

#### Abstract

Led by an interdisciplinary team from the UTC, HU, and CSCC, the proposed Anthropocentric Data Analytics for Community Enrichment (ADACE) program will develop a sustainable education and research platform for human-centric data science, where humans are either considered as the research subjects or regarded as a component of data analytics. The ADACE program includes the following activities: (1) advancing or innovating the data science curricula of the participating institutions; (2) recruiting undergraduate students in the program; (3) enriching the local communities by organizing a number of open seminars, workshops, or hackathons; and (4) developing cooperative community projects with the local business and research institutions. These community projects focus on topics pertaining to anthropocentric data science, such as seamless human-machine interaction, interpretable neural networks, human-in-the-loop machine learning, social networks, and AI ethics, etc. Participating institutions will take advantage of their connections to local businesses to expose students to practical data science issues and offer networking opportunities. Through this proposed program, students will acquire systematic data science knowledge, problem-solving abilities, practical experience, and rigorous research training. All curricular materials will be designed to be portable, sustainable, and easily disseminated to ensure their expanded impact. They are being evaluated for measurable outcomes and tailored to include non-traditional students, who form a large portion of the potential data science workforce in the regions surrounding the participating institutions.

**Keywords:** anthropocentric data science, community enrichment, machine learning, workforce training.

#### 1. Introduction and Objectives of ADACE

The goal of ADACE is to develop an application-oriented, project-based, sustainable and interdisciplinary curriculum that supports resource-sharing and community-enrichment. The above goal is associated with following objectives: (1) developing a systematic, project-oriented educational program for the theories and application of data science; (2) strengthen the collaborations among interdisciplinary institutions, departments, and communities; (3) developing an integrated data-sharing center for the education and AI research; (4) Catalyzing breakthrough, multidisciplinary research of anthropocentric data science; (5): Stimulating the application of anthropocentric data sciences through inter- and intra-community collaboration and information sharing.

##### 1.1. Definition of Anthropocentric Data Analytics

- **By the human:** e.g., Human-in-the-Loop ML, Human-Machine Interaction
- **Of the human:** e.g., Interpretable NN, physics-guided NN
- **For the human:** e.g., AI ethics, Social network, AI-enabled medical device

