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Crowd Detection Camera System for Virus Prevention

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Abstract*— This research proposes an advanced framework for monitoring social distancing in public spaces using computer vision techniques. The system leverages the YOLO v3 (You Only Look Once, Version 3) object detection algorithm, optimized for high accuracy in identifying individuals in diverse and crowded environments. YOLO v3 is chosen for its real-time processing and precise detection capabilities. By fine-tuning the model with a diverse dataset, the system improves performance in challenging conditions, such as varying scales and occlusions. Once individuals are detected, the DeepSORT (Simple Online and Realtime Tracking) algorithm is used to track them across consecutive video frames. DeepSORT effectively combines motion and appearance data, ensuring accurate tracking of individuals, even in dense crowds. This allows the system to maintain consistent identities over time. The integrated YOLO v3 and DeepSORT system measures the distances between people and detects violations of social distancing guidelines in realtime. By setting a threshold distance, instances of noncompliance can be flagged for further action. Tested on various public datasets and real-world video feeds, the system demonstrates high detection accuracy and robust tracking performance. The approach provides a practical solution for monitoring social distancing, helping enforce public health guidelines with real-time alerts and statistical insights.

***Index Terms*—YOLO v3, DeepSORT, Fine-tuning, Computer Vision**

I. INTRODUCTION

COVID-19 is a class of coronavirus diseases initially detected By an end of Dec 2020 in Wuhan, communist china. On 11 March, the WHO proclaimed this pandemic in With 118,000 active cases and 114 countries 4,000 fatalities. More than 3,519,901 cases and 247,630 fatalities were recorded globally on 4 May 2020. Several health organisations, medical professionals and scientists are striving to find the right treatments and vaccines for this deadly virus, but no progress has been recorded to yet. This obliges the world community to find measures to halt this deadly virus from spreading. Social distance is the finest discharge stopper in the current environment, and all the nations concerned To facilitate overall distance, they are shut down. This study aims Encourage and minimize Coronaviral epidemic together including the lowest level at income losses and proposes a way to identify social differences between people in any public space. The term ”social distance” is best practised to reduce or disrupt the transmission of COVID-19 via a variety of methods. It seeks to reduce the Physical interaction amongst potentially contaminated and healthful people individuals. In accordance with the WHO standards, people should preserve at least 6 feet apart to observe social distances.[1] A new study shows that social distance is a significant and necessary method of containment in order To prevent SARSCoV-2, those with mild or non- symptoms may probably have corona disease and transmit another. It suggests that the greatest method to limit infectious physical contact is by adequate social distance, therefore reducing the infection rate. This lowered peak certainly corresponds to the existing healthcare infrastructure and helps patients fight the coronavirus epidemic to improve their facilities. Epidemiology is the study of infectious disease causes and explanations. Theoretical models are always the best option to investigate pandemic issues. Nearly every model comes from Kermack and McKendrick’s original SIR model created in 1927.

A number of studies have been carried out on the SIR model and its expansions through the years, resulting in several researchers studying Biomedical probabilistic networks and pandemic theories. Air diseases are persistent if the rate and way in which the virus is transmitted is most essential to cure or stop the viral replication community. Respiratory diseases are the most important elements.

Several medical and pandemic research groups are working to produce COVID-19 vaccines, however there is yet no well-known therapeutic medication accessible. Precautionary measures are thus implemented around the to the earth curb a occurrence with illness. Eksin et al. [2] Furthermore, an updated SIR model with social distance criteria was proposed a (I, R), which may be measured by the amount of contaminated as well as recovering people individuals represented respectively as R and I are a couple. Similarly, on 16 April 2020, Dr. Andrew Ng, a Landing AI company[10] led by the most known AI names, revealed the invention of an AI tool for social separation at work. In a short post, the business stated that the next tool may determine if individuals keep the physical distance safe by analysing real-time video feeds from the camera. This technology may also simply be linked with current Surveillance cameras that are available to various companies to guarantee a stable distance for all personnel. A short example shows three steps: sociological space tracking calibrating, recognition and measurement. Gartner, Inc. selected Landing AI as the coolest supplier for AI Development Tools on 21 April 2020 to acknowledge the quick initiatives taken to assist COVID 19 in this new sector.[3]

II. LITERATURE REVIEW

A. "Maintaining the Integrity of the Specifications"

Non-pharmaceutical measures for non-health care pandemic influenza — international travel related measures The nationwide flu epidemic testing techniques generally includes worldwide non-pharmaceutical personal travel interventions (NPIs), involving transit monitoring, journey constraints and borders closures. We have conducted systematic reviews to uncover evidence of its efficacy. We identified a total of 15 studies. Some research indicate that NPIs may delay influenza virus introduction. However, there is no data available indicating that the inbound passenger screening Preventing pediatric infectious spreading would have had a major effect but there were no trials examining the outgoing assessment. Many studies have shown that constraints on transportation can slow the localized transmissions and hamper international propagation, through total frontier closure, to avoid the introduction of pandemic influenza in 1918–19. This limited basis of data suggests the limited effectiveness of international travel-related pandemic influenza control NPIs and that these measures need significant resources to apply.

