Smart Umpiring System For Cricket Using Machine Learning

PROJECT REPORT

Submitted by

LALITH KUMAR S	**REGISTER NO. : 17TC0299**
KISHAN P	**REGISTER NO. : 17TC0292**
NAVEEN KUMAR A	**REGISTER NO. : 17TC0322**
NAVEEN K	**REGISTER NO. : 17TC0321**

Under the Guidance of

Mr.K.Vijayakumar

Assistant Professor

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DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that the project work entitled **" Smart Umpiring System For Cricket Using Machine Learning "** is a bonafide work done by **LALITH KUMAR S [REGISTER NO. : 17TC0299], KISHAN P [REGISTER NO. : 17TC0292], NAVEEN KUMAR A[REGISTER NO. : 17TC0322], NAVEEN K [REGISTER NO. : 17TC0321]** in partial fulfilment of the requirement for the award of B.Tech., Degree in the Department of Electronics and Communication Engineering during the academic year 2020-2021.

HEAD OF THE DEPARTMENT
Dr. P. Raja
Professor and Head

GUIDE
Mr.K.Vijayakumar
Assistant Professor

Submitted for the End Semester Examination held on.....

INTERNAL EXAMINER **EXTERNAL EXAMINER**

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ABSTRACT

Cricket is one of the major featuring games in India. Though the game is being advanced by Ultraedge & Hotstop technology, still the no-ball and event are not being predicted clearly by the third umpire. The project aims at exactly detecting the event of no-ball with help of smart umpiring system and indicates the batsman by visual and audio indicators. It assists the on-field umpire present in the ground with help of embedded technology and image processing. The sensors are placed at the sticks and at the ground, which is in-line with the crease. The edge detection sensors which are placed at the ground are made to pop up only for the finite duration with the help of servo motor. The project also identifies the no-ball event occurred due to failure of maintaining specified number of players inside the in-circle during the delivery of the ball. The in-circle fielder's count is processed by the image processing. Thus the proposed method will reduce the on-field umpire error and increase feasibility of a batsman to score extra runs.

Keywords– No-ball, Overstepping no-ball, Fielders restriction no-ball, image processing.

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INTRODUCTION

1.1 OVERVIEW

- Cricket is one of the major featuring games in India. Though the game is being advanced by Ultra edge & Hotspot technology, still the no-ball and run-out event are not being predicted clearly by the third umpire.

- The project aims at exactly detecting the event of no-ball with help of smart umpiring system and indicates the batsman by visual and audio indicators. It assists the on-field umpire present in the ground with help of embedded technology and image processing.

- The sensors are placed at the sticks and at the ground, which is in-line with the crease. The edge detection sensors which are placed at the ground are made to pop up only for the finite duration with the help of servo motor.

- The project also identifies the no-ball event occurred due to failure of maintaining specified number of players inside the in-circle during the delivery of the ball. Thus, the proposed method will reduce the on-field umpire error and increase feasibility of a batsman to score extra runs.

1.2 KEY FINDINGS

- The ICC tells that approximately 20-30 umpire mistakes are happening in every month. Due to that even the powerful team lose the game.
- One incident which was talked by all over the world is the last year IPL run-out event. It is because of the human error so that the important match for a team is ended in a loss.
- Even though there are many technologies in the game but the run-out events and

no-ball event is quite difficult to detect instantly.

- So, on that day onward an extra team is set up for detecting the run-out and No-ball event which requires large human resource and takes lot of time.

1.3 INTRODUCTION TO EMBEDDED SYSTEMS

The chip-based framework is built for controlling a capacity or scope of capacities and isn't intended to be customized by the end client similarly a PC is characterized as an implanted framework. An embedded system is accomplished to perform one particular task albeit with distinct choices and options. Embedded systems consist of processing cores that are either micro controllers or digital signal processors.

Microcontrollers are broadly known as "chip", which may itself be packaged with other microcontrollers in a combination system of Application Specific Integrated Circuit (ASIC). In general, input always comes from a detector or sensors in more accurate words and meanwhile the output goes to the activator which may initiate or terminate the operation of the machine or the operating system. An embedded system is a hybrid of both hardware and software, each embedded system is uncommon and the hardware is highly specialized in the application domain. Hardware comprises processors, micro controllers, IR sensors

A clock system provides synchronizations across of those components. And to conclude on trip power management hardware is used for regulation and monitoring. a spread of peripheral hardware maybe included during a micro controller. Some typical peripheral functionality includes communication, analog signal processing, input and output, timing and processor support. Embedded systems have unique software platforms because they are do not have an abundance of computation power, memory, or peripheral hardware.

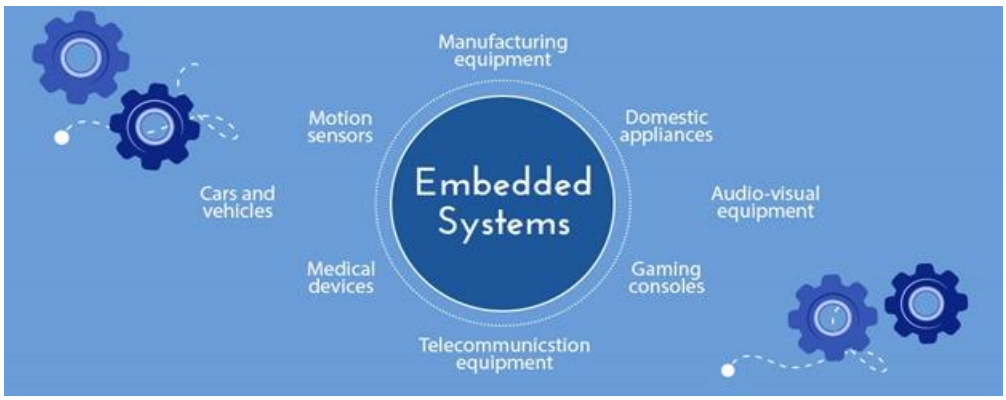

Fig.1 Embedded System

On the flip side of the coin, Software is just like a brain of the whole embedded system as this consists of the programming languages used which makes hardware work. Consequently, embedded systems programming can be a widely varying experience. An embedded structure is an amalgamation of computer paraphernalia and software program, either fixed incapability or programmable, that is specifically designed for a particular kind of application device. Manufacturing appliances, motorcar, medical tools, vending contrivance and toys (as well as the more obvious cellular mobile phone and PDA) are among the countless possible hosts of an embedded system. Embedded systems that are programmable and provided with a programming interface, and embedded systems programming id specialized occupation.

On the flip side of the coin, the microcontroller is a single silicon chip consisting of all input, output and peripherals on it. A single microcontroller has the following characteristics:

1. Arithmetic and logic unit
2. Memory for storing program
3. EEPROM for non-volatile and special function registers
4. Input/output ports
5. Analog to digital converter
6. Circuits
7. Serial communication ports.

1.3.1 STRUCTURE OF EMBEDDED SYSTEMS

Embedded systems vary in complexity but, generally, contains three main elements:

- **Hardware**. The hardware of embedded systems is predicated on microprocessors and microcontrollers. Microprocessors are very almost like microcontrollers and, typically, ask a CPU (central processing unit) that's integrated with other basic computing components like memory chips and digital signal processors (DSPs). Microcontrollers have those components built into one chip.
- **Software and firmware**. Software for embedded systems can vary in complexity. However, industrial-grade microcontrollers and embedded IOT systems usually run very simple software that requires small memory.
- **Real-time operating system**. These aren't always included in embedded systems, especially smaller-scale systems. RTOS defines how the system works by supervising the software and setting works during program execution.