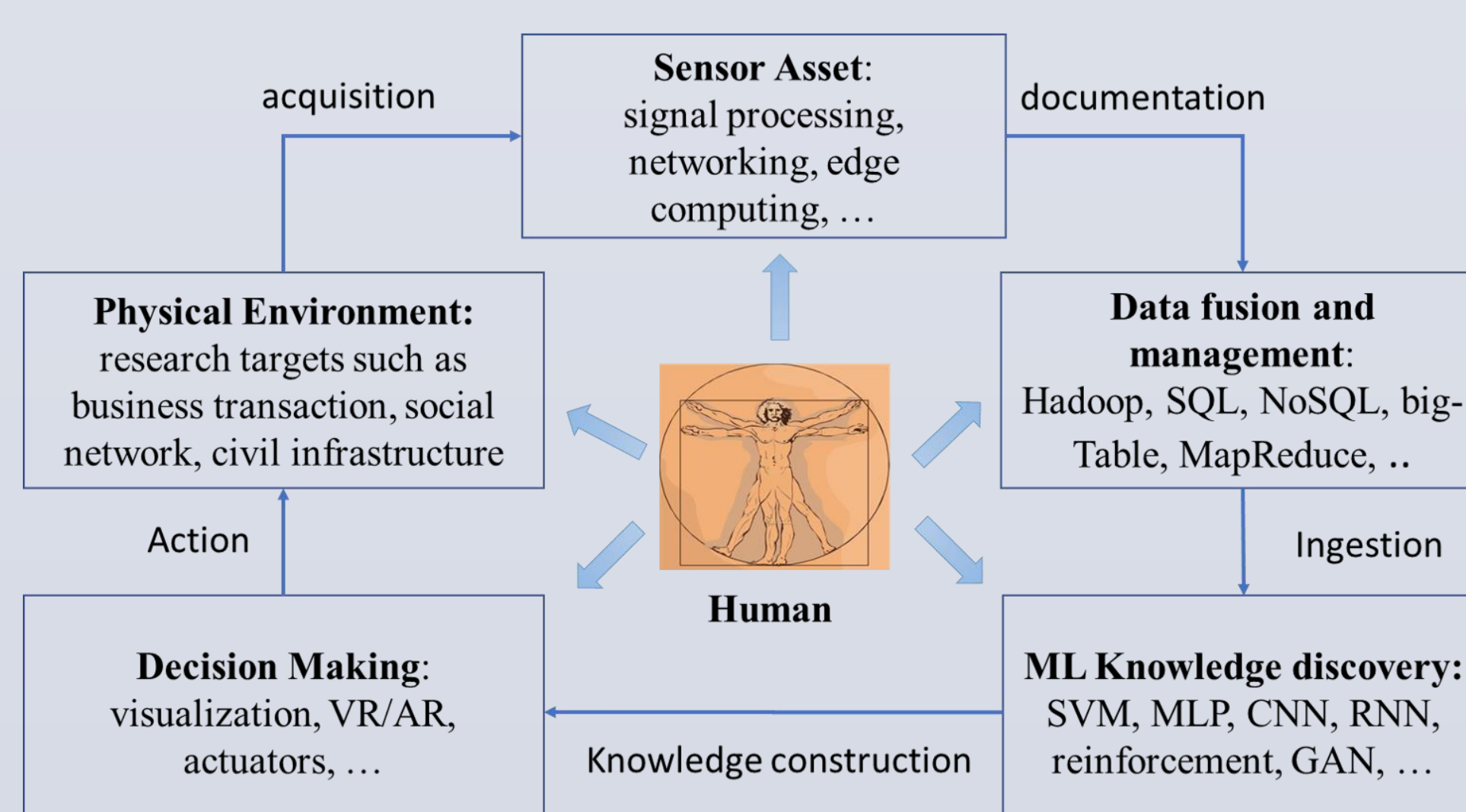


Fig. 1. Framework of Anthropocentric Data Analytics

##### 1.2 Participating Institutions and Stakeholder



Fig. 2. Organization of Team ADACE

#### 2. Major Activities

- Advancing or innovating the **data science curricula** of the participating institutions;
- **Recruiting** undergraduate students in the program;
- Enriching the local communities by organizing a number of open seminars, workshops, or hackathons; and
- Developing **cooperative community projects** with the local business and research institutions.

##### 2.1 Most Recent Advancement of Data Science Education

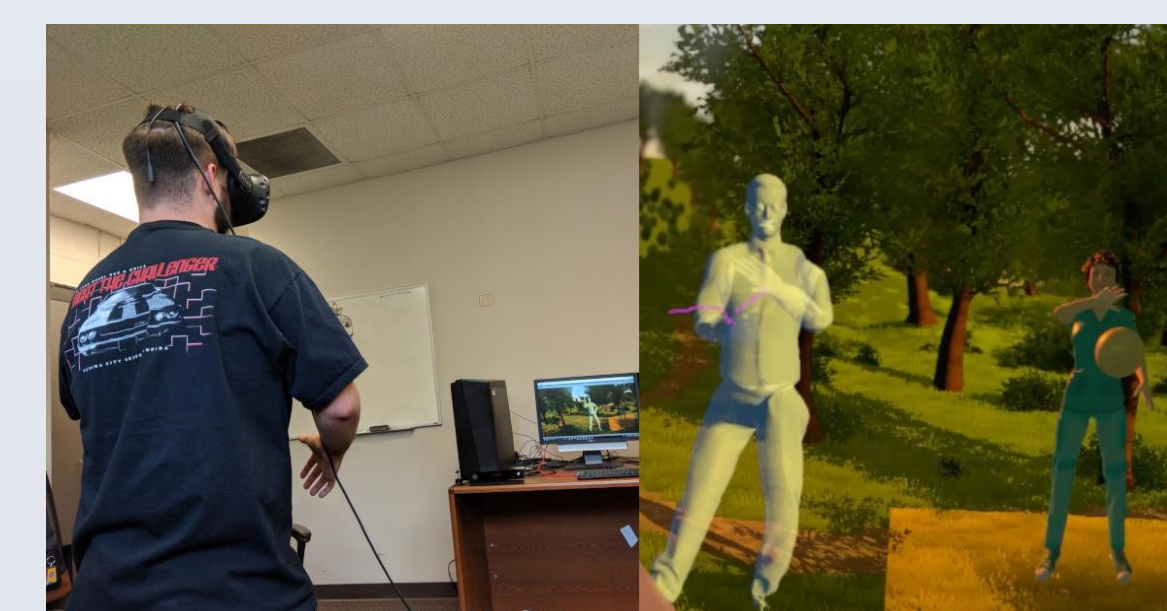
Inspired by ADACE program, the following new programs or curriculum have been developed or advanced:

- Advancing BS/MS, MS/PhD, and PhD-DS, at the Department of Computer Science and Engineering and MSDA at the School of Business
- Developed two AI certificates – AI Certificate for Undergraduate Student and AI certificate for MS programs at UTC.
- Developed a certificate entitled "Quantum Information System (QIS)" under the collaboration of Physics Department and Mathematics Department. The QIS covers mathematics foundations, quantum mechanics, quantum algorithms and computing, quantum machine learning, and quantum cybersecurity. Etc.