B. "The effectiveness of laboratory methods to reduce the spread of influenza"

A comprehensive review, Social distance is one of the Community strategies to mitigate influenza pandemics. Social distance can Minimize the effects are expected in socially packed communities, including schools or workplaces by raising physical distances or lowering the frequency of congregations. We undertook a systemic assessment to examine evidence of the reduction or slowing of influenza transmission in social distances in non-health care settings.

C. Systematic biases in disease forecasting–the role of behavior change,"

In a basic The earliest spike mostly in Simulation study, that predicts the long-term fate of the pandemic for people infected. Nonetheless, unlike genuine outbreaks, persons are able to modify their activities and take preventative actions to decrease their risk of complications. The relationship between the early sustained release and the eventual number of incidents might seem as weak. The dynamisms of a fundamental SIR epidemic method is assessed by evaluating the dynamical of an updated Simulation study wherein the persons are decreased by the present or accumulated lot of incidents. Those characteristics with behavioral interventions reveal lower overall end instances, but the starting rate of disease spread is virtually the same for both systems. We illustrate that this change in eventual size estimations depends heavily on changes in individual conduct. These outcomes also justify the integration of group developed into recurrent predictors. We thus recommend using a Kalman filter to modify algorithms with and without behavioural changes in recurrent estimates. If there is a psychological shift in the Basic Truth Outbreak, successive forecasts using a basic SIR are not happy today various measurements can adjust for early forecast mistakes. These results emphasise the significance of adding behavioural changes into basic epidemic and dynamic forecast models.

D. "Asymptotic behavior of global positive solution to stochastic sir model incorporating the media coverage,"

The fundamental dynamic characteristics A probabilistic SIR epidemic concept including press attention is being investigated. Throughout the stochastic atmosphere the positive and limitations of optimum concentration, as well as the exponential instability and world peace of the determinism corresponding point, are studied. Furthermore, we prove that perhaps the random variable has a distinctive, favorable comprehensive solution that pulsates from around balance of the path diagram under certain circumstances. Lastly, we illustrate our experimental data with a series of theoretical calculations.[4]

III. METHODOLOGY

A. Existing System

There is no automatic way to monitor social distance by object detection, therefore our system now operates manually, as the government appoints somebody to monitor individuals for social distance to be maintained or not.

Disadvantages of Existing System:

1.It is tough to identify those who are not socially distant

2.So much effort has been made to provide sources of human energy and cost-effective energy[5]

B. Proposed System

Throughout the method we deliver great, in-depth skills in real moment to automating the social distance surveillance process involves selecting and based on the capability

individual is recognised using bounding boxes in real time. The produced bounding frames assist to identify the clusters or groups of persons who meet the proximity characteristics calculated using a pair of vectorized methods. Advantages of Proposed Sy

stem:

1. This reduces more human labour
2. Cost reduction
3. Simple to maintain

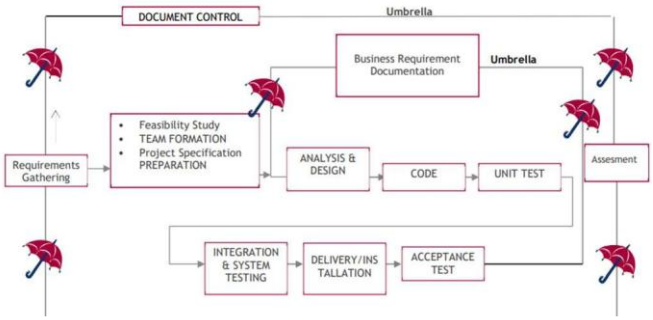

Fig.2. SDLC (Umbrella Model)

