Project Roadmap

Objective

- Develop robust AI solution to interpret body cues and facial expressions of players to analyze emotional and psychological states in real time.

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1. Data Collection

A. Video Footage Acquisition

- **Target Sports:**
    - Selected a diverse range of College Division 1 Basketball and NBA G League videos on YouTube to gather varied data.
- **Data Source(s):**
    - YouTube
- **Diversity Considerations:**
    - Ensured a diverse sample of player selection

B. Annotation of Emotional States

- **Labeling Video Data:**
    - Created a structured approach to label video footage with specific emotional cues, e.g., confidence (upright posture, smiles), frustration (slumped shoulders, frowning).

- **Annotation Tool:**
    - Used annotation tool VGG Image Annotator to efficiently label and organize the dataset.

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2. Algorithm Development

A. Machine Learning Frameworks

- **Framework Selection:**
    - Chose robust machine learning framework PyTorch for developing deep learning models.
- **Initial Model Selection:**
    - Explored Convolutional Neural Networks (CNNs) for image recognition tasks and Long Short-Term Memory (LSTM) networks for temporal data analysis.

B. Feature Engineering

- **Identification of Key Features:**
    - Extracted key features from video frames, focusing on facial landmarks (e.g., eye movements, mouth shape) and body posture (e.g., arm position, stance).
- **Techniques:**

- Used Histogram of Oriented Gradients (HOG) and facial landmark detection to enhance feature extraction.

C. Development of Recognition Models

- **Facial Expression Recognition (FER):**
  - Developed separate models to recognize basic emotions (e.g., happiness, anger, surprise) from facial cues.
- **Body Language Analysis:**
  - Created models to interpret body posture and movements that correlate with emotional states.
- **Integration of Data Streams:**
  - Designed a multi-modal approach that combines facial and body language data for more accurate emotion recognition.

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3. Model Training

A. Dataset Preparation

- **Data Splitting:**
  - Split the annotated dataset into training, validation, and test sets, using an 80-10-10 split to ensure a robust evaluation.
- **Data Augmentation:**
  - Applied data augmentation techniques (flipping, rotation, scaling) to enhance the dataset and improve model generalization.

B. Training Process

- **Hyperparameter Tuning:**
    - Experimented with various hyperparameters (e.g., learning rate, batch size, number of layers) to optimize model performance.
- **Regularization Techniques:**
    - Implemented techniques like dropout and batch normalization to prevent overfitting during training.

C. Performance Evaluation

- **Metrics Selection:**
    - Used metrics such as accuracy, precision, recall, and F1-score to evaluate model performance.
- **Confusion Matrix Analysis:**
    - Analyzed confusion matrices to identify misclassifications and areas for improvement in the models.

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4. Feedback Mechanism

- **Real-Time Output:**
    - Designed an output system that provides immediate feedback to coaches, displaying recognized cues and associated metrics.
- **User Interface Integration:**

- Ensured seamless integration with the user interface, allowing coaches to visualize data instantly during practice or games.

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5. Security and Compliance

A. Data Privacy Considerations

- **Compliance with Regulations:**
  - Ensured strict adherence to data privacy regulations (e.g., GDPR, CCPA) regarding the collection and storage of player data.
- **Anonymization Techniques:**
  - Implemented techniques to anonymize player data to protect identities during analysis and storage.

B. Security Measures

- **Data Encryption:**
  - Utilized encryption protocols for data in transit and at rest to safeguard sensitive information.
- **Access Controls:**
  - Established role-based access controls to restrict data access to authorized personnel only.