ENGINEERING AND R&D SERVICES

HCL

Social Distance Monitoring (SDM)

WHITEPAPER

TABLE OF CONTENTS

Executive Summary

The landscape of AI Technologies has changed over the last few years. With rapid strides in related backbone areas like machine learning, deep learning and NLP, AI technologies has quickly ascended to the spotlight. Every day, there are more applications that rely on deep learning techniques across industries and find rapid advances in fields such as automotive, industrial, medical, energy, and others.

Due to the sudden rise in cases of COVID-19, lockdown was enforced in many parts of the world. After months, governments across the world has started relaxing the guidelines and allowing organizations to open with strict norms of social distancing, as it is crucial for preventing the spread of viral diseases illnesses [1]. By minimizing physical contact between people, we can reduce the chances of catching the virus and potentially spreading it throughout the community. This paper aims to provide a solution that helps in tracking whether social distancing protocols are being followed. This paper also shows how emerging technologies, such as AI can enable, encourage, and even enforce social distancing.

https://www.intel.com/content/www/us/en/policy/policy-human-rights.html

Introduction

COVID-19 has completely changed the world's view of how a pandemic can have dire consequences on global health and economic stability. Within only four months (from January to April 2020), 210 countries and territories around the world have reported more than three million infected people, including more than two hundred thousand deaths. Besides the global health crisis, COVID-19 has also been causing massive economic losses (e.g., a possible 25% unemployment rate in the U.S., one million people lost their jobs in Canada during March 2020, 1.4 million jobs lost in Australia, and a projected global 3% GDP loss) [2], resulting in a global recession as predicted by many experts. In such a context, there is an urgent need for solutions to contain the spread of the COVID-19 infection, thereby reducing its negative impacts, and buying more time for pharmaceutical companies to develop vaccines.

During the ongoing COVID-19 pandemic, many governments have implemented various social distancing measures such as travel restrictions, border control, closing public places, and warning their citizens to keep a 6 ft. distance from each other when they have to go outside [3]. Nevertheless, such aggressive and large-scale measures are not easy to implement, e.g., not all public spaces can be closed, and people still go outside for food, healthcare, or essential work. In such a context, technologies can play a key role in facilitating social distancing measures. For example, wireless positioning systems such as phone GPS can effectively help people to keep a safe distance by measuring the distances between people and alerting them when they are too close to each other [4]. Moreover, other technologies such as Artificial Intelligence (AI) technologies can be used to facilitate or even enforce social distancing.

Thus, we have addressed this crucial need to help enable social distancing measures by building an inference ready model that can be deployed on edge devices to easily facilitate the monitoring of social distancing.

Architecture

As the economy opens, it is difficult to follow social distancing at all times. As deep learning (DL) has helped in building a solution for various problems in different industries, a DL based model has been used to build the solution that tracks and notifies for any violation of social distancing.

YOLO has been identified as one of the fastest object detection algorithms and used as a basis for this social distancing algorithm. The third version of YOLO was used in the solution that has 30 FPS. YOLO v3 uses a variant of Darknet, which has a 53-layer network trained on Imagenet. For the task of detection, 53 more layers are stacked onto it, giving a 106 layer fully convolutional underlying architecture for YOLO v3. The most salient feature of v3 is that it makes detections at three different scales. Figure 2 shows the YOLO V3 architecture, which is faster, better, and more accurate. Figure 1 shows the Yolo V3 architecture that was used in the solution [6].