##### 2.2 Representative Recent ADACE Projects

###### 2.2(A) Virtual Tai Chi for Individuals with Mobile Disability

- Recognize and Score
- Coaching and Advising
- Choreography
- Phantom Limb
- Avatar

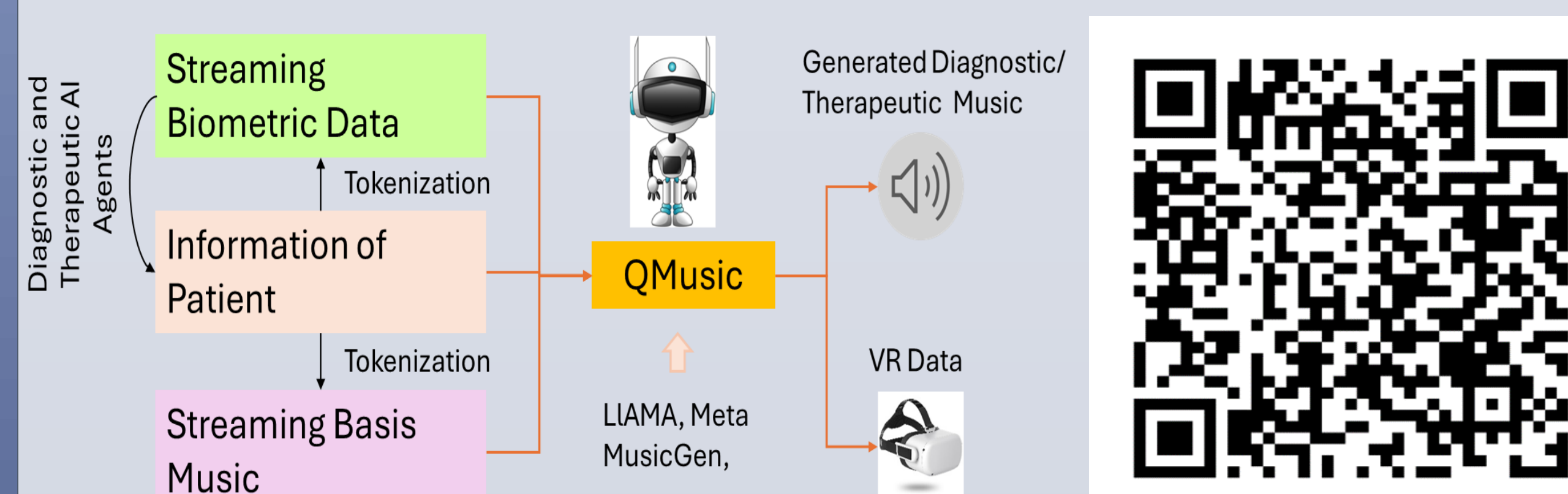


(a) Virtual Tai-Chi User Interface



(b) Generation of Phantom Limbs

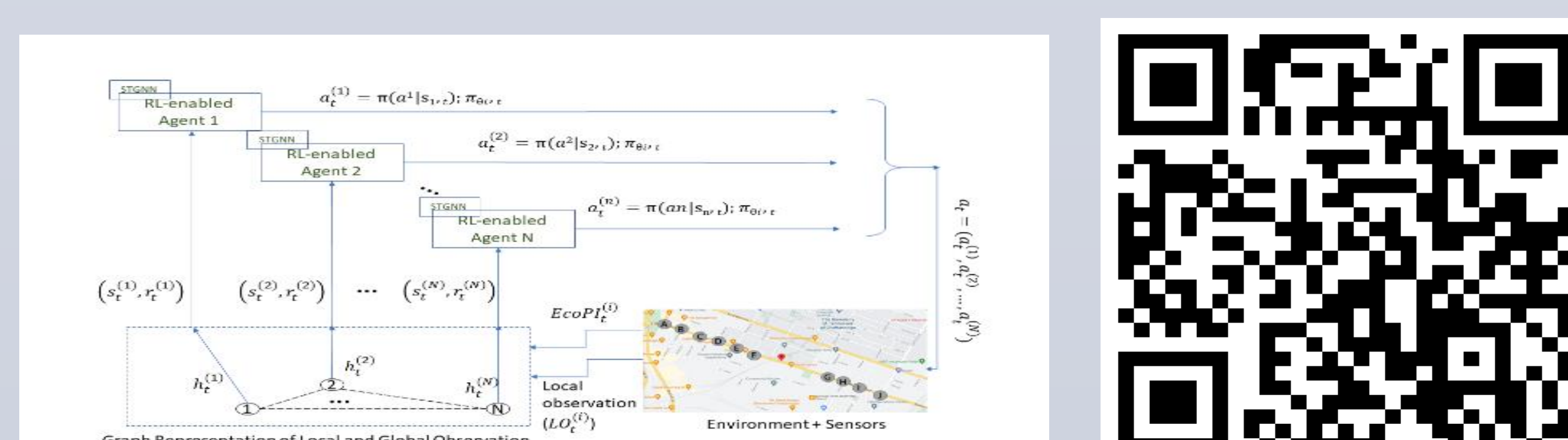
###### 2.2(B) Music-oriented Diagnostic and Therapeutic Modality



(c) Flow chart of QMusic

(d) Therapeutic Music to Release Depression

###### 2.2(C) Optimize the Vehicle and Pedestrian Transportation



(e) Infrastructure of DGMARL

(f) Demo of the result of DGMARL

#### 3. Most Recent Products of ADACE

The ADACE project has produced the following deliverables:

- Deliverable 1: developing an interdisciplinary anthropocentric data science curriculum that is open to the public.
- Deliverable 2: workforce training.
- Deliverable 3: organizing workshops/hackathons about the education and research of data science.
- Deliverable 4: introducing the community real-world data-science application projects into the program.

##### 3.1 Dissemination by ADACE

- Publications: about seven peer-reviewed journal or conference papers were published under the sponsorship of ADACE.
- Shared dataset: Diagnostic and therapeutic music generated out of EEG data.
- Online workshop and bootcamp teaching materials about the education and research of data science.
- Subprojects with the local business (VW and TVA)

##### 3.2 Workforce Training

- Six ADACE graduated awardees joined the graduate school in 2024
- Collaborative training programs in the fields of quantum computing, VR/AR, and generative AI with local business (VW, TVA, and UNUM).

