IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol.-7, Issue-3, March 2019 E-ISSN: 2347-2693

Audio Assistance in Tennis for The Visually Disabled

Ahlam Ansari[1], Zainab Pirani[2], Shaikh Guffran[3*], Sayyed Naziya Ajaz[4], Khan Junaid [5]

[1,2,3,4,5]Department of Computer Engineering, M.H. Saboo Siddik College of Engineering, Mumbai, India

**Corresponding Author: guffran.shaikh7@gmail.com , Tel.: +91-9022847734*

DOI: https://doi.org/10.26438/ijcse/v7i3.680683 | Available online at: www.ijcseonline.org

Accepted: 17/Mar/2019, Published: 31/Mar/2019

***Abstract*— ** Tennis is one of the leading sports all around the world. In the past few years there has been tremendous growth in the use of high-end technology to follow every instance of every match in a Tennis Tournament. Unfortunately, the visually disabled players cannot completely enjoy following and playing the sport as they cannot determine the position of the ball precisely. This rises their stress and anxiety levels and thus many players eventually give up. Training the players and the instructors is difficult because the players need to be extensively trained to determine where is the ball currently, how is the ball being hit and where will the ball land on the court. Thus, there is a dire need for a system that makes the sport less stressful and more enjoyable. The existing systems for the visually disabled Tennis make use of special sound balls that rattle when they bounce. This paper presents a extensive survey of Tennis for the visually disabled, the existing technologies that are being used for analyzing the game and, finally, propose a system that would allow the visually disabled players to follow and play the sport with enthusiasm, just like everyone by following the match closely.

***Keywords*—** Computer Vision, Internet of Things (IoT), Object detection, Object tracking, Sound Generation, Visually impaired tennis.

I. INTRODUCTION

The World Health Organization estimates that the number of people of all ages visually impaired is estimated to be 285 million, of whom 39 million are blind. People 50 years old and above are 82% of all blind. Visual impairment is a major global health issue: the preventable causes are as high as 80% of the total global burden [1]. To overcome the difficulties faced in playing tennis, blind tennis was created in Japan, in 1984 by Miyoshi Takei. After a few modifications, a preferable system was arranged. The Blind tennis features a narrower court, with junior tennis rackets having bigger heads and shorter handles. Players use a foam ball which is filled with metal beads which, on impact, make sound, allowing the players to locate the position of the ball when it strikes the ground or racket. Once the ball is served, the players have to return the ball to the other player before it bounces three times.

Yet, the visually impaired face considerable difficulties as they cannot gain information for bypassing obstacles. Visual information is the crux for most navigational tasks and thus the visually-impaired sports are still at a disadvantage. People with disabilities can benefit greatly by assistive technology. It can help them with work, education and recreational activities.

Predominantly, it empowers the disabled and improves their quality of life. Of the widely available different technologies, we focus on those that enhance the maneuverability of the visually disabled. With recent advancement in inclusive technology, we can provide support to players with visual disability during their movement. In this paper, we propose a system that will provide assistance to the visually disabled to move in an unfamiliar background, through the medium of sound. There are three main steps involved in this system: 1. Recognition of target objects, mainly ball, used in the match. 2. Tracking the object from frame to frame. 3. Production of sound according to the spatial location of the ball in real-time.

II. REVIEW OF THE EXISTING SYSTEM

The authors in [2] have proposed an algorithm to detect the ball and note its trajectory in broadcast tennis video (BTV). Using this algorithm, we can decide whether the trajectory is a ball trajectory or not, and to locate the ball locations for most frames.

The authors in [3] have proposed an interactive object annotation method that incrementally trains an object detector while the user provides annotations. The authors have focused on minimizing human annotation time rather than pure algorithm learning performance. The method proposed by the authors is suitable for both still images and videos.

The authors in [4] present an algorithm, which offers the possibility to control remote software with information extracted from the digital image of a human hand. The paper primarily focuses on human hands, whereas it should have tested the same for other body parts or other obstacles as well.

