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Designing the IoT based Social Distancing Monitoring System for Reducing the impact of Covid-19

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ABSTRACT: The unprecedented pandemic of 2019 that was COVID-19 of the Health Organization (WHO) has left hundreds of governments precarious around the world. The strain on virtually every nation in the world of the COVID 19 virus, the consequences of which the Chinese alone had previously seen. Along with fear of overwhelming care systems, a large proportion of these countries were compelled, due to lack of resources to resist the COVID 19 outbreak, to partly or completely cut off. Social distancing is essential if viral diseases such as COVID-19 are to be prevented. By reducing close physical contact between people, we reduce the chance of capturing and spreading the virus throughout the community. The pandemic has been rapidly exploited by various research communities since it started and IoT is one of the pioneers in this field, taking advantage of a wide variety of technologies to address this global threat. The IoT system / liable devices / applications are used in the context of COVID-19 to reduce COVID-19 spread to others in early diagnostic procedures, patient monitoring and post-patient recuperation practice of defined protocols. We emphasize here for an Open-CV, Computer Vision and Deep Learning surveillance method to keep track of footpaths and prevent overcrowding. The objects can be detected using Closed Circuit TV (CCTV) and Drones can be used to detect and measure the distance between the crowds by the camera.

KEY WORDS:COVID-19, IoT, Social Distancing, Deep Learning, Computer Vision

I. INTRODUCTION

COVID-19 is a respiratory infection similar to severe acute respiratory syndrome (SARS-CoV-2), a highly infectious one-beach positive sensory virus in the family of coronsensus coronaviridae. SARS-CoV-2 attacks the respiratory system as well as the influenza virus, which causes symptoms such as poison, fever, nausea and breathlessness. Even though the precise origins of the virus is not known, researchers have mapped the SARS-CoV-2 gene sequence and concluded that the SARS-CoV-2 has been part of the β-CoV coronavirus, typically obtained from bats and rodents[1]. It was first reported that COVID-19 had an influence on human life in Wuhan City (China Hubei Province) in December 2019. At that moment, COVID-19 has grown like a wilderness across the world and has its roots in 213 countries and sovereign territories. Statistics on the COVID 19 countries most affected in the world and the total number of cases and victims are provided in Fig. 1, Fig. 2, and 3 respectively.

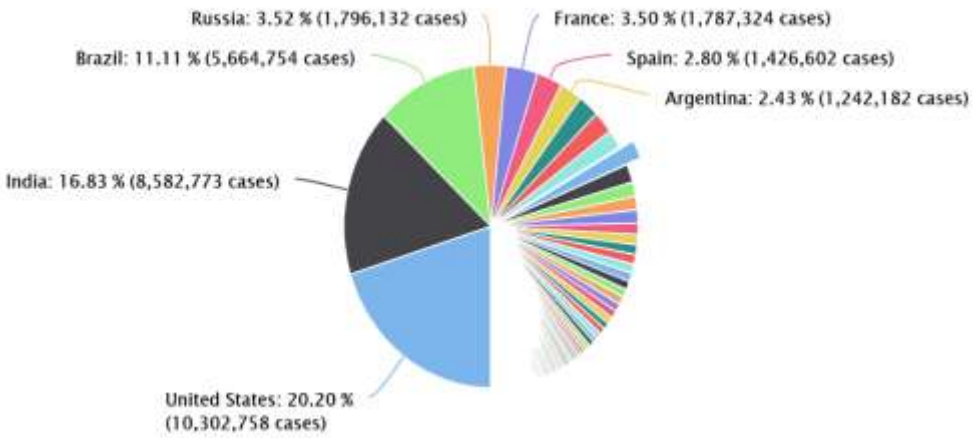

Fig. 1. Statistical Overview of Covid-19 Cases based of WHO Report Dated 05th November 2020 [3].

