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# Flappy Bird AI using Reinforcement Learning

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**ABSTRACT:** This project introduces an AI-enhanced version of the classic Flappy Bird game by integrating real-time hand and face detection as the primary control mechanism. Using MediaPipe and OpenCV, the system captures webcam input to detect gestures such as hand raises, head movements, or facial expressions, which are then mapped to in-game actions like flapping. Unlike the traditional keyboard- or touch-controlled gameplay, this model provides a contact-free and interactive gaming experience. The system is developed using Python and Pygame, supported by an OOAD design approach and UML modeling. The proposed solution enhances accessibility, user engagement, and demonstrates the application of computer vision and AI in intuitive human-computer interaction. This project highlights the potential of gesture-controlled gaming systems and serves as a foundation for future adaptive and intelligent game designs.

## I. INTRODUCTION

The project titled “*Flappy Bird AI Using Reinforcement Learning*” presents an innovative approach to enhancing traditional gaming by integrating Artificial Intelligence and Computer Vision techniques. Unlike the conventional Flappy Bird game that relies on keyboard or touch inputs, this system introduces a contact-free, gesture-based control mechanism using real-time hand and facial detection. By utilizing technologies such as MediaPipe, OpenCV, and Pygame, the system captures and interprets user gestures through a webcam and maps them to in-game actions like flapping the bird. This approach not only improves user interaction and engagement but also promotes accessibility and hygienic, touchless gameplay. The project demonstrates how modern AI-driven human-computer interaction can transform simple games into intelligent, immersive experiences, paving the way for future advancements in gesture-controlled applications.

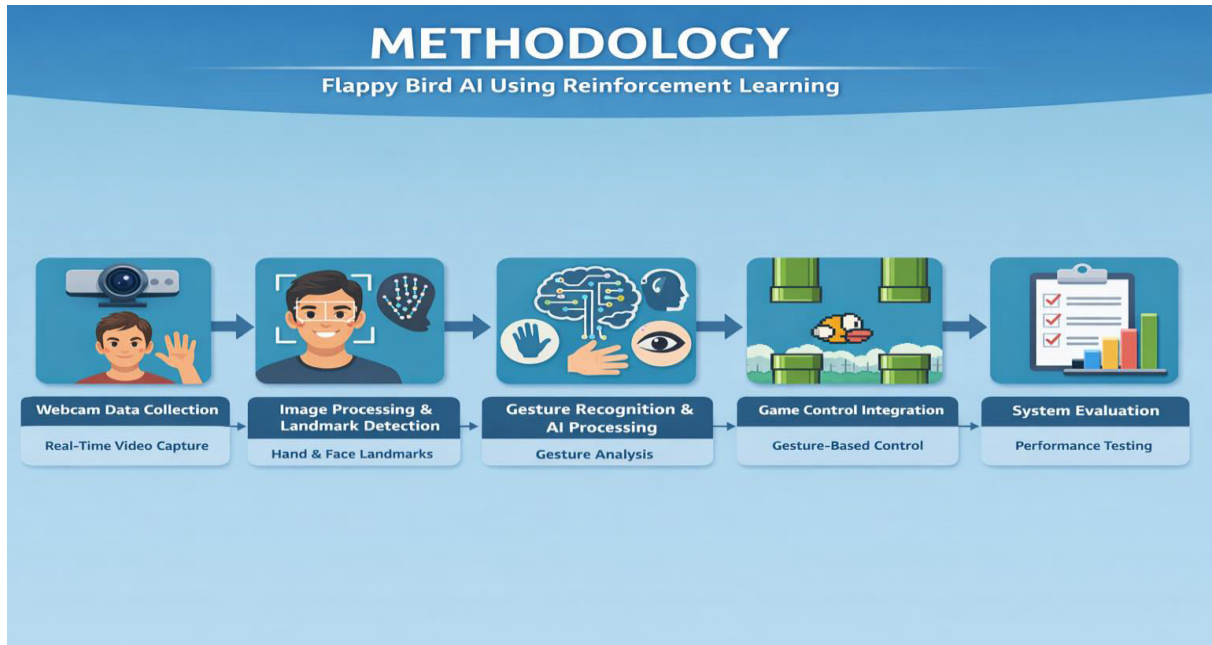
## II. EXISTING SYSTEM

The existing Flappy Bird system is a simple 2D game that operates using traditional input methods such as keyboard keys or touchscreen taps. In this system, the player controls the bird by pressing a key (like the spacebar) or tapping the screen to make the bird flap and avoid obstacles. The gameplay is completely manual and follows fixed rules without any form of intelligence or adaptability. It does not support gesture recognition, facial detection, or any kind of AI-based interaction. Additionally, the system depends entirely on physical contact with input devices, which limits user interaction and accessibility. There is no use of computer vision or real-time data processing, making the experience less immersive and less interactive. Overall, the existing system is simple and effective but lacks modern features like touchless control, intelligent input processing, and enhanced user engagement.

