Market Intelligence Analysis on Age Estimation and Gender Classification on Events with deep learning hyperparameters optimization and SDN Controllers

Khaing Suu Htet
GIS Research Lab
University of Computer Studies,
Yangon
Yangon
khaingsuuhtet@ucsy.edu.mm

Myint Myint Sein
GIS Research Lab
University of Computer Studies,
Yangon
Yangon
myintucsy@gmail.com

Abstract

Nowadays, understanding demographic information on social influencer events is important for target customer analysis. Hence monitoring the crowded event requires an intelligent sophisticated technology with human gender classification and classify age group. This paper is using hyper-parameter optimization and SDN controller on age gender classification on events cameras to monitor and classify to cover the whole event. Many cameras will need and lead to weak performance in classification. This system targets for getting better result in multi-IP-cameras managing port under SDN controller. Classification for image processing is used by fast R-CNN with hyper-parameter optimization model data training and achieving result from SDNs based web cameras. With constraints of hardware, this system will rely on group of Sony IP-Cameras with SDN controller environment. And OpenCV2 libraries is used to train hyper-parameter optimization model, SDN controller run on Mininet , Openflow protocol and IMDB Image Datasets and Asia Image Dataset are used to achieve better satisfactory performance.

Keywords: *Gender classification, IP-Camera, SDN, OpenCV, OpenFlow, IMDB image Datasets*

I. INTRODUCTION

Present Days, Business Analytics is main driven to not even business planning but also in Government national planning. Hence, collection of data and data mining are critical parts in demographic data. Video analytics application helps in providing information as people counting, evaluate impact of advertising and determine optimal decision.

The system proposed to detect and compute in human gender classification, tracking and counting people with different age classes in events streaming video. Gender classification and age estimation automated systems have become relevant to many applications, particularly since the rise of social media and platform events [1]. In private event, many cameras will need in monitoring all entrances and exits and input to detection system. There is challenge in accuracy of classification and delay due to traditional network will leads to system performance and reliability. The growing complexity of fast R-CNN architectures causes many problems, an important one is ”overfitting” and this happens when the network trains the dataset, but is not able to recognize slightly different objects outside of the dataset.

This study focuses on improving performance of classification task can be defined as recognition rate, i.e. percentage of correctly classified images. The performance can be influenced not only different datasets, but also changing training parameters and additional parameters as hyper-parameters. To get optimized hyper-parameters, this study used Nelder-Mead method as applied to hyper-parameter tuning problems. This searching algorithm will help to save a lot of tedious effort using some intelligent search strategy. This paper indicated that providing better fast R-CNN architectures than a baseline method and achieving nearly state of the art performance without any user intervention provides better results under certain conditions.

Monitoring events are play role in the growth of business analysis data and placed huge demands on data network. This system also tried to modify video streaming performance by using port management on SDN controller. The system improves the packet delay and loss performance of streaming video over Mininet and Open v-Switch based IP cameras cluster OpenFlow networks.

In this paper has 6 Sections, Section 2 has explained related works. Section 3 includes the brief overall system flow, and explains fast R-CNN, Hyper-

parameter optimization hybrid model and SDN configurations to classify gender detection. Section 4 discusses preparation of datasets and training and Section 5 has detail results and followed by conclusion and future works are under in Section 6.

II. Related Works

Human gender classification and age estimation have been developing many methods and platforms. The major issue of gender prediction is how to extract representation features from face detection and age. As per "Real-time age and gender estimation from face images" by JANG-HEE YOO, SO-HEE PARK (iCMLDE-2017) [2] : Face Detection and pose estimation methods are adopted to acquire frontal face images. One famous method is CNN (Convolution Neutral Network) and the enhancement fast R-CNN proposed by ROSS GIRSHICK (iCCV-2015) [3] some of the drawbacks of R-CNN to build a faster object detection algorithm and similar approach on modified R-CNN algorithm.