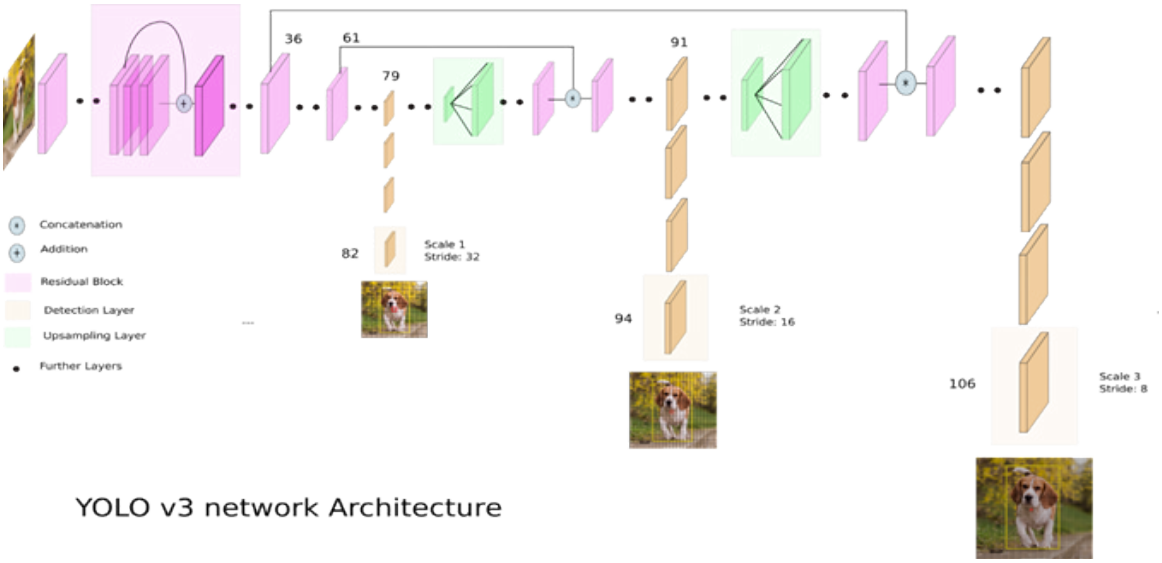

Fig 1 - YOLO V3 Network Architecture

Solution Approach

The HCL Social Distancing solution optimizes a YOLO V3 based person detection model using Intel® Distribution of OpenVINO™ toolkit for inference on various edge devices. The Intel Optimization for TensorFlow based model is converted to an Intermediate Representation (IR) model which can be used by the Intel inference engine. The Intel inference Engine facilitates speeding up the execution time by selectively executing different layers on specific computational hardware available. After the algorithm successfully identifies people, the distance between the individuals is then calculated using an OpenCV based calibration technique, and if that distance falls below 6ft, then the frame shows the people marked in red, and considers it as a violation. Figure 2 shows the block diagram for HCL's SDM solution.

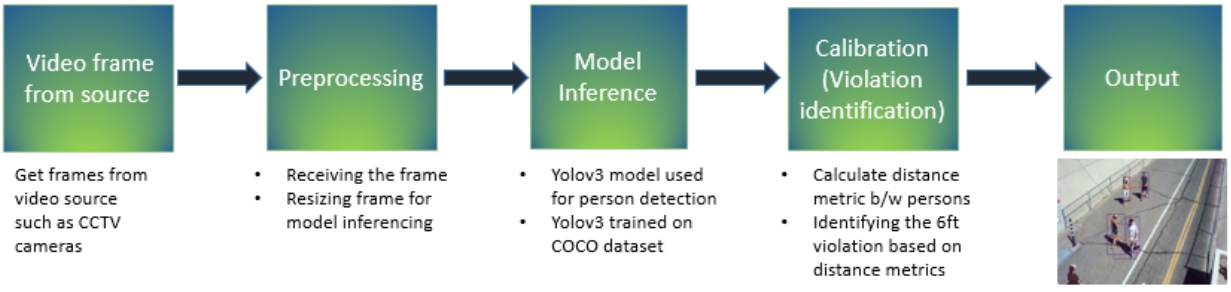

Fig 2 - Block Diagram of HCL's Social Distance Monitoring (SDM)

Results and Discussions

COVID-19 has completely changed the world's view of how a pandemic can have dire The normalized performance for latency and FPS is 17 times faster using the Intel Xeon® Gold 6252 when inferenced with Intel Distribution of OpenVINO Toolkit compared to Intel Xeon Gold 6252 with TF 1.14.0. Figure 3 shows the normalized performance for latency and FPS on in Intel Xeon Gold 6252 processor.

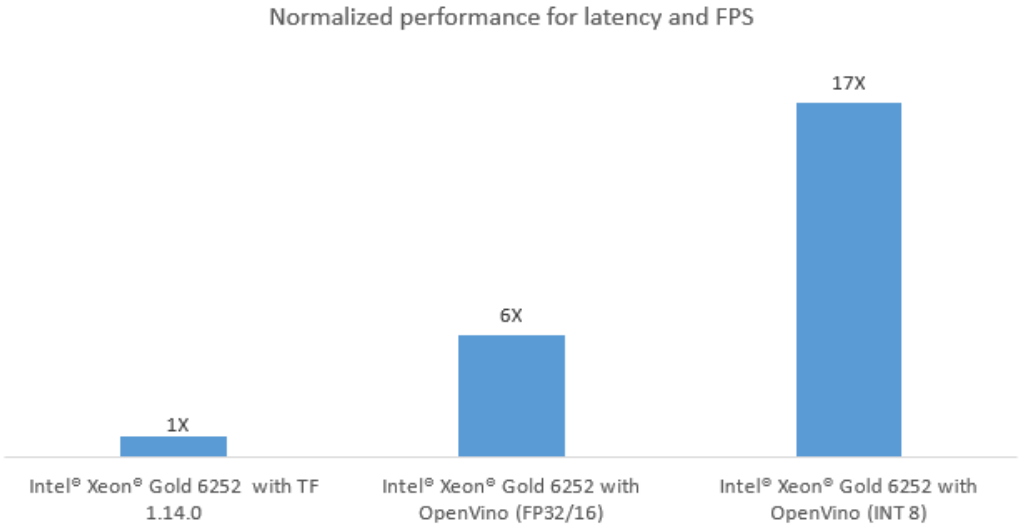

Fig 9 - GD&T Controls Size, Form, Location and Orientation in drawings[3]

The Intel Xeon Gold 6252 processor is a 14nm processor with 35.75M cache memory which has 24 cores and 48 threads with processor base frequency of 2.10 GHz and Max turbo frequency of 3.70 GHz [5]. It has TDB of 150 W with a max memory size of 1 TB. It consists of 6 memory channels which support advanced technologies such as Intel® Deep Learning Boost (Intel DL Boost), Intel Speed Shift Technology etc. Utilizing the incredible processing power of Intel architecture coupled with crucial Intel software optimizations, we have been able to create a social distancing detection solution that can effectively monitor and alert individuals when social distancing is not being followed in a timely manner.

