# RUGBY EVENT DETECTION IN BROADCAST VIDEOS BASED ON VISUAL FEATURES USING DEEP LEARNING

Dulan Priyanga Jayasuriya

209337M

Master of Science in Computer Science and Engineering

Department of Computer Science and Engineering
Faculty of Engineering

University of Moratuwa
Sri Lanka

May 2022

# RUGBY EVENT DETECTION IN BROADCAST VIDEOS BASED ON VISUAL FEATURES USING DEEP LEARNING

Dulan Priyanga Jayasuriya
209337M

Thesis/Dissertation submitted in partial fulfilment of the requirements of the degree
Master of Science in Computer Science and Engineering

Department of Computer Science and Engineering
Faculty of Engineering

University of Moratuwa
Sri Lanka

May 2022

# Declaration

I declare that this is my own work and this thesis/dissertation2 does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Also, I hereby grant to University of Moratuwa the non-exclusive right to reproduce and distribute my thesis/dissertation, in whole or in part in print, electronic or other medium. I retain the right to use this content in whole or part in future works (such as articles or books).

Student Name: **D. P. Jayasuriya**

Index Number: **209337M**

Signature: Date:

The above candidate has carried out research for the Masters dissertation under my supervision.

Certified by;

Supervisor Name: **Dr. S. Ahangama (B.Sc, PhD)**

Signature: Date:

# Dedication

This thesis is dedicated to my parents.

For their endless love, support and encouragement.

# Acknowledgements

I would like to express my deep sense of gratitude and a profound feeling of admiration to all those who helped me and encouraged me in any aspects to accomplish this project. My special thanks to the University of Moratuwa for giving me an opportunity to carry out this project.

I would like to take this opportunity to thank Dr. Sapumal Ahangama, Supervisor of this project for his guidance throughout the project. I extend my thanks to the external supervisor of my project, Dr. Chitraka Wickramarachchi for his guidance and continuous support throughout the whole duration of the project. I am really thankful to Mr. Hansa Perera for sharing the experiences and expert knowledge with the project matters.

Further, I would like to thank all my colleagues for their help in finding relevant research material, sharing knowledge and experience and for their encouragement. Finally, yet importantly, I thank all those who like to remain anonymous although the help they provided me was valuable.

Thank you.

# Abstract

A sports play event is an athletic activity that is performed by multiple players during a sporting event. Sports Event Detection is a challenging task in the domain of sports video analytics. Numerous attempts were made to detect events occurring in sports such as soccer, basketball, and cricket. Our primary objective in this research is to detect events in a Rugby sports video. In comparison to other sports, this one is more difficult due to the sport's chaotic nature. As a result, very little research is conducted on the Rugby sport. The Rugby Events Dataset is presented in this paper as a benchmark dataset for event detection in rugby. It contains videos with temporal annotations for events as well as images with bounding box annotations for the same. Nevertheless, using deep learning and computer vision techniques, this research was able to successfully train on this dataset and detect rugby events as well as temporally localize those events in broadcasted videos. A simple classification model is used to distinguish between sports fields and other scenes in these videos, while an object detection model is used to identify sporting events. Whereas current object detection models are used to detect objects, this research demonstrates that these models can be extended to detect sports events and still produce satisfactory results. Combining tracking with object detection models increased our accuracy of localizing events in the temporal domain even further. This project has released a Sports Event Detection Framework which can be deployed in any machine. The RugbyEvents dataset is publicly available in https://github.com/CodeProcessor/rugby-events-dataset and the event detection framework is available at https://github.com/CodeProcessor/sports-events-detection.

*Keywords : Sports Event Detection, Deep Learning, Broadcast Sports Videos, SriLankan Rugby*

# Table of Contents

# List of Figures

# List of Tables

# List of Abbreviations

| Abbreviation | Description |
|---|---|
| ANN | Artificial Neural Network |
| BOW | Bag of Words |
| CA | Classification Accuracy |
| CNN | Convolutional Neural Network |
| CSV | Comma-Separated Values |
| DBN | Dynamic Bayesian Network |
| DCNN | Deep Convolutional Neural Networks |
| DNN | Deep Neural Networks |
| ED | Euclidean Distance |
| EM | Expectation-Maximization |
| FFT | Fast Fourier Transform |
| GP | Genetic programming |
| GT | Ground Truth |
| HMM | Hidden Markov Model |
| HPE | Human Pose Estimation |
| JSON | JavaScript Object Notation |
| KNN | K-Nearest Neighbor |
| LDA | Linear Discriminant Analysis |
| LPC | Linear Prediction Coefficients |
| LPCC | Linear Prediction Coefficients |
| LSTM | Long Short-tern Memory |
| LTC | Long-term temporal convolutions |
| MFCC | Mel-Frequency Cepstral Coefficients |
| MLP | Multi-layer Perceptron |
| MSE | Mean Squared Error |
| PB | Part-Based |
| PS | Pictorial Structures |
| RF | Random Forest |
| STE | Short Time Energy |
| SVM | Support Vector Machine |
| VAE | Variational Autoencoders |
| ZCR | Zero-Crossing Rate |