To get better performance on fast R-CNN, hyper-parameters can add the pre-processing. CHAIRE HAVAS proposed hyper-parameter optimization on continuous parameters sets for better machine learning. Hence, it can use input as additional hyper-parameter sets in fast RCNN machine learning[4]. It has also compared possible algorithm and methods for better optimization results.

And then SDN (Software define Network) is a logically centralized controller, with a global view of network, which can monitor traffic flows, make forwarding decisions and install efficient rules at runtime. The flexibility control accomplished to provide services like inter-domain network layer multicast. SDN-based multicast frameworks supported to offer content and/or network providers with sufficient control to realize and better result on a video streaming service.

III. Proposed Overall System

As Fig.1, the proposed overall system have two main parts. First, the input streaming videos from many cameras from multiple location and passed over the SDN controller network with optimization streaming flow. The centralized controller of network by separating the control logic to its desired devices such as routers, switches and IP based cameras. The proposed network system can resolve delay video streaming problems with SDN based networks. The controller applications can be used configuring and controlling the network. SDN controller run on POX based controller rely on OpenFlow installed Raspberry Pi clustered and mininet for its local testbed. The proposed system aims to efficient real time video streaming through SDN controller to reroute streaming packets faster and efficient.

The second part is classification of input real time video stream from events (such as music concerts, festival) via SDN based controller to assign deep learning system, which applied Fast RCNN based gender classification for market analysis information.

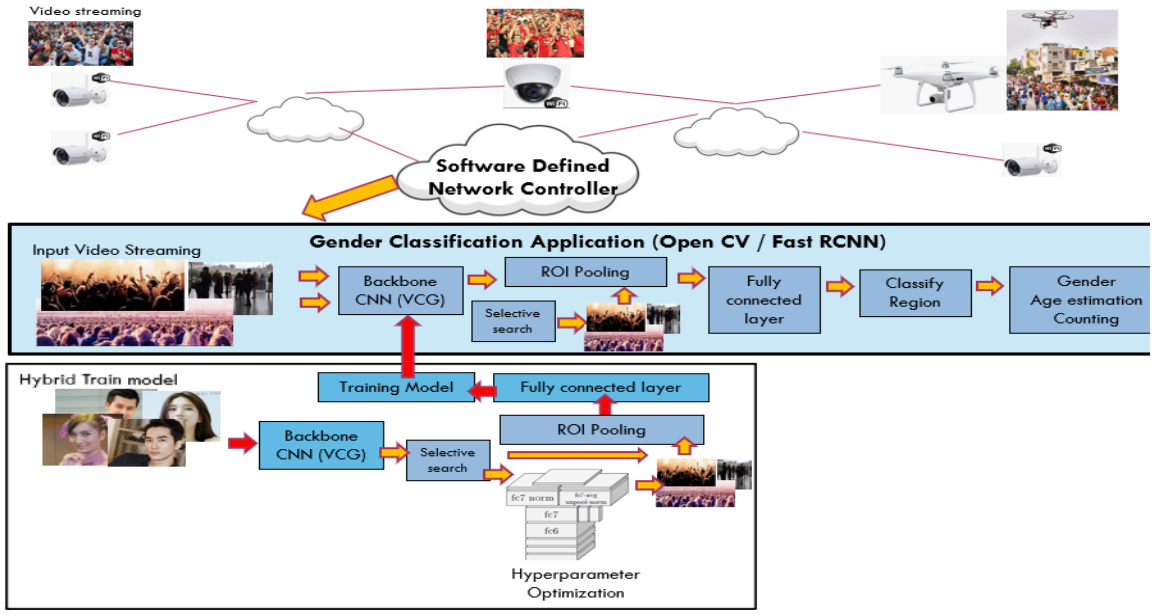

Figure 1. Overall system architecture

And the system used the hybrid system added with hyper-parameter optimization method on