1.3.2 CLASSIFICATION OF EMBEDDED SYSTEMS

Embedded Systems are classified based on:

- Function
- Performance

Based on functions, embedded systems are classified as:

• **Mobile embedded systems** are independent systems that are designed to be portable. Digital cameras are an example of this.

• **Networked embedded systems** are connected to a network to supply output to other systems. Examples include home security systems (HSS) and point of sale (POS) systems.

• **Standalone embedded systems** aren't reliant on a number system. like all embedded system, they perform a specialized task. However, they are doing not necessarily belong to a number system, unlike other embedded systems. A calculator or music player is an example of this.

• **Real-time embedded systems** give the specified output during a defined interval. they're often utilized in medical, industrial and military sectors because they're liable for time-critical tasks. A control system is an example of this.

Based on performance, embedded systems are classified as:

• **Small-scale embedded systems** often use no quite an 8-bit microcontroller.

• **Medium-scale embedded systems** use a bigger microcontroller (16-32 bit) and sometimes link microcontrollers together.

• **Sophisticated-scale embedded systems** often use several algorithms that end in software and hardware complexities and should require more complex software, a configurable processor and/or a programmable logic array.

1.4 MACHINE LEARNING (ML)

Machine learning is the method of data analysis and computer algorithms that improve automatically through experience. It is a branch of Artificial Intelligence (AI). Machine learning algorithms build a model supported sample data, mentioned as "training data", so on form predictions or decisions without being explicitly programmed to undertake to to so. Machine learning algorithms are used during a good kind of applications, like E-mail Spam and Malware Filtering and computer vision, where it's difficult or unfeasible to develop conventional algorithms to perform the needed tasks.

A subset of machine learning is related to computational statistics, which gives a prediction using computers; but not all machine learning is statistical learning. The study of mathematical optimization provides methods, theory and application domains to the world

of machine learning. data processing could also be a related field of study, that concentrate on exploratory data analysis through unsupervised learning. In its application across business problems, machine learning is additionally mentioned as predictive analytics.

1.4.1 Artificial intelligence

Artificial intelligence (AI) is an ability of machines to learn from experience, adjust to new inputs and perform human-like tasks.AI is achieved by analysing how the human brain works while solving an issue and then using that analytical problem-solving technique.

1.4.2 Data mining

Machine learning and data processing often uses an equivalent method and overlap significantly, but while machine learning focuses on prediction, supported known properties learned from the training data, data mining focuses on the creating of (previously) unknown properties in the data (this is the analysis step of knowledge creating in databases). Data mining uses many machine learning methods, but with different goals; on the opposite hand, machine learning also employs data processing methods as "unsupervised learning" or as a pre-processing step to improve learner accuracy.

1.4.3 Optimization

Machine learning also has intimate ties to optimization: it is a problem of finding a set of inputs to an objective function that results in a maximum or minimum function evaluation. Optimization formulations and methods are proving to be vital in designing algorithms to extract essential knowledge from huge volumes of data.

1.4.4 Generalization

The difference between optimization and machine learning arises from the goal of generalization: while optimization algorithms can minimize the loss on a training set, machine learning is concerned with minimizing the loss on unseen samples. Characterizing the generalization of various learning algorithms is an active topic of current research,

especially for deep learning algorithms.

1.4.5 Statistics

Machine learning and statistics are related fields in terms of methods, but distinct in their principal goal: statistics draws population inferences from a sample, while machine learning finds generalizable predictive patterns. consistent with Michael I. Jordan, the ideas of machine learning, from methodological principles to theoretical tools, have had an extended pre-history in statistics. And also suggested the term data science as a placeholder to call the general field.

1.5 OBJECTIVE

The main focus of the project is to develop a No-Ball detection using Machine learning. To play error free cricket and to reduce the time used by the umpire(real time detection)

1.6 ORGANIZATION OF THESIS

The organization of the report is given as follows:

CHAPTER 1 Gives the introduction about the Smart umpiring system. This chapter describes about the device which comprises of machine learning and embedded systems. It is then followed by the objective of the project.

CHAPTER 2 Deals with a detailed analysis of the previously proposed systems on regarding Smart umpiring system. This literature survey adds sufficient information regarding the different author's work.

CHAPTER 3 Describes in detail about the proposed system and their advantages over the conventional ones. It also explains in detail about the components used, the working of the system with the block diagrams and the implementation of the proposed system**.**

CHAPTER 4 Deals with result analysis of the project.

CHAPTER 5 Deals conclusion and future scope of the proposal**.**

CHAPTER 2
LITERATURE SURVEY

2.1 OVERVIEW

The related works in the field of cricket and Smart umpiring system using Internet of Things along with some of its applications are discussed below. It also includes a detailed analysis on the previously proposed works by different authors. It also highlights some defective areas which are required to be filled up in this regard.

2.2 LITERATURE SURVEY

Nikhil Batra,et.al[1] The entire uprightness of any game rests with the umpire, but erroneous umpiring can spoil the sport . like all other game, cricket depends immensely on its umpires and their deciding abilities. Therefore, computer-based observational systems assist umpires in refining the judgment. a piece ongoing of a tool designed to assist game umpires, coaches to assist in deciding, analyzing the players using pervasive computing. Wide ball detection has been successfully implemented on images by using edge detection. Approximation of the trajectory of the ball has been done by applying simple laws of reflection and geometry to offer the deviated angle between the particular and therefore the predicted path. The wide ball detection module is often extended in many sports to guage if the ball is out of play in sports like football, tennis, Ping-Pong, volleyball. In tennis, the technique might be extended to see for faults, order of service in doubles and aces.

AZM Ehtesham Chowdhury.Bet.al [2] Cricket is a game of bat and ball where a single delivery can turn the expected winner into loser. So, every delivery is counted as crucial moment for both teams. In every cricket match, umpires are responsible for deciding the approval of a ball bowled by a bowler. There are many Scenarios when a delivery is disapproved by umpires. Some of the scenarios are declared as No Ball. A No Ball can be declared for illegal actions by bowlers or fielders. As a consequence of a No Ball, the opposition team gets an extra run and delivery. Furthermore, batsman will not be given out except run out. One of the most common reasons is overstepping of popping crease by front

foot during delivering the ball. But the examination of this kind of No Ball requires some minutes in certain cases using television replay. So, umpires make their decisions on their perception. But human perception can't be accurate all the time. Besides, it's not always possible to conclude the accurate judgment due to the restrictions of existing technology. In that case, the benefit of doubt goes with the batting team. And this creates mass confusion and debates among the viewers and cricket lovers. Then, we have applied image subtraction analogy among the video frames and template frame from the umpire's selected camera. Our proposed method has eradicated the shortcoming of human perception to decide overstepped no ball on wiped out popping crease. To better of our knowledge and consistent with the several bowling detections approaches and their application, our approach are often effective and efficient.

Dr. Tariq Mahmood et.al [3] Cricket is a famous sport that involves two teams, say Team A and Team B. Each team comprises eleven players, alongside two field umpires. Based on the result of a toss, one among the teams, say Team A, initially bats (by employing a wooden structure called a bat) so as to attain some runs. These runs are scored while Team B is balling (by employing a special sort of a ball). Then, the roles get reversed: Team A balls and Team B bats, while trying to beat the score posted by Team A. If this happens, then Team B wins. Otherwise, Team A wins. The balling team aims to urge the batsmen out, i.e., dismiss them from batting, so as to attenuate the scoring. Only ways during which this might happen may be a run-out, i.e., the batsman fails to enter a specific playing field, before the bowling team dislodges three wooden stumps in that area. It is generally very difficult for the umpires to detect this scenario through the eye. Hence, it's typically mentioned a 3rd umpire, who makes the 'Run-Out/Not-Out' decision through video technology. The only limitation of technology is that it cannot operate if the camera (for filming the run-out) is installed at a certain height from the ground. Hence, it requires a camera that is installed on the ground (at zero height). We don't consider this as a limitation, because the introduction of a new technology always requires some sort of a change, e.g., the Hawk-Eye feature used

in cricket requires the installation of 4 video cameras located at pre-specified angles and locations round the field.

