Animation Game Engine For Interactive Presentation Of Educational Media

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Highlights

The goal is to develop a flexible and interactive animation engine for educational media using the Godot Engine and GDScript. Traditional educational tools lack interactivity, adaptability, and real-time feedback, leading to passive learning experiences. Static materials struggle to convey dynamic processes, making it difficult for learners to grasp abstract concepts.

- Develop a lightweight, accessible animation engine using Godot Engine and GDScript for dynamic educational media.
- Provide keyframe-based animations for smooth and effective visualization of complex concepts.
- Offer an intuitive scripting interface for easy content creation by educators.
- Integrate interactive elements such as quizzes, variable manipulation, and real-time feedback to enhance learner engagement.
- Enable real-time tracking and analysis of learner interactions to personalize learning experiences.
- Ensure compatibility with low-end devices to promote broad accessibility and democratize interactive learning.

Dataset Description

Josephus:- The dataset consists of Player Name, Total People, Wrong Moves, and Timestamp.

Towers Of Hanoi:-The dataset consists of Player, Disks, Moves Taken, Minimum Moves, Solution Status, and Timestamp.

N-Queens:-The dataset consists of Player Name, Board Size, Moves Taken, Result, and Timestamp.

Dutch National Flag:-The dataset consists of Player, Score, Result, and Timestamp.

Proposed Model

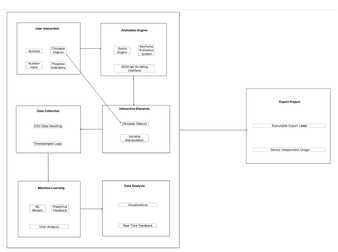

Figure 1. Architecture Diagram

Performance Analysis

Metric	Value
Mean Absolute Error (MAE)	0.06
Mean Squared Error (MSE)	0.01
Root Mean Squared Error (RMSE)	0.12
R-squared (R^2 Score)	1.00

Table 1. Performance Metrics for Dutch National Flag Algorithm using Random Forest Regressor

Decision Tree Classifier				
Class	**Precision**	**Recall**	**F1-Score**	**Support**
Keep trying	0.94	1.00	0.97	17
Solved!	1.00	0.75	0.86	4
Accuracy	-	-	0.95	21
Macro avg	0.97	0.88	0.91	21
Weighted avg	0.96	0.95	0.95	21

Table 2. Classification Report for Tower of Hanoi using Decision Tree Classifier

SVM Classifier				
Class	**Precision**	**Recall**	**F1-Score**	**Support**
Keep trying	0.86	0.35	0.50	17
Solved!	0.21	0.75	0.33	4
Accuracy	-	-	0.43	21
Macro avg	0.54	0.55	0.42	21
Weighted avg	0.73	0.43	0.47	21

Table 3. Classification Report for Tower of Hanoi using SVM Classifier

Metric	Precision	Recall	F1-Score	Support
Accuracy	-	-	0.94	31
Macro Avg	0.73	0.77	0.75	31
Weighted Avg	0.91	0.94	0.92	31

Table 4. Classification Report Summary for Josephus Problem using Random Forest Regression

Class	Precision	Recall	F1-Score	Support
0 (Correct Placement)	0.70	0.59	0.64	27
1 (Invalid Placement)	0.39	0.50	0.44	14
Accuracy	-	-	0.56	41
Macro Avg	0.54	0.55	0.54	41
Weighted Avg	0.59	0.56	0.57	41

Table 5. Classification Report for N-Queens Problem using Decision Tree Classifier

Performance Analysis Conclusions

- **Dutch National Flag (DNF) Algorithm**
  - Achieved excellent performance using Random Forest Regressor with an **R^2 score of 1.00**, indicating perfect prediction.
  - Errors (**MAE: 0.06, MSE: 0.01, RMSE: 0.12**) are minimal, confirming high accuracy.
- **Tower of Hanoi**
  - **Decision Tree Classifier** performed well with **95% accuracy**, with high precision and recall for successful solutions.
  - **SVM Classifier** showed **poor performance (43% accuracy)** due to imbalance in class predictions, making it less reliable.
- **Josephus Problem**
  - **Random Forest Regression** delivered **94% accuracy**, with strong weighted averages (Precision: 0.91, Recall: 0.94, F1-score: 0.92).
  - The model effectively distinguishes correct patterns in the problem.
- **N-Queens Problem**
  - **Decision Tree Classifier** achieved **56% accuracy**, with precision differences between correct (0.70) and incorrect placements (0.39).
  - Moderate classification performance suggests scope for improvement.
- **Overall Conclusion**
  - Decision Trees and Random Forest perform well, while SVM struggles.
  - Performance varies across problems, requiring model selection based on task complexity.

Inferences

- Develops an interactive animation engine using Godot Engine and GDScript.
- Facilitates creation of keyframe-based animations to visualize dynamic, complex processes.
- Embeds interactive components like quizzes, clickable objects, and variable manipulation.
- Tracks learner interactions in real time and records data in CSV format for analysis.
- Integrates machine learning models to classify learner performance and provide predictive feedback.
- Exports the educational content as standalone executable files compatible with multiple platforms.
- Ensures smooth performance on low-end hardware, promoting broad accessibility.
- Allows educators to create engaging content without deep programming expertise.