



IEEE IES Tunisia Section Chapter & IEEE SMCS Tunisia Section Chapter & IEEE EdSoc Tunisia Section Chapter

TSYP 12 TECHNICAL CHALLENGE

Chess Coach Robot:

A Personalised Learning Experience for Young Students

Welcome to **Tunisia 2056**, where education meets innovation. In the Chess Coach Robot challenge, we're creating a personalized learning experience for young students, using robotics to teach chess in an engaging and interactive way, shaping the next generation of strategic thinkers in Tunisia.

SCOPE & TOPIC:

Developing a Chess Coach Robot that fosters sustainability, safety, and technological innovation in the education of young students (K-12).



PROBLEM:

While robotics has revolutionised numerous sectors by overcoming human physical limitations, its predominant application remains in industry. Surprisingly, its integration into education has been limited. This challenge project seeks to address this gap by creating an engaging robotic arm for students, serving as a chess coach. This innovative device will use a camera for real-time visualisation and leverage AI to autonomously move chess pieces on the chessboard and enhance the learning process of students while playing chess.

GOALS:

To develop an efficient Chess Coach Robot able to assist young students in identifying their mistakes and offer them realistic practice, suggestions and advice during games to make better decisions. It should evaluate positions on the chessboard to teach strategic and tactical principles and offer immediate feedback to students through a real-time interaction.

INSTRUCTIONS & DELIVERABLES:

Students have two choices:

- To develop a Robotic Arm from scratch.
- OR to Assess and evaluate the capabilities of an existing Robotic Arm.

Participants who wish to examine the existing chess coach robot and review the current energy system can contact the IEEE IES Tunisia chapter officers via ies.tn@ieee.org. They will facilitate visits and provide access to the chess coach robot for participants interested in evaluating the current energy system and robot models. This contact information allows participants to easily arrange visits and gather insights for their energy optimization proposals. It's important to encourage direct engagement with the robots to foster innovation and informed decision-making this critical aspect of the challenge.

The project has 4 main phases and the following are the required instructions:

- **Phase 1: Chess Robot Construction (IES topic).**
 - **Energy Optimization:** Explore renewable energy sources, and consider the integration of the "Smart Sunflower" for intelligent energy harvesting.

- Chess Coach Robot Model Enhancement: Identify and select superior construction materials and enhance safety features for students.

- **Phase 2: Human-machine Systems (SMCS topic).**

Integrate AI algorithms to:

- Track state of the game via camera.
- Calculate the optimal move using decision-making algorithm.
- Detect illegal moves and suggest pick-and-place task.
- Evaluate the developed system in a real-time setup.

- **Phase 3: Student Learning Outcomes (EdSoc topic).**

Teach student strategic and tactical principles to create a system that enables personalised learning experiences based on the student performance using machine learning techniques:

- Create a data pipeline for downloading and processing the data efficiently.
- Implement classification models to predict the outcome of chess games.
- Analyse the results of the models and clusters to determine their usefulness in isolation.
- Evaluate the models and clusters to determine their usefulness in providing insights into patterns in chess games (how successful were they, what were their limitations, and how can we improve them?)

- **Selected teams will advance to the next phase.**

- **Phase 4: Strategic direction and financial structure of the project.**

- Develop a comprehensive Business Model Canvas (BMC) for the chess coach robot project.
- Budgeting: Create a consolidated budget plan for the entire project, encompassing all phases.
- Selected teams submit a 5-minute presentation.
- Each team should submit a PDF document containing a detailed description of their project development organised in phases. This document should be structured in a clear and organised manner to facilitate evaluation.
- Participants are expected to provide a link to a public GitHub repository containing their code, datasets, and any additional resources necessary for the replication and review of their work.
- From 1 to 5 min video of Live Demo.
- Language should be the same for all communication supports (written and verbal).