Charles Gleason,et.al[4] Sensor networks have the potential to enhance the quality of our lives in many different ways. This is especially true for the aged and those with disabilities. Consider smart adaptive spaces for assistive living scenarios. In such a group environment, whether it be a disabled person and their family or a group of individuals with different disabilities, it may be necessary for the environment to adapt to those who are present. For example, when a person in a wheelchair enters the kitchen, the counter may move to a different height. It is conceivable that furniture would need to rearrange itself to accommodate a person in a wheelchair. However, we were unable to successfully track a moving object,
with even moderate mobility, at an acceptable level of precision for our assisted-living, smart space application. As part of future work, we plan to make changes
to the tracking algorithm and add additional sensors to the listener to improve the ability of CLS to track a faster moving object in complex paths. Ultimately, 3-D localization and tracking will be needed by our application. Whether or not CLS can be enhanced to meet this requirement is remains an open question.

M.V.Chilukuri,**et.al**[5] The advancement of technology lead to the development of innovative applications for the analysis and broadcast of sports. Technology is playing an ever-increasing role in Test cricket, and Channel 4 has been at the forefront of bringing it to TV audiences in UK. From the Red Zone to Hawk-Eye, Channel 4 is always looking for new and better ways of bringing, and explaining cricket, to the widest possible audience. The use of such technology had spurned a lot of interest in the audience and particularly the sports fan with information as well enthusiasm. Some of these technologies which are currently in use are Dartfish, Hawk-Eye, Snickometer and Hot spot. These technologies not only helped the TV broadcast channels to get more audience but also found to be useful in adjudication process in various games. The proposed pattern recognition system is quite simple in

approach while novel in its application and satisfactory in detection and classification. However, the proposed system can be easily extended to a fuzzy expert system with automatic rule generation using neural networks for the development of robust and accurate system for real-time implementation. Certainly, such a system will be quite useful in live broadcast of cricket match for the benefit of audience and adjudicators, especially when it is followed by one billion fans all over the world.

S. Takahashi,et.al [6] In recently years, observing the behavior of creatures attracts attention in various fields. For example, insects which consist of micro brain are able to show their adaptive action in accordance with the situation. We aim to analyze the behavior observation of the cricket *Gryllus bimaculatus*. The cricket changes its behavior by the situation and experience. In particular, we treated the aggressive attacking behavior of males. Namely, the simultaneous observation of crickets is important. Then, the time cost and misrecognition by human eye evaluations is often problematic. Therefore, in order to improve the method of creature observation, we proposed image. Therefore, we detected the only crickets in the box. The calculation area which takes maximum value in search area was extracted to detect the position of a cricket using a center of gravity in the extracted area. Furthermore, the proposed discrimination method derives true results even when the target cricket approaches other crickets. When detection by background subtraction based on a statistical reach feature is difficult temporarily, difficult we proposed a method which expands the search area for cricket motion in order to keep the target cricket processing method which automatically derives the action trajectory of creatures and conducts creature observation quantitatively.

Chung-Lin Huang,et.al [7]. This proposal a human object identification by using a simplified fast Region-based Convolutional Network (RCNN). Human identification may be a problem of considerable practical interest. Here, we propose that the state-of-the art method which is tested for large pedestrian datasets. Human detection part is used to detect head and shoulder, torso, and pair of legs, with three, two and 4 different appearances respectively.

These detectors are integrated as to identify the human object with different position. Fast R-CNN may be a well-known method for visual perception using deep CNN. Hybrid part detector demonstrates the merits for partially occluded human detection by integrating the many the individual part detectors based on the occlusion map. The objective function can be exactly evaluated by using the optimization algorithm. We compare each of the occlusion compensate score with a constant global detection threshold which is adjustable for trading off precision and recall of detections.

Ganesh Neelakanta Iyer,et.al [8] Cricket, which is being played across 105 countries, is the second most popular sport in the world after soccer. The popularity of sports has made room for a lot of development in the technology side of the game. The introduction of technology into cricket started with the arrival of the Third Umpire. Later came more advanced improvements like the Hawk-eye, Snicko-Meter, Hotspot, to name a few. With the inception of T20 cricket, the game has become fast paced, and it is the team winning the greatest number of crunches. Improving the quality of the game is what this model sets out to do. No-ball and run-out model tries to classify the images to make fair and unbiased decisions, and also in this process our models reduce the overhead cost of making these decisions, thus maintains the rhythm of the game. While the presence of real original datasets would have been more helpful in these classifying problems, but with the help of synthetic data a fairly good model was made possible.

Huang Rui, et.al [9] In the field of automatic control, machine vision and image recognition have become the hot core technologies. This design uses the camera to collect image information, and realizes the arbitrary movement of the ball on the flat plate through the processing of the single chip computer. This design realizes the precise positioning and control of an object in a certain range, which has certain reference value and use value in industrial production and University teaching. At present, cricket control system has some application examples in College teaching, mainly using it to study or verify some algorithms. Because of the high cost and the poor openness of the code, it has not been popularized. In

this paper, the cost of the system design is relatively low, the selection of device materials is relatively flexible, and the algorithm program is easy to understand. Compared with other cricket control systems, this system also has the outstanding advantage of integrating computer vision technology.

Md. Kowsher, et.al [10] Cricket is not only a national game but also international game was played among two teams of 11 players. In this game, every legal or illegal ball is calculated crucial because every ball is the game changer in any match. Cricket is a 'Gentleman's Game' but nowadays it has increased incidents of match-fixing, cheating sledding. In the Cricket uncovered a new era, when it proposed a limited overs match where each team batting and bowling at least one innings. An umpiring is a crucial moment in a match of cricket. So, Every Cricketer and umpire should obey the 42 rules in this game. In this game, two umpires stand on the field whose declare many decided in matches. In this paper, we find the probability of third umpire result and umpire signal classification applying SoftMax. Training a CNN using pre-trained Inception-V3 has showed a great outcome to separate cricket images for proposed tasks. We have exerted seven types of image datasets to train our system and re-trained Inception-V3's final layer. Then we have tested the re-trained model imparting an image which imparts the probability of the probable decisions.

Liding Chen, et.al [11] This proposal a human object identification by using a simplified fast Region-based Convolutional Network (RCNN). Human identification is a problem of considerable practical interest. Here, we propose that the state-of-the art method which is tested for large pedestrian datasets. Human detection consists of the part detectors which detect head and shoulder, torso, and pair of legs, with three, two and 4 different appearances respectively. These detectors are integrated as to identify the human object with different position. Fast R-CNN may be a well-known method for visual perception using deep CNN. Hybrid part detector demonstrates the merits for partially occluded human detection by integrating the many the individual part detectors based on the occlusion map. The objective function can be exactly evaluated by using the optimization algorithm. We compare each of the occlusion compensate score with a constant global detection threshold

which is adjustable for trading off precision and recall of detections.