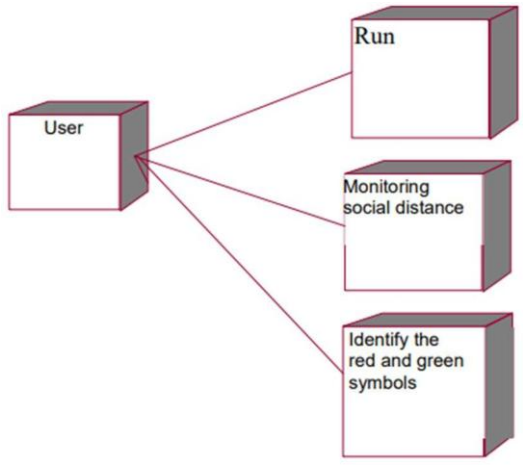

Fig.1. Deployment Diagram

Modules:

1. Run: The run is the first and crucial module when the project is started.
2. Social distance monitoring: Social distance monitoring is the second element in our study. We observe the social gap between the people here.
3. Identify the symbols red and green. During monitoring the people with a red symbol do not follow the distance but follow the social distance with a green symbol.[6]

C. Process model used with justification SDLC (Umbrella Model)

The requirements collection process is the input SDLC is nothing other than the Life Cycle Design of application. The software industry uses this standard to create excellent software. Stages in SDLC:

- Requirements collection
- Analyses
- Designing
- Coding
- Testing

1. Maintenance

2. Requirements Gathering stage:

The main functionalities of the proposed application are defined, the managed Dataset regions including dimensional analysis regions must be specified and the initial data items established. Important roles includes key inputs, outcomes and organizational design reporting. A hierarchy of user classes is created and linked to these main Operations, information, regions and information items. Every one with them descriptions is referred to as a need. Unique requirement IDs are identified and at least include a requirements title and text description.

The RTM includes, during the requirement phase, a set of Higher rate objectives or objectives, by name, such as the accompanying requirements provided by requirement title for each purpose. In this hierarchical list, RTM demonstrates that each need officially connected to a particular product objective established during this phase. In this style every need may be linked to a particular product objective, thus the traceability of the word requirements.

3. Analysis Stage:

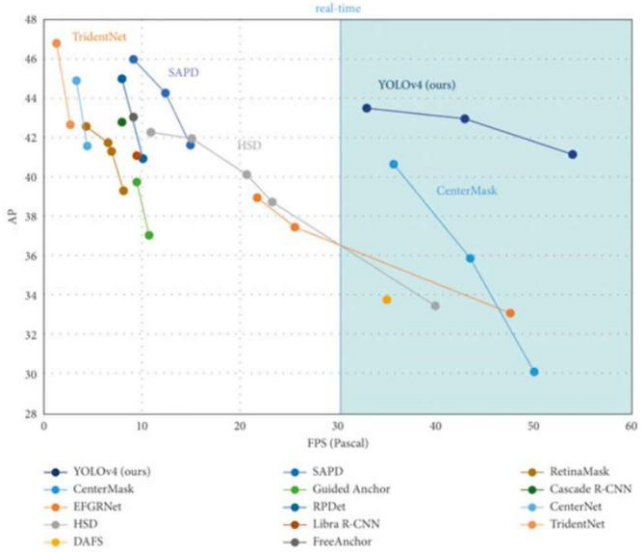

Fig.3. Performance analysis of YOLO v4 over the MS-COCO dataset.

The design stage offers an eye view of a software system, uses it for the core process map, assess project viability and hazards, and define suitable management and engineering methods.

A number of Quality products demands are repeatedly alluded to as goals most important part of the project plan. All the

software application requirements to be created from several of these objectives throughout the requirement definition phase. The minimal Metadata consisting of a name and textual explanation for each function, but may contain extra information and hyperlinks to other resources. These results of the project design phase include the configuration plans, the quality control plan as well as the project schedule and timeline, a comprehensive description of the planned work during the next phase of size and high phase voltage project scope.

4. Designing Stage:

The designing phase takes place the needs specified with in approved requirements document as its first input. A collection with one or more design components will be created for each need via interviews, workshops and/or prototyping. Design components explain the required characteristics of the programme in detail, usually including system architecture diagrams, page layouts diagrams, business rule tables, business intelligence graphs, flow charts, With a comprehensive object connection Schematic of a complete database. these are all designs components are designed to provide a sufficient description of the software to allow experienced programmers to build the software with little further input.

Whenever the development step is finished and authorised, the RTM is modified to indicate that another Component of designing has a particular formal required. Following results of its planning phase include a conceptual phase begins a revised RTM and a enhanced critical path.