## III. PROPOSED SYSTEM

The proposed system introduces an advanced version of the Flappy Bird game by integrating Artificial Intelligence and Computer Vision techniques to enable gesture-based control. Unlike the traditional system, this model uses a webcam to capture real-time video input and detect user gestures such as hand movements, head tilts, eye blinks, and facial expressions using MediaPipe and OpenCV. These detected gestures are processed and mapped to in-game actions like flapping the bird, allowing completely touchless interaction. The system is implemented using Python and Pygame, ensuring smooth gameplay and real-time responsiveness. This approach enhances user engagement, provides a more natural and interactive gaming experience, and improves accessibility for users with limited mobility. Overall, the proposed system transforms a simple game into an intelligent, contact-free, and immersive application by combining AI-driven gesture recognition with traditional game mechanics.

#### IV. METHODOLOGY



##### i. Webcam Data Collection

This module is responsible for capturing real-time video input using the system's webcam. It continuously collects frames that contain the user's hand and facial movements. The collected data is essential for detecting gestures and serves as the primary input to the system. Additionally, the module ensures proper frame resolution and consistency for accurate processing in subsequent stages.

##### ii. Image Processing and Landmark Detection

The Image Processing Module uses OpenCV to preprocess the captured video frames by resizing, flipping, and converting them into suitable formats. These processed frames are then passed to MediaPipe, which detects hand and facial landmarks with high accuracy. The module ensures reliable detection even under varying lighting conditions and prepares structured landmark data for gesture recognition.

##### iii. Gesture Recognition and AI Processing

The Gesture Recognition Module analyzes the detected hand and face landmarks to identify specific gestures such as hand raise, head movement, eye blink, or smile. Based on predefined logic and AI-based processing, the system interprets these movements as valid inputs. This module plays a key role in converting human gestures into meaningful commands, enabling natural human-computer interaction.

##### iv. Game Control Integration

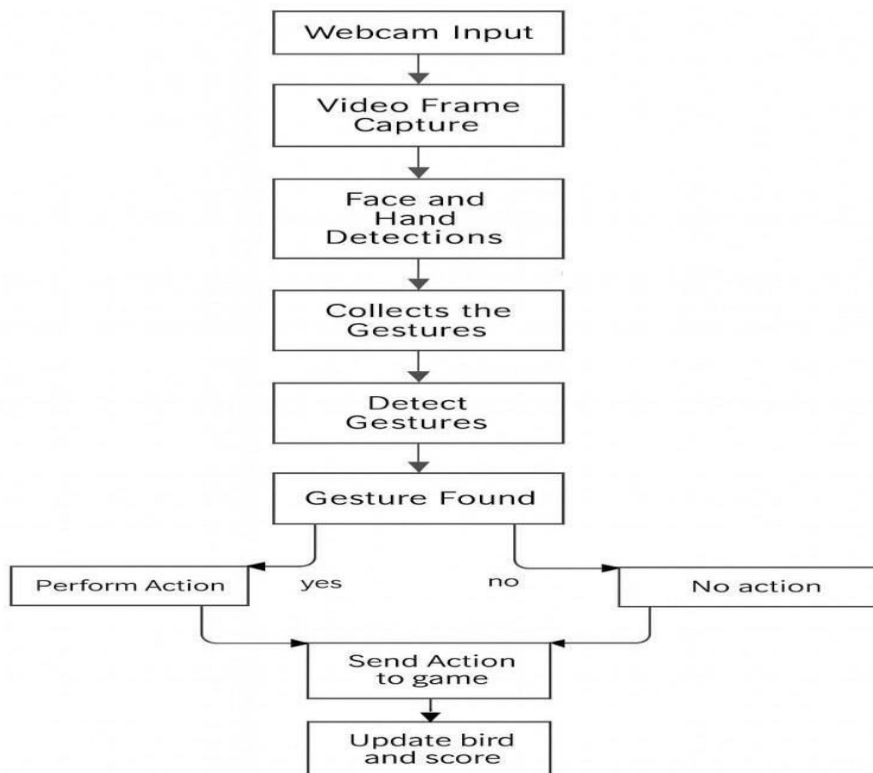
The Game Control Module maps the recognized gestures to corresponding in-game actions. For example, a hand raise or head tilt triggers the bird to flap. This module interacts directly with the Pygame engine to control bird movement, update game physics, and handle collisions. It ensures real-time responsiveness so that the gameplay remains smooth and interactive.

