Zekai Ai

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Research Interest: Robotic Arm/ Artificial Intelligence/ Digital Twin/ Wearable Devices/ EV Battery Disassembly

Education Experience

Jul. 2023 – Jan.2025 (Expected)	National University of Singapore, Singapore College of Design and Engineering	Mechanical Engineering Master of Science
Sep.2019 - Jun.2023	Jilin University, Changchun, China School of Mechanical and Aerospace Engineering	Mechanical Engineering Bachelor of Engineering (Overall Score: 85.28/100)
Sep.2020 - Jun.2023	Jilin University, Changchun, China College of Computer Science and Technology	Computer Science and Engineering Bachelor of Science (Double Degree)
Sep.2022 – May.2023	National University of Singapore (Suzhou) Research Institute, Suzhou, China	Mechanical Engineering (Joint Education)

Publications

- **Artificial Intelligence in Electric Vehicle Battery Disassembly: A Systematic Review** **(First Author)(Published)**

https://doi.org/10.3390/automation5040028

Zekai Ai, A.Y.C. Nee and S.K. Ong *, College of Design of Engineering, National University of Singapore

- **Beta Random Restart Strategy-based Remora Optimization Algorithm for Global Optimization** **(First Author)(Accepted)**

Zekai Ai, Heming Jia * (EI) (ICIST)

- **Improved Crayfish Optimization Algorithm for Solving Engineering Application Problems** **(First Author)(Currently Writing)**

Zekai Ai, Heming Jia *

- **Augmented Reality Digital Twin Visualization and Interaction Dashboard** **(First Author)(Currently Writing)**

Zekai Ai, A.Y.C. Nee and S.K. Ong *, College of Design of Engineering, National University of Singapore

Academic Experience

Artificial Intelligence in Electric Vehicle Battery Disassembly (Single Project) Jan.2024-Now

Supervisor: Prof. Ong Soh Khim/ Prof. Nee Yeh Ching, College of Design of Engineering, National University of Singapore

AI application in electric vehicle battery disassembly process, including state-of-health estimation, disassembly sequence planning, disassembly operations.

Achieve to date: A review paper written down (under review).

Digital Twin Augmented Reality Visualization and Interaction Dashboard (Single Project) Jul.2023-Jan.2025 (Expected)

Supervisor: Prof. Ong Soh Khim/ Prof. Nee Yeh Ching, College of Design of Engineering, National University of Singapore

Established an AR visualization and interaction platform that allows users to perform annotation of real physical products/processes with detailed manufacturing information. Physical products can be controlled by a virtual model, and changes in the physical product will be reflected in the virtual model. Hand gesture recognition control and multi-object control are integrated.

Implementation Process: Model the virtual object in SolidWorks software, import the model into Unity through Blender software as a transition, implement the augmented reality of the virtual object in Unity and design the user interface, and write scripts in C# language in VSCode software to control the control logic of the user interface. Control the physical object in Python language in PyCharm, establish communication between Unity and Python through Socket, and control the physical object in Python by extracting the key points of the hand and calculating the distance between the key points.

Difficulty: modeling virtual objects, control logic of user interface windows, two-way control between the physical and virtual ends, implementation of gesture control, and simultaneous control of multiple objects.

Responsible part: All

Assistive Navigation Device for the Low Vision Users Sep.2022-May.2023

Supervisor: Prof. Ong Soh Khim/ Prof. Nee Yeh Ching, College of Design of Engineering, National University of Singapore

Developed an assistive traveling device for low-vision users. Arduino, Raspberry Pi, camera, and sensors are used to form a smart cane and a head-mounted intelligent identification device.

Implementation process: Arduino, ultrasonic sensor, buzzer, LED bulb, angle sensor, button are integrated on the cane, and Raspberry Pi, ultrasonic sensor, bone conduction headset, and camera are integrated on the head-mounted intelligent recognition device. When the cane detects a low object, Arduino will control the buzzer to alarm. When the cane falls, the angle sensor can recognize it, and the buzzer will also alarm, thereby reminding people around that the user may be in a state of falling. The user can also actively press the button to ask for help from people around; Raspberry Pi connected to the camera can help the user identify the surrounding environment, such as traffic lights, zebra crossings, and vehicles, and remind the user through bone conduction headphones. The object recognition algorithm can also be used to find indoor objects, such as laptops, mice, and keyboards. At the same time, the ultrasonic sensor installed on the head-mounted intelligent recognition device can also be used to help users avoid high obstacles.

Difficulty: Configuration of OpenCV in Raspberry Pi, object recognition algorithm, configuration of Raspberry Pi and Arduino with different sensors.

Responsible part: All

Mail Size Measurement and Sorting Based on Line-Structured Light Vision May.2021 - Apr.2022

Supervisor: Prof. Liu Siyuan, School of Mechanical and Aerospace Engineering, Jilin University

Developed a mail size measurement method based on line-structured light vision. Mails can be measured and sorted automatically.

Implementation process: After the mail enters the scanning area, the vertex coordinates of the mail are measured by the line structured light camera, and then the size of the mail is calculated by the algorithm. After entering the sorting stage, the mail is sent to a specific track through the universal wheel at the bottom.

Difficulty: Modeling of the scanning device, implementation of the mail size calculation algorithm.

Responsible part: Modeling of some parts, algorithm implementation.

Selected Grants and Honors

Jun.2023 Dec.2022	Jilin University Academic Scholarship ×2
Dec.2021	Jilin University College Excellent Student Leader
Jan.2021	Jilin University Social Practice Scholarship
Dec.2021	Second Prize of the National 3D Digital Innovation Design Competition (Jilin Province Outstanding Prize) (as the captain)
May.2021	Outstanding Prize of Jilin Province in the National College Students Engineering Training Comprehensive Ability Competition (as the captain)
April.2022	Meritorious Winner of 2022 Interdisciplinary Contest In Modeling(MCM/ICM)
April.2021	Honorable Mention of 2021 Interdisciplinary Contest In Modeling(MCM/ICM)
May.2022	Provincial College Students Innovation and Entrepreneurship Training Program
Jun.2023 Dec.2022	Jilin University Third Class Scholarship ×4
Dec.2021 Jan.2021	

Language Competence and Skills

Language	IELTS: 6.5 (all bands⩾6) CET-6: 567 CET-4: 601
Other Skills	National Computer Rank Examination Level II
	Mandarin Proficiency Test Level 2-A
	C# Python SolidWorks Unity Raspberry Pi Arduino