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Virtual Spy (Automating the Role of Third Umpire in the Game of Gully Cricket)

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Abstract: *A fair decision is important in any game to give justice to the game. Any wrong decision due to a person's misunderstanding can be caused by the outcome of the game. Computer vision and image processing techniques have been cited in book reviews that have used multiple cameras to display. This paper focuses on a system that helps the umpire to make decisions such as no ball, Running, out, etc. with the help of a good quality smartphone camera. The Decision Review System (DRS) aims to provide decisions such as run-out and stump-out. Tkinter is used to develop the GUI of DRS. Object classification and object recognition is implemented using Histogram of Gradients (HOG) and Support Vector Machine (SVM). To detect the cricket ball from the video we optimized and used frame subtraction, contour detection and minimum enclosing circle algorithms using OpenCV library. Linear regression and quadratic regression are used to track and predict the motion of the ball from video source. VPython is used for the visual representation..*

Keywords: Virtual Spy

I. INTRODUCTION

[1] Throughout the game of cricket, umpires are responsible for determining the approval of a ball bowled by a bowler . There are many cases where the delivery may not be approved by the umpire. Decisions like no ball, end and exit require some minutes in certain situations using the television playback. So the umpires make their own decisions based on their own ideas, but human opinion cannot always be accurate. Besides, it is not always possible to conclude accurate judgments due to the limitations of available technology and this creates confusion and debate between viewers and cricket fans. The umpire on the field at the end of the bowler shows a square screen TV mime to tell the third umpire to review the decision. The third umpire begins by checking for official delivery before proceeding to watch the replays for run out or other decisions.

1.1 Aim and Objective

It is necessary to eradicate the debate to increase the acceptability of the decisions. If this can be achieved with the help of technology, then the game will be fine and enjoyable. Previously proposed research in this field has tried to solve the problem, but it is not possible, it is expensive and often makes mistakes due to the use of sensors in the field and spells. On the other hand, we have proposed a computer-based approach to this paper that does not require additional infrastructure as it will receive video feeds from streaming cameras. Our proposed method is expected to create better and lower operating costs due to the lack of infield sensor and other devices.

The rest of the paper is edited as Section II includes a brief overview of the Related Work and Proposed Plan. Section III covers the operating system and implementation. Section IV covers Results that summarize the conclusions reached using various computer vision algorithms. Finally, SectionV covers the conclusion and scope of the future that undermines the outcomes of the proposed work.

II. LITERATURE SURVEY

2.1 Related Work

In the past a number of technologies have been developed, some of which are more specific to the use of "Application of Computer Vision in Cricket : Foot Overstep No-Ball Detection" proposed by AZM Ehtesham Chowdhury, Md Shamsur

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Rahim, Md Asif Ur Rahman [2] where image removal is available. used and this principle applies only to the front bowler foot and bowling end popping crease.

"Cricket umpire's assistance and ball tracking system using a single phone camera" by Udit Arora, Sohit Verma, Sarthak Sahni, and Tushar Sharma [3] have proposed a system that includes computer visual cues algorithms to detect, identify and track cricket and machine learning. strategies to develop and predict various outcomes and decisions.

In another research paper, B.L.Velammal, P. Anandha Kumar proposed "An Efficient Ball Detection Framework for Cricket" [4]. In this case the non-ball objects and objects with the ball are seen. The regional growth phase is selected for division. After segmentation, ball and non-ball objects are classified based on shape properties. Non-ball items are eliminated and outbound frames contain only the ball object. Ball objects are continuously used to detect the ball.

"Implementation of Augmented Reality in Cricket for Ball Tracking and Automated Decision Making for No ball" by Nikhil Batra, Harsh Gupta, Nakul Yadav, Anshika Gupta, Amita Yadav

[5] proposed a system that determines whether a ball is a no-ball or wide ball. The system applies different techniques like canny edge detector, Hough line transform algorithms, Douglas Peucker algorithm contour. No More Third Umpires" by Alex Joseph, Alistar Fernandez, Jasir Ahamed P.A., Treesa Joseph [6] proposed a system that uses image and video processing techniques, which automates the role of the third umpire.

2.2 Problem Formulation

In India, everyone enjoys cricket. Many training centers, tournaments, and even gully cricket limit the use of a decision-making process to make decisions because of its high cost. As a result many unfair decisions were made by the umpire and the negative for both parties, as a result, has been the subject of much controversy. Our project aims to develop a computer program that assists the umpire in making low-cost cricket decisions and can be used in various competitions, institutions of higher learning and even gully cricket.

