

SOCIAL DISTANCING MONITORING IN COVID-19 USING DEEP LEARNING

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Abstract

The purpose of this design is to give an effective social distance monitoring result in low light surroundings in an epidemic situation. The raging coronavirus complaint 2019 (COVID-19) caused by the SARS-CoV-2 contagion has brought a global extremity with its deadly spread all over the world. In the absence of effective treatment and the vaccine the sweat to control this epidemic rigorously calculate particular preventative conduct and most importantly social distancing which is the only advisable approach to manage this situation. In such a situation, it's necessary to take effective measures to cover the safety distance criteria to avoid more positive cases and to control the death risk. In this design, a deep Learning-grounded result is proposed for the below-pronounced problem. The proposed frame utilizes the Computer Vision fashion (OpenCV), you only look formerly (YOLO) model for real-time object discovery, and the social distance measuring approach is introduced with a single motionless time of flight (ToF) camera. The threat factor is indicated grounded on the advised distance and safety distance violations are stressed. design results show that the proposed model exhibits good performance with an a97.84 mean average perfection (Chart) score and the observed mean absolute error (MAE) between factual and measured social distance values is1.01 cm.

Key Words:

- Social Distance Monitoring
- Open CV
- Yolo Model
- Mean Absolute Error
- Safety Distance

1. INTRODUCTION

DATA SCIENCE:

Data wisdom is an interdisciplinary field that uses scientific styles, processes, algorithms, and systems to prize knowledge and perceptivity from structured and unshaped data and apply knowledge and practicable perceptivity from data across a broad range of operation disciplines.

The term "data wisdom" has been traced back to 1974, when Peter Naur proposed it as an indispensable name for computer wisdom. In 1996, the International Federation of Bracket Societies came to the first conference to specifically feature data wisdom as content. Still, the description was in flux.

The term "data wisdom" was first chased in 2008 by D.J. Patil, and Jeff Hammerbacher, the colonist leads of data and analytics sweats at LinkedIn and Facebook. In lower than a decade, it has come one of the hottest and most trending professions in the request.

Data wisdom in the field of study combines sphere moxie, programming chops, and knowledge of mathematics and statistics to prize meaningful perceptivity from data.

Data wisdom can be defined as a mix of mathematics, business wit, tools, algorithms, and machine Learning ways, all of which help us in chancing out the hidden perceptivity

DATA SCIENTIST:

Data scientists examine which questions need answering and where to find the combined data. They have business wit and logical chops as well as the capability to mine, clean, and present data. Businesses use data scientists to source, manage, and anatomize large amounts of unstructured data.

ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) refers to the simulation of mortal intelligence in machines that are programmed to suppose like humans and mimic their conduct. The term may also be applied to any machine that exhibits traits associated with a mortal mind analogous to knowledge and problem-working.

Artificial intelligence is the simulation of mortal intelligence processes by machines, especially computer systems. Specific operations of AI include expert systems, natural language processing, speech recognition, and machine vision.

MACHINE LEARNING

Machine Knowledge is to predict the future from formerly data. Machine knowledge (ML) is a type of artificial intelligence (AI) that provides computers with the capability to learn without being explicitly programmed. Machine knowledge focuses on the development of Computer Programs that can change when exposed to new data and the basics of Machine Knowledge, the performance of a simple machine learning algorithm using python. The process of training and prophecy involves the use of specialized algorithms. It feeds the training data to an algorithm, and the algorithm uses this training data to give prognostications on a new test data

DEEP LEARNING

Deep Learning is a branch of Machine Learning that is fully grounded on artificial neural networks, as the neural network is going to mimic the mortal brain so deep Learning is also a kind of mimic of the mortal brain. It's on hype currently because earlier we didn't have that important processing power and a lot of data. A formal description of deep Learning is-neurons Deep Learning is a particular kind of machine learning that achieves great power and inflexibility by learning to represent the world as a nested scale of generalities, with each conception defined by simpler generalities, and more abstract representations reckoned in terms of lower abstract bones.

Deep- Learning infrastructures similar to deep neural networks, deep belief networks, deep underpinning Learning, intermittent neural networks, and convolutional neural networks have been applied to fields including computer vision, speech recognition, natural language processing, machine restatement, bioinformatics, medicine design, medical image analysis, material examination, and board game programs.

