FaceVue: A Review For Dynamic Advertising And Cost Management System

Lakshmi Nandana
Dept. Computer Science and Engineering
Amal Jyothi College of Engineering
Kottayam, Kerala
lakshminandana27@gmail.com

Mariyam Emamudeen
Dept. Computer Science and Engineering
Amal Jyothi College of Engineering
Kottayam, Kerala
mariyamemamudeen@gmail.com

Nikitha Mary Varghese
Dept. Computer Science and Engineering
Amal Jyothi College of Engineering
Kottayam, Kerala
nikithamaryvarghese@gmail.com

Susan Andrews
Dept. Computer Science and Engineering
Amal Jyothi College of Engineering
Kottayam, Kerala
susanandrews2001@gmail.com

Dr. Manoj T Joy
Dept. Computer Science and Engineering
Amal Jyothi College of Engineering
Kottayam, Kerala
manojtjoy@amaljyothi.ac.in

***Abstract*— FaceVue is an innovative project aimed at revolutionizing traditional advertising methods by introducing a real-time face analytics system for dynamic cost management. Traditional billboard and hoarding advertisements are replaced with a digitalized system that not only offers cost efficiency but also enhances marketing effectiveness through targeted audience engagement.FaceVue analyses audience demographics in real-time, including age, gender identification and number of faces. Then we curate advertisements perfectly suited to each viewer, ensuring maximum engagement and relevance. The system employs the face detection and recognition module to gauge audience engagement, providing insights into the number of viewers for each advertisement displayed. The cost of advertising is directly linked to this analytics of advertisement viewership, offering a transparent and fair pricing model for clients making it fair and accessible for business of all shapes and sizes.**

FaceVue targets small businesses and startups, providing an economical and efficient platform for advertising. This democratizes marketing opportunities, allowing businesses with limited resources to compete effectively in the market. Future enhancements include improving the efficiency of the system through the automation of uploading advertisement videos, empowering clients to directly upload their advertisement content. Additionally, automation of payment invoice processes will streamline financial transactions, enhancing overall user experience and operational efficiency.

Keywords*— *FaceVue,Convolutional Framework

I. Introduction

By blending technological innovation with strategic marketing insight, this project aims to show the path to a new phase of tailored advertising. With the use of camera sensors, the system recognizes and counts faces that are associated to the billboard screen, establishing the platform for highly customized ads that are targeted to specific populations of audiences.

The development of a transparent business platform that enables companies to maximize their marketing strategies is at the core of our objective. Our solution seeks to transform audience measurement by providing accurate face detection, giving businesses a more comprehensive insight of the reach and effectiveness of their campaigns.

Our project's scope includes every stage of the smart billboard system's lifespan, from design and development to deployment. For face detection, real-time tracking, and feature extraction, this calls for the integration of robust machine learning methods. In addition, we put inclusion first by guaranteeing accessibility with a user interface that can be used by organizations with different levels of technical proficiency. Our platform will provide companies with easy-to-use controls and an extensive analytics dashboard, making it easier to get valuable insights from generated data.

10.5281/zenodo.12512956

II. LITERATURE SURVEY

A. [1] DBCFace: Towards Pure Convolutional Neural Network Face Detection

Authors: Xin Li, Shenqi Lai, Xueming Qian, Member, IEEE

a) *Methodology:* The paper introduces the Dual-Branch Center Face Detector (DBCFace), a pure convolutional neural network for face detection. DBCFace leverages keypoint estimation to locate faces and parallel regression to predict face scales. To handle large variations in face scales, a dual-branch architecture is proposed, with each branch responsible for detecting faces in a fixed range. A Branch Route (BR) module and Feature Pyramid Aggregation (FPA) module are introduced to avoid duplicated detection boxes and improve detection performance. The method eliminates the need for anchor design and non-maximum suppression (NMS) postprocessing. Extensive experiments on popular face detection benchmarks demonstrate the effectiveness and efficiency of DBCFace.

b) *Advantages:* Introduces a simplified and efficient face detection method, eliminating the need for anchor design and NMS.

Utilizes key point estimation and parallel regression to locate faces and predict scales, improving detection accuracy.

