BEACONHOUSE NATIONAL UNIVERSITY

ShotSense

PRJ-F23/xxx [project ID]

PROJECT PROPOSAL REPORT

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SCHOOL OF COMPUTER & IT

October 2023

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Problem Statement

Amateur street cricket players in Pakistan face a significant challenge due to the absence of accessible formal coaching and advanced training resources. This limitation obstructs their progress in honing their batting skills and impedes their capacity to make well-informed decisions during gameplay.

Existing System

Street cricket stands as one of the most beloved forms of amateur cricket in Pakistan. In this informal setting, players spontaneously assemble teams and engage in spirited matches. Unlike the international broadcast level, where sophisticated technology like Hawk-Eye provides supervision and analysis, amateur players must rely on their experience and intuition.

Despite the profound cricketing passion in Pakistan, especially within the street cricket culture, the absence of accessible coaching resources poses a significant impediment to the growth of emerging talents. Street cricket players primarily rely on self-assessment and occasionally capture their performances on smartphones for later reflection.

However, the absence of real-time analytical tools is striking. The current ecosystem lacks a system for tracking and scrutinizing critical factors such as ball trajectory, speed, and the quality of shots executed by street cricket enthusiasts. This lack of data-driven insights leaves players to make decisions based purely on intuition and anecdotal knowledge, limiting their ability to make informed choices on the field.

Literature Survey

Introduction

Pakistan holds a significant place in the world of cricket, renowned for nurturing world-class players who often emerge from the vibrant culture of street cricket. The purpose of this literature review is to explore existing research and technological advancements related to cricket coaching and performance improvement. We seek to identify gaps in the literature that our proposed cricket batting improvement application can address, aiming to empower aspiring cricketers and revolutionize street cricket training in Pakistan.

Technology in Cricket

The utilization of technology in cricket is a well-established practice. Advanced technological innovations have had a global presence in cricket broadcasts worldwide. One of the most prominent among these technological advancements is the Hawk-eye system. Hawk-eye technology was created by Dr. Paul Hawkings and it was developed by the engineers of Roke Monor Research Limited [1]. It is the means to determine the LBW (leg before wicket) decision through ball tracking, proving to be a vital part of the DRS (decision review system). The Hawk-Eye system consists of an extensive network of cameras positioned around the entire cricket pitch, complemented by additional motion sensors to precisely gauge the ball's speed [2]. These collected data inputs are then transmitted to a sophisticated statistical algorithm responsible for calculating the ball's trajectory. While immensely effective in cricket analysis, it's worth noting that Hawk-Eye systems are both cost-intensive and intricate, making them less accessible and challenging for the general public to comprehend.

Current Systems and Mobile Applications

Over the years, several coaching options have emerged in the realm of cricket, including mobile applications and websites that provide extensive coaching content through courses and tutorials [3]. However none of these are able to cater specifically to the unique needs of street cricket players in Pakistan. A cricket coach is expected to provide real-time analysis and feedback, which is particularly crucial for refining batting skills in the ever-changing and dynamic context of street cricket. Existing applications have yet to incorporate this essential aspect, leaving a noticeable gap in meeting this specific need. An illustrative mobile application, such as fulltrack.ai, demonstrates how simplicity can aid players without overwhelming intricacies [4]. This app, tailored for bowlers, offers real-time ball tracking, measures ball speed, and determines the trajectory, spin, or swing of each delivery. However, there remains an evident requirement for a comparable application designed specifically for cricket batsmen.

A machine learning approach to Shot Classification

Cricket videos require unequivocally accurate understanding of the type of shot being played for effective coaching and learning. Classifying the type of shot played by a player using learning algorithms has always been an arduous task. The factors that contribute to classifying a shot to one and not the other vary slightly in terms of footwork and the players pose. In 2010, Yao and Fei-Fei presented a paper[5] focused on the interaction activities involving objects and human poses. Their research introduced a novel random field model aimed at encoding human poses during

interactions with objects. To address this problem, they formulated it as a learning task for the model. The key components of this approach involved summarizing human activity poses and identifying body parts.

Due to the similarity between different batting shots, manual feature extraction from video frames is tedious. The most effective way of feature extraction is through deep neural networks. When it comes to video analysis, Convolutional Neural Networks (CNN) emerge as one of the most formidable models, akin to their success in image classification. CNN's prowess in classification accuracy surpasses that of traditional video classification algorithms [6]. What sets CNN apart is its ability to automatically extract relevant features from video frames, eliminating the need for manual feature selection—a requirement in many other video classification techniques. CNN employs a variety of layers, including the convolutional layer, which employs moving filters or kernels to traverse the video frames. These filters scan through the 2D matrices representing the frames, performing dot multiplications at specific regions and storing the results in another matrix. This process enables CNN to capture intricate patterns and features within video data, making it a powerful tool for video classification tasks.

