Reachsak Ly

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Blacksburg, VA - 24060, USA

Research Interest

I'm currently a Ph.D student at Virginia Tech's Myers-Lawson School of Construction, advised by Dr. Alireza Shojaei. My research interests include smart building systems, blockchain, Decentralized Autonomous Organizations, Digital Twins, Augmented/Extended Reality (AR/XR), Machine Learning, construction robotics, and Large Language Models (LLMs). I have extensive experience in applying machine learning/deep learning techniques as well as both vision and large language models to construction-related applications, to enhance smart building control and construction operations, management, and safety.

Education

- **Virginia Polytechnic Institute and State University** *08/22 – Expected 05/25*
  Doctor of Philosophy in Environmental Design and Planning (EDP) Blacksburg, USA
  - Dissertations: Leveraging Artificial Intelligence and Distributed Ledger Technologies Toward Smart and Autonomous Buildings
- **Zhejiang University (ZJU)** *09/17 – 07/21*
  Bachelor of Engineering in Civil Engineering Hangzhou, China
  - Specialization: Structural Engineering

Work Experience

[Academic Experience]

Graduate Teaching/Research Assistant *Blacksburg, Virginia, USA*
Virginia Tech's Myers Lawson School of Construction *08/22 – Present*
Advised by Dr. Alireza Shojaei

- Research foci: Blockchain, Artificial Intelligence, Large Language Models (LLMs), AR/XR, Digital Twin and robotics for smart building and construction industry

Undergraduate Research Assistant *Hangzhou, China*
Zhejiang University *03/19 – 07/21*
Advised by Dr. Shu Jiangpeng

- Research foci: Artificial Intelligence in the Construction industry, with notable work including the application of Deep Learning in structural damage identification and crack segmentation

[Professional Experience]

Structural Engineer *Phnom Penh, Cambodia*
China Railway Construction Corporation [] *06/20 – 04/21*
The Peak Project and Shangri-La Hotel [], Phnom Penh

Honors and Awards

- **Student award recipient for the IIBEC International Convention and Trade Show**. RCI-IIBEC Foundation, 2023
- **Excellent Award in the 1st International Project Competition in Structural Health Monitoring**. The International Project Competition in Structural Health Monitoring, organized by University of Illinois Urbana-Champaign and Harbin Institute of Technology, 2021. **(Result)** **(Award)**
- **Outstanding International Leader of Zhejiang University**. Zhejiang University, 2020
- **Student travel grants for ASCE competition, (USD 2000)**. Zhejiang University, 2020
- **Fully-funded government scholarship for the undergraduate program** (11/1000+). Zhejiang University, 2016
- **1st Place in Microsoft Hackathon: Window App Studio Challenge**. Microsoft, 2016 **(Award)**

Teaching Experience

Graduate Teaching Assistant
BC 4434 (undergraduate) Construction Practice I (Fall 2022,Spring 2023,Fall 2023)
BC 4444 (undergraduate) Construction Practice II (Capstone Project) (Fall 2022,Spring 2023,Fall 2023)
BC 4164 (undergraduate) Process Planning and Production Design for Construction (Spring 2024,Fall 2024)
BC 5984 (graduate) Decision-Making and Risk Management (Spring 2024,Fall 2024)

PUBLICATIONS

C=CONFERENCE, J=JOURNAL, S=IN SUBMISSION

[C.4] **Reachsak Ly**, Alireza Shojaei; Hossein Naderi (2024). **DT-DAO: Digital Twin and Blockchain-Based DAO Integration Framework for Smart Building Facility Management**. In *Construction Research Congress 2024*, pp. 796-805. American Society of Civil Engineers. 2024-03-18, Des Moines, Iowa. DOI: 10.1061/9780784485262.081

[C.3] Hossein Naderi, **Reachsak Ly**, Alireza Shojaei(2024). **From Data to Value: Introducing an NFT-Powered Framework for Data Exchange of Digital Twins in the AEC Industry**. In *Construction Research Congress 2024*, pp. 299-308. American Society of Civil Engineers. 2024-03-18, Des Moines, Iowa. DOI: 10.1061/9780784485262.081

[J.3] Saeed Rokooei, Alireza Shojaei, **Reachsak Ly** (2024). **Faculty development program to enhance teaching quality in construction**. *International Journal of Construction Management* DOI: 10.1080/15623599.2024.2304475

[J.2] Alireza Shojaei, **Reachsak Ly** (2023), Saeed Rokooei, Amirsamman Mahdavian, Ahmed Al-Bayati **Faculty development program to enhance teaching quality in construction**. *Journal of Information Technology in Construction* DOI: 10.36680/j.itcon.2023.036

[J.1] Hossein Naderi, Alireza Shojaei, **Reachsak Ly** (2023). **Autonomous construction safety incentive mechanism using blockchain-enabled tokens and vision-based techniques**. *Automation in Construction*, Vol. 153 DOI: 10.1016/j.autcon.2023.104959

[S.3] **Reachsak Ly**, Alireza Shojaei (2024). **Decentralized autonomous organizations in Built Environments: Applications, Potentials and Limitations**. Manuscript submitted for publication in *Information Systems and e-Business Management Journal*.