##### v. System Evaluation

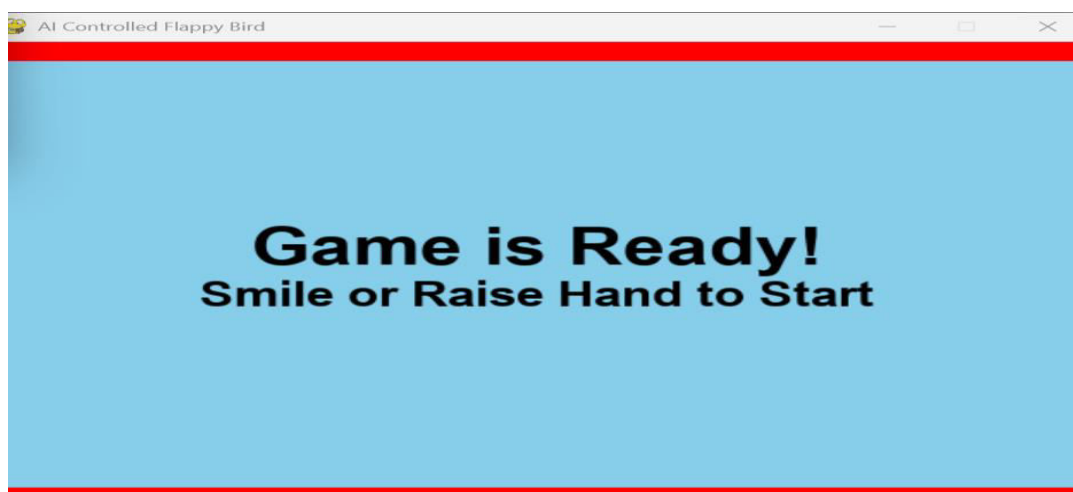
The System Evaluation Module measures the performance and efficiency of the proposed system. It evaluates factors such as gesture detection accuracy, response time, and gameplay smoothness. The system is tested under different conditions to ensure reliability and robustness. User experience and interaction quality are also analyzed to confirm that the system provides an engaging and effective touchless gaming experience.

### V. SYSTEM ARCHITECTURE

The system architecture consists of multiple modules that work together to enable gesture-based gameplay. The webcam captures real-time video input, which is processed using OpenCV. MediaPipe is then used to detect hand and facial landmarks. These landmarks are analyzed in the gesture recognition module to identify user gestures. The recognized gestures are mapped to game actions through the game control module. Finally, the Pygame engine updates the game and displays the output on the screen in real time.

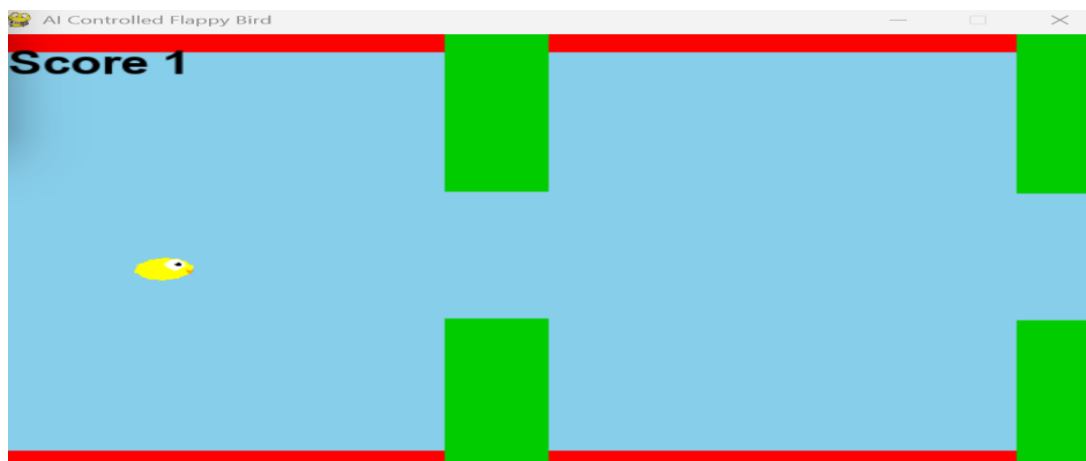


### VI. RESULTS AND OUTPUT





GAME SCREEN DISPLAY



SCORE UPDATION



GAME OVER SCREEN

## VII. CONCLUSION

The project “*Flappy Bird AI Using Reinforcement Learning*” successfully demonstrates the integration of Artificial Intelligence and Computer Vision into a traditional 2D game to create a modern, touchless gaming experience. By utilizing MediaPipe for real-time hand and facial detection and OpenCV for image processing, the system enables users to control the game using natural gestures instead of conventional input devices. The implementation using Python and Pygame ensures smooth gameplay and real-time responsiveness. This project enhances user interaction, improves accessibility, and provides an engaging and hygienic interface. Overall, it highlights the potential of gesture-based systems in gaming and opens opportunities for future advancements in AI-driven human–computer interaction.

## VIII. FUTURE SCOPE

The proposed system can be further enhanced by incorporating more advanced gesture recognition techniques using deep learning models to improve accuracy under different lighting and background conditions. Additional gesture controls can be introduced for functions such as pause, restart, and speed adjustment to make the gameplay more interactive. The system can also be extended to support voice commands along with gestures for a more flexible user experience. Furthermore, multiplayer functionality can be added, allowing multiple users to interact with the game simultaneously. The graphical interface and game design can be improved to provide a more immersive experience. In the future, this gesture-based control system can be applied to other games, virtual reality environments, educational tools, and assistive technologies, making it a versatile application of AI-driven human–computer interaction.

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