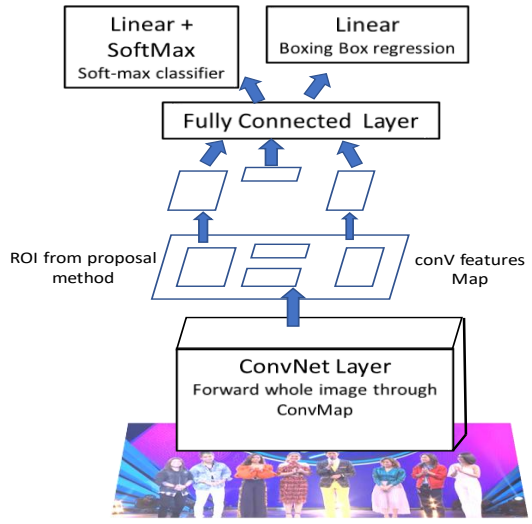

Figure 2. Fast R-CNN architecture

training dataset in preprocessing recursive Fast R-CNN method to get better results as benchmark and accuracy rate is higher with hybrid hyperparameters trained system. The result can show to reduce time consumption and performing to accurate result.

A. Fast R-CNN

As Fig. 2, at the pre-processing stage, the input streaming videos has passed as the input image to the Convolutional Neural Network, which one at a time generates the convolutional feature maps. In view of utilizing these maps, the region extracted due to regional proposal. Then, a RoI pooling layer has applied on all of these regions to reform them as per the input of the ConvNet into a fixed size. Therefore, each region can feed to a fully connected network. On the softmax layer, it has applied on top of the fully connected network and the linear regression layer has applied parallel to output bounding box organized for pre-trained predicted classes.

B. Hyper-parameter Optimization Hybrid Model

In deep learning, a hyperparameter optimization model can be formulated as a stochastic black box optimization model to minimize a noisy black box objective function *f*(*x*)[5].

$$\min_{x \in \mathbb{R}} \ f(x)$$

This system applied Nelder-Mead optimization methods to adjust fewer hyper-parameters. It is developed with fewer computing resources. The

Initialization: Choose an initial simplex of vertices $\mathbf{Y}_0 = \{\mathbf{y}_0^0, \mathbf{y}_0^1, \ldots, \mathbf{y}_0^n\}$. Evaluate f at the points in $\mathbf{Y}_0$.
Choose constants:

$$0 < \gamma^s < 1, \quad -1 < \delta^{ic} < 0 < \delta^{oc} < \delta^r < \delta^e.$$

for $k = 0, 1, \ldots$ **do**
  Set $\mathbf{Y} = \mathbf{Y}_k$;
  Order;
  Reflect;
  Expand;
  Contract;
  Shrink;
end

Figure 3. Nelder-Mead Algorithm

following Algorithm:Nelder-Mead method (Fig. 3) is applied for the hyperparameter tuning problem in support vector machine modelling. This method also finds better hyperparameter settings reliably for support vector machines.

C. Configuration of SDN Controller

This paper used two IP based cameras connected Raspberry Pi 3b+ as SDN based camera and input to SDN controller based on Raspberry Pi 3b. And then the output will lead to application layer (in this case- OpenCV). All cameras are set up on each entrance to catch up the people in events.