[S.2] **Reachsak Ly**, Mohammad Hossein Heydari, Hossein Naderi, Josh Iorio, Alireza Shojaei (2024). **Investigation of Gender and Racial Diversity in U.S. Construction Higher Education**. Manuscript submitted for publication in *International Journal of Construction Education and Research*.

[S.1] Hassan Azad, Alireza Shojaei, Laurie M. Heller, **Reachsak Ly** (2024). **Assessment of annoyance from traffic noise inside a school and a hospital**. Manuscript submitted for publication in *Inter-Noise 2024 Conference*.

[C.2] Jiawei Zhang, Jiangpeng Shu , **Reachsak Ly**, Yiran Ji (2021). **Continual-learning-based framework for structural damage recognition**. In *The 10th International Conference on Structural Health Monitoring of Intelligent Infrastructure*, 2021-06-30-2021-07-02, Porto, Portugal.

[C.1] Jiawei Zhang, **Reachsak Ly**, Weijian Zhao, Yunyi Liu(2021). **Image-Based Structural Damage Recognition using Deep Convolutional Neural Networks**. In *Proceeding of the fib Symposium 2020 Concrete Structure for Resilience Society*, 2020-22-11-2020-24-11, Shanghai, China.

PROFESSIONAL SERVICES

[Workshop Organization]

Building Leaders for Advancing Science and Technology (BLAST) program

- Research demonstration on the integration of LLM-based AI agent and Augmented reality for smart building control to high school student from the (BLAST) program of the National space grant foundation. (Myers Lawson School of Construction July 09, 2024 Blacksburg, VA)

Virginia 4-H Youth development program

- Demonstration of Quadruped robots application in construction industry from my lab to the high school student in Virginia through the Virginia 4-H Youth development program.(Myers Lawson School of Construction June 19, 2024 Blacksburg, VA)

PRESENTATION

- **DT-DAO: Digital Twin and Blockchain-Based DAO Integration Framework for Smart Building Facility Management**. Presented at the Construction Research Congress 2024 . **(Presentation)**
- **Automatic Pixel-level Crack Detection and Evaluation of Concrete Structures using Crack Feature Pyramid Network**. Presented at the 1st International Project Competition in Structural Health Monitoring, 2021-08. **(Presentation)**
- **Continual-learning-based framework for structural damage recognition**. Presented at the 10th International Conference on Structural Health Monitoring of Intelligent Infrastructure, 2021-06. **(Presentation)**
- **Renovation proposal of Santa Clara Street in San Jose**. Presented at ASCE Mid-Pac 2019 Conference, 2019-04. **(Report) (Presentation)**

RESEARCH EXPERIENCE/ PROJECT

- **LLM-based AI agents and (XR) Extended Reality applications for smart building control** *01/24 – Present*
  Virginia Polytechnic Institute and State University Blacksburg, USA
  ◦ Developed LLM-based AI agents and extended reality (XR) applications to enhance smart building control, integrating AI-driven insights and immersive XR interfaces to optimize facility management and user interaction. **(Demo 1)** **(Demo 2)**

- **Blockchain-based IoT and Digital Twin for Decentralized Automation of Building Facilities Operation** *01/24 – Present*
  Virginia Polytechnic Institute and State University Blacksburg, USA
  ◦ Developed a blockchain-based IoT framework and digital twin model to automate and optimize building facilities operations, enhancing system efficiency and security. **(Demo 1)** **(Demo 2)** **(Demo 3)**

- **Large Language Model for Human-Building Interaction** *01/24 – Present*
  Virginia Polytechnic Institute and State University Blacksburg, USA
  ◦ Designed and implemented a large language model to facilitate natural language interactions between building occupants and facility management systems, improving user experience and system responsiveness. **(Demo)**

- **LLM-based Retrieval-Augmented Generation (RAG) Chatbot for Construction Safety** *01/24 – Present*
  Virginia Polytechnic Institute and State University Blacksburg, USA
  ◦ Created a retrieval-augmented generation (RAG) chatbot utilizing LLM to provide real-time safety information and guidance on construction sites, enhancing safety protocols and worker awareness. **(Demo)**

- **Vision-based Language Model for Construction Site Progress and Safety Monitoring** *01/24 – Present*
  Virginia Polytechnic Institute and State University Blacksburg, USA
  ◦ Developed a vision-based language model to monitor construction site progress and safety conditions, integrating computer vision and natural language processing for comprehensive site analysis. **(Demo 1)** **(Demo 2)**

- **Data-driven and Distributed Governance for Smart Building Facilities Management** *01/24 – Present*
  Virginia Polytechnic Institute and State University Blacksburg, USA
  ◦ Implemented a data-driven governance model using distributed ledger technologies to manage and automate smart building facilities, focusing on transparency, accountability, and decentralized decision-making.**(Demo)**

- **Small Language Models for Human-Building Interaction** *01/24 – Present*
  Virginia Polytechnic Institute and State University Blacksburg, USA
  ◦ Developed and evaluated small language models to enhance human-building interaction, optimizing communication and control interfaces for smart building systems. **(Demo)**

- **AI Agent for Smart Building Emergency Response** *01/24 – Present*
  Virginia Polytechnic Institute and State University Blacksburg, USA
  ◦ Created an AI agent for emergency response in smart buildings, integrating real-time data analysis and decision-making capabilities to improve response times and safety measures.

