

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

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**Abstract:** *The conclusion of the game might induce any incorrect decision owing to a person's misunderstanding. In book reviews that employed many cameras to display, computer vision and image processing techniques were mentioned. This study focuses on a system that employs a high-quality smartphone camera to assist the umpire in making judgments such as no ball, running, and out. The Decision Review System (DRS) intends to offer run-out and stump-out rulings. Tkinter is used to create DRS's graphical user interface. The Histogram of Gradients (HOG) and Support Vector Machine are used to classify and recognise objects (SVM). Using the OpenCV library, we optimised and applied frame subtraction, contour detection, and minimal enclosing circle methods to detect the cricket ball from the video. To monitor and forecast the motion of the ball from a video source, linear regression and quadratic regression are utilised. The visual depiction is done with VPython..*

**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, Section V covers the conclusion and scope of the future that undermines the outcomes of the proposed work.

## II. LITERATURE SURVEY

### 2.1 Related Work

Literature Review Several systems have been developed in the past, some of which are more particular to the usage of "Application of Computer Vision in Cricket: Foot Overstep No-Ball Detection" suggested by AZM Ehtesham Chowdhury

and Md Shamsur.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.

Udit Arora, Sohit Verma, Sarthak Sahni, and Tushar Sharma [3] 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 their paper "Cricket umpire's assistance and ball tracking system using a single phone camera." B.L. Velammal and P. Anandha Kumar suggested "An Efficient Ball Detection Framework for Cricket" [4] in another research article. Non-ball items and things with the ball are visible in this situation. For division, the regional growth phase is chosen. Ball and non-ball objects are identified based on form attributes after segmentation.

Non-ball components are removed, leaving only the ball object in outgoing frames. The ball is constantly detected using ball objects. Nikhil Batra, Harsh Gupta, Nakul Yadav, Anshika Gupta, and Amita Yadav developed a method to identify whether a ball is a no-ball or a wide ball in their paper "Implementation of Augmented Reality in Cricket for Ball Tracking and Automated Decision Making for No Ball" [5]. The system employs many techniques.

Canny edge detector, Hough line transform algorithms, and Douglas Peucker algorithm contour are examples of approaches. Alex Joseph, Alistar Fernandez, and Jasir Ahamed P.A., "No More Third Umpires," Treasa Joseph [6] presented a method that automates the third umpire's duties using image and video processing techniques.

## 2.2 Problem Formulation

Cricket is a popular sport in India. Because of its exorbitant cost, many training centres, competitions, and even gully cricket prohibit the usage of a decision-making process to make decisions. As a result, the umpire made several unjust rulings, and the negative for both teams has been the topic of much debate.

Our research intends to create a computer software that supports umpires in making low-cost cricket judgments and may be utilised in a variety of events, higher education institutions, and even gully cricket.

## III. PROPOSED SYSTEM

Python and Tkinter are used to develop our project "DRS helping umpire utilising computer vision." Our project's GUI, DRS, provides the user with options such as Stump out, Run out, and No ball. Stump out and Run out may be determined by watching the original footage in slow or fast motion.

Additional judgments, such as No Ball, can be made by extracting frames from the original video. The extracted frames are used to detect the ball and the height of the batter. Ball tracking is done using the observed ball coordinates. Regression algorithms are used to transfer 2D coordinates into 3D coordinates and smooth them out.

Vpython is used to implement visualisation, which displays the outcomes of all of 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 Python (Graphical User Interface). It is on top of Tcl/Tk, a thin object-oriented layer. Tkinter is not the only Python toolkit for GuiProgramming. 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".

#### B. Open CV

The Open-Source Computer Vision Library is a collection of programming functions geared for real-time computer vision. It was developed by Intel and then funded by Willow Garage and Itseez (later acquired by Intel). Under the open-source Apache 2 License, the framework is cross-platform and free to use. Since 2011, OpenCV has included GPU acceleration for real-time tasks.