Shinya Honda,et.al [12] Recent advances in PLD and FPGA technologies make it possible to implement an entire embedded system using multiple processors on one programmable device. An obvious advantage of this type of multiprocessor SoPC (System on Programmable Chip) is its great flexibility in hardware configuration. Suitable sorts of processors and suitable interconnection method between them are often chosen for every application. Real-time operating systems (RTOS) used for multiprocessor SoPC should be connected to a good rage of multiprocessor architecture. Because the configuration of RTOS depends on hardware architecture, it's advantageous to configure multiprocessor architecture and RTOS simultaneously. We call this process as hardware/software configuration. This proposal work-in-progress report of our research. Our future plan is to implement some RTOS-support functions with hardware and to evaluate sits effectiveness., such as spin locks. In addition, larger function blocks of RTOS, like semaphores and queues, also can be implemented with hardware.

Sachin Aggarwal,et.al[13] Obstacle detection may be a requirement for Advanced Driver Assistance Systems (ADAS). The precursors to autonomous vehicle systems. A number of sensor systems are used before to perform obstacle detection. One particular sensor system is the LIDAR system which is noted for its accuracy in measuring distances. However, largest commercially available LIDAR (Light Detection and Ranging) systems are costly and computationally intensive. This research characterizes a cheap 2D LIDAR system using the LIDAR-Lite v1 to be used in obstacle detection for autonomous vehicles. However, the filter also smoothened out the distance map data that were significant especially the singular isolated peaks that occur when the system samples far narrow obstacles. The lack of positional feedback and absolute starting position also served to decrease the consistency of features in the distance map.

Paul Mitchell,et.al [14] Wireless Sensor Networks (WSNs) contains small, self-powered electronic nodes, each equipped with limited resources: embedded processors,

memory, batteries, radio transceivers and environmental sensors. WSNs are envisaged for industrial, civil and military purposes to monitor, track and detect events based on the application requirements. Processing capabilities and energy restrictions are the important obstacles to achieving high performance in terms of service availability and quality of service (QoS). In this proposal, we have proposed a load balancing algorithm based on a pheromone signalling mechanism. We showed the long-term benefit of the proposed technique via a system level simulation model. The short-term energy efficiency benefits of our load balancing technique have been evaluated on real sensor deployment. We have two major goals: solving the service availability versus energy consumption trade-off with the proposed algorithm, and demonstrating good performance via the two evaluation methodologies of system-level simulation and hardware deployment.

Nithesh Singh Sanjay,et.al[15] currently, state-of-the-art object detection algorithms used for object detection require very high GPU computing power and even then, are not always able to detect in real-time. Mobile Net-Tiny tries to address this problem. Using the Single Shot Multibox Detector (SSD) [1] based MobileNetV2 [2] as a starting point, Mobile Net-Tiny is an attempt to get a real-time object detection algorithm on non-GPU computers and edge device such as Raspberry Pi.

2.3 SUMMARY

From the above literature review, it could be understood that the published information on International Cricket Council and Smart Umpiring System are very much used all over the world. The previously proposed works on the cricket field usage by Cricket councils, emergency messages are taken and analysed to propose a better future work. The existing systems proposed by different authors with several disadvantages which acts as a base for the proposal. Thus, the literature review gives more importance and very recent reviews among the researches and this indicates the high priority of researches towards this area.

CHAPTER 3
EXISTING SYSTEM

3.1 OVERVIEW

Cricket Is the First Card On The Eastern Continents And 706 Unique Viewers all Over The world. In cricket there is lots of technology involves for better match making and wicket identification. Some of the technologies are,

- Hawkeye
- Ultra-Edge
- Hotspot

3.2 EXISTING TECHNOLOGIES

3.2.1 HAWKEYE

Hawk-Eye's Hawk-Eye's latest innovation Ultra Edge uses vision and audio to detect if a ball contact with the ball or not, whilst our SMART Replay technology records all camera feeds in live and makes them available in real time to enable third umpires to make quick decisions on key incidents like run outs, stumping and no-balls.

All Hawk-Eye systems are based on the principles of triangulation using timing data provided by a number of high-speed video cameras located at different locations and angles around the ground and visual images. ball tracking is done by the system rapidly processes the video feeds from the cameras. A predefined data store contains a playing area and includes rules of the game.

In each and every frame sent from each camera, the system identifies the set of pixels which is corresponds to the image of the ball. And then calculates for each frame the position of the ball by comparing its position on at least two of the another physically separate cameras at the same in time. A succession of frames builds up a by the record of the path along with the ball has travel. It also "predicts" the future flight path of the ball and it will interact with the any of the playing area features already programmed into the database. The system can

also interpret these interactions to predicts infringements of the rules of the game.

The system provides a graphic image of the playing area and ball path, it means that information can be provided to judges, viewers in television or coaching staff in near real-time.

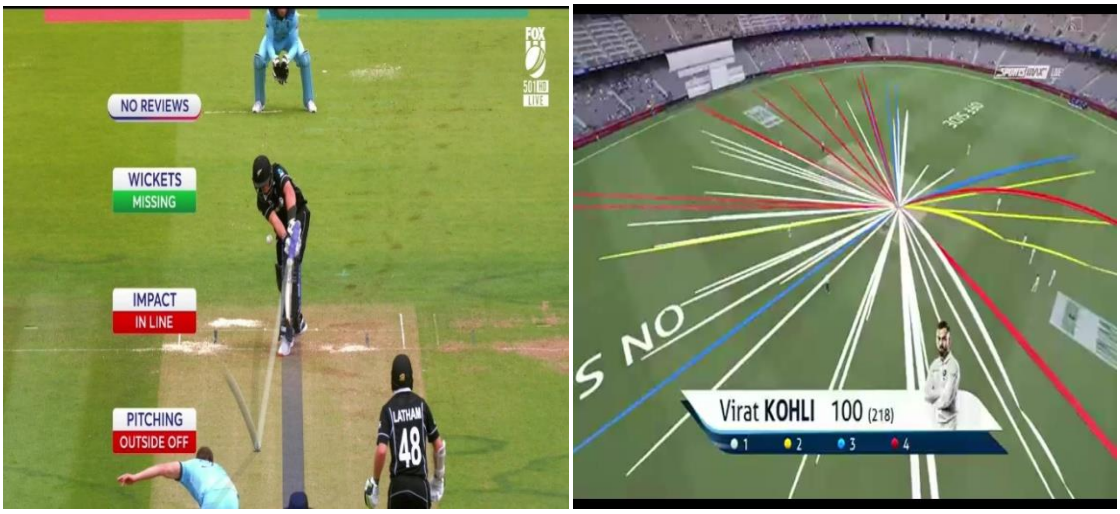

Figure3.1 (Hawk-Eye)

Figure3.2 (schematic Layout of Hawk-Eye)

3.2.2 ULTRAEDGE

He technology uses the microphones in stump to differentiate clearly between the sounds created by different ball and bat, which helps in deciding the close-calls situation in LBWs and bat-pad situations.

For this understanding the Snickometer and Hawk-eye how they works because Ultra Edge is a improved version of Snicko by Hawk-eye.

The Snickometer technology(Snicko) discovered by British Scientist Allan Plaskett in 1990 combines sound and visual data to help the umpires make the decision whether a batsman has actually nicked the ball – especially within the case of caught behind, bat-pad and lbw appeals.

The live sound pick up from stump microphone picks, filters the nose and relays it to the oscilloscope connected to it, which then traces the relevant sound waves. At the same time, visual recorded by the cameras and replay it in slow motion.

If the bat is suspected to have hit the ball, the sound graph is checked for impact from Snicko - a single, sharp spike on the graph will confirm the contact between the ball and bat. If it no impact, a flatter impact is observed thereon . The sound is then correlated by the third umpire while the ball passing the bat and slow motion replays of to make his final decision.