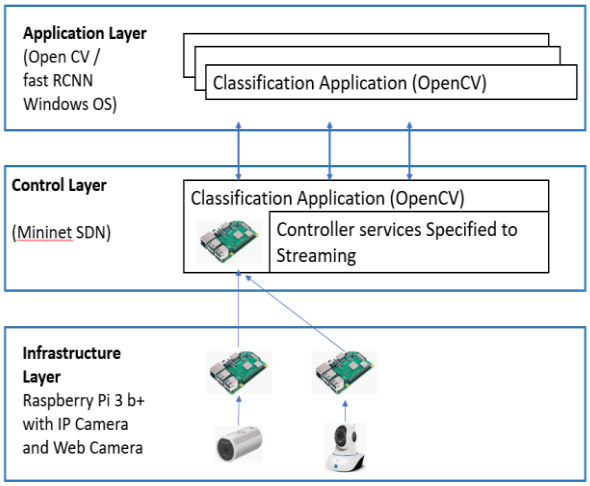

Figure 4. SDN basic configuration System

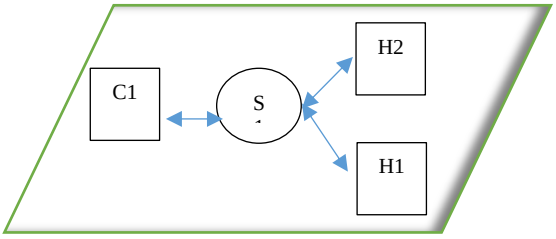

Figure 5. SDN basic configuration System

In a software-defined network, there are two types of architectures, physically distributed multi-controller architecture and physically centralized, just in the case of the physically distributed network. The system used a physically centralized controller at each pair of critical point for the underlying layer, there is just one controller that manage the specified video port over the whole network. The paper set SDN network with 2 hosts (h1, h2), 1 SDN switch (s1) and Controller (c1). POX SDN based controller is set up as centralized controller and Mininet is used as network emulator over Raspibian OS and emulate overall OpenFlow network on the overall system [10]. IP configuration for H1 and H2 is 10.0.0.2 and 10.0.0.3 respectively and this work set openflow default port for controller as 6633. H1 and H2 are two Raspberry Pi 3B+ with bypass port forwarding to entire system application notebook via controller.

TABLE I. IP ASSIGN AND PORT FORWARDING IN SDN CONTROLLER

Devices / Description	**IP or Port**
Nodes	c0 h1 h2 s1
Raspberry Pi with camera (h1)	10.0.0.2 (eth0)
Raspberry Pi with camera (h2)	10.0.0.3 (eth1)
SD Switch	s1-eth1:h1-eth0 s1-eth2:h2-eth0
Port forwarding (video)	8081

The above Table 1 shows the configuration set up for each node in the system OpenFlow.

IV. DATASETS AND TRAINING

This paper defined Gender in two classes – Male (0), Female (1) and trained in OpenCV to get configuration with two different Datasets, IMDB and Asia Image Dataset. Moreover, head position and facial expression had not considered in this system. Age class division did not follow equal interval, and this system defined as divided ten classes for Age- (0-2), (3-6), (7-13), (14-20), (21-24), (25-32), (33-37),(38-43), (48-53) and (54-70). In each dataset, the image file with metadata file included as following format - DOB, phototaken, full_filepath, gender and age group.

All fast R-CNNs are trained with openCV2 and additional hyperparameters are minimize the objective function by repeating its evaluation vertex. To set and generate initial parameters randomly, then perform optimization for up to 600 evaluations (included initialization). The system trained all two Datasets IMDB and Asia Image Datasets. Since IMDB original datasets has 460723, this system used IMDB wiki images as 3209 facial images while the second, Asia Image Dataset, is from Tsinghua Science and Technology 2019 with 13322 images [7] as Fig. 6.

In training process, the system divided the dataset into five sets, train the network with four sets, and test it with one set. Note that these processes require significant calculation time; thus, in the optimization process, cross validations are not performed. The system performs cross validation for only the optimal solution among the optimal solutions of all methods.

As per training time is too high, the system used to run over Open CV2 with GPU 640 Cores (GeForce GTX 1050 (2GB)) on desktop with 2 days.

V. EXPERIMENTAL RESULT AND FINDINGS

This system found that the classification on and accuracy of detection for Myanmar video streaming, used current Myanmar Idol season 4, as benchmark and accuracy rate is higher with hybrid hyperparameters trained system as Fig. 7. and Fig. 8.

