

Course Title: Research Methodology in Computer Science

Course Code: AI800

Weighting: 30 %

Lecturer: Dr. Mohammed Anbar

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Assignment Report 2: Leverage computer science and artificial intelligence for optimizing energy systems.

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Problem statement

The integration of AI and ML technologies across the energy and manufacturing sectors presents many challenges that hinder implementation and optimization in a realistic manner. Relying on CV and MV for real-time quality control raises concerns due to the lack of sufficient data to detect defects and increase the error rate, while the complexity of integrating AI with the manufacturing workflow poses logistical and technical barriers that may deter organization from adopting this field.

In the energy sector, the shift from conventional energy (i.e., fossil fuel) to renewable energy sources is of paramount importance due to concerns about energy security and climate change. However, this shifting is complicated by self-sufficiency issues, especially in coal-dependent regions such as Poland. Here, challenges arise on intermittent energy production and its limitation. Green hydrogen stands out as a potential solution, but its effective integration with AI to improve production, storage and management tools are still under exploration. In addition, its consumption is a challenge that raises ethical concerns that require a focus on sustainable practices in AI development.

In addition, although the developments in the fields of AI and ML have shown promising results in improving energy systems and improving developmental modeling in materials science, the need for a deeper exploration of concepts and techniques that will contribute to the study of the current literature and their practical application has become essential to provide insights and effective strategic solution to overcome the challenges in this field.

Research Objective:

- 1- To Strengthen Quality Control in Manufacturing: It's necessary to Improve defective detection rates and reduce the error rate, by exploring the applications of CV and MV technology in quality control process.
- 2- To Study of hydrogen integration with AI: study the potential of green hydrogen as a major resource to enhance sustainability and self-sufficiency of energy. The research will focus on how to enable the improvement of hydrogen production, storage and monitoring methods, and address the challenges facing the consumer sector dependent on traditional energy.
- 3- To ease energy systems through AI: to help the transition to renewable energy and improve system efficiency, it is necessary to analyze the potential of technologies to enhance energy production distribution and consumption.
- 4- To promote sustainable AI practices: to promote eco-friendly AI practitioners that reduce carbon emissions, it is necessary to evaluate the energy composition and efficiency of ML algorithms, especially decision trees.
- 5- To use predictive modeling in materials science: AI techniques should be used to enhance modeling to make energy conversion in organic solar cells more efficient, to offer valuable insights into the factors affecting their efficiency.

In end, AI and renewable energy technologies offer greet potential to revolutionize various sectors. In manufacturing, they can improve quality control, and in energy, they can facilitate the transition to renewable, improve systems, and reduce carbon emission. To maximize the benefits and mitigate the risks. Sustainable AI practices are essential.

Reference

- 1- AI and Computer Vision-based Real-time Quality Control: A Review of Industrial Applications - ScienceDirect 2024**
- 2- Use of hydrogen and AI as an opportunity to increase energy autarky and create more sustainable business - ScienceDirect 2023**
- 3- Energy and AI - ScienceDirect 2020**
- 4- (PDF) Performance and Energy efficiency Analysis of Machine Learning algorithms Towards Green AI: a case study of decision tree algorithms 2021**
- 5- Energetics Systems and artificial intelligence: Applications of industry 4.0 - ScienceDirect 2022**
- 6- Enhancing predictive modeling of photovoltaic materials' solar power conversion efficiency using explainable AI - ScienceDirect. 2024**