Anik Sen[7] introduces a hybrid neural network architecture for classifying 10 distinct cricket batting shots within videos, using a self-created dataset due to the unavailability of a public dataset with comparable uniqueness and variety. The hybrid CNN–GRU model, adapted from a pretrained VGG16 model, achieved an impressive accuracy of 93%, highlighting the advantages of transfer learning and model fine-tuning when working with limited data. Furthermore, plans are in place to expand the dataset and make it publicly accessible for further experimentation and accuracy enhancements. This dataset, known as the CricShot10 dataset, can serve as the baseline for our development of a deep learning algorithm to classify cricket shots.

Conclusion

This literature review underscores the significance of technology in cricket, exemplified by the Hawk-Eye system. While highly effective, such technology can be complex and costly. Examining the current coaching landscape, we observed the emergence of mobile applications and websites providing comprehensive coaching content. However, a conspicuous gap persists in catering to the unique needs of street cricket players in Pakistan, who thrive in an ever-changing and dynamic environment. The importance of real-time analysis and feedback, particularly for refining batting skills, was underscored as an essential yet unmet need.

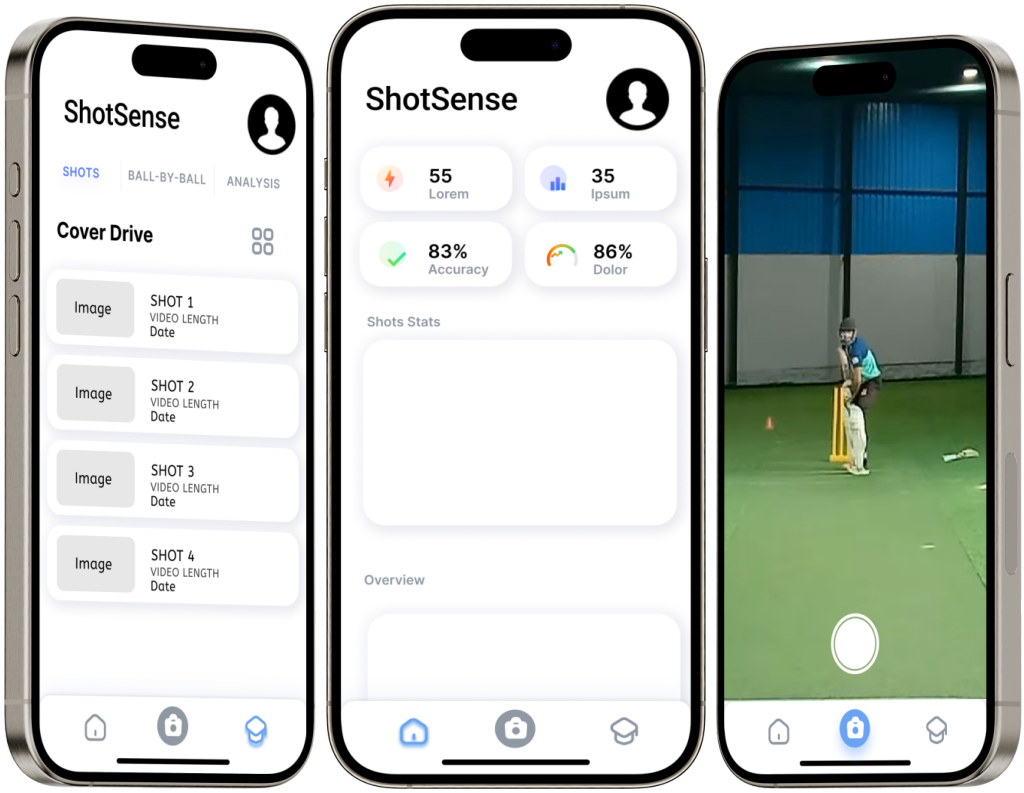
The importance of machine learning and shot classification in cricket analysis is evident, with Convolutional Neural Networks (CNNs) emerging as powerful tools for video analysis. A notable project, CricShotClassify, achieved a 93% accuracy in classifying cricket shots using a hybrid CNN–GRU model, highlighting the potential of transfer learning and model fine-tuning with limited data.

In essence, our literature review sets the stage for our proposed cricket batting improvement application, which aims to bridge coaching gaps, offer real-time analysis, and empower street cricket players in Pakistan, revolutionizing their training experiences.