Proposes a dual-branch architecture and BR module to prevent duplicated detection results and enhance modeling capability.

Achieves comparable performance to state-of-the-art anchor-based methods on multiple face detection benchmarks.

Offers a faster detection speed, making it suitable for real-time applications.

Demonstrates that complex components like anchors and NMS are unnecessary for face detection.

c) *Disadvantages:* Implementing a dual-branch structure and feature aggregation module may increase the complexity of the network architecture, potentially impacting training and inference times.

Fine-tuning the model with these components may require additional computational resources and training data, leading to increased training costs.

B. [2] Locate, Size, and Count: Accurately Resolving People in Dense Crowds via Detection

Authors: Deepak Babu Sam, Skand Vishwanath Peri, Mukuntha Narayanan Sundararaman, Amogh Kamath, and R. Venkatesh Babu, Senior Member, IEEE

d) *Methodology:* Introduces a detection framework for dense crowd counting. Shifts away from the common density regression approach for crowd counting. Focuses on locating every person in the crowd, sizing their heads with bounding boxes, and counting them. Develops the LSC-CNN model to address the challenges of detecting heads in diverse and dense crowds. Utilizes a multi-column architecture with topdown feature modulation for better resolution and refined predictions.

e) *Advantages:* Offers a novel approach to crowd counting by directly detecting and counting individuals.

Addresses challenges specific to dense crowds and contiguous box predictions. Requires only point head annotations for training, simplifying the annotation process.

Demonstrate superior localization and counting performance compared to existing density regressors.

f) *Disadvantages:* While the dense detection model may be technically advanced, its practical application or real-world relevance is not clearly articulated, leaving uncertainty about its utility or value in practical scenarios.

A. [3] Masked Face Recognition Dataset and Application

Authors: Zhongyuan Wang, Member, IEEE, Baojin Huang, Guangcheng Wang, Peng Yi, and Kui Jiang

a) *Methodology:* The paper addresses the issue of traditional face recognition models failing to work effectively in the presence of masks during the COVID-19 pandemic. It focuses on improving masked face recognition, which is critical for applications like security checks and community visit checkins. The authors propose three types of masked face datasets: Masked Face Detection Dataset (MFDD), Real-world Masked Face Recognition Dataset (RMFRD), and Synthetic Masked Face Recognition Dataset (SMFRD). The datasets are intended to facilitate research in masked face recognition and are made publicly available for download. The paper also discusses the importance of masked face recognition in maintaining safety measures during the pandemic.

b) *Advantages:* The paper provides three distinct masked face datasets, which can be valuable resources for researchers and developers working on masked face recognition.

These datasets have practical applications, such as identifying mask-wearing individuals, encouraging mask compliance, and improving public face recognition systems for masked faces.

The Real-world Masked Face Recognition Dataset (RMFRD) is the first publicly available realistic masked face recognition dataset.

The datasets aim to assist in training and testing deep learning based masked face recognition models, contributing to the development of more robust systems during the pandemic and beyond.

c) *Disadvantages:* Models trained on synthetic masked face datasets may experience a drop in performance on normal face recognition tasks due to the lack of exposure to discriminative features of normal faces.

Finding the optimal proportion of mask data augmentation for practical use remains a challenge, as the performance on masked face datasets may improve at the expense of normal face recognition performance.

The privacy restrictions of certain datasets, like ICCV2021-MFR-MASK, limit their utility as validation sets for model optimization during training phases.

B. [4] Multi-Camera Face Detection and Recognition in Unconstrained Environment

Authors: Yi Jie Wong, Mau-Luen Tham, Kian Huang Lee, Ban-Hoe Kwan

a) *Methodology:* The proposed Multi-Camera Face Detection and Recognition (MCFDR) pipeline involves three key components: face detection, face recognition, and tracking. Model training is conducted on an open-source dataset to develop a robust pipeline. YOLOv5n is employed for face detection with mAP 0.495, precision of 0.868, and recall of 0.781. The SphereFace SFNet20 model is used for face recognition, achieving an accuracy of 82.05.

b) *Advantages:* The MCFDR pipeline demonstrates high accuracy rates in detecting and recognizing human faces in real-world, uncontrolled environments.