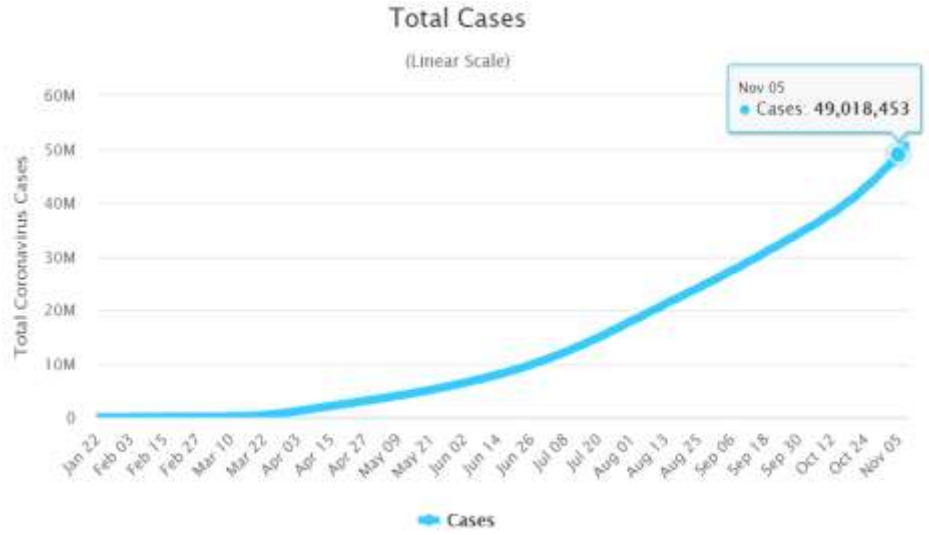

Fig. 2. Total Number of Cases Worldwide as of 5th Nov. 2020

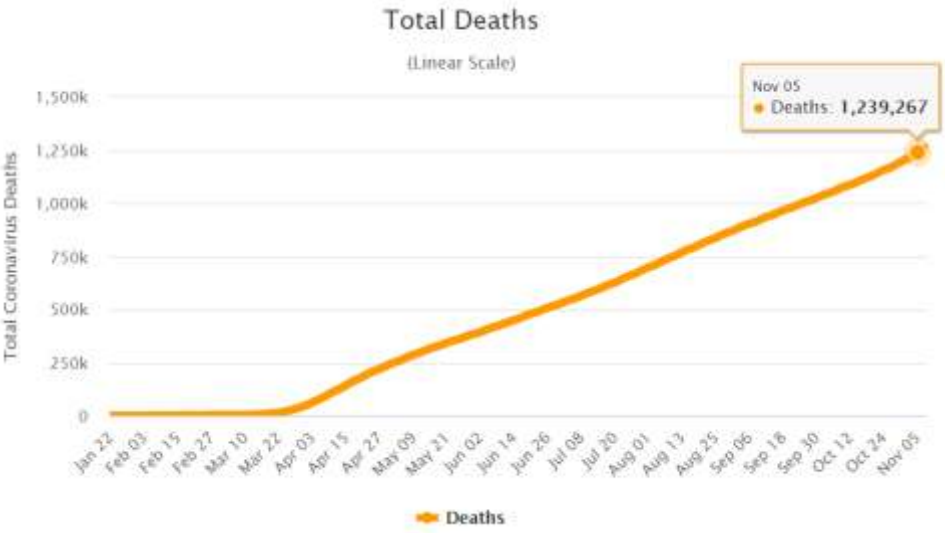

Fig. 3. Total Number of Deaths Worldwide as of 5th Nov. 2020

The WHO estimated that there are total 4,90,18,453 cases, out of which there are 12,39,267 cases of coronavirus that are now tallying worldwide resulted into deaths[2]. With the enormous hike in the

Covid-19 Cases across the world, the need for immediate and effective countermeasure is evident for mitigation of the catastrophic pandemic.

This infection has similar symptoms to influenza, like fever, health effects and fatigue, which are essential to diagnosis and treatment. COVID-19 takes 1 to 14 days for incubation. Interestingly, a non-symptomatic patient can potentially be a COVID-19 virus transmitter to others. This is needed if these people are to be quarantined. The recovery time of this disease also varies according to the age, condition, and so on, but can take between 6 and 41 days in general. Although there are many active attempts and many research initiatives to mitigate this virus while this disease has a high potential to be transmitted easily in contrast with similar diseases within the coronavirus family.

The worldwide pandemic situation is worsening and vaccination against the contagious disease is currently in developing stage and social distancing has thus proved to be one of the best means of preventing COVID-19 spread. As per the name, Social distancing refers to maintain the physical distancing between people in public places or in social gathering. The cases have escalated very rapidly across the world, and social distance is therefore important.