The authors in [5] consider the problem of object detection. A short description of the object detection system with its algorithm along with a discriminatively trained part-based model and a gradient boosting trees algorithm is given. The algorithm is successful but it is based on the research part more (machine learning). The research is basically more inclined towards the machine learning part which makes the scope of this research concise.

The work in [6] deals with multi moving object detection and tracking under moving camera. Moving objects are detected by homograph-based motion detection. Online-boosting trackers are applied to track moving objects once they are detected.

The authors in [7] introduce OpenCV software as an important tool in the field of Computer Vision. The paper explores various built-in algorithms for detecting static and moving objects using the software

The authors in [8] have proposed to track and detect real-time images using high tech cameras and OpenCV based on image processing.

The authors in [8] have developed and implemented object detection and tracking system operational in an unknown background, using real-time video processing and a single camera

The authors in [9] introduce a technique for automating the methodology of detecting and tracking objects utilizing color feature and motion. Video Tracking is the methodology of finding and tracking a moving object over the long distance using a camera. Video tracking aims to relate target objects in consecutive video frames.

The authors in [10] discuss some famous and basic algorithms of object detection and tracking and also give their general applications and results.

The authors in [11] start with the introduction to human face detection and tracking, followed by an apprehension of the Vila Jones algorithm and then discussing the implementation in real video applications.

III. METHODOLOGY

The proposed system uses camera to capture each frame, and computer vision to detect the ball and its trajectory. When the ball hits the ground, the sound is generated by the nearest speaker present, and transmitted to the blind person. Block Diagram of proposed system

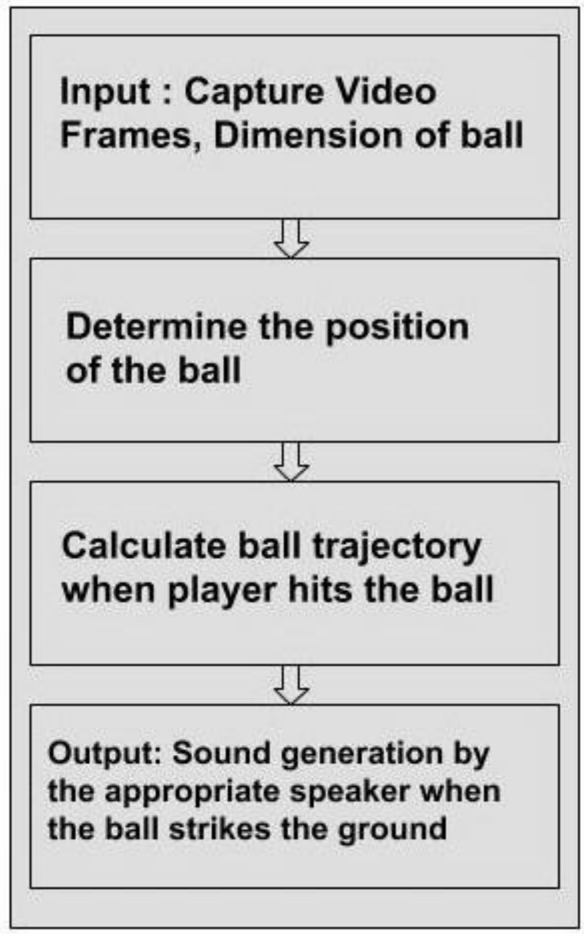

Figure 1. Overview of our proposed system

The figure above is the basic flow of the system. The input that the system obtains is frames and the position of the ball. Once the ball gets hit, the ball trajectory is calculated. On striking the respected surface, the speaker produces a sound for the player.