REFERENCES:

- [1] R. McIlroy-Young, R. Wang, S. Sen, J. Kleinberg, and A. Anderson, 'Learning Models of Individual Behavior in Chess', in Proceedings of the 28th ACM SIGKDD Conference on Knowledge Discovery and Data Mining, in KDD '22. New York, NY, USA: Association for Computing Machinery, Aug. 2022, pp. 1253–1263. doi: 10.1145/3534678.3539367.
- [2] L. Yong, Z. Zhan, X. Zou, L. Chen, Z. Lin, and W. Zhan, 'Applying a Blended Board Game System with Robotic Arm for Training Computational Thinking: Learning through Human-Machine Competition', in Proceedings of the 7th International Conference on Education and Multimedia Technology, in ICEMT '23. New York, NY, USA: Association for Computing Machinery, Dec. 2023, pp. 74–81. doi: 10.1145/3625704.3625766.
- [3] Cheng, Isaac, and Chico Camargo. "Machine Learning to Study Patterns in Chess Games." 2023.
- [4] Zhang, Renchi, et al. "An Open-Source Reproducible Chess Robot for Human-Robot Interaction Research." arXiv preprint arXiv:2405.18170 (2024).
- [5] Peter Forbrig, Alexandru Bunde, Ann Pedersen & Thomas Platz, "Digitalization of Training Tasks and Specification of the Behaviour of a Social Humanoid Robot as Coach", International Conference on Human-Centred Software Engineering (2020).
- [6] Uludag, Kadir, "Accusations of Cheating in Chess and Relevant Psychological Factors: Innocent Until Proven Guilty Unless You are World Champion" (June 30, 2023). Available at SSRN: <https://ssrn.com/abstract=4496354> or <http://dx.doi.org/10.2139/ssrn.4496354>.
- [7] Gaessler, F., & Piezunka, H. (2023). Training with AI: Evidence from chess computers. Strategic Management Journal, 44(11), 2724–2750. <https://doi.org/10.1002/smj.3512>.
- [8] Bozhinovski, A. , & Jankuloski, F.(2020). Chess as Played by Artificial Intelligence. ICT Innovations conference 2020. ISSN 1857-7288; <http://hdl.handle.net/20.500.12188/9487>.
- [9] Yuan, Q., Chen, K., Yang, Q., Pan, Z., Xu, J., & Yao, Z. (2023). Exploring Intuitive Visuo-Tactile Interaction Design for Culture Education: A Chinese-Chess-Based Case Study. International Journal of Human–Computer Interaction, 40(8), 2099–2119. <https://doi.org/10.1080/10447318.2023.2223863>.
- [10] Karvonen, A. (2024). Emergent world models and latent variable estimation in chess-playing language models. arXiv preprint arXiv:2403.15498.

RULES & CRITERIA:

This challenge is for SBs only, any SB can participate in this challenge, each SB is represented by one team, with a minimum of **3** participants and a maximum of **6** participants per team.

All the teams must have at least one member from each society (IES, SMCS and EdSoc).

SUBMISSION:

Deliverables are highlighted above, and submitted by filling out this [form](#).

PITCHING DURATION:

5 minutes + **5** minutes (Q&A) + **5** minutes (Live demo)

PITCHING LANGUAGE:

English

Français

العربية

SCORING:

Total score: 100 points

- Pre-selection:
 - Phase 1: Chess Robot Construction **[30 pts]**
 - Energy Optimization: **15 pts**
 - Chess Coach Robot Model Enhancement: **15 Pts**
 - Phase 2: Human-Machine Systems **[30 pts]**
 - Phase 3: Student Learning Outcome **[30 pts]**
- Final selection:
 - Phase 1: Chess Robot Construction **[20 pts]**
 - Phase 2: Human-Machine Systems **[20 pts]**
 - Phase 3: Student Learning Outcome **[20 pts]**
 - Phase 4: Strategic direction and financial structure of the project **[10 pts]**
 - Business Model Canvas (BMC): **5 pts**
 - Budgeting: **5pts**
 - Presentation and Q&A quality **[30 pts]**
 - Live demo **(Bonus)**: Participants with live demo will be favoured in case of execo scores

WINNERS:

- Number of winners: **3** teams
- Each participant in the selected projects will receive a certificate of participation in his/her name.

- Prize:
 - Award Certificate for the 3 best Projects.
 - Surprise Gift.
 - Coaching for Student Paper Contest Participation.
 - Guidance for Competing in International Challenges and Competitions.

IMPORTANT DATES:

- Initial submission deadline: **20/11/2024 at 23:59**



Please contact us through the following email address
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or **abir.abid@ieee.org** for any inquiries
or clarifications.