- **Smart and Autonomous Building Cyber-Physical System with LLM and DAO** *01/24 – Present*
  Virginia Polytechnic Institute and State University Blacksburg, USA
  ◦ Developed and evaluated a smart, autonomous cyber-physical system incorporating LLM and decentralized autonomous organization (DAO) technologies to facilitate advanced human-building interaction and management.

- **Community-based Facilities Management in Smart Buildings Using Blockchain-based DAO** *01/24 – Present*
  Virginia Polytechnic Institute and State University Blacksburg, USA
  ◦ Implemented a blockchain-based DAO system for community-based management of smart buildings, promoting decentralized governance and stakeholder engagement in facilities management.

- **LLM-based AI Agent for Construction Site Safety Monitoring** *01/24 – Present*
  Virginia Polytechnic Institute and State University Blacksburg, USA
  ◦ Developed an LLM-based AI agent for monitoring construction site safety, incorporating real-time data analysis and contextual understanding to enhance safety protocols and hazard detection.

- **AI assistant with Khmer language using large language model** *01/24 – Present*
  Virginia Polytechnic Institute and State University Blacksburg, USA
  ◦ Developed an LLM-based AI assistant for khmer language.**(Demo)**

- **Automatic Pixel-level Crack Detection using Crack Feature Pyramid Network** *06/20 – 09/20*
  Virginia Polytechnic Institute and State University Hangzhou, China
  ◦ Applied Feature Pyramid Network in image-based identification of fatigue cracks in bridge girders.

- **A Continual Learning-Based CNN Framework for Damage Recognition** *06/20 – 01/21*
  Virginia Polytechnic Institute and State University Hangzhou, China
  ◦ Developed a novel training framework for deep learning models for recognition tasks, specifically designed for models requiring multiple recognition task features with ResNet-34

- **Structural Damage Recognition using Learning Without Forgetting** *11/20 – 04/21*
  Virginia Polytechnic Institute and State University Hangzhou, China

◦ Structural damage classifications (damage level evaluation, damage type identification, spalling condition check, damage type identification) using deep learning and the Learning Without Forgetting technique.

- **Image-Based Structural Damage Recognition using DCNN** *01/20 – 03/20*
  Virginia Polytechnic Institute and State University Hangzhou, China
  ◦ Utilized transfer learning by using pretrained ResNet-34 architecture with a local dataset for crack detection.

- **ASCE Mid-Pac 2019 Conference Transportation Challenge (San Jose State University)** *09/18 – 04/19*
  Virginia Polytechnic Institute and State University Hangzhou, China
  ◦ Applied methods of intersection design, geometric design, pavement design, surveying, and drafting techniques in planning and designing the alignment design, sight triangle, street cross-sections, profile design, and bus stop design while maintaining a reasonable cost for a proposal for the renovation of Santa Clara Street in San Jose

- **AISC Student Steel Bridge Competition 2020 (UC Berkeley)** *09/19 – 01/20*
  Virginia Polytechnic Institute and State University Hangzhou, China
  ◦ Applied methods of intersection design, geometric design, pavement design, surveying, and drafting techniques in planning and designing the alignment design, sight triangle, street cross-sections, profile design, and bus stop design while maintaining a reasonable cost for a proposal for the renovation of Santa Clara Street in San Jose

- **Microsoft Hackathon: Window App Studio Challenge)** *03/16*
  Virginia Polytechnic Institute and State University Phnom Penh, Cambodia
  ◦ Designed a mobile and window application using Microsoft Visual Studio.

SKILLS

- **Languages:** English, Chinese, Khmer
- **Programming Languages:** Python, CSharp, Javascript, Java, HTML/CSS, Solidity, C++
- **Web Technologies:** React.js, Node.js, Express.js, RESTful APIs, Flask, WebSockets
- **Database Systems:** MySQL, MongoDB, Qdrant, ChromaDB
- **Data Science & Machine Learning:** TensorFlow, PyTorch, Scikit-Learn, Pandas, NumPy, Matplotlib, MLX, Cuda
- **Specialized Area:** Large language models, Blockchain Development, Smart Contracts, Digital Twin Technology, AR/XR Development
- **Mathematical & Statistical Tools:** MATLAB, R, JMP
- **Other Tools & Technologies:** Docker, Git/GitHub, LaTeX

Last updated on August 25, 2024