Artificial neural networks (ANNs) were inspired by information processing and distributed communication bumps in natural systems. ANNs have colorful differences from natural smarts. Specifically, neural networks tend to be stationary and emblematic, while the natural brain of utmost living organisms is dynamic (plastic) and analog

INTERPRETATIONS:

Deep neural networks are generally interpreted in terms of the universal approximation theorem or probabilistic conclusion.

The classic universal approximation theorem concerns the capacity of feedforward neural networks with a single retired subcaste of finite size to approximate nonstop functions. activation functions and was generalized to feed-forward multi-layer infrastructures in 1991 by Kurt Hornik. Recent work also showed that universal approximation also holds for-bounded activation functions similar to the remedied direct unit.

The universal approximation theorem for deep neural networks concerns the capacity of networks with bounded range but the depth is allowed to grow proving that if the range of a deep neural network with ReLU activation is rigorously larger than the input dimension, also the network can compare any Lebesgue integrable function; If the range is lower or equal to the input dimension, also a deep neural network isn't a universal approximator.

The probabilistic interpretation derives from the field of machine learning. It features a conclusion, as well as the optimization generalities of training and testing, related to befitting and conception, independently. More specifically, the probabilistic interpretation considers the activation nonlinearity as an accretive distribution function. The probabilistic interpretation led to the preface of a powerhouse as a regularizer in neural networks. The probabilistic interpretation was introduced by experimenters including Hopfield, Widrow, and Narendra and vulgarized in checks similar to the one by Bishop.

DEEP LEARNING REVOLUTION

In 2012, a platoon led with the aid of using George. Dahl gained the "Merck Molecular Activity Challenge" using multi-project deep neural networks to prognosticate the biomolecular goal of 1 medicine. In 2014, Hochreiter's organization used deep Learning to descry out- goal and toxic items of environmental chemical substances in nutrients, ménage merchandise, and drugs and gained the "Tox21 Data Challenge" of NIH, FDA, and NCATS.

Significant clean influences in picture or item popularity have been felt from 2011 to 2012. Although CNN's ' skills with the aid of using back-propagation have been around for decades, and GPU executions of NNs for times, inclusive of CNNs, speedy executions of CNNs on GPUs have been demanded development on pc vision. In 2011, this method accomplished for the primary time preternatural overall performance in a visible sample popularity contest. Also in 2011, it gained the ICDAR Chinese handwriting contest, and in May 2012, it gained the ISBI picture segmentation contest. In November 2012, Ciresan et al.'s device additionally gained the ICPR contest on evaluation of big clinical pics for most cancers discovery, and withinside the resulting time additionally the MICCAI Grand Challenge at the equal content. In 2013 and 2014, the mistake price at the ImageNet project the use of deep Learning became in addition reduced, following an analogous fashion in big-scale speech popularity.

Image bracket became additionally prolonged to the additional grueling project of producing descriptions (captions) for pics, often as an aggregate of CNNs and LSTMs

2. Environmental Requirements

2.1. Software Requirements:

Operating System: Windows

Tool: Anaconda with Jupyter Notebook

2.2. Hardware requirements:

Processor : Intel core i3

Hard disk : minimum 300 GB

RAM : minimum 4 GB

2.3 MODULES USED:

Social Distance Monitoring:

It has been used in colorful operations to descry business signals, people, parking measures, and creatures. This composition introduces compendiums to the YOLO algorithm for object discovery and explains how it works. It also highlights some of its real-life operations. Object discovery is a miracle in computer vision that involves the discovery of colorful objects in digital images or vids. Some of the objects detected include people, buses, chairpersons, monuments, structures, and creatures. YOLO is a condensation for the term you ' only Look Once'. Object discovery in YOLO is done as a retrogression problem and provides the class chances of the detected images.

YOLO algorithm employs convolutional neural networks (CNN) to descry objects in real-time. As the name suggests, the algorithm requires only a single forward propagation through a neural network to descry objects.

This means that vaticination in the entire image is done in a single algorithm run. The CNN is used to prognosticate colorful class chances and bounding boxes contemporaneously.

The YOLO algorithm consists of colorful variants. Some of the common bones include bitsy YOLO and YOLOv3.

- **Speed:** This algorithm improves the speed of discovery because it can prognosticate objects in real-time.
- **High accuracy:** YOLO is a prophetic fashion that provides accurate results with minimum background crimes.
- **Learning capabilities:** The algorithm has excellent Learning capabilities that enable it to learn the representations of objects and apply them in object discovery.