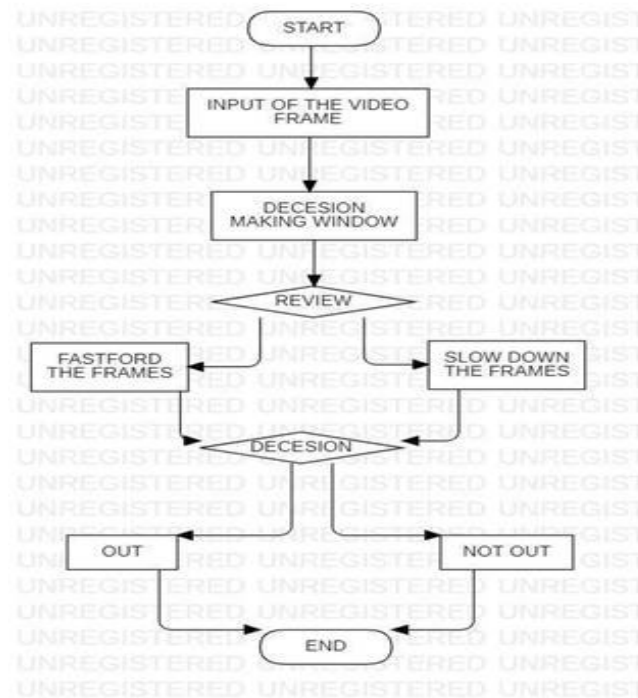
2D and 3D feature toolkits are examples of open CV applications. Estimation of egomotion, Recognition of gestures etc.

### C. Pillow

The Standard Python Library (abbreviated as PIL) (now known as Pillow in latest versions) is a free and open-source Python computer language library that allows you to access, manipulate, and save a variety of image file types. 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"

### D. Imultis

It's much easier to identify contours, rotate, reformat, image segment, display Matplotlib pictures, and sort basic image processing tasks using Open CV with both Python 2.7 and Python



### What was the purpose of these tools?

**Detection of Balls** The frames are extracted using a frame differencing approach before being converted to grayscale. These frames are then used to extract HOG features, which are then put into an OpenCV SVM model, which is then used to detect the ball using the frame subtraction approach. Positive and negative data samples are gathered, and HOG characteristics are extracted.

### The Ball Tracking

The Ball Tracking SVM model is utilised to detect the exact presence of the ball in each frame. The ball's coordinates, which are obtained as 'x' and 'y' coordinates, are saved in a separate file.

### Batsman Detection and Tracking

**Detection and Tracking of Batsmen** The batsman is detected from the given footage using OpenCV's built-in People Detector SVM models. Limiting the search window to the neighbourhood of the initial detection presented on the frame allows the batsman's progress to be followed.

**Converting two-dimensional coordinates to three-dimensional world coordinates** The tracked ball's 2D coordinates, which are generated after a sequence of transformations using the Minimum Enclosing Circle technique, are then transferred into 3D world coordinates based on the dimensions of the cricket pitch. The depth is determined by comparing the radius acquired at the start of the pitch to the radius obtained at the conclusion of the pitch. The ratio is then scaled to the pitch's length.

**Tracked Ball and Cricket Pitch 3D Visualization** Using the VPython visualisation package, the acquired x,y, and z coordinates are utilised to view the objects in 3D. By limiting the search window to the neighbourhood of the initial detection presented on the frame, linear and quadratic regression is conducted across multiple dimension monitored for better visualisation.

#### IV. WORKING PLAN

We created a method to assist the third umpire in making decisions on various field calls.

##### 4.1 DRS GUI

It has the ability to make decisions such as No-ball, Stump-out, LBW, and Run out. The Decision Review System's GUI is built with Tkinter, and several computer vision algorithms are utilised to generate conclusions depending on criteria.



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. He/she is declared out if he/she leaves no part of his bat or body behind the crease in an effort to smash the ball and the wicket-keeper dislodges the bails. The batter will not be given out if the keeper removes the bails before the ball reaches him.



Figure 4.2: Stump out decision

##### 4.3 Run Out

The technology plays the selected footage in both slow and rapid motion to decide the run-out decision. If the wicketkeeper or any fielder moves the bails while any of the players is on the field,

When a batsman fails to make contact with the ground while dashing between the wickets, he is declared a run-out. To be safe, the batters must have something behind the line unless they are on the same side, in which case the batsman who is furthest away from the stumps is declared chevalier. A legitimate run-out requires a fielder to touch the ball before it strikes the wicket. If a batsman smashes the ball and it reaches the stumps on the other end when the opposing side's batter or non-striker is out of the crease and the bowler has touched the ball, the batsman is out of the crease.



**Figure 4.3: Run out decision**

#### 4.4 No Ball

The no-ball is established by first locating the position of the ball closest to the batsman's wicket crease, then determining if the ball hasn't bounced off the ground and the ball height is more than the batsman's height. Section IV

### 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

The following are the outcomes of DRS employing computer vision to aid the umpire:

1. Play the video in slow or rapid motion to stump out and run-out decisions.
2. Detecting no ball decision
3. The ball's location in relation to the batsman's wicket crease.
4. The ball hasn't bounced off the ground, and its height exceeds that of the batter

### VII. CONCLUSION

Our project's main goal is to help umpires in cricket games make more accurate and timely decisions. Our study looks at how computer vision techniques may be used to extract frames and track the ball from a given source.

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.

### 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.

### REFERENCES

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