##### 3.3 Funded Proposals Resulted from ADACE

- NIH (IOT2OD032581-02): "AI-enabled musical formulation of biometric data for promoting medical equity".
- NSF (2345852): "Collaborative Research: CPS: Medium: RUI: Realtime Subsurface Sensing with Cognitive Networked Robotic System"
- NSF (2431552): "Collaborative Research: CISE MSI: RDP: CPS: Enhancing Efficiency and Sustainability in Electric Transportation and Power Systems through Interaction-aware Management"
- Volkswagen Group of America: "Gateway Programming with CAPL/Vector/CANalyzer Tool"
- UTC, "Intelligent Reconfigurable Battery System for Enhanced and Robust Electric Mobility".

##### 3.4. Quantum Computing Workshop (07/09-07/11/2024)

- Fundamental Quantum Computing: Fundamental principles and concepts of quantum computing, including quantum mechanics, quantum computer architecture, qubits, superposition, and entanglement, etc.
- Hilbert Space Linear Algebra: The mathematical foundations of quantum computing with an emphasis on Hilbert space linear algebra and its significance in quantum algorithms.
- Quantum Programming: Qiskit, Cirq, and Pennylane.
- Quantum Algorithm Design: Adder, Deutsch-Josias, Superdense coding, Teleportation, Shor's algorithm, and Grover's algorithms.
- Quantum Machine Learning: develop parameterized quantum circuits, encoding algorithms, and quantum state measurement strategies to revolutionize machine learning by enabling faster processing and handling of complex datasets.
- Quantum Cybersecurity: quantum cryptography and the future of secure communications.



(g) webpage of workshop;



(h) workshop video

#### 4. Challenges

- Machine learning and AI are advancing at a pace that exceeds our expectations.
- It is always challenging to retain students in the lab, despite the allure of opportunities in industry.