The pipeline leverages state-of-the-art models like YOLOv5n and SphereFace SFNet20, ensuring robust performance.

Multi-camera tracking enhances the system's ability to track individuals across different camera feeds, providing comprehensive coverage.

c) *Disadvantages:* Despite its effectiveness, recognizing individuals in open environments still presents challenges, including variations in illumination, movement, and occlusions.

The system's performance may be contingent on the quality and coverage of the camera placements.

Inadequate camera placement may lead to limited coverage and potential gaps in recognition.

C. [5] RefineFace: Refinement Neural Network for High Performance Face Detection

Authors: Shifeng Zhang, Cheng Chi, Zhen Lei, Senior Member, IEEE, and Stan Z. Li, Fellow, IEEE

a) *Methodology:* The methodology employed in this study focuses on enhancing face detection through the RefineFace model. It starts by establishing a strong baseline detector using RetinaNet with a ResNet-50 backbone, serving as the initial reference point. The methodology introduces innovative modules like Selective Two-step Regression (STR) and Selective Two-step Classification (STC) to improve localization and classification accuracy, respectively. Scale-aware Margin Loss (SML) refines discrimination, while the Feature Supervision Module (FSM) enhances feature learning. Additionally, Receptive Field Enhancement (RFE) extends the model's capability to detect faces in challenging poses, leading to substantial improvements in face detection accuracy.

b) *Advantages:* The introduction of the Selective Two-step Regression (STR) module improves the location accuracy of detected faces. By coarsely adjusting anchor locations and sizes, RefineFace provides better initialization for the subsequent regression steps, reducing location errors.

RefineFace achieves near real-time speed, making it suitable for real-world applications. It can run efficiently on both GPU and CPU devices.

c) *Disadvantages:* The RefineFace approach involves multiple modules and techniques to improve face detection accuracy. This complexity might make it challenging to implement and fine-tune for specific use cases, especially for researchers and developers with limited resources or expertise.

Although the paper mentions that RefineFace incorporates techniques to reduce false positives, it does not provide a detailed analysis of false positive rates or scenarios where the model might produce inaccurate detections. False positives can be a concern in applications where precision is critical, such as security systems.

III. DISCUSSION AND ANALYSIS

[1] DBCFace: Towards Pure Convolutional Neural Network Face Detection

The research explores the novel DBCFace framework, which introduces a dual-branch fully convolutional architecture that does away with the requirement for non-maximum suppression and anchor design, thereby revolutionizing face identification. The dual-branch architecture for controlling scale variations, the multi-level feature fusion capability of the Feature Pyramid Aggregation module, and the incorporation of a scale-adjustable Gauss mask for enhanced performance are noteworthy elements. Through the use of a bounding box regression module and an anchor-free detector, DBCFace is able to accomplish reliable and effective face detection, as demonstrated by competitive outcomes on well-established benchmarks. The method's practical relevance is highlighted, designating it as a noteworthy innovation in the field with applications in security, surveillance, and human-computer interaction.

[2] Locate, Size, and Count: Accurately Resolving People in Dense Crowds via Detection

The paper presents LSC-CNN, a dense detection framework intended for precise person identification in densely populated areas. Using a multi-column architecture and a training procedure that only requires point-head annotations, LSC-CNN tackles issues including data imbalance, scale variations, and appearance variety. Top-down modulation and box categorization are two properties that help LSC-CNN perform well in sizing, localizing, and counting heads in crowded environments. It performs better than conventional regression-based methods, providing accurate localization and the ability to count crowds. In order to increase precision and decrease false positives in subsequent studies, the paper recommends more investigation into dense detection techniques.

[3] Masked Face Recognition Dataset and Application

The paper discusses the difficulty of the COVID-19 pandemic has presented for face recognition algorithms and suggests creating a masked face recognition model. To support this project, it introduces three masked face datasets: MFDD, RMFRD, and SMFRD. Its goals are to enhance face recognition performance for masked faces and enable face-based security checks without removing masks. Deep learning-based face recognition models, trained on datasets such as Glint360k and MS1MV3, are used in this study. The models' performance is assessed using benchmarks such as ICCV2021-MFR-All and ICCV2021-MFR-Mask. It also introduces a mask synthesis method to provide training photos with artificial masked faces. The study emphasizes how important it is to modify facial recognition software to work with masks during the pandemic, highlighting how this could potentially reduce the danger of virus transmission.