Proposed Solution

A mobile app empowering amateur cricket players to enhance their batting skills. This user-friendly app, acting as a virtual coach, offers a fresh perspective on their gameplay. Through real-time pose and footwork tracking, players gain a comprehensive understanding of their technical proficiency. Additionally, we plan to implement machine learning algorithms for classifying shot types, enabling players to make informed decisions. This app provides valuable insights, highlighting areas of improvement, such as shot placement on the bat and shot selection. It essentially brings a coach to their smartphones, enhancing the excitement and enjoyment of street cricket

Wireframes



Deliverables

1. Shot Classification NN: Implementation of machine learning algorithms for shot classification.
2. Pose Estimation: Algorithms to track the player's body movements and positions during their shots.
3. Ball Tracking: Implementing a ball tracking algorithm to trace the path of the ball in the video.
4. Shot Quality Assessment: Evaluation of the point of contact on the bat (e.g., edge, middle) for each shot and its impact on shot quality.
5. Decision-Making Feedback: Feedback on shot selection and decision-making during gameplay.
6. Mobile App: A fully functional mobile application compatible with Android and iOS devices.

Technologies

1. Mobile App Frameworks: Flutter, TensorFlow Lite or Pytorch Mobile
2. Cloud Storage: AWS, Google Cloud Storage for storing, processing videos
3. Computer Vision Libraries: OpenCV and ByteTrack for computer vision tasks
4. Pose Estimation: YOLO or OpenPose or TensorFlow Lite
5. Database: PostgreSQL or MongoDB or Firebase for storing non-relational data
6. Hosting: Vercel, Render

Business Model

The app will offer users a free basic version while generating income through subscription-based premium features and in-app advertisements tailored to the cricket community. Our key value proposition lies in delivering real-time pose estimation, ball tracking and personalized coaching, attracting amateur cricket players seeking to enhance their batting skills.

Project Methodology

Project Proposal Phase

- Form the project group, select the external supervisor, and finalize the project.
- Develop the Project Proposal Document, which includes the objective of the project, statement of the problem, description of the existing system, literature survey, proposed solution, phases of the project, project methodology, cost-benefit analysis, and references.
- Deliverable: Proposal Document
- Deliverable: Proposal Presentation

Requirement Analysis Phase

- Conduct a detailed analysis of the problem or current system through literature survey and data gathering.
- Formalize the findings in the form of a Software Requirement Specification (SRS) document, Use Case document, and Test cases.
- Start learning the technologies to be employed in the project.
- Deliverable: Requirement Analysis Document

Design Phase

- Develop the Design Document, which includes the system architecture, class diagram, sequence diagram, and database diagram.
- Deliverable: Design Document

Implementation Phase

- Begin the development of the mobile app, focusing on the implementation of machine learning algorithms for shot classification, pose estimation, ball tracking, shot quality assessment, and decision-making feedback.
- Deliverable: Implementation Document with Screen Shots and Reports depicting 30% functionality of the system