III. PROPOSED SYSTEM

Our project "DRS assisting umpire using computer vision" is implemented using Python and Tkinter. GUI of our project i.e. DRS gives options to choose from to the user which contains Stump out, Run out, No ball, Stump out and Run out can be decided by playing the source video in slow or fast motion. Further decisions like No Ball can be implemented by extracting frames through the source video. Ball detection and Batsman height detection is done from the extracted frames. The detected ball coordinates are further used for ball tracking. 3D coordinates are mapped into 3D coordinates and smoothen using regression techniques. Visualization is implemented through Vpython which shows results for all these decisions.

3.1 Required Tools:

- Python
- Tkinter for GUI
- Pillow, opencv and imutils packages for python.

A. Tkinter

"Tkinter is a de-facto standard GUI package for Pythons (Graphical User Interface). It is on top of Tcl/Tk, a thin object-oriented layer. TKinter is not the only Python toolkit for Gui Programming. However, it is the most commonly used one.

Cameron Laird calls the annual decision to keep Tkinter "one of the minor traditions of the Python world." If you run python-m tkinter from the command prompt, it is important to open a window showing a simple Tk interface, letting you know that tkinter is correctly installed on your device, and also showing which version of Tcl/Tk is running''.

3.2 Open CV

Open-Source Computer Vision Library is a library of programming functions aimed specifically at real-time computer vision. Originally designed by Intel, it was later sponsored by Willow Garage and then Itseez (later acquired by Intel). The framework is cross-platform and free-to-use under the open-source Apache 2 License. For real time operations beginning in 2011, OpenCV features GPU acceleration. Application areas for open CV include:

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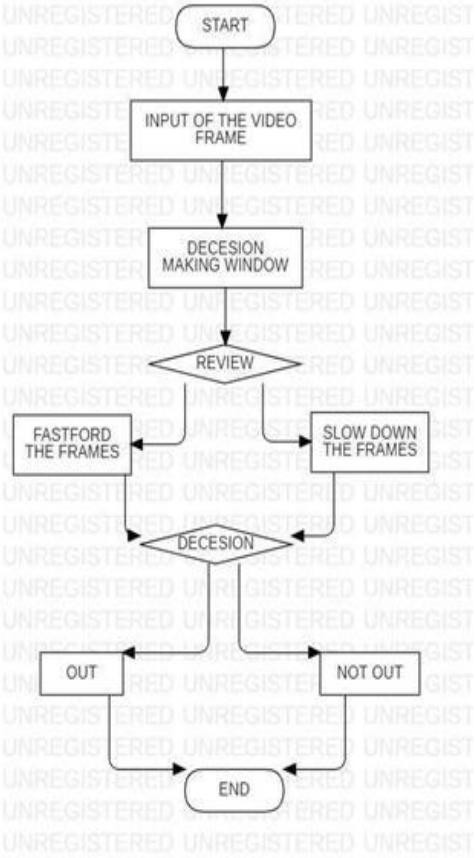
- 2D and 3D feature toolkits
- Egomotion estimation
- Gesture recognition

3.3 Pillow

The Standard Python Library (abbreviated as PIL) (known in newer versions as Pillow) is an additional free and open-source Python programming language library that supports the opening, manipulation, and saving of several different image file formats. There are Windows, Mac OS X and Linux available. "The most recent version of PIL is 1.1.7, which was released in September 2009 and supports Python 1.5.2-2.7, with "later" Python 3 support''

3.4 Imultis

With Open CV and both Python 2.7 and Python 3, it is much simpler to detect contours, a variety of high - quality custom such as transcription, rotation, reformatting, image segmentation, view of Matplotlib images, sorting of basic image processing functions.



3.5 Where this tools used?

A. Ball Detection

Frame differencing technique is used to extract frames which further converted into grayscale. These frames are then used extract HOG features which then fed to SVM model which is built using OpenCV SVM library is then used to detect the ball by using frame subtraction method. Positive and negative data samples are collected which are also used to extract HOG features.

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B. Ball Tracking

SVM model is used to detect the exact presence of the ball where the ball is detected in the particular frame. A separate file is created to store the coordinates of the ball which are obtains as 'x' and 'y' coordinates.

C. Batsman Detection and Tracking

OpenCV's built-in People Detector SVM models are used to detect the batsman from the provided video. The batsman movement is tracked by limiting the search window to the neighborhood of the first detection which is displayed on the frame.