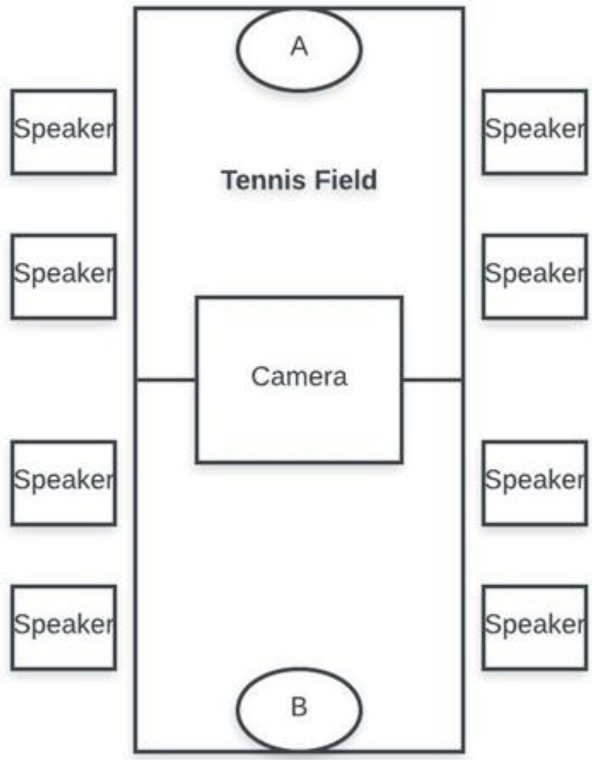

Figure 2. Layout of the Tennis Court

The above figure shows the layout of the court. The length and breadth of the court is divided according to the rules of tennis. The camera is placed where it can track the entire ground. Speakers are arranged in a sequential manner to produce sound with respect to the tennis ball's proximity.

Tracking is defined as a methodology to locate an object in successive frames. The definition sounds straightforward but in computer vision and machine learning, tracking is a very broad term that encompasses conceptually similar but technically different ideas. OpenCV is mainly aimed at real-time computer vision which is a library of programming functions. The camera will detect the ball and OpenCV will be used to track the motion of the ball. The input of our system is a frame captured using a camera. The position of the ball and player is being detected and the continuously changing position of the ball is determined. As soon as the player hits the ball trajectory of the ball is calculated using different algorithms. There are multiple speakers fixed at positions around the court. Thus, when the ball strikes the ground, the speaker located nearest to that point will generate a sound. the sound production conveys the position of the ball to the visually-disabled player.

Table. 1. Summary of work on Object Detection & Tracking and Sound Generation

Work Cited	Parameter	Features	Additional Features	Dataset	Evaluation Measure
[3]	OpenCV	Creation of Mask of Tracked Object, Mask Segmentation, Thumb Identification and Naming of Fingers, Designed Graphical Interface	---	---	---
[4]	Optimal Scanning	Digital Fovea, Object Detection	Multinomial Distribution	3,500 images of faces	1/5th were <10% of the image major axis, and 1/5th each were 10-20%, 20-30%, 30- 40% and 40%+ of the image major axis
[5]	Object Detection & Tracking	Homograph, Online Boosting	---	---	---
[6]	OpenCV	3D reconstruction, Visual Tracking, Image Registration	---	---	---
[7]	OpenCV	Video Stabilization, Object Detection	Panorama Stitching	---	---
[8]	Object Detection & Tracking	Color Segmentation, Edge Tracking, Real-time Object Tracking, Recognition	Contrast Stretching, Histogram Equalization	---	---
[8]	Object	Object	Morphologi	---	---

	Detecti on & Trackin g	Detection, Real-time Tracking, Background Subtraction, Motion Detection	cal Filtering		
[10]	Human Face Detecti on & Trackin g	Adaboost, Real-time Object Tracking	---	---	Adjustme nt of the threshold can be done to detect 100% of the faces with a false positive rate of 40%
[11]	Object Detecti on	SIFT, SURF, Object Detection, Visual Substitution	PCASIFT	---	---

IV. CONCLUSION

This paper presents to you a new system, representations and insights, which have a wide range of applications to reinforce visually disabled sports. Although there are various algorithms which contain object detection and tracking and sound generation, they are isolated. Our proposed system presents both the algorithms merged together. The system detects the ball, track its motion using OpenCV, find the point of collision of the ball with the ground, and generates the sound at the right time and right place. Finally, this paper presents a set of experiments which were conducted on a wide range of conditions. These conditions include - real-time ball tracking and detection, ball trajectory, sound generation and camera variation. So, the system is flexible enough to adjust to the changing conditions. Our proposed system will enhance the experience for the visually disabled tennis players and will make it easier for them to grasp and enjoy the sport.