The upgraded version of 'Ultra Edge' is Hawk Eye's which was recently approved to be used as a part of the DRS package in game. Structurally, it's almost like the Snickometer which works with sound feed from the stump mic and visual evidence, however, Hawkeye’s improved, advanced version using live sound feed and its ultra-motion cameras is claimed to be more accurate in differentiating the sounds with more clarity.

Figure3.3 (Ultra Edge)

3.2.3 HOTSPOT

Hot Spot is an infrared imaging system utilized in cricket to work out whether the ball has struck the batsman, bat or pad. Hot Spot requires two infrared cameras on opposite sides of the bottom above the sector of play that are continuously recording a picture .

Hot Spot is an infrared image sensing system which used in of infra-red cameras to find out if the batsman has nicked the ball. This technology was first implemented in cricket by a Melbourne based company, BBG Sports. Although two infrared cameras are used, generally four infrared cameras are used to record the match continuously. The Hot Spot technology was originally developed by a French scientist Nicholas Bion. this technology also developed for tracking military tanks and fighter jets.The thermal wave remote sensing is that the basic principle. When the ball or bat makes contact with the pad, or the batsman, friction is generated. This friction between the bat and ball causes heat, the temperature change is observed by the infrared imaging camera system. And that is how the contact zone is detected by the cameras. Any suspected temperature change or bat/pad event can be verified by examining the infrared image. This technology was first utilized in 2006 during the Ashes in Australia.

Figure 3.4 (Hot Spot)

3.3 DRAWBACKS

Still cricket have so many advanced technologies there are some errors occurred due to that the match results and game play may get spoiled. Finding the No Ball and Run Out Is Cat On The Wall For The Third Umpire. To eliminate this error the ICC has implemented a new umpire (a man power) for only to detect the no-ball. He has to check the player on a run up ball moment for every time they bowled a ball. Even though sometimes they made a mistake on instant and that will consume a little time which affects the game play. To rectify this and to avoid the human mistakes on detecting the no-ball events we are going to propose our new model.

Figure 3.5 (controversial moments due umpire error)

CHAPTER 4

PROPOSED SYSTEM

4.1 OVERVIEW

In this project, we will discuss about the technology that uses a simple hardware connection and a software coding using machine learning. The main focus of the proposed system is to find the Over-Stepping and Field-Placement No-Ball in a cricket field. The technology we proposed is operated by the on-field umpire by a switch. The Arduino NANO is embedded with the distance sensor which all together is placed on the servo motor. The module is buried on the ground beneath the grease so the sensors can detect and find the no-ball.

4.2 BLOCK DIAGRAM

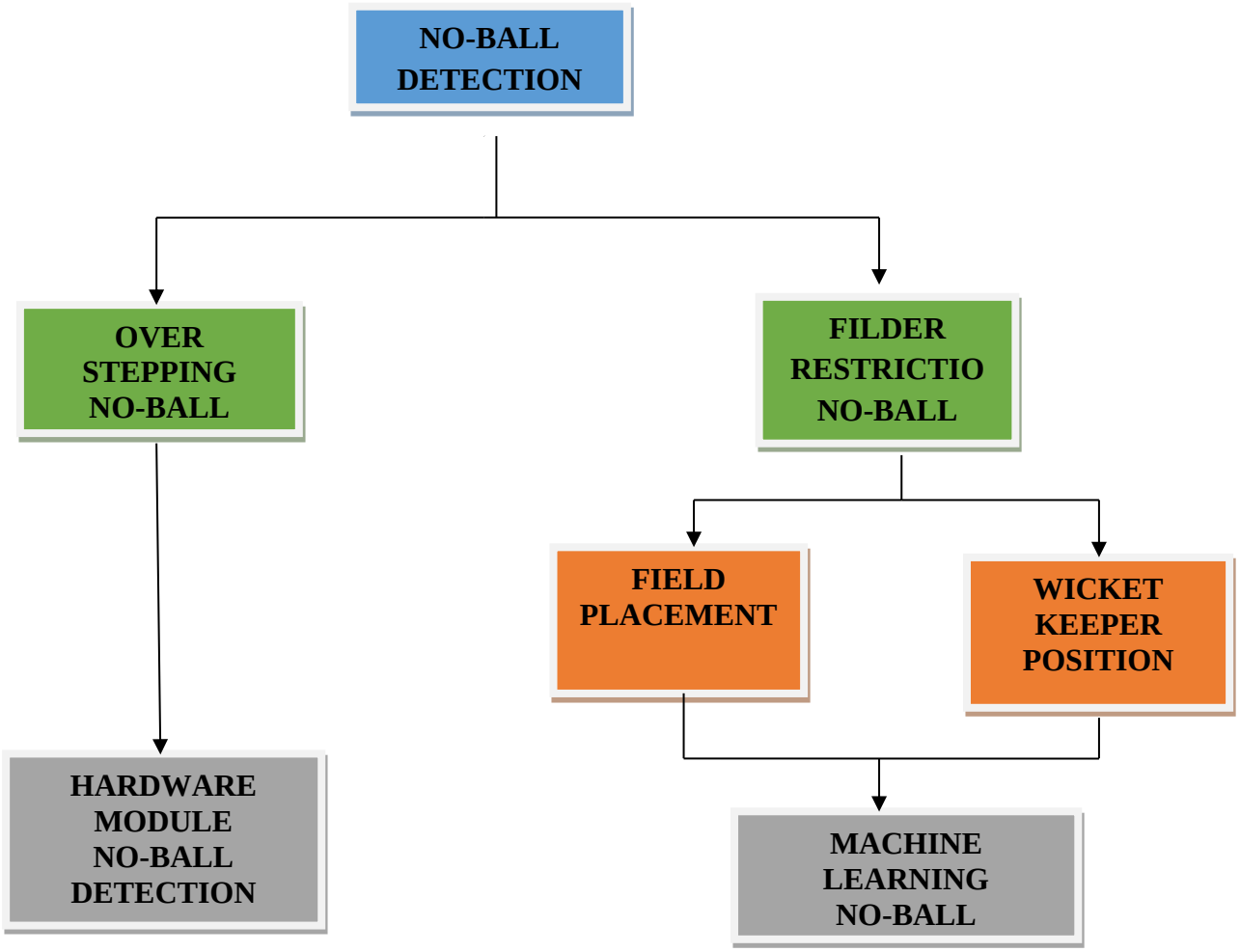

Figure 4.1 (BLOCK DIAGRAM)

4.3 PROJECT DESCRIPTION

The aim of our proposed system is to eliminate the errors and to provide a better a decision on the no-ball. Sometimes it may be difficult to find a over-stepping no-ball instantly. So, this model works on that part to find the no-ball with great accuracy and speed. Thus, this model will eliminate the use of the third man power for finding the no-ball.

4.3.1 OVER-STEPPING NO-BALL

This is one of the major controversial problem in cricket. When a bowler bowls, their little part of the foot must present behind the grease. When there is no foot present on the grease that is consider as an Over-Stepping no-ball. This plays a major role in a nail biting matches.

