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## THE 13TH INTERNATIONAL INNOVATION, INVENTION & DESIGN COMPETITION 2024

## EXTENDED ABSTRACTS

### e-BOOK

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## THE 13th INTERNATIONAL INNOVATION, INVENTION & DESIGN COMPETITION 2024

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# SILAT-AI: TRANSFORMING SILAT GAYONG TRAINING WITH AI-ENHANCED POSE DETECTION

Ahmad Suffian Muhammad Shahril[1], Pradeep Isawasan[2*],
Ong Song-Quan[3], Khairulliza Ahmad Salleh[4]

[1,2,4]Department Computing Studies, Universiti Teknologi MARA (UiTM),
Perak Branch, Tapah Campus, Malaysia

[3]Institute for Tropical Biology and Conservation (ITBC), Universiti Malaysia
Sabah (UMS), Malaysia

*pradeep@uitm.edu.my

## ABSTRACT

The Silat-AI innovatively applies artificial intelligence (AI) to enhance the training of Silat Gayong, a traditional Malaysian martial art. This web-based system uses a camera to capture and analyze practitioners' movements in real time. By employing machine learning models, specifically Random Forest, the system achieves high accuracy in recognizing and classifying martial arts techniques. This not only modernizes the learning experience but also makes Silat training more accessible and appealing to today's learners, blending traditional practices with modern technology.

*Keyword:* artificial intelligence, machine learning, pose landmark detection, classification, silat gayong

## 1. INTRODUCTION

Silat-AI is a web-based system that modernizes the traditional Malaysian martial art, Silat Gayong, by leveraging advanced AI. This innovative educational tool uses real-time pose detection and machine learning algorithms, specifically Random Forest, to automate the classification of martial arts techniques. Unlike other Augmented Reality (AR)-based training aids in Silat Pencak (Muktiani et al., 2022) and Taekwondo (Kim et al., 2021) that focus on visual augmentation, Silat-AI provides instant feedback and detailed technique analysis (Refer Table 1 for comparison).

This approach not only enhances the precision of technique execution but also makes learning more dynamic and accessible, particularly to the younger generation who may find traditional methods less engaging. By integrating AI technology with cultural education, Silat-AI preserves traditional practices while adapting them to modern educational preferences, setting a new standard in martial arts training.

**Table 1** Innovation in Martial Arts Training: Silat-AI vs. Augmented Reality Systems

| Feature | Silat-AI | AR-based Training Systems |
|---|---|---|
| Technology Used | Utilizes advanced machine learning algorithms and real-time pose detection. | Primarily uses augmented reality for visual enhancements. |
| Feedback Mechanism | Provides immediate, data-driven feedback on techniques based on precise movement analysis. | Feedback is often visual and not based on real-time movement analysis. |

| Learning Adaptability | Adapts to the individual's performance and provides tailored feedback and training suggestions. | Generally, provides a standard training experience without customization to individual needs. |
| --- | --- | --- |
| Technological Innovation | Use machine learning, namely Random Forest models for martial arts technique recognition and classification. | Often utilize less advanced or different types of technology, such as basic AR. |

## 2. METHODOLOGY

The Silat-AI utilizes Agile methodologies and Machine Learning Life Cycle (MLLC) techniques to create a web-based system for classifying Silat techniques, increasing flexibility and responsiveness through iterative development stages (Al-Zewairi et al., 2017; Al-Saqqa et al., 2020; Ashmore et al., 2021). The system architecture, as shown in Figure 1, features a webcam that captures practitioners' movements, which are then converted into keypoint landmarks for analysis. These data points are stored and processed via a Random Forest model. A Flask-based interface, using the MediaPipe library, provides real-time feedback on users' poses, facilitating immediate posture correction and technique refinement.
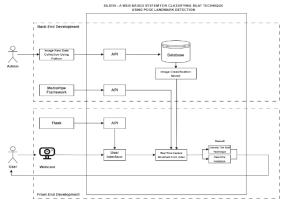


**Figure 1** System Architecture of Silat-AI System.



**Figure 2** Volunteer performing Silat Gayong.

The Silat-AI employs a uniquely designed outdoor setup (Figure 2) to capture the intricate movements of Silat practitioners, enhancing the precision of Silat techniques classification. Utilizing a laptop equipped with a high-resolution camera, the setup is strategically placed in a park setting to leverage natural lighting and open space, which are critical for clear and unobstructed video capture. This environment not only mimics the traditional settings where Silat is often practiced but also provides a familiar and comfortable space for practitioners.

A skilled practitioner from Pertubuhan Silat Seni Gayong Malaysia Kebangsaan performed various Silat techniques for the data collection process. Using a real-time video feed processed by the MediaPipe library, the system applied pose estimation technology to accurately track 33 key points on the practitioner's body. These keypoints, representing essential joints and limbs, allowed the creation of a detailed skeletal model capturing the full range of motion for each technique. Figure 3 below provides an example of the "Tumbuk Lurus Pintal Tali" technique.

**Figure 3** "Tumbuk Lurus Pintal Tali" Keypoint Landmarks

## 3.     MODEL PERFORMANCE

The "Tumbuk Lurus Pintal Tali" technique's performance evaluation using the Silat-AI system demonstrates strong results from advanced classification models. The Random Forest and KNN models both show high levels of accuracy and precision (0.9884 and 0.9900, respectively), proving their robustness in technique classification. The Decision Tree, though slightly less consistent, also registers good performance metrics with an accuracy of 0.9654 and precision of 0.9717. These findings, detailed in Table 3, underscore the system's effectiveness in leveraging complex algorithms to ensure precise and reliable technique classification.

**Table 2** Performance of The SilatAI Model

| Classification Model Report | Accuracy Score | F1-Score | Precision | Recall |
|---|---|---|---|---|
| Random Forest | 0.9884 | 0.9900 | 0.9900 | 0.9833 |
| Decision Tree | 0.9654 | 0.9583 | 0.9717 | 0.9417 |
| KNN | 0.9884 | 0.9900 | 0.9900 | 0.9900 |

## 4.     CONCLUSION

Silat-AI demonstrates innovation in martial arts training by integrating artificial intelligence with traditional Silat Gayong practices. This web-based system not only modernizes martial arts education but also provides a dynamic learning tool that offers precise, real-time feedback through advanced pose detection technology. By making Silat training more accessible and engaging, Silat-AI caters to the needs of today's learners and preserves cultural heritage through cutting-edge educational methodologies. This makes Silat-AI a benchmark for how AI can enhance and transform traditional educational practices.

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