IoT technology is a safe and efficient way to deal with the COVID-19 pandemic in this context. In this context. This study discuss about the effective and cost efficient method based on IoT. It will help the organization in countering the spread of the disease as per the safety guidelines and standards for Covid-19. The most preliminary indoor actions that we focus on is maintaining the physical distance of at least 1.5-2 meters between the people. We use the Raspberry Pi-2 computer with one board equipped with camera for two other scenarios to take advantage of computer vision techniques.

The epidemic and its possible effects are not thoroughly investigated at the time of this article, considering the abundance of studies in the field of COVID-19 assessment and drug production, although we know. In this work, the possible technical strategies for pandemic effect control of COVID-19 are discussed.

II. PANDEMICS IN THE PAST CENTURY

A host of outbreaks and epidemics have occurred in the last century. While the majority of these outbreaks are accountable for coronaviruses like SARS-Cov& MERS-CoV (refer to Table 2), the four pandemics have been led by various different types of ASV, including H1N1 H2N2 and H3N2 over the last 105 years. Two epidemics were responsible for the H1N1 virus alone-one of the Spanish flu in the years 1918-1919, and one of the two of Swine <bal> in the years 2009-2010. Asian flu in the years 1958-1958 and 1968-1969 respectively were responsible for H2N2 and H3N2 in the pandemic. In this section, we summarize all the enormous pandemics faced by the world.

2.1 Spanish Flu Pandemic (1918-1919)

Many know of the Spanish flu as the deadliest pandemic in mankind's history, with a total of over 50,000 deaths[3]. The illness was caused by the H1N1 virus supposedly derived from birds. Contrary to many diseases, Spanish Flu is particularly lethal to young and healthy populations. This has been attributed to cytokine storms that infected hosts with a virus and sometimes led to death [4] in the patient's inflammatory process. They were more likely than healthier adults to die from influenza while young people have better immune systems.

2.2 Asian Flu Pandemic (1957-1958)

In February 1957, Asia got hit by a catastrophic pandemic originated in Singapore. After the Spanish flu pandemic of 1918, it was the second largest pandemic of the 20th century. There were an estimated 116,000 deaths annually in the United States, totaling 1.1 million[5]. The problem has been exacerbated by a Type A virus that is suspected to be of avian origin as H1N1. The strain was similar to the H2N2 virus. Eleven years of a disease that can no longer influence personal hosts evolved after the H2N2 virus infection.

2.3 Hong Kong Flu Pandemic (1968-1969)

In the 20th century, Kenya faced the outbreak of the third biggest flu pandemic known as the Hong Kong flu. It was allegedly produced by the Asian pandemic of H2N2 that triggered the H3N2 virus resulted in Hong Kong Flu. An HA mutated antigen which was present in H2N2. Whereas the H3N2 retained the same N2 antigen. The worldwide results of the Hong Kong flu pandemic were errantly identified because of previous N2 immunization as a result of the Asian flu pandemic[4]. With the exception of the Spanish influenza pandemic causing the H1N1 strain, the H3N2 virus is more dangerous for people 65 and older.

2.4 Swine Flu Pandemic (2009-2010)

A new strain type A H1N1 led to the swine flu pandemic in Spring 2009. The Swine — Teenu Pandemic was more lethal to people younger than 65 due to another form of the same virus, like Spanish Grippe. One factor is thought to be pre-acquired immunity in elderly people due to prior exposure to H1N1. US CDC reports that more than 43.3 million individuals have registered in the US with 195.086 admissions and 8.868 deaths alone, relative to 151.700 [6] worldwide death toll figures. This figure is estimated by the US CDC to be over 35 million.

III. PREVENTION FOR COVID- SOCIAL DISTANCING

When the world is countering the catastrophic pandemic of Covid-19, the most important and vigilant way to counter this is maintain the social distancing.

It is very likely that when the people come together as a crowd, someone may come across or get in touch with someone who is infected with Coronavirus and therefore has a strict law on maintaining 1 meter of distance (3 feet) in each pair from the World Health Organization. This idea of a social distance sensor has therefore emerged to track the social distance between the public.

This paper provides a pinpointing solution for monitoring social distancing in public areas. We can track human activities in public sites during this pandemic using CCTV and drones and from that point on calculate and summaries distances between people as well as monitor violations of social distance across the city. In addition, this proposed survey will prevent people from gathering and prevent social gatherings. Individuals collecting in large sums in religious areas can worsen conditions. Recently, every country on earth has been and is mainly during the locks and that has made it impossible for the citizen to be in the house. As the time goes, there may be a situation where more and more people tends to visit the public places or destination of tourist and religious importance.