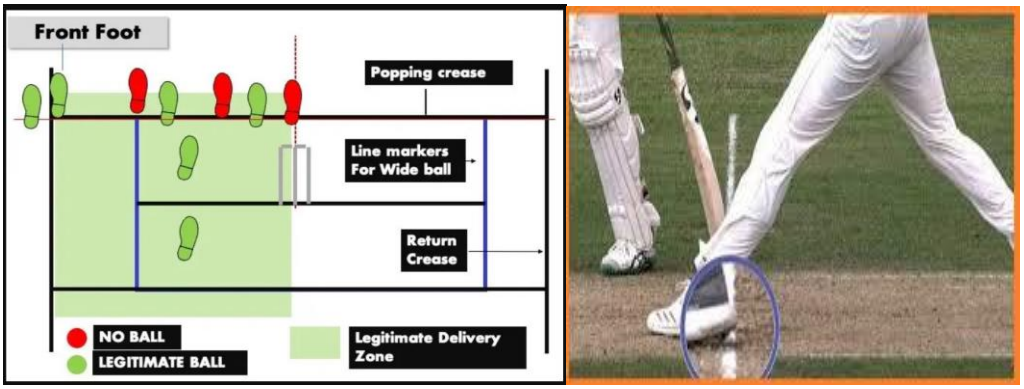

Figure 4.2 (Over-Stepping no-ball)

4.3.2 COMPONENTS

The names of the components that are used in the proposed system are as follows:

- Arduino NANO
- Distance Sensor
- Servo Motors
- Buzzer

4.3.2.1 ARDUINO NANO:

The Arduino Nano Every is a small, robust and powerful board with the same classic Nano footprint. It has more or less similar functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and its working with a Mini-B USB cable instead of a standard one. It was designed and being developed by Gravitech.

Arduino Nano is used in this proposal to execute the code to process the whole circuit. Using the Arduino IDE to develop the code.

The major reason for using Arduino Nano version is for compatibility in this proposal and it enough for required operation in the proposal.

Using Arduino Nano to control the sever distance sensor, servomotor, buzzer with code to identify the overstepping no-ball.

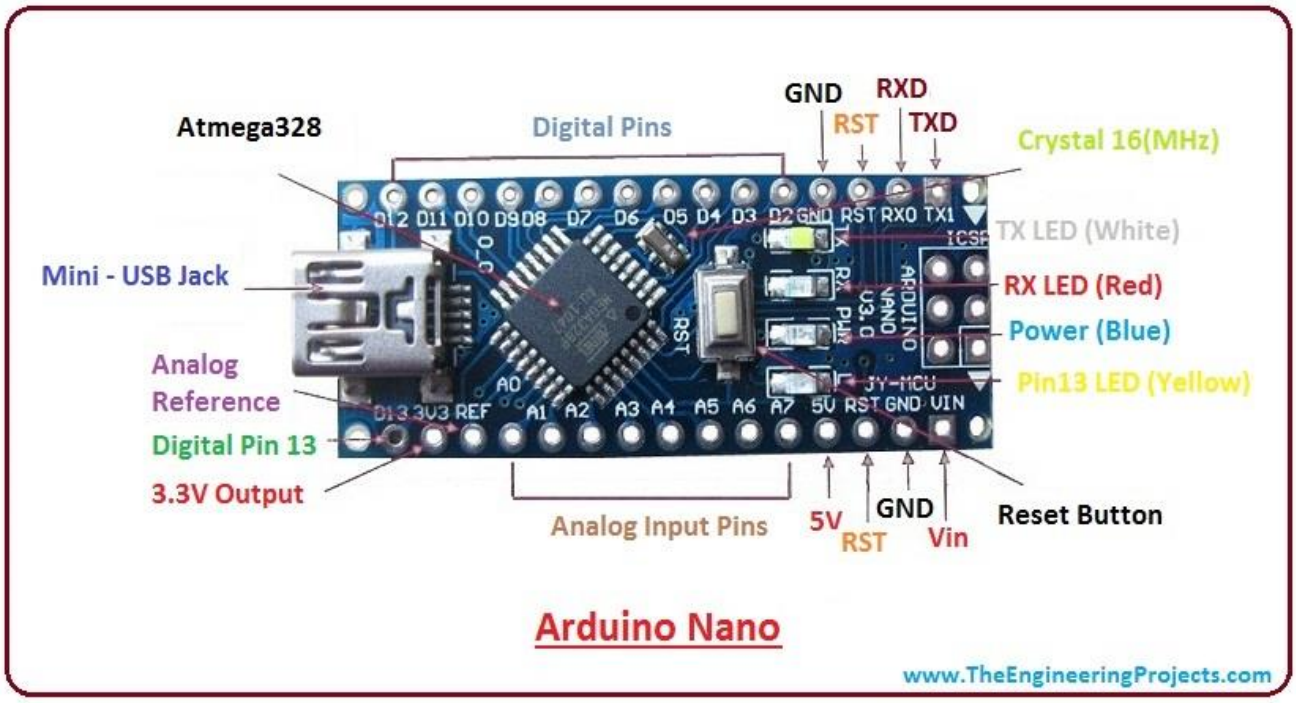

Figure 4.3 (Arduino Nano)

4.3.2.2 DISTANCE SENSOR

The VL53L0X is a new version Time-of-Flight(ToF) laser-ranging module in the smallest package on the market today, providing accurate distance measurement whatever the target reflectances unlike conventional technologies.

The VL53L0X (Distance Sensor) is in this proposal to find the bowler foot are inside the crease or not.It is work like a ultrsonic sensor but only difference emmit the wave like a laser emmition.

It is place edge of the creas and embedded with servo motor and Ardunio Nano and it is work according to the code .And code is contain the condition to detect the foot.which means in this proposal going to measure the distance of the bowler foot an the crease line

If the laser from the distance sensor is interrupted by bowler foot it return back to the sensor and give the desired output according to the code.

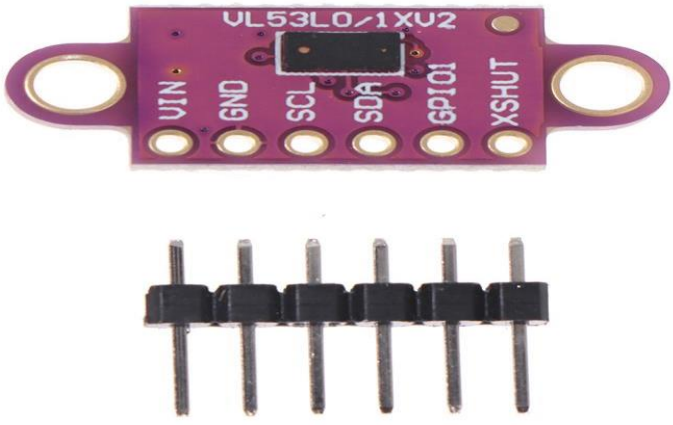

Figure 4.4 (Distance Sensor)

4.3.2.3 SERVO MOTOR

A servomotor is a linear actuator or rotary actuator that used for precise control of linear or angular position, acceleration, and velocity. It consists of a motor connected to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module developed specifically for use with servomotors.

In this proposal servo motor is worked for specific angular rotation with the help of additional servomechanism. The servo motor is control by the Ardunio Nano.

The servomotor is used to lift distance sensor which is buried on ground.so we can reduced the damage done by the fielder or bolwer.It has the own power source.

When bowler is ready to bowl the motor is triggered it rotates 5kmph and rise those distance sensors just above ground up to 2cm. And detect the bowler it goes back down to the ground.

The main reason was using a servo motor in this proposal that is provides angular precision.

Figure 4.5 (servo motor)

4.3.2.4 BUZZER:

A buzzer or beeper is an audio signalling device, it can be a mechanical, electromechanical, or piezoelectric (piezo). Typical uses of buzzers and beepers for alarm devices, timers, and confirmation of user input like a click or keystroke.

The buzzer is embedded with the Arduino nano. Whenever the distance sensor detects the no-ball and give the output signal as sound to alert the umpire.