VI. CONCLUSIONS AND FUTURE WORKS

In this system presented gender classification method based on fast R-CNN with hyperparameter optimizations and experimental results provided. The major contributions are twofold: (1) organizing Myanmar Image datasets for gender classification; (2) proposing new hyperparameter optimization configuring model for Myanmar people gender classification with competitive performance on the Myanmar Image Dataset and Asia Image dataset. To get better results, Myanmar Image Dataset with more images. Many tests and evaluation along with the reliability of Software-defined network based configuration and applications have many challenges. These challenges include scaling to ability to adjust easily between prototype and test environments.

Figure 6. IMDB Datasets and Asia Image Datasets

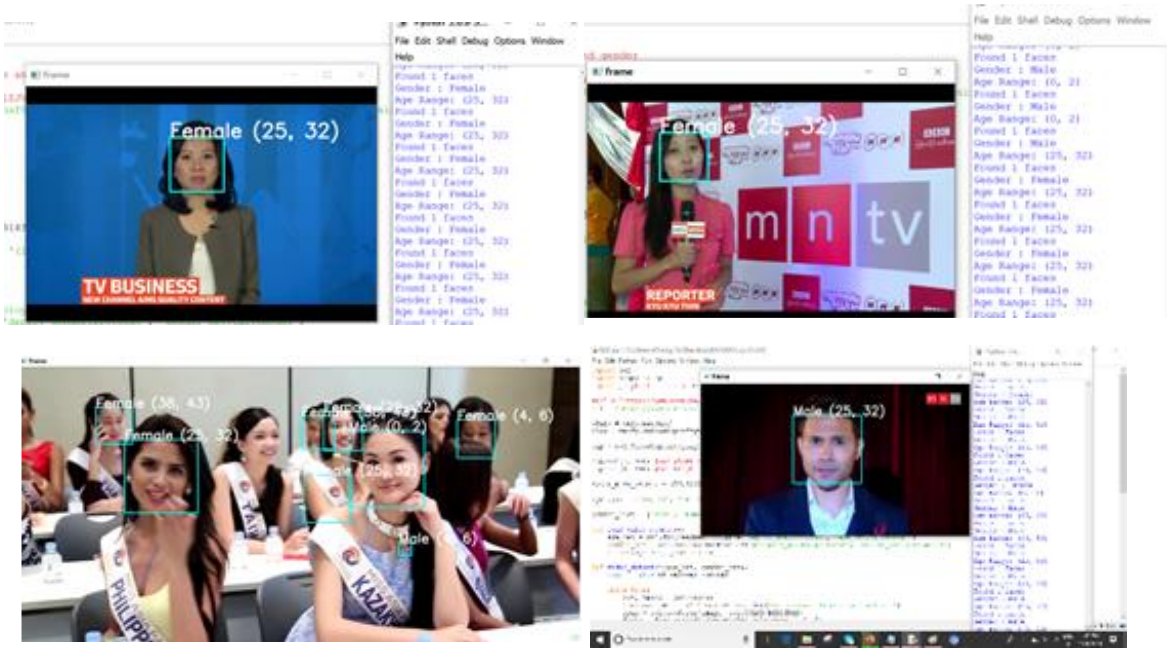

Figure 7. Experiment results

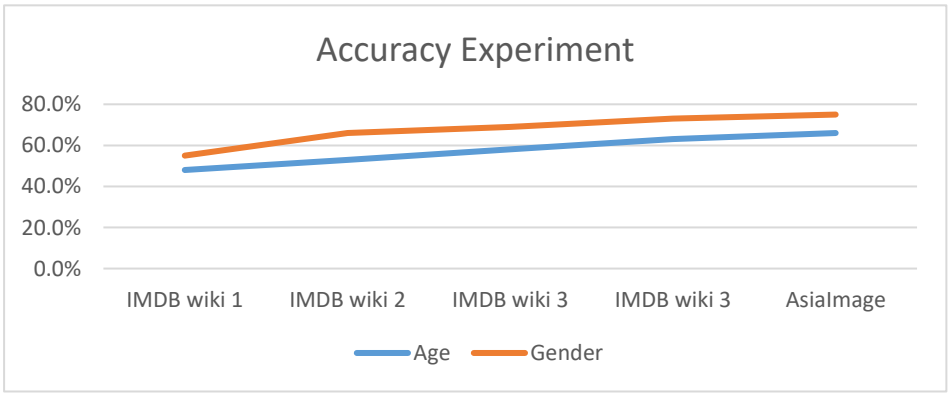

Figure 8. Accuracy Experiment

REFERENCES

[1] Gil Levi and Tal Hassner. “Age and Gender Classification Using Convolutional Neural Networks”. IEEE Workshop on Analysis and Modeling of Faces and Gestures (AMFG), at the IEEE Conf. on Computer Vision and Pattern Recognition (CVPR), Boston, 2015.

[2] Yoo, Jang-Hee, So-Hee Park, and Yongjin Lee. "Real-Time Age and Gender Estimation from Face Images." Proc. 1st International Conference on Machine Learning and Data Engineering (iCMLDE2017) 20-22 Nov 2017, Sydney, Australia

[3] Girshick R. Fast r-cnn. InProceedings of the IEEE international conference on computer vision 2015 (pp. 1440-1448).

[4] Pedregosa, Fabian. "Hyperparameter optimization with approximate gradient." arXiv preprint arXiv:1602.02355 (2016).

[5] Bibaeva, Victoria. "Hyper-Parameter Search for Convolutional Neural Networks-An Evolutionary Approach." SKILL 2018-Studierendenkonferenz Informatik (2018).

[6] Einstein, A., B. Podolsky, and N. Rosen, 1935, “Can quantum-mechanical description of physical reality be considered complete?”, Phys. Rev. 47, 777-780