REFERENCES

[1] Pascolini D, Mariotti SPM. "*Global estimates of visual impairment: 2010*", British Journal Ophthalmology Online, 1 December 2011.

[2] X. Yu; C.-H. Sim; J.R. Wang; L.F. Cheong, "*A trajectory-based ball detection and tracking algorithm in broadcast tennis video*", IEEE International Conference on Image Processing, 2004. ICIP '04 on 24-27 Oct. 2004.

[3] M. Michalko; J. Onuška; A. Lavrín; D. Cymbalák; O. Kainz, "*Tracking the object features in video based on OpenCV*", International Conference on Emerging eLearning Technologies and Applications (ICETA),2016 on 24-25 Nov. 2016.

[4] Nicholas J. Butko; Javier R. Movellan, "*Optimal scanning for faster object detection*", IEEE Conference on Computer Vision and Pattern Recognition, 2009. CVPR 2009 on 20-25 June 2009.

[5] Won Jin Kim; In-So Kweon, "*Moving object detection and tracking from moving camera*", 8th International Conference on Ubiquitous Robots and Ambient Intelligence (URAI), 2011 23-26 Nov. 2011.

[6] Ivan Culjak; David Abram; Tomislav Pribanic; Hrvoje Dzapo; Mario Cifrek, "*A brief introduction to OpenCV*", Proceedings of the 35th Convention International on MIPRO, 2012 21-25 May 2012.

[7] Kari Pulli; Anatoly Baksheev; Kirill Kornyakov; Victor Eruhimov, "*Real-time computer vision with OpenCV*", Magazine Communications of the ACM, Volume 55 Issue 6, June 2012, pp. 61-69

[8] S. Prasad and S. Sinha, "*Real-time object detection and tracking in an unknown environment,*" 2011 World Congress on Information and Communication Technologies, Mumbai, 2011, pp. 1056-1061.

[9] Singh, B. B. V. L. Deepak, T. Sethi and M. D. P. Murthy, "*Real-time object detection and Tracking using color feature and motion,*" 2015 International Conference on Communications and Signal Processing (ICCSP), Melmaruvathur, 2015, pp. 1236-1241.

[10] J. Chatrath, P. Gupta, P. Ahuja, A. Goel and S. M. Arora, "*Real-time human face detection and tracking,*" 2014 International Conference on Signal Processing and Integrated Networks (SPIN), Noida, 2014, pp. 705-710. [16] K. Bhure and J. Dhande, "*Object Detection Methodologies for Blind People*", International Journal on Recent and Innovation Trends in Computing and Communication, Vol. 5, No. 1, pp. 194-198, 2017.

[11] K. Bhure and J. Dhande, "*Object Detection Methodologies for Blind People*", International Journal on Recent and Innovation Trends in Computing and Communication, Vol. 5, No. 1, pp. 194-198, 2017.

Authors Profile

Ms. Ahlam Ansari, Assistant Professor at M.H. Saboo Siddik College of Engineering, Computer Engineering Department.

Dr. Zainab Pirani, Head of the Department of Computer Engineering at M.H. Saboo Siddik College of Engineering.

Mr. Guffran Shaikh, currently pursuing Computer Engineering from M.H. Saboo Siddik College of Engineering and belongs to Computer Engineering Department.

Ms. Naziya Ajaz Sayyed, currently pursuing Computer Engineering from M.H. Saboo Siddik College of Engineering and belongs to Computer Engineering Department.

Mr. Junaid Khan, currently pursuing Computer Engineering from M.H. Saboo Siddik College of Engineering and belongs to Computer Engineering Department.