D. Mapping 2D Coordinates to 3D World Coordinates

The 2D coordinates of the tracked ball which are obtained after series of transformation using Minimum Enclosing Circle algorithm are then mapped into 3D world coordinates according to the cricket pitch dimensions. The z-coordinates i.e. depth is obtained by comparing it with the radius which is obtained at the beginning vs. Obtained at the end of the pitch. It is then scaled the ratio to the length of the pitch.

E. 3D Visualization of Tracked Ball and Cricket Pitch

The obtained x,y and z coordinates are used to visualize the objects in 3D using VPython visualization library. For better visualization, linear and quadratic regression is applied over various dimension tracked by limiting the search window to the neighborhood of the first detection which is displayed on the frame.

IV. WORKING PLAN

We developed a system that helps the third umpire to make a decision on various calls on the field.

4.1 DRS GUI

It Provides facilities to give any decision like No-ball, Stump-out, LBW and Run out. Tkinter is used to make GUI of the Decision review system and various computer vision algorithms are used to give these decisions based on criteria.
batsmen fails to make his ground while running between the wickets, the batsman is determined as a run-out. The batsmen must have something behind the line to be safe except they are on the same side, in that case, the batsman further away from the stumps determines as run-out. A fielder must touch the ball before it hits the wicket for the run-out to be genuine. If the batsman hits the ball and it strikes the stumps on the other end while the other side batsman or non-striker is out of the crease and the bowler has touched the ball before it hits the wicket then it will be determined as run-out.

Figure 4.1: DRS Gui

4.2 Stump Out

The Stump-out decision is determined by playing the video in slow motion also in fast motion based on further conditions. If batsman out of his ground leaving no part of his bat or body behind the crease in an attempt to hit the ball and the wicket-keeper dislodges the bails, he/she is termed out. In case the keeper displaces the bails before the ball reaches him/her, the batsman will not be given out.

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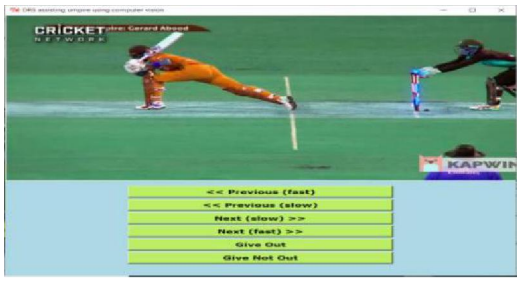

Figure 4.2: Stump out decision

4.3 Run Out

To determine the run-out decision the system plays the selected video in slow motion as well as in fast motion. If the wicket-keeper or any of the fielder displace the bails while either of the

Figure 4.3: Run out decision

4.4 No Ball

To determine the no-ball first we have to locate the position of the ball nearest the batsman wicket crease then if the ball hasn't bounced off the ground, and the ball height is greater than the batsman height, it is determined as a no-ball.

V. APPLICATIONS

1. **Diversity:** The diversified nature of the project inturn helps in using the software in every other sport rather than bound to a single sport(cricket).
2. **Small Scale Use:** The technology can be used at small as a district and inter school competitions.
3. **Large Scale Use:** The technology can be used at high level tournaments like inter-state competitions.
4. **Commercial Use:** The software can be used as a source of income, as in between the decisions, a small time-break has also been added to show commercial advertisements, which intake can be a good source for gaining profit even at a small level of inter-school tournaments

VI. RESULTS

Our project DRS assisting umpire using computer vision gives the following results:

1. Stump out and Run-out decisions by playing video either in slow or fast motion.
2. No ball decision by detecting
3. The position of the ball nearest the batsman wicket crease.
4. And the ball hasn't bounced off the ground, and the ball height is greater than the batsman's height.

VII. CONCLUSION

The main objective of our project is to assist the umpire in game of cricket to make fair decision in efficient way. Our project discusses the use of computer vision algorithms to extract frames and to detect, tracked the ball from the provided source video. Vpython helps to visualize the results of various decisions which makes the UI more attractive and interactive. Also use of single smartphone camera makes the system cost efficient and easy to use.

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FUTURE SCOPE

The program is designed primarily for training centers, gully cricket tournaments and small-scale cricket tournaments, but can also be used at an advanced level in national and international cricket matches by installing multiple cameras, microphones that can be useful for accurate and in-depth analysis.

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