

Image Classification and Targeted Transmission over Simulated Networks using NS-3 and OpenCV

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Abstract

1. Introduction

The integration of computer vision with network simulation enables exploration of intelligent content delivery strategies in modern networks. As multimedia data proliferates, the need for smart, adaptive transmission mechanisms becomes vital for efficient resource utilization and enhanced user experience. Combining OpenCV for image analysis and NS-3 for realistic network emulation creates a powerful platform to study and optimize automated content routing solutions.

2. Problem Statement

This project aims to develop a system that classifies images of footballers at the sender side using computer vision techniques, then intelligently forwards each image to its designated receiver node in a simulated network environment. The solution models a content-aware, targeted transmission mechanism where each of five receiver nodes corresponds to one of five predefined footballers, embodying the concept of smart content-routing in communication networks.

3. Implementation

- Image Classification:** The sender employs OpenCV to perform face detection or recognize specific football players from an input set of images. This classification step identifies which receiver should obtain the content.
- Packetized Transmission:** The identified image is converted into network packets and transmitted via an NS-3-simulated network, following a path: Sender → Classifier → Correct Receiver.
- Receiver Assignment:** Each of the five receiver nodes is exclusively assigned to a particular footballer, ensuring targeted delivery.
- Visualization:** NetAnim is used to visually depict the flow of packets across the network, aiding in comprehending routing dynamics and performance.
- Performance Metrics:** The simulation captures and analyzes key indicators such as end-to-end latency, throughput, and packet loss, providing empirical data on system effectiveness.

4. Input & Output

Stage	Data/Artifact
Input	Raw footballer images (JPG/PNG)
Output (Receiver)	Annotated image delivered at the correct node
Output (Stats)	Network statistics: latency, packet loss

5. Result

The project demonstrates the successful application of image classifier-guided, targeted content delivery in a simulated networking environment. Results show accurate classification and assured transmission to the appropriate receiver node, while measured performance metrics offer insights into network behavior under content-aware routing policies. This work provides a basis for further exploration of intelligent content distribution approaches in networks, with applications in media streaming, surveillance, and personalized services.

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