With computer vision and depth learning and CCTV installed, we can track human beings and measure their distance in pixels using algorithms on computer distance, set the standard distance to track and obtain overviews of lawbreakers and the authorities concerned can take appropriate action[7].

IV. RELATED WORK

In paper [8] authors proposed to use raspberry-pi and Open-CV for human-person monitoring and crowd management. The OpenCV hair function has been used to prepare a sequence detector for scene head detection. Their whole concept was to record an all-encapsulated scene using an ARMv8 central processing unit that processes the frame by frame with a camera and Raspberry pi3. The count of heads is measured, the crowd controlled, when the value is compared to the threshold, and prevention can be done accordingly if it exceeds the threshold.

In 2018, researchers in [9] suggested an identification system of traffic density based on image processing. Pictures taken from the camera recorded the queue length and traffic densities. The video input was taken and the concept of partial truth was handled in a fluffy way. Anywhere between totally true and completely false the result of the partial truth conception could be there.

An article [6] on an OpenCV, a Computer Vision and a Deep Learning concept based on the social distancing detector. The paper demonstrates social distance across most pandemics and reflects street social observation by means of CCTV cameras. In contrast with regular calculation, the pixel distance is registered and is thus a device for social distance. This application for social distance sensors resides in the file.py script and this file ensures that people have a healthy distance from one another through the frame of a video stream. The video and webcam streams are supported.

In 2019, authors in [10] proposed a complete working model consisting of an algorithm for reinforcement and object detection. They have used real time object detection YOLO (You Look Only Once) with fewer deficiencies, much quicker, deliver accurate results and are able to be taught for more than 200 lessons. Strengthened learning is a machine learning area that provides the green phase schedule to current traffic conditions and learns from actions that have been taken [10].

WHO officials said at a press conference that took place in March 2020 that "before people know that they are sick it is important to stay away from the others, even if they have no symptoms, as people can spread the virus. Since social distancing is essential to prevent spreading Covid- 19, social distancing has been observed in a public area and hence the idea that social distancing is being violated." We use object detection to monitor safe distance between individuals in this research [10].

CCTVs and drones may be used for human identification. Closed Circuit TV (CCTV) is for a long time used as a surveillance system, but due to its weakness it is not fully accurate. Thus the drone has stronger coordination to pursue the human being with the rest of the swarm and divides the area between the drones in order to keep the individual from losing contact. OpenCV, computer vision and in-depth expertise was used to track social gap across the field. Item detection is originally used to identify pedestrians in a video stream. The next step is to measure the pair distances of all people observed and then to equate the default distance of 6 feet (2 meters) with the red frame, if violated. When 5-6 people meet in a specific location, the local or local police departments are alerted immediately.

Recently, the police officials have been forced to patrol the city since the virus outbreak. In this concept of social distance detection, the police can search to reach the exact location and follow the situation immediately. The distribution of COVID-19 can therefore be regulated socially and indirectly [11].

It is possible to use cloud-based data clients to migrate data from their systems to cloud-based servers as discussed in [12]. As a result, the customer is relieved of the cost of maintenance while still receiving high-quality data storage facilities. Cloud storage raises many security concerns. Cloud service providers and data servers are not without flaws. The consumer is worried with whether or not the information stored on the cloud is in order. Furthermore, for data dynamics, this facilitates dynamic operations such as insert, update, remove, and alter at the block stage. The defragmentation technique can be used to determine whether or not the file that the user wishes to store in cloud storage already exists on the cloud server. This system is powerful and safe against malicious server-launched replace attacks.

V. IMPLEMENTATION

Ontology is also used to incorporate data from heterogeneously embedded devices and their sensors and unify the regulation for interoperability in IoT systems. In this paper, we follow a similar approach with respect to COVID-19 safety monitoring for sementhe representation, but expand it to include elements of spatial reasoning.

This article is based on a device management system that uses standard computers from Raspberry Pi and Edge Servers[14]. Our key goal is to provide COVID-19 with a highly reliable safety surveillance solution for IoT devices which will concurrently excel.

In figure 4, a summary of the IoT-based approach suggested to ensure that the COVID-19 safety standards are adequately enforced indoors.