[7] Cheng, Jingchun, Yali Li, Jilong Wang, Le Yu, and Shengjin Wang. "Exploiting effective facial patches for robust gender recognition." Tsinghua Science and Technology 24, no. 3 (2019): 333-345.

[8] Girshick, Ross, Jeff Donahue, Trevor Darrell, and Jitendra Malik. "Rich feature hierarchies for accurate object detection and semantic segmentation." In Proceedings of the IEEE conference on computer vision and pattern recognition, pp. 580-587. 2014.

[9] “What is a Raspberry Pi?”. Raspberry Foundation, 2015. [Online]. Avail: https://www.raspberrypi.org/help/what-is-a-raspberry-pi/. [Accessed 12 03 2019].

[10] S. W. Smith. “Image Formation and Display,” in The Scientists and Engineers' Guide to Digital Signal Processing, San Diego, California, California Technical Publishing, 199, pp. 373-376.

[11] OpenFlow Specification 1.3, ONF

[12] NamHui Kang, “Internet of Things Security-IETF Standard trends”, IETF mirror forum technology workshop, 2015

[13] S. Syed Ameer Abbas, M. Anitha and X. Vinitha Jaini, “Realization of Multiple Human Head Detection and Direction Movement Using Raspberry Pi”, IEEE WiSPNET 2017 conference. 2017

[14] Souhail Guennouni, Ali Ahaitouf, and Anass Mansouri, “Multiple object detection using OpenCV on an embedded platform,” IEEE International colloquium in information science and technology, IEEE, 2014.

[15] Ashfin Dehghan, Haroon Idrees, Amir Roshan Zamir, and Mubrarak Shah, “Automatic detection and tracking of Pedestrians in videos with various crowd densities,” Computer vision lab, University of Central Florida, Springer International Publishing Switzerland, Orlando, USA, 2014.

[16] Dongping Zhang, Yafei Lu, Liwei Hu, and Huailiang Peng, “Multi-human tracking in crowds based on head detection and energy optimization,” College of information engineering, China Jiliang University, Hangzhou 310018, China, 2103 Asian Network for Scientific Information.

[17] “OpenFlow Switch Specification”, Version 1.5.1. ONF.