5. Development (Coding) Stage:

Its evolution process receives main input from the system elements described inside the acceptable prototype. A gathering is formed between first or much more software applications each design element. Software artefacts include menus, dialogues and application development forms, performance monitoring format and specialised processes and features but are not restricted to these. For every set of functionally linked software devices, corresponding test cases will be created as well as an internet support system built to ensure completeness in their interaction with the programme.

In reality, the RTM would be changed must demonstrate this every artefact generated is tied to a certain security feature, which contains one or more test scenarios. The RTM is currently in its setup. Developing deliverables it included a fully functioning piece of software to meet predefined time designs and construction aspects, a software operations- described help centre system and implementation map to identify the main inputs with all important systems work.Integration and Test Stage:

Application It artefacts, Support internet and testing Information is moved of it's design industry to a different Environmental testing during integration and testing. All testing phase are being performed to validate the completeness and accuracy of the programme. Successful implementation of the test cases shows that migration is resilient and comprehensive. During this phase, reference information for use in production is completed and users of production are identified and connected to their respective responsibilities.

After the first operational data load is confirmed by the client's staff as well as the test suite has also been performed with acceptable results, the customer approves officially the delivery. The main results ultimate phase involves implementation and approval consist of a registered products, a full appropriate testing suites as well as a program acceptability declaration. The PDR is now archiving essential mobile applications, the time line, the raw data, and potential study guides to "freeze" any enterprise.

6. Maintenance:

Outside box illustrates the upkeep of projects, technicians begin needs studies, documentation knowledge will be allocated to the job of the workers and training will be provided for this specific category. There is no end to this life cycle, it will continue like a parachute (No umbrella sticks ending point).[7]

IV. IMPLEMETATION

A. Implementation and Testing:

Deployment is among the most essential responsibilities in the program, as all activities done during in the proposal are extremely participatory. Caution is needed. Installation has been the most important phase for productive systems and provides users with trust that the new scheme is functional and efficient. Each programme is independently tested on example information at the point of creation and checked that these programmes are linked in the manner required in the programme specifications. To satisfy the user, the computer network and its surroundings are verified.

B. Implementation

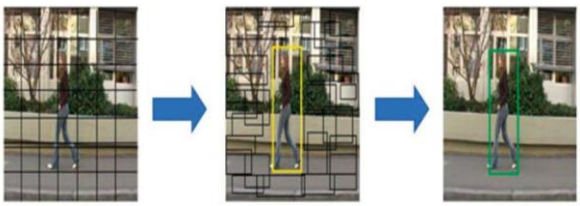

Fig.4. Object detection by YOLO

The development process is far less innovative than that of the layout. The focus is on user involvement and document control. The technology may require significant instruction. The proposed software settings must be changed by programming. A basic working process is offered so that the visitor may easily and rapidly learn the much functionality. The many results may be received on the Applicable for the operators, inkjet but rather dot matrix printer. The described technique can be installed relatively easily. The designed to sort new or modified system architecture a functional one is utilised in particular.[8]

C. Testing

Assessment is the procedure in which test results are produced and the verification supplied for the fields is utilised to test the components separately and afterwards. The network test ensures that all elements of the levels work as a unit. The test results should indeed be selected so that all potential conditions are fulfilled. Tests are really done to ensure that the program operates properly before the actual issue happened. The preceding describes the test strategies performed out throughout the training phase.

D. System Testing

Monitoring is becoming an important element of every project, particularly in the realm of IT. Analysis is an important reason to excuse whether you are willing to continue on, be it to verify that you are able to endure the rigours of a certain circumstance, and that is why checking even before construction is so important. When the programme has been produced before the user has been given the program, it must be checked if it resolves its objective. This test includes several types through which the programme can be dependable. The programme has been logically checked and the pattern of the programme execution is reproduced For a sample group. The code had been therefore thoroughly monitored Imagine for all of the other correct data as well as outcomes likewise validated.[9]

E. Module Testing

Each component is checked independently to detect problems. This allows us to discover and repair errors before impacting neighboring components. When that software does not meet the needed function, the necessary outcome will be modified. Therefore all components are independently checked from the bottoms to another level commencing the with lightest and cheapest components. Every module works individually in the scheme. Each job categorization component is, for examples, examined independently. That process is undertaken with several tasks and its approximated compiled code and the values are presented with both the conventional outcomes. The analysis proves that only the potential explanations outputs operate effectively compared to the current system. Every module works individually in the network. This method independently tests the capacity categorization and task planning components and obtains the relevant findings to decrease the queuing.