YOLO algorithm works using the following three ways

- **Residual blocks**
- **Bounding box retrogression**
- Intersection Over Union (IOU)

Residual blocks

First, the image is divided into colorful grids

Bounding box regression

An abounding box is a figure that highlights an object in an image.

Every bounding box in the image consists of the following attributes

- Width (BW)
- Height (bh)
- Class (for illustration, person, auto, business light, etc.)-This is represented by the letters.
- Bounding box centre (bx, by)

. The following image shows an illustration of a bounding box. The bounding box has been represented by an unheroic figure.

First, the image is divided into grid cells. Each grid cell vaticinations B bounding boxes and provides their confidence scores. The cells prognosticate the class chances to establish the class of each object.

For illustration, we can notice at least three classes of objects an auto, a canine, and a bike. All the prognostications are made contemporaneously using a single convolutional neural network.

Crossroad over union ensures that the prognosticated bounding boxes are equal to the real boxes of the objects. This miracle eliminates gratuitous bounding boxes that don't meet the characteristics of the objects (like height and range). The final discovery will correspond to unique bounding boxes that fit the objects impeccably.

For illustration, the auto is girdled by the pink bounding box while the bike is girdled by the unheroic bounding box. The canine has been stressed using the blue bounding box

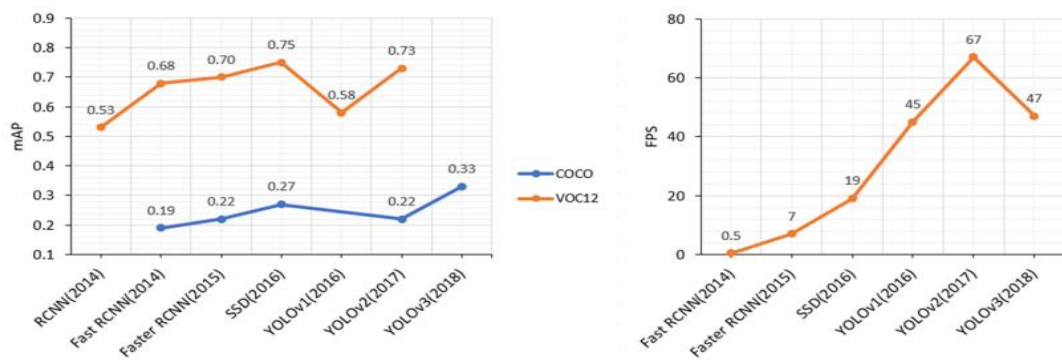
3. PROPOSED METHOD:

The proposed deep Learning technology grounded system can be installed for content within a certain limited distance. The algorithm could be enforced on the live images of CCTV cameras to perform the task. The simulated model uses deep Learning algorithms with the OpenCV library to estimate the distance between the people in the frame, and a YOLO model trained on the COCO dataset to identify people in the frame. The system has to be configured according to the position it's being installed at. By enforcing the algorithm, the number of violations is reported grounded on the distance and set threshold. The number of violations reported is one and two for two real-time images independently. The red box pressing the violations is displayed along with distance. Reporting effectiveness and correctness were validated for a further number of samples.

3.1 DATASET

Our dataset contains a set of information that is in YOLO format. Generally, distance computation has some set of information like a particular sphere. This dataset contains information about introductory quires and chancing the distance calculating. For object discovery, another contender of SSD is YOLO. This system can prognosticate the type and position of an object by looking only formerly at the image. YOLO considers the object discovery problem as a retrogression task rather than a bracket to assign class chances to the anchor boxes. A single convolutional network contemporaneously predicts multiple bounding boxes and class chances. Majorly, there are three performances of YOLO v1, v2, and v3. YOLO v1 is inspired by Google Net (Inception network) which is designed for object brackets in an image. This network consists of 24 convolutional layers and 2 completely