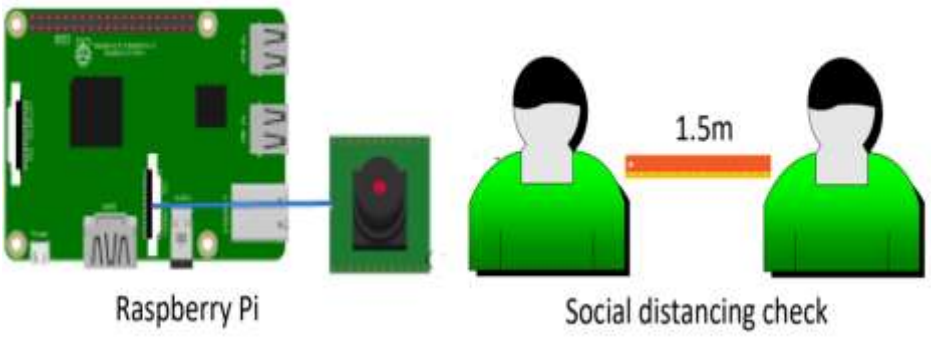

Fig. 4. Architecture for Proposed System

5.1 Social Distancing Check Algorithm

As far as the social distance proposed algorithm is concerned, it leverages OpenCV's haarcascade-fullbody classifier within the captured image for human body identification. The algorithm for social distance verification computer - aided diagnostic is given in the following pseudo-code.

5.2 Pseudo-Code of Social Distancing Check Algorithm

Input: image, $threshold_d$
Output: label
Steps:

```
gray_image=ConvertToGray(image);
bodies=DetectFaces(gray_image);
if(bodies.length≤1)
    text="Not enough people for check!"
else
    for each b1 in bodies
        for each b2 in bodies
            d=sqrt((b1.x-b2.x)^2 +(b1.y-b2.y)^2);
            d_m=ConvertPixelsToMeters(d);
                if(b1 ≠ b2 and d_m< threshold_d)
                    label="Social distancing not applied!";
                    sendMQTT("social distancing alert", "location name");
                end if;
end if;
return label;
end.
```

First, the camera frame is converted to a grey image, as required by the OpenCV hair waterfall classification, which is used for face detection. In addition, a new copy is also created with the additional black and white camera frame version. Body detection is also applied.

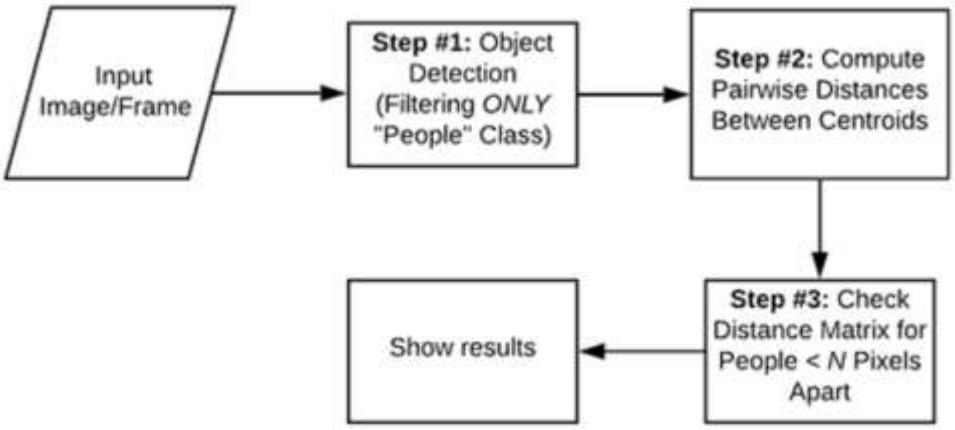

Fig.5. Steps involved in Social Distancing Detection

Moreover, the distance between each two individuals is determined when more than one person is seen and compared to a threshold of meters. However all distances by camera properties and object orientation should be standardized before contrast.The pixels are mapped in meters to actual world dimensions in relation to formula:

$$\frac{image\ dimension}{focal\ length} = \frac{object\ dimension}{distance\ to\ object}$$

Social distance must be correctly applied in a given case where the distance between the two bodies is higher or equal to a threshold. If the message is not used by at least a pair of bodies, the message is directed to the security operator and the server.Fig. 6 displays a social remote control application screenshot.