Figure 4.6(buzzer)

4.3.2 WORKING OF PROPOSED MODEL

- Whenever the bowler is ready is bowls the umpire knows the bowler's side (around the wicket or over the wicket).
- Then umpire need to press the switch on their hand which invokes the circuit.
- When circuit is invoked, the servomotor is triggered and it will begin to rise up the distance sensor (Lasers) upon the grease which is embedded on the servo motor.
- Then the distance sensors emit the coherent light source (Lasers) which detects the bowler's foot on the grease.
- The lasers just touch the bowler's foot and reflect it back to the sensors.
- Then the data is collected by the Arduino NANO on which the distance sensors are embedded.
- The Arduino board is uploaded with a code to measure the distance of the foot and

the grease.

- If the small part of the foot is present behinds the grease the bowler bowls a correct ball otherwise it's a no-ball.

4.3.3 IMPLEMENTATION

- The module is buried under the ground beneath the grease.
- The Arduino is charged with battery (5V) which gives a constant power to the Arduino boards
- Then the sensors and the servomotors charged with the battery(5V) which gives a constant power to the circuits.
- This circuit is triggered by the switch which is used by the umpire.
- By triggering the circuit, it will just calculate the bowler's foot and grease distance.
- Then the data is collected and provides the desired output.

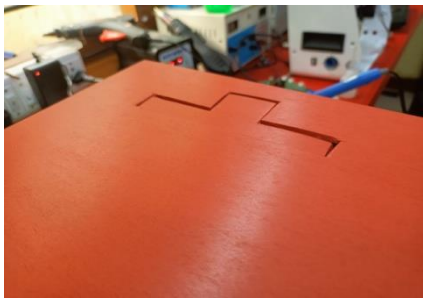

Figure 4.7(In off state)

Figure 4.8 (In On state)

4.4 FIELDER RESTRICTION NO-BALL

- It is also a one kind of no-ball which is not strictly considered in a local games. Eventhough in some international matches this kind of no-balls where not identified.
- If more than two players detected outside the inner circle during the power play, it is considered as No-Ball.
- They track the fielder position in the ground with the help of spider camera.

Figure 4.9 (Live graphical field placement)

- Then, tracking the object can be performed by a Multi-Object Tracking R-CNN algorithm based only on the detected position of the object at the real time.
- These required the machine learning and the AI concept for the implementation.

4.4.1 ALGORITHM

Step 1 - Multi-Object Tracking R-CNN Algorithm.

Step 2 - Finding the centroid of the ground (0,0).

Step 3 - Then find the centroid of the fielder's position on the field

Step 4 -Measurement of centroids of image and centroid of the fielders are calculated and fielder position are predicted.

Step 5 - When the fielder's measurement is more than 30yards then the fielder must be outside of the circle, otherwise fielder is inside.

Step 6 – If the fielder's position is correct according to the active power play the field is consider as a correct field placement otherwise, it an error field and the bowler's ball is consider as a no-ball.

4. 4.2 FLOW CHART

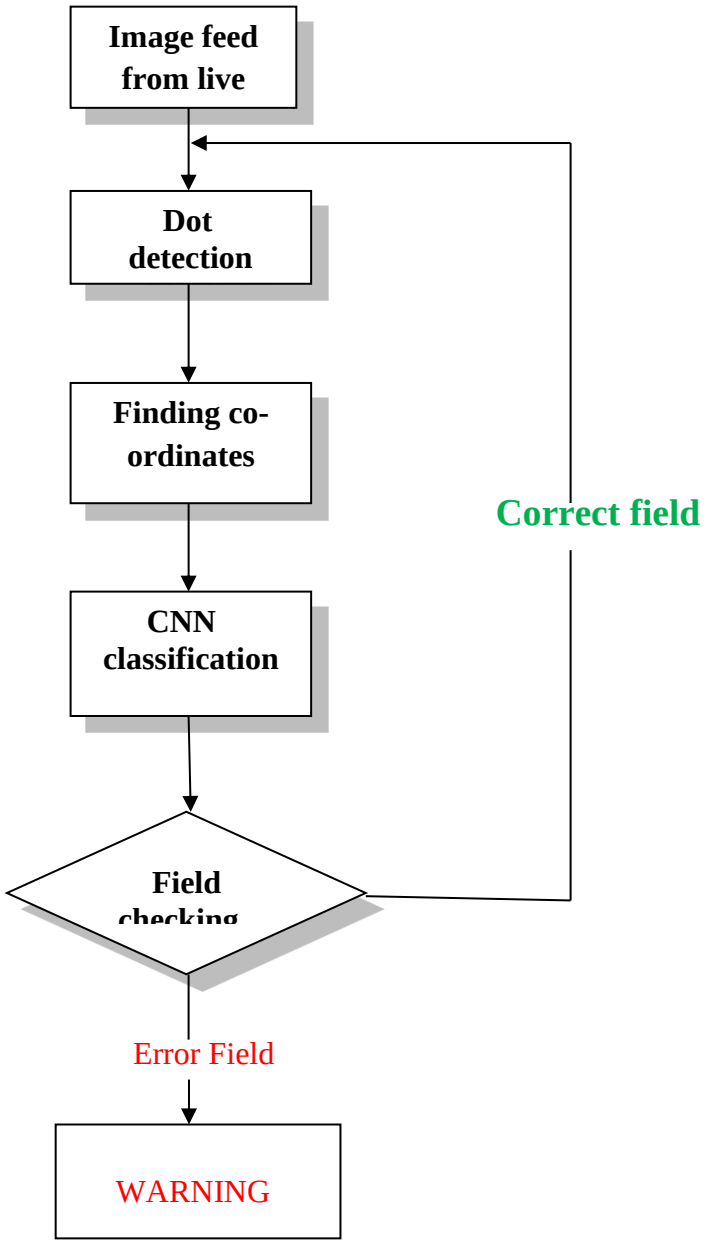

Figure 4.10 (Flowchart of fielder restriction no-ball)

4.4.3 TOOLS REQUIRED

- OpenCV
- Keras
- TensorFlow

4.4.3.1 OpenCV

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was built to supply a standard infrastructure for computer vision applications and to accelerate the utilization of machine perception within the commercial products.

It is used in this proposal to develop the code for fielder restriction no-ball .And also used for feed the input to the system and view the output .Using this software to interface the machine learning tools and images to produce the output in screen. the main reason for using OpenCV in this proposal is contain a library of programming functions mainly aimed at real-time computer vision.So that we can get the output at the realtime.

4.4.3.2 KERAS

Keras is an open-source software library that provides a Python interface for artificial neural networks. Using keras for is proposal is to create the conventional neural network for image classification.

Keras provides a Python interface for artificial neural networks and acts as an interface for the TensorFlow library.so that we can code in the python language .it make the code so simple and understandable

4.4.3.3 TENSORFLOW

TensorFlow is an end-to-end open source platform for machine learning. It has Comprehensive, flexible ecosystem of tools, libraries,and community resources that lets researchers push the state-of-the-art in ML and developers easily build and deploy ML-powered applications.

Using this tool in this proposal to accesses the many ML libraries and resources. So that easily build ML algorithm for image processing.

CHAPTER 5

RESULT ANALYSIS

5.1 OVERVIEW

This chapter gives a brief discussion about the results obtained from over-stepping no-ball (hardware system) and the Field restriction no-ball using machine learning.

5.2 OVER-STEPPING NO-BALL

The two distance sensors just measure the bowler's foot and the grease line, when the part of foot is behind the grease the ball is correct ball and it is indicated by the white light. If the foot is not inside the grease it is indicated by the red light.