connected layers. Rather than the Inception modules used by GoogLeNet, YOLO v1 simply uses a reduction subcaste followed by convolutional layers. Latterly, YOLO v2 (64) is proposed with the idea of perfecting the delicacy significantly while making it briskly. YOLO v2 uses Darknet-19 as a backbone network conforming of 19 complication layers along with 5 maximum pooling layers and an affair SoftMax subcaste for object bracket. YOLO v2 outperformed its precursor (YOLO v1) with significant advancements in chart, FPS, and object bracket score. In discrepancy, YOLO v3 performs multi-label brackets with the help of logistic classifiers rather than using SoftMax as in the case of YOLO v1 and v2. In YOLO v3 Redmon et al. proposed Darknet-53 as a backbone armature that excerpts features charts for the bracket. In discrepancy to Darknet-19, Darknet-53 consists of residual blocks (short connections) along with the up slice layers for consecution and added depth to the network. YOLO v3 generates three prognostications for each spatial position at different scales in an image, which eliminates the problem of not being suitable to descry small objects efficiently. Each vaticination is covered by calculating objectless, boundary box regressor, and bracket scores



(a) Map for best models on VOC and COCO datasets.

(b) FPS for different models on VOC Datasets executed on GeForce TX Titan X.

Fig 1: Dataset representation

This design is to give an effective social distance monitoring result. The maturity of governments and public health authorities has set the 2-m physical distancing as an obligatory safety measure in shopping centers, seminaries, and other covered areas. In this exploration, we develop a mongrel Computer Vision and YOLOv4- grounded Deep Neural Network (DNN) model for automated people discovery in the crowd in inner and out-of-door surroundings using common CCTV security cameras. The proposed DNN model in combination with an acclimated inverse perspective mapping (IPM) fashion and Kind shadowing algorithm leads to a robust people discovery and social distancing monitoring. We identify high-threat zones with the loftiest possibility of contagion spread and infection. This may help authorities to redesign the layout of a public place or to take palladium conduct to alleviate high-threat zones. The developed model is a general and accurate people discovery and shadowing result that can be applied in numerous other fields similar as independent vehicles, mortal action recognition, anomaly discovery, sports, crowd analysis, or any other exploration areas where the mortal discovery is in the center of attention. We proposed a Deep Neural Network- Grounded mortal sensor model called Deep SOCIAL to descry and track static and dynamic people in public places to cover social distancing criteria in the COVID-19 period and beyond.

3.2 Advantages

- These reports are to the disquisition of connection of deep Learning ways to cover social distancing.
- Eventually, it highlights some compliances on unborn exploration issues, challenges, and needs.

3.3 System Architecture

Object discovery is a computer vision approach, which locates the objects in an image or videotape. Relating the equals of the individualities in the thermal vids is the first stage of this exploration. We used YOLO for people’s discovery in the thermal vids. We erected the CNN with 37 layers for YOLO. These exploration points are to design a lightweight model to regard the demand of CNNs’ real-time operation in low-cost bedded systems similar to IoT bias. The proposed approach is biddable to the YOLO model. The total weight is reduced for the final deep Learning model. YOLO utilizes a couple of different changes from the original YOLOv4 network to achieve fast prosecution on low- cost bedded system. In addition, the number of

YOLO layers has been reduced to two rather than three, and there with many anchor boxes for vaticination. YOLO consists of three major modules.