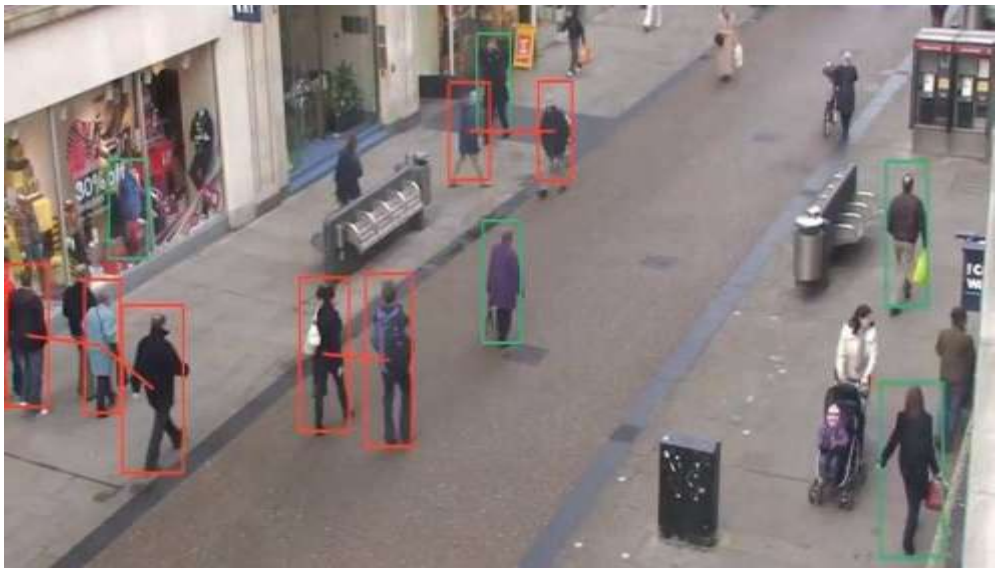

Fig. 6. Social Distancing Applications

VI. EXPERIMENTAL ANALYSIS

The following devices were used for evaluation: the laptop with Intel i7 7700-HQ quad-core CPU with DDR4 RAM 16 GB and the 1 TB HDD as edge server at 2.80 GHz; Raspberry Pi 2B (RPi 2B), Raspberry Pi 3 (RPi 3). For the evaluation the following devices were used.

The findings of the performance analysis are provided with different circumstances, processes and configurations. In the first column, you can see the name of the remote control case. The second column

indicates the user's hardware setup. Moreover the third column is the frame size represented by vertical pixels horizontally. The outcome results obtained as number of frames (fps) processed or measured per second will be shown in the next column (mps). The condition was correct in the last panel. In socially faraway breaches, the proportion of cases detected successfully is on average.

TABLE I

EXPERIMENTAL RESULTS

Distancing check	RPi 2B	640x480	0.72	65-73%
		320x240	2.65	
	RPi 3	640x480	1.12	
		320x240	4.29	
	Laptop	640x480	16.77	
		320x240	61.17	

Considering all the aspects, the result is summarized in Table I, it is possible to conclude that RPi 3 is performer than RPi 2B. The fact that RPi 3 uses newer ARM cortex-A53 quads with a capacity of 1200 M Hz compared to RPi 2Bs can be explained.

Cortex-A7 ARM 900 MHz. However, both have only 1 GB of RAM and the performance behind the laptop is still significant. Furthermore, any system shows better results for lower specifications, as anticipated. We can also see that the other one is quicker as compared with the results of social distance tests, since only one type (complete body) would be used. In all experiments in the social distance check processing, CCTV images have been assessed for busy street numbers while the number of people in the camera is expected to decrease. Distance checking performance changes with the distance of the camera objects, as the ratio between pixels and meters is initially calculated. Finally, the reliability of both machine simulations improves with resolution but the expense is compensated for with decreased performance.

VII. CONCLUSION REMARKS

Based on the outcome, with such output constraints (e.g. number of frames or metrics per second), the proposed solution can be used for its purposes. The proposed solution It also affects open hardware as well as free software, since these technologies have a distinct and attractive benefits.

To reach improved frame rates with deep learning and computer vision, tests will be able to be carried out in future on various frames for identification of Raspberry Pi artefacts. So as to contain the indoor spread of the covid-19, particularly in the summer, this approach is to be expanded to include sustainability practices for improved building climate control and natural ventilation security.

Our resource efficiency planning mechanism must ultimately be incorporated in the framework discussed in this chapter during the pandemic crisis with the aid of this paper to allow successful protection and mask distribution and risk analysis based on outcomes of safety advice and aerospace quality.

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