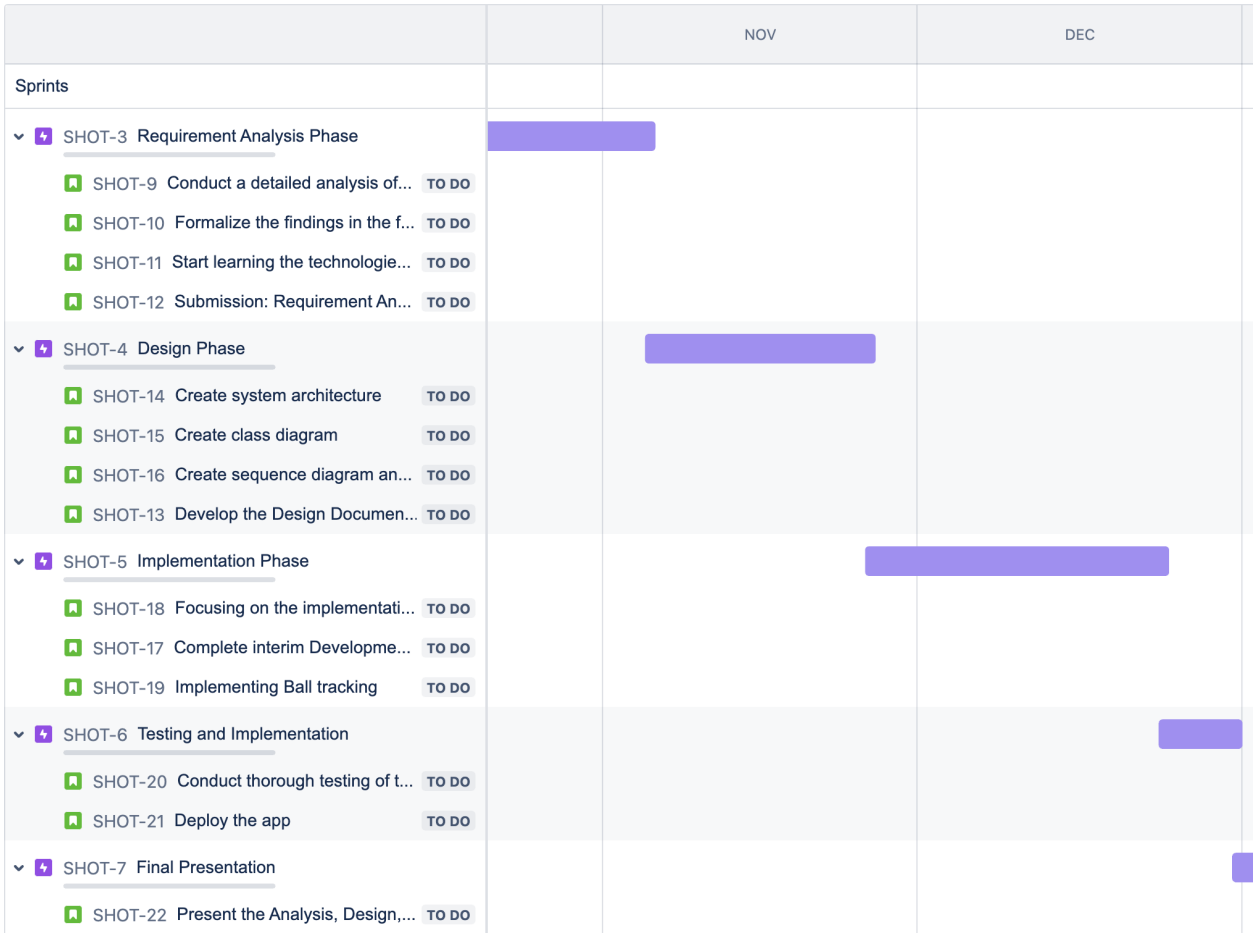
Testing and Deployment Phase

- Conduct thorough testing of the developed app, ensuring it aligns with the Software Requirement Specification (SRS) Document.
- Deploy the app on Android and iOS platforms.
- Deliverable: Testing and Deployment Document

Final Presentation

- Present the Analysis, Design, and Implementation Document before the Faculty Panel.
- Deliverable: Final Presentation

Timelines


NOV
DEC
Sprints
SHOT-3 Requirement Analysis Phase
SHOT-9 Conduct a detailed analysis of... TO DO
SHOT-10 Formalize the findings in the f... TO DO
SHOT-11 Start learning the technologie... TO DO
SHOT-12 Submission: Requirement An... TO DO
SHOT-4 Design Phase
SHOT-14 Create system architecture TO DO
SHOT-15 Create class diagram TO DO
SHOT-16 Create sequence diagram an... TO DO
SHOT-13 Develop the Design Documen... TO DO
SHOT-5 Implementation Phase
SHOT-18 Focusing on the implementati... TO DO
SHOT-17 Complete interim Developme... TO DO
SHOT-19 Implementing Ball tracking TO DO
SHOT-6 Testing and Implementation
SHOT-20 Conduct thorough testing of t... TO DO
SHOT-21 Deploy the app TO DO
SHOT-7 Final Presentation
SHOT-22 Present the Analysis, Design,... TO DO

Expertise

Umair Ali Khan

Courses

Artificial Intelligence, Neural Networks and Deep Learning, Mobile Computing, Database Systems

Certificates

Machine Learning Specialization (Ongoing) *Stanford University & DeepLearning.AI*

Machine Learning on Google Cloud Specialization (Ongoing) *Google Cloud*

Google Advanced Data Analytics Career Certificate (Ongoing) *Google*

Muhammad Fahad

Courses

Artificial Intelligence, Neural Networks and Deep Learning, Mobile Computing, Database Systems

Experience & Tools

MERN stack and various other platforms.

React Native

Developing backend solutions using Firebase and Express.

Utilizing and refining NLP algorithms for various business applications, as well as crafting customized chatbots.

Certifications

Google IT Automation Career Certificate (Ongoing)

External Supervisor

Mirza Danial Masood *ML & CV Engineer | Data Scientist* *Resume Link*

References

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2. Jayalath, L. M. "Hawk Eye Technology Used In Cricket." South Asian Research Journal of Engineering and Technology 3.2 (2021): 55-67.\
3. https://www.cricuru.com/browse#cricurus
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5. Yao, B., Fei-Fei, L.: Modeling Mutual Context of Object and Human Pose in Human-Object Interaction Activities. IEEE (2010). 978-1-4244-6985-7/10/26.00
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7. Sen, Anik, et al. "CricShotClassify: an approach to classifying batting shots from cricket videos using a convolutional neural network and gated recurrent unit." Sensors 21.8 (2021): 2846.