F. Integration Testing

The interaction test is designed just after individual modules. When the modules are connected, there may be a possibility of mistakes, these faults are rectified with this examination. All modules can be connected and verified in this configuration. The findings of the tests are extremely precise. Thus, the program appropriately maps jobs with supplies

G. Acceptance Testing

When the user hasn't fined any serious accuracy flaws, the system passes a last testing process. The test shows that during research, which reduction waste work and cash acceptability trials on the shoulders of client and user, is eventually suitable and suitable for functioning, the process needs the original aims, targets and conditions. Test Case Id Test Case Name Test Case Desc. Test Steps Test Case Status Test Priority Step Expected Actual 01 Run project Testing if the project was running

or not If We can't do it implement our system properly We can't do more process We can undertake more operations High High 02 Monitoring social distance Verify either the social distance monitoring or not If the project may not run properly We cannot able to monitor the social distance We can monitoring the social distance successfully High High 03 Identify the red and green symbols Verify either the red and green symbols are identified or not Without monitoring We cannot Identify the red and green symbols Red and green symbols are identified successfully High.[10]

V. RESULTS

The red symbolic individuals do not follow the distance, the green symbol follows the social distance.

Fig.5. Result1

The image shows people walking outside a building, where bounding boxes are drawn around individuals to detect and track them. Green boxes represent individuals maintaining appropriate social distance, while orange boxes likely highlight those closer than the required threshold, indicating social distancing violations. The system likely uses these color-coded boxes to flag compliance and non-compliance in real-time. This visualization provides a clear, automated method to assess adherence to social distancing guidelines in public spaces.

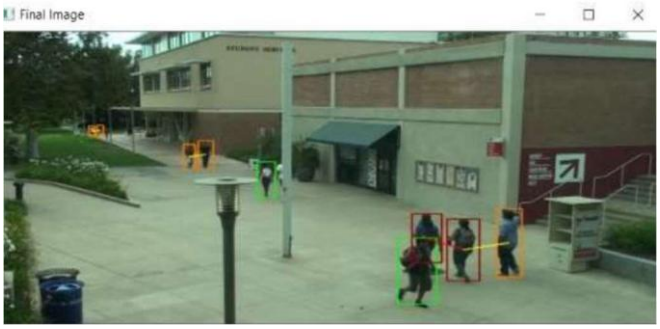

Fig.6. Result2

These figures shows the result of a system designed to monitor COVID-19 social distancing using finetuned YOLO v3 and DeepSort techniques for person detection and tracking. Here's an explanation of the components visible in the image:

A. Person Detection:

The YOLO v3 algorithm has identified and bounded individuals in the scene with colored boxes. Each person detected is enclosed within a distinct rectangle, showcasing the effectiveness of YOLO v3 in real-time object detection.

B. Person Tracking:

The DeepSort algorithm is used to track these detected individuals over time. Different colored rectangles likely indicate different tracked IDs, ensuring each person is uniquely identified and followed as they move within the frame.

C. Social Distancing Monitoring:

The system is designed to measure the distance between individuals. If two people are too close to each other (within the defined threshold for social distancing), the system could potentially highlight this with red colour frames and if two people are maintaining social distance then the system will highlight this with green coloured frames.

D. Siren Alert:

If any person is not obeying social distance, a siren alert will be activated and alert sound will ring to alert the crowd to maintain social distance.

Overall, this visualization demonstrates how the integrated YOLO v3 and DeepSort techniques can effectively detect and track individuals in public spaces, providing valuable data for monitoring social distancing compliance during the COVID19 pandemic.

VI. CONCLUSION

This research introduces an advanced deep learning framework for automated monitoring of social distancing in public spaces using object detection and tracking techniques.Each individual is identified using bounding boxes, which mark their positions clearly within the scene. These bounding boxes are utilized to detect groups or clusters of people who are within close proximity, based on a vectorized pairwise distance calculation. The system identifies violations by calculating the number of clusters formed and determining a breach index. This breach index is calculated as the ratio of individuals within close proximity to the total number of people in the observed area. Several popular object detection models, including Faster RCNN v3, SSD v3, and YOLO v3, were extensively tested. Among these, YOLO v3 demonstrated an effective balance between mean Average Precision (mAP) and Frames Per Second (FPS), making it a suitable choice for real-time applications. The approach is highly sensitive to the spatial positioning of cameras, which may impact detection accuracy. However, the core concept can be adapted for different environments and display categories, offering a flexible and efficient solution for monitoring compliance with social distancing guidelines in various public settings.

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