Interfaces, in 6th IEEE International Conference on Information Management, 2020. Full text: <https://bit.ly/3ajhOzS>

Awards:

- The following publication received the best paper award
- N.Caporusso, N.Elleman, S.Cho, I.Perilli, A Digital Platform for Improving Accessibility in Physical User Interfaces, in 6th IEEE International Conference on Information Management, 2020. Full text: <https://bit.ly/3ajhOzS>

Summer 2022: Project Grant, 5.200 USD

The fellowship supported the development of a software system that enables users to share the location of their mouse and gaze in real-time while screen-sharing in remote-conferencing sessions, to enhance interaction and render it more natural. The functionality of the system is similar to the collaboration features of Google Documents/Microsoft 365, which enable users to see where the others are editing. However, it works with any type of documents and applications, including clinical reports, source code, videos, within or outside the browser. To this end, it acquires the gaze and mouse input of the connected users using dedicated eye-tracking hardware as well as from standard webcams. Using the gaze results in a more immediate and natural interaction with content. By doing this, the system can be utilized for enhancing interaction between faculty and students, during 1:1 mentoring sessions, and for real-time remote collaboration and second opinion during clinical procedures and diagnoses.

The deliverable consists in a software product that immediately benefits the NKU community and provides faculty with an additional instructional tool specially designed for teaching remotely and during virtual office hours. In addition, it is particularly suitable as a tool for clinicians as well as a general-purpose software.

The project, which initially focused on developing just a tool that could be integrated into video conferencing tools, changed after being accepted into a start-up accelerator. As a result, the team instead decided to use the core eye-tracking technology to detect the presence and severity of a concussion in athletes, and worked on developing a commercial solution that would be utilized by coaches as well as individual athletes to realize high-quality, quantitative assessments, remotely.

Publications:

- Thaman, Cao, Aossey, Shrestha, Caporusso, Evaluating the Correlation of Gaze and Mouse Interaction, to appear in Journal of Information Systems Applied Research (JISAR) (2022).
- Thaman, Cao, Aossey, Shrestha, Caporusso, Analysis of Research and User Experience with Eye-Tracking Technology, to appear in Advances in Science, Technology and Engineering Systems Journal (ASTESJ) (2022).
- Caporusso, Sanders, Thaman, Hall, An Eye-Tracking Solution Using Consumer Grade Webcams for Potential Concussion Diagnosis and Evaluation, to appear in Proceedings of the 46th International Conference on Information, Communication, and Electronic Technology (MiPro 2023) (undefined).
- Thaman, Cao, Caporusso, Face Mask Detection using Mediapipe Facemesh, to appear in Proceedings of the 45th International Conference on Information, Communication, and Electronic Technology (MiPro 2022) (undefined).
- Thaman, Cao, Caporusso, A Landmark Detection and Iris Prediction Dataset for Gaze Tracking Research, to appear in Proceedings of the 7th

- International Conference on Human Interaction and Emerging Technologies (IHiet 2022).
- Samuel, Caporusso, A systematic assessment of the impact of the pandemic on academic and scientific conferences, to appear in 13th International Conference on Applied Human Factors and Ergonomics (AHFE 2022).
 - Thaman, Cao, Caporusso, Improving Eye-Tracking using RGB Cameras for Large-Scale Human-Machine Applications, to appear in 5th International Conference on Intelligent Human Systems Integration: Integrating People and Intelligent Systems (IHSI 2022).

Subsequent external awards and funding:

- KCV IMPACT grant
- VentureWell e-Team grant
- NSF National I-Corps

Summer 2023: Summer Fellowship, 6.000 USD

The project focused on using generative AI to create visual representations that translate literary masterpieces into collections of images that can be utilized to evaluate the user experience of content generated with GANs, improve the performance of generative algorithms, and gain more insight into the potential of ML and its impact on society.

The project outcomes were the following:

1. A book documenting the research project and describing the work and its value to an audience of researchers and artists interested in Computer Science and AI, visual arts.
2. A virtual showcase and, potentially, a physical exhibition of the collection. The exhibition is going to be held in November 2023 at the Campbell Public Library in Newport.