[4] Multi-Camera Face Detection and Recognition in Unconstrained Environment

The multi-camera face detection and recognition (MCFDR) pipeline, a technological innovation that uses many cameras and artificial intelligence to accurately identify and track human faces in complicated, real-world contexts, is introduced in this study. This novel method combines face detection, tracking, and identification elements, using cutting-edge models like YOLOv5n and SphereFace SFNet20 for improved performance and accuracy. Advanced object-tracking algorithms such as DeepSORT are used in the pipeline to provide reliable tracking and real-time individual position across numerous camera streams. The system is specifically made for real-world use in security, crowd monitoring, and surveillance. It can also be optimized for edge devices using the OpenVINO toolkit. All things considered, the MCFDR pipeline is a noteworthy development in face detection and identification technology, providing potential answers to problems that arise in unrestricted settings.

[5] RefineFace: Refinement Neural Network for High Performance Face Detection

RefineFace is a state-of-the-art single-shot refinement face detector that is presented in the paper with the goal of greatly improving high-performance face detection's capacity for both regression and classification. Five essential modules of RefineFace—Selective Two-step Regression (STR), Selective Two-step Classification (STC), Scale-aware Margin Loss (SML), Feature Supervision Module (FSM), and Receptive Field Enhancement (RFE)—address the problems of location accuracy and recall efficiency. Through deliberate refinement of regression and classification tasks, RefineFace outperforms earlier approaches like DSFD by a large margin on benchmark datasets. RefineFace is a top option for face detection applications in the real world because of its notable ability to handle variations in position, scale, expression, occlusion, and lighting conditions. Lightweight architectures that allow for real-time operation on both GPU and CPU devices are the focus of future research.

IV. CONCLUSION

The project's goal is to create a sophisticated smart billboard platform that will revolutionize traditional advertising by utilizing cutting-edge technology like AI and machine learning. Key approaches for the project's development are provided by insights from recent research articles, such as anchor-free face detection, dense crowd counting, and high-performance face detection.

Furthermore, including masked facial recognition datasets shows flexibility in response to COVID-19 difficulties, improving public safety protocols. The Multi-Camera Face Detection and Recognition pipeline provides solid insights for real-world scenarios such as crowd monitoring and surveillance.

In the end, the project aims to provide businesses with an engaging platform that maximizes the impact of advertising by engaging specific audiences. It seeks to transform marketing tactics by seamlessly combining cutting-edge technologies and producing customized, effective campaigns for target consumers.

References

[1] Xin Li, Shenqi Lai, and Xueming Qian. "DBCFace: Towards Pure Convolutional Neural Network Face Detection". In: IEEE Transactions on Circuits and Systems for Video Technology 32.4 (2022), pp. 1792–1804. DOI: 10.1109/TCSVT.2021.3082635.

[2] Deepak Babu Sam et al. "Locate, Size, and Count: Accurately Resolving People in Dense Crowds via Detection". In: IEEE Transactions on Pattern Analysis and Machine Intelligence 43.8 (2021), pp. 2739–2751. DOI: 10.1109/ TPAMI.2020.2974830.

[3] Zhongyuan Wang et al. “Masked Face Recognition Dataset and Application”. In: IEEE Transactions on Biometrics, Behavior, and Identity Science 5.2 (2023), pp. 298–304. DOI: 10.1109/TBIOM.2023.3242085.

[4] Yi Jie Wong et al. “Multi-Camera Face Detection and Recognition in Unconstrained Environment”. In: 2023 IEEE World AI IoT Congress (AIIoT). 2023, pp. 0548– 0553. DOI: 10.1109/AIIoT58121.2023.10174362.

[5] Shifeng Zhang et al. “RefineFace: Refinement Neural Network for High Performance Face Detection”. In: IEEE Transactions on Pattern Analysis and Machine Intelligence 43.11 (2021), pp. 4008–4020. DOI: 10.1109/ TPAMI.2020.2997456.