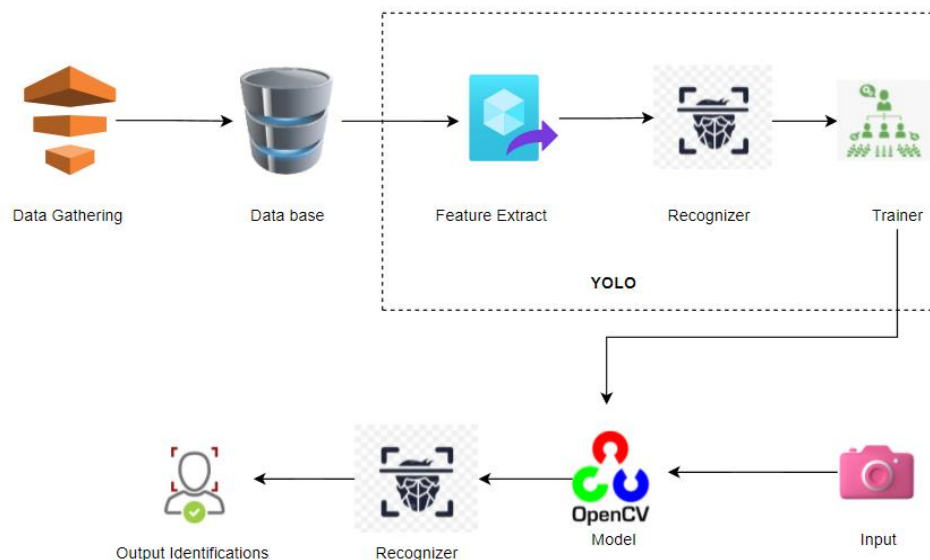


Fig 2: System Architecture

4. LITERATURE SURVEY

4.1 General

A literature review is a body of textbooks that aims to review the critical points of current knowledge on and/ or methodological approaches to particular content. It's secondary sources and bandy published information in a particular subject area and occasionally information in a particular subject area within a certain period. Its ultimate thing is to bring the anthology up to date with current literature on content and forms the base for another thing, similar to an unborn exploration that may be demanded in the area and precedes an exploration offer and maybe just a simple summary of sources. Generally, it has an organizational pattern and combines both summary and conflation.

A summary is a recap of important information about the source, but a conflation is the are-organization, reshuffling of information. Depending on the situation, the literature review may estimate the sources and advise the anthology on the most material or applicable of them. Loan dereliction trends have been long studied from a socio-profitable stage point. Utmost economics checks believe in empirical modeling of these complex systems to be suitable to prognosticate the loan dereliction rate for a particular existent. The use of machine Learning for similar tasks is a trend that it's observing now. Some of the checks to understand the history and present perspective of loan blessing or not

4.2 Review of Literature Survey

Title: Monitoring COVID-19 social distancing with person detection and tracking via fine-tuned YOLO v3 and Deepsort techniques

Author: Narinder Singh Pun, Sanjay Kumar Sonbhadra, Sonali Agarwal

Year: 2021

The rampant coronavirus disease 2019 (COVID-19) has brought a global crisis with its deadly spread to more than 180 countries, and about 3,519,901 confirmed cases along with 247,630 deaths globally as of May 4, 2020. The absence of any active therapeutic agents and the lack of immunity against COVID-19 increases the vulnerability of the population. The only feasible approach to fight against this pandemic. Motivated by this notion, this article proposes a deep learning-based framework for automating the task of monitoring social distancing using surveillance video. The proposed framework utilizes the YOLO v3 object detection model to segregate humans from the background and the Deepsort approach to tracking the

identified people with the help of bounding boxes and assigned IDs. The results of the YOLO v3 model are further compared with other popular state-of-the-art models, e.g. faster region-based CNN (convolution neural network) and single-shot detector (SSD) in terms of mean average precision (mAP), frames per second (FPS) and loss values defined by object classification and localization. The article proposes an efficient real-time deep learning-based framework to automate the process of monitoring social distancing via object detection and tracking approaches, where each individual is identified in real-time with the 9 help of bounding boxes. The generated bounding boxes aid in identifying the clusters or groups of people satisfying the closeness property computed with the help of a pairwise vectorized approach. The number of violations is confirmed by computing the number of groups formed and the violation index term is computed as the ratio of the number of people to the number of groups. The extensive trials were conducted with popular state-of-the-art object detection models: Faster RCNN, SSD, and YOLO v3, where YOLO v3 illustrated efficient performance with balanced FPS and mAP scores. Since this approach is highly sensitive to the spatial location of the camera, the same approach can be fine-tuned to better adjust to the corresponding field of view.

Title : DeepSOCIAL: Social Distancing Monitoring and Infection Risk Assessment in COVID-19 Pandemic

Author : Mahdi Rezaei , Mohsen Azarmi

Year : 2020

Social distancing is a recommended result by the World Health Organisation (WHO) to minimize the spread of COVID-19 in public places. The maturity of governments and public health authorities have set the 2- cadence physical distancing as an obligatory safety measure in shopping centers, seminaries, and other covered areas. In this exploration, we develop a general Deep Neural Network- Grounded model for automated people discovery, shadowing, and inter-people distances estimation in the crowd, using common CCTV security cameras. The proposed model includes a YOLOv4- grounded frame and inverse perspective mapping for accurate people discovery and social distancing monitoring in grueling conditions, including people occlusion, partial visibility, and lighting variations. Deep Neural Network- Grounded mortal sensor model called DeepSOCIAL to descry and track static and dynamic people in public places to cover social distancing criteria in the COVID-19 period and beyond. We utilized a CSPDarkNet53 backbone along with an SPP/ Visage and SAM neck, Mish activation function, and Complete IoU loss function and developed an effective and accurate mortal sensor, applicable in colorful surroundings using any type of CCTV surveillance camera.