Publications:

- The legacy of Southgate Street School: Preserving a Landmark of the Black History of Newport, Kentucky
<https://www.amazon.com/dp/B0C2SG2HQP>

Summer 2024: Project Grant, 5.200 USD – In progress

This objective of the project is the design, development, and testing of an innovative AI-driven system that aims to enhance verbal communication skills in individuals with challenges caused, for instance, by learning disabilities or other conditions such as anxiety or autism, that impact communication. Specifically, the proposed system consists in an AI-based conversation environment (i.e., a chat similar to ChatGPT) that is specifically trained to generate guided conversational scenarios that provide the user with the opportunity to practice communication in a safe environment and overcome challenges such as social anxiety. Simultaneously, the system enables an assistant, therapist, or clinician, to access a data visualization dashboard that presents comprehensive data analytics to monitor the individual's progress and improvement. The grant will support the development of the system, which will be deployed and tested with AFHASS, an Italian organization that supports people with disabilities, which accepted to partner with the applicant. The collaboration with AFHASS, already secured, will provide the PI with specific domain knowledge and will enable the PI to collect data that will help evaluate the validity of the system. Also, it demonstrates the actual interest of organizations in the system.

The project deliverable consists in a software product that can be utilized by therapists, organizations supporting people with disabilities, as well as by individuals who want to improve their communication and social skills. Another deliverable will consist in published scholarly articles that will report on the research realized about the user experience and effectiveness of the system.

The project is in progress.

Current status:

- Thanks to the grant, the project's activities resulted in securing support from Uaccel, KCV, NIH.
- 13 students are currently involved in the project.
- Two scholarly papers have been submitted to academic conferences and are currently under review.

FDA Sabbatical Evaluation Form for Chairs

Instructions: Please print or type in the following form. Comment length is limited to this page.
Forward a copy to Faculty Senate Benefits Committee c/o Grace Hiles hilesg1@nku.edu

Faculty applicant name: Nicholas Caporusso

Evaluations are based on criteria as defined in the Faculty Handbook **11. FACULTY**

DEVELOPMENT PROGRAMS sections 11.1 through 11.4

This individual qualifies to receive the proposed sabbatical (tenured/tenure track, after twelve (12) semesters of employment at the University, excluding summer terms, have elapsed since last sabbatical).

Yes X No

Indicate your assessment of the following items from very low to very high:

	Very low	Low	Neutral	High	Very high
Overall quality of proposal					X
Ability of applicant to carry out project					X
Overall value of project					X
Value to the department					X
Value to student learning					X
Value to the field of study					X

General Comments:

I strongly recommend funding Nicholas Caporusso's sabbatical, focused on advancing three key projects in human-computer interaction, AI, and behavioral analysis: eye-tracking for brain-vision coordination, conversational AI for mental health, and auction behavior analysis.

These projects hold significant societal potential. The eye-tracking tool could revolutionize remote concussion diagnosis, while the conversational AI aims to improve mental health support through chatbots. The auction analysis will offer insights into economic behavior, influencing e-commerce and policy.

Caporusso's work aligns with current NSF and NIH grants, and the sabbatical will enable him to achieve critical milestones, fostering scholarly output and potential commercialization

Specific comments on categorical rankings including any category ranked neutral, low, or very low:

Name (typed or signed) Traian Truta

Date 10-04-2024

School: Computing and Analytics

FDA Sabbatical Evaluation Form for Deans

Instructions: Please print or type in the following form. Comment length is limited to this page.

Forward a copy to Faculty Senate Benefits Committee c/o Grace Hiles hilesq1@nku.edu

Faculty applicant name. [Nicholas Caporusso](#)

Evaluations are based on criteria as defined in the Faculty Handbook **11. FACULTY DEVELOPMENT PROGRAMS** sections 11.1 through 11.4.

This individual qualifies to receive the proposed sabbatical (tenured/tenure track, after twelve (12) semesters of employment at the University, excluding summer terms, have elapsed since last sabbatical).

Yes X No

Indicate your assessment of the following items from very low to very high:

	Very low	Low	Neutral	High	Very high
Overall quality of proposal					X
Ability of applicant to carry out project					X
Overall value of project					X
Value to the college					X
Value to student learning					X

General comments:

This is an exceptionally strong sabbatical proposal. It builds on Dr. Caporusso's extensive body of past and ongoing work, which has engaged NKU students, attracted external grant funding, and brought in investment to support commercialization. Dr. Caporusso's lab is one of the busiest on campus, and this one-semester sabbatical will give him time to concentrate on these three timely, high-societal-impact R&D projects. He has been an excellent research mentor and has had broad interactions across many colleges and the IHI. This is a paradigmatic example of the kind of applied research that helps make NKU a compelling destination for students (and faculty).

Specific comments on categorical rankings including any category ranked neutral, low, or very low:

Kevin G. Kirby

Name (typed or signed)

10/8/2024

Date

College: Informatics