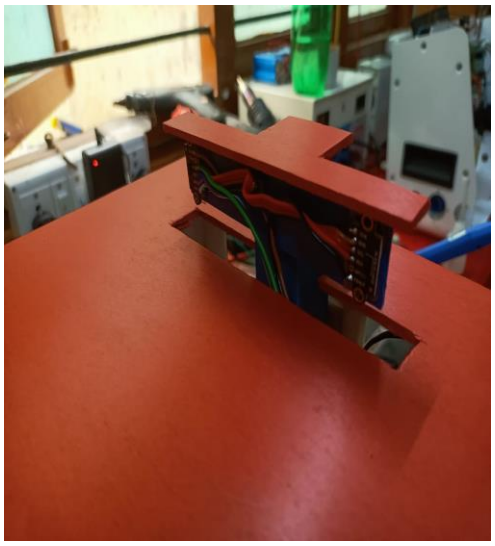

Figure 5.1 (Top view of module)

Figure 5.2 (bottom view of module)

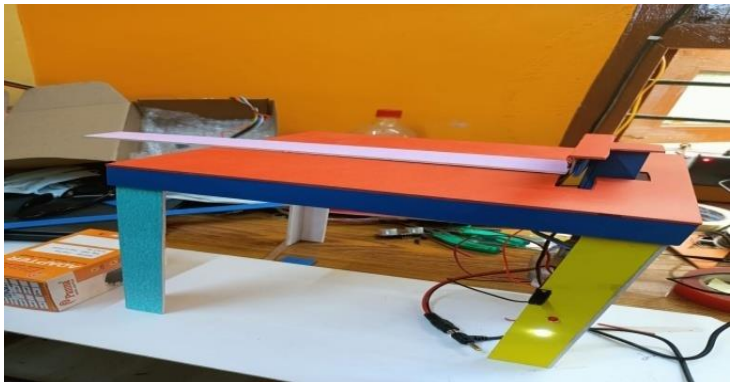

Figure 5.3 (overstepping No-Ball module)

5.3 FIELD RESTRICTION NO-BALL

5.3.1 SAMPLE INPUT

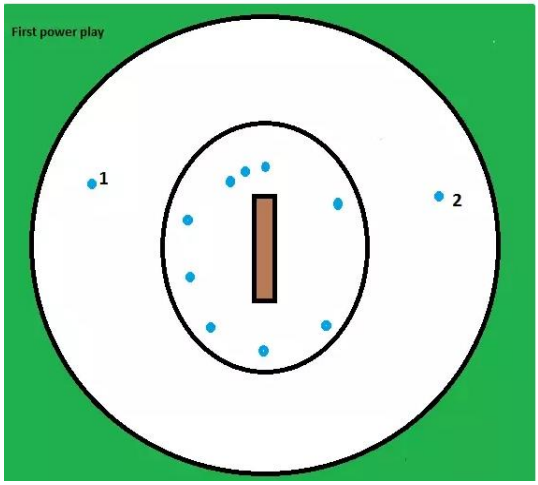

Figure5.4(First power play)

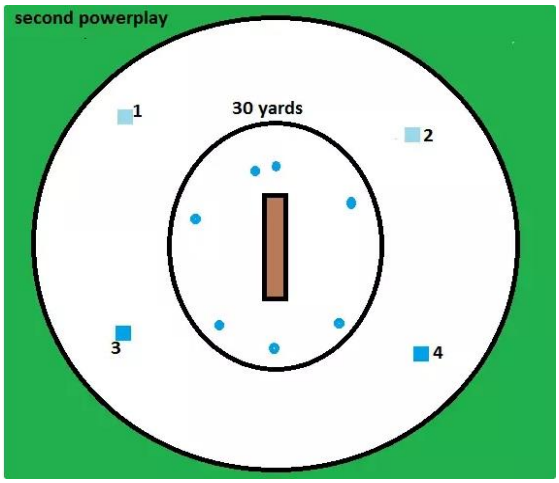

Figure 5.5(Second power play)

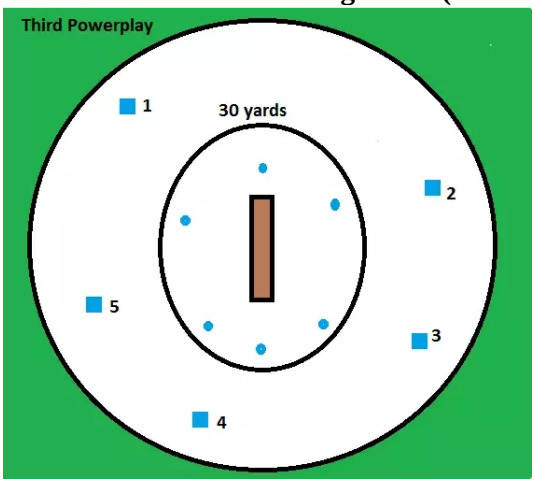

Figure 5.6(Third power play)

- In First power play only 2 fielders are allowed to field on outside the 30yard circle.
- On Second power play only 4 fielders are allowed to field outside the yard circle.
- On Third power play only 5 fielders are allowed to field outside the yard circle.

5.3.2 OUTPUT OF FIELDER RESTRICTION NO-BALL

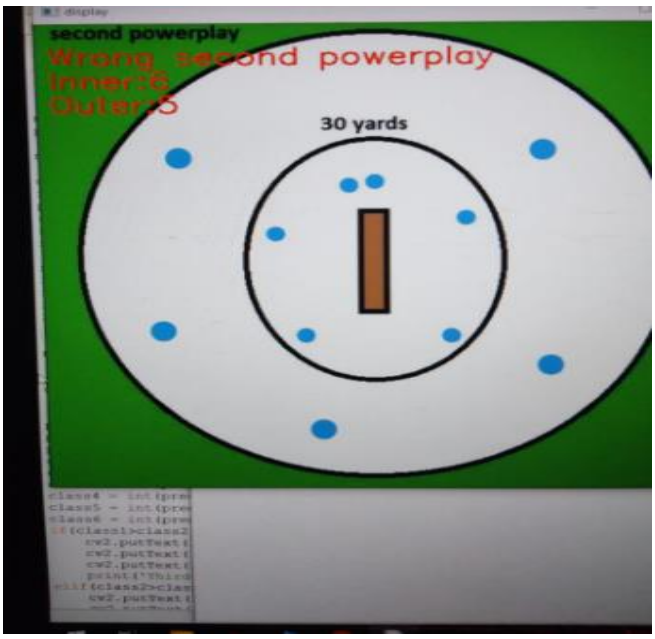

Figure 5.7(Output of Fielder restriction No-Ball)

The fielder's position is feed to the machine by the camera, whenever the field position is changed according to power play it checks with the reference position by using the machine learning algorithm. When the field position is wrong, it shows the wrong field placement of the current power play, otherwise it shows it's a correct field position.

CHAPTER 6

CONCLUSION AND FUTURE SCOPE

6.1 CONCLUSION

The entire uprightness of any game rests with the umpire, but erroneous umpiring can spoil the sport. Cricket is a game of bat and ball where a single delivery can turn the expected winner into loser. So, every delivery is counted as crucial moment for both teams. In every cricket match, umpires are responsible for deciding the approval of a ball bowled by a bowler. There are many Scenarios when a delivery is disapproved by umpires. Some of the scenarios are declared as No Ball. But human perception can't be accurate all the time. Besides, it's not always possible to conclude the accurate judgment due to the restrictions of existing technology. So, we develop a module to find the overstepping and fielder restriction no-ball at the real time. Thus, the proposed method will reduce the on-field umpire error and increase feasibility of a batsman to score extra runs. And increase the quality and standard of the game.

6.2 FUTURE SCOPE

The future works may focus on the utilization of outer factors such as using high resolution cameras with efficient machine learning algorithm to remove the on-field umpire in the cricket ground**.** This project can be implemented as a mobile application to produce the clear evidence of the result to the viewers at the live.It increase the integrity of the game.

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