Conclusion

The COVID-19 pandemic is unprecedented and has disrupted the lives of millions of people across the globe. This pandemic has opened several research challenges and opportunities that our community must address to equip itself for the future. The Intel architecture and AI-assisted applications discussed in the article can be used to effectively and help to enforce social distancing practices throughout the community, helping to optimize the use of resources in critical situations. In order to help play our part to combat the disruptive COVID-19 pandemic, we will continue to develop these AI-driven applications for wider adoption in the community.

References

1. https://www.financialexpress.com/lifestyle/health/lockdown-5-0-guidelines-state-wise-lockdown-extension-5-0-rules-latest-updates/1975135/

2. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9172058

3. https://www.transformative-mobility.org/news/the-covid-19-outbreak-and-implications-to-public-transport-some-observations

4. https://arxiv.org/pdf/2005.02816

5. https://www.intel.in/content/www/in/en/products/processors/xeon/scalable/gold-processors/gold-6252.html

6. https://towardsdatascience.com/yolo-v3-object-detection-53fb7d3bfe6b

7. https://www.intel.com/content/www/us/en/policy/policy-human-rights.html

Author Info

Guda Ramachandra.K.S

Guda Ramachandra currently works as Data Scientist in Artificial Intelligence with deep expertise in Deep learning/Machine learning. He is an SME in developing Deep Learning computer vision Solutions. Guda Ramachandra has published 16 white papers in international forums/conferences.

Shubham Vijay Chaudhari

Shubham Vijay Chaudhari works as Lead Engineer at NEXT.ai CoE of HCL. He is an expert in Artificial Intelligence with Deep Learning, Machine Learning and Robotics background.

Sheryansh Doshi

Sheryansh Doshi works as Business Analyst at NEXT.ai CoE of HCL. He is an MBA graduate with core expertise in market research and Data Analysis

ABOUT HCL TECHNOLOGIES

HCL Technologies (HCL) is a leading global IT services company that helps global enterprises re-imagine and transform their businesses through digital technology transformation. HCL operates out of 45 countries and has consolidated revenues of US$ 9.7 billion, for 12 months ended 31st December, 2016. HCL focuses on providing an integrated portfolio of services underlined by its Mode 1-2-3 growth strategy. Mode 1 encompasses the core services in the areas of Applications, Infrastructure, BPO, and Engineering & R&D services, leveraging DRYiCE™Autonomics to transform clients' business and IT landscape, making them 'lean' and 'agile'. Mode 2 focuses on experience-centric and outcome-oriented, services such as Digital and Analytics Services (BEYONDigital™), IoT WorKS™, Cloud and Security, utilizing DRYiCE™ Orchestration to drive business outcomes and enable enterprise digitalization. Mode 3 strategy is ecosystem-driven, creating innovative

IP-partnerships to build products and platforms business.

HCL leverages its global network of integrated co-innovation labs, and global delivery capabilities to provide holistic multi-service delivery in key industry verticals including Financial Services, Manufacturing, Telecommunications, Media, Publishing, Entertainment, Retail CPG, Life Sciences Healthcare, Oil & Gas, Energy & Utilities, Travel, Transportation & Logistics and Government. With 149,000 professionals from diverse nationalities, HCL focuses on creating real value for customers by taking 'Relationships Beyond the Contract'. For more information, please visit **www.hcltech.com**.

ABOUT HCL ENTERPRISE

HCL is a $9..95 billion leading global technology and IT enterprise comprising two companies listed in India – HCL Technologies and HCL Infosystems. Founded in 1976, HCL is one of India's original IT garage start-ups. A pioneer of modern computing, HCL is a global transformational enterprise today. Its range of offerings includes product engineering, custom & package applications, BPO, IT infrastructure services, IT hardware, systems integration, and distribution of information and communications technology (ICT) products across a wide range of focused industry verticals. The HCL team consists of over 153,000+ ideapreneurs of diverse nationalities, who operate from 50 countries including over

500 points of presence in India. HCL has partnerships with several leading global 1000 firms, including leading IT and technology firms. For more information, please **www.hcl.com**

WI-10322031677078959 6-EN00GL

www.hcltech.com

Hello there! I am an Ideapreneur. I believe that sustainable business outcomes are driven by relationships nurtured through values like trust, transparency and flexibility. I respect the contract, but believe in going beyond through collaboration, applied innovation and new generation partnership models that put your interest above everything else. Right now 153,000+ Ideapreneurs are in a Relationship Beyond the Contract™ with 500 customers in 50 countries. **How can I help you?**

HCL