Title: Monitoring social distancing through human detection for preventing/reducing COVID spread

Author: Swati Singh Ena Garg Nandita Goyal

Year:2021

COVID-19 is a severe epidemic that has put the world in a global extremity. Over 42 Million people are infected, and 1.14 Million deaths are reported worldwide as of Oct 23, 2020. A deeper understanding of the epidemic suggests that a person's negligence can beget wide detriment that would be delicate to negate. Since no vaccine is yet developed, social distancing must be rehearsed to detain the COVID-19 spread. Thus, we aim to develop a frame that tracks humans for covering the social distancing being rehearsed. To negotiate this ideal of social distance monitoring. This composition suggests deep Learning grounded mortal discovery ways to cover social distancing in the real-time terrain. These ways have been developed with the help of a deep sophisticated network that has used sliding window conception as a region offer. Further, they're used with the social distancing algorithm to measure the distancing criteria among people. This estimated distancing criteria decide whether two people are following social distancing morals or not.

Title: Manav Rakshak: Device to Help Maintain Social Distancing

Author: Abhiruchi Passi, Devdut

Year: 2020

On March 11, 2020, the World Health Organization (WHO) confirmed COVID-19 a pandemic, in response to the more than 1,00,000 confirmed cases globally in more than 100 countries, and the persistent threat of spreading further. Presently, there is no medicine to cure or vaccine to prevent the spread of COVID 19. The only way to curb its menace is to take precautionary measures as advised by Health experts. Social distancing i.e. maintaining a minimum distance of 1-1.5 meters between two individuals is one of the proactive measures advised by WHO.

Title: The Effect of Social Presence and Chatbot Errors on Trust

Author : Diana-Cezara Toader , Grat,iela Boca

Year: December. 2020

This composition explores the eventuality of Artificial Intelligence (AI) chatbots for creating positive change by supporting guests in the digital realm. Our study, which focuses on the client and his/ her declarative cerebral responses to commerce with a virtual adjunct, will fill a gap in the digital marketing exploration, where little attention has been paid to the impact of Error and Gender, as well as the extent to which Social Presence and Perceived Capability intervene the connections between Anthropomorphic design cues and Trust. We give harmonious substantiation of the significant negative effect of incorrect conversational interfaces on several constructs considered in our abstract model, similar to perceived capability, trust, as well as positive consumer responses. We also give support to former exploration findings and confirm that people employ prejudiced thinking across gender and this categorization also influences their acceptance of chatbots taking social places. The results of an empirical study demonstrated that largely anthropomorphized womanish chatbots that engage in social actions are significantly shaping positive consumer responses, indeed in the error condition. Also, womanish virtual sidekicks are much more generally forgiven when committing crimes compared to manly chatbot

5.1. Experimental results

To estimate the performance of our social distance monitoring result, we perform many tests at three different fixed camera distances 400 cm, 500 cm, and 600 cm. Test frames are collected from the motionless ToF camera of Samsung world note 10 placed 4.5 bases above the ground where C_p is 0° (a regular camera view). At each specific fixed camera distance, we tested 2 scripts one above the specified safety threshold (100 cm) at 140 cm and one below the specified safety threshold at 52 cm. Qualitative results; whereas, the quantitative results in terms of the distance between objects in pixels and cm, factual given distance in cm, and per test error rate. We can see that model displayed overall good performance. People violating the safety distance are stressed by red bounding boxes; whereas, green bounding boxes show people following safety distance criteria. The Absolute Error (AE) is calculated for all tests, between factual distance in units (Announcement) and measured distance in units (D_u) by using and grounded on AE mean absolute error (MAE) is calculated by The Announcement and D_u plot where the blue color shows the factual given distance in cm and the red line shows the measured distance in cm.

$$AE = D_{u_i} - A_{d_i}$$

$$MAE = \frac{1}{n} \sum_{i=1}^n |D_{u_i} - A_{d_i}|$$



Fig 3 : Monitoring view

6. Conclusion

With the government taking extreme steps to contain the spread of the novel Coronavirus, we must follow the advice in letter and spirit. Technology can play a crucial role in facilitating social distancing, which is an effective way of preventing COVID 19. The system described in this paper uses the most commonly used components. A simple, but the easy-to-wear device will help the community at large, in fighting against novel coronavirus.

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