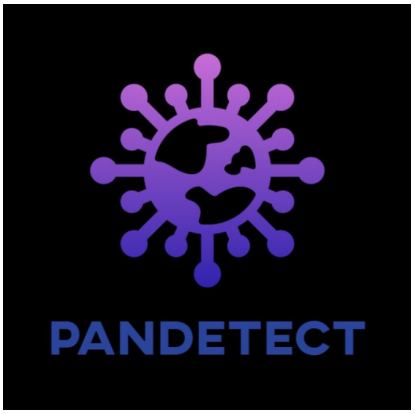
Bilkent University
Department of Computer Engineering

CS 491- Senior Design Project

Project Name: PANDETECT

Project Specifications Report



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1 Introduction

Over the last 10 months, the infamous COVID-19 virus has taken over the globe. Around 36 million people have been infected by the virus which resulted in the death of more than million people's death [1]. In our country, the first confirmed case of a patient with COVID-19 virus was in March [2]. Over the span of the last 6 months, there were 332.382 cases and 8.722 lost their lives among those [3].

Apart from quarantining there are two methodologies that are suggested by the World Health Organization (WHO) to avoid getting infected by the virus: Social distancing and wearing a mask that covers both the mouth and nose [4]. Following the WHO's advice, countries including Turkey made it mandatory to wear a mask in public spaces and comply with the social distancing regulations. Although these two methods have been turned into regulations by the government, there have been individuals who did not comply with these regulations which further increased the spread of COVID-19 virus.

Government assigned the duty of inspecting the public places and closed areas such as restaurants, to see whether they comply with the COVID-19 regulations to the law enforcement officers but it requires a lot of ground-work and it is known that humans are more error-prone compared to the machine. In order to maximize efficiency of the regulations given by the WHO and governments, it can be continuously checked whether the regulations are being complied with, and statistics will be generated according to the camera device's field of view.

In the remaining part of this report, a description of PANDETECT will be provided. Our main constraints are inspected in terms of ethical, safety, technological, environmental, implementation, language, economic, sustainability, data and usability. Following that, professional and ethical issues will be discussed. Finally, further information about the functional and nonfunctional requirements of PANDETECT will be included.

1.1 Description

PANDETECT is an application that will detect whether people in a particular area obey social distance rules and whether they wear masks or not. The main goal of this application is to identify places that do not comply with pandemic rules such as restaurants, workplaces and public areas. In this way, it is aimed to increase the control in the places where do not comply with the rules. In addition, this information will be shared on a map in the mobile

application using the data of the places where rules are followed and not followed. That way, people can choose not to go to areas where the rules are not followed according to the map provided.

Although many pandemics have been fought so far, COVID-19 is the pandemic that most affects our lifestyle. Whereas only healthcare workers used to wear the mask before, now it is mandatory by most governments to wear a mask and comply with social distance. Since COVID-19 has been in our lives for only a year, technological products for these controls are very few and very new. There exist some mask detection and social distance algorithms that have been developed, and applications have been made since the beginning of the pandemic. However, these applications are generally small-scale and not sufficient to provide large-scale supervision. In addition, current practices generally only provide either mask detection or social distance detection. Our application will provide both mask detection and social distance control at the same time, so it will be separated from other applications in this respect. The fact that we will not only provide mask and social distance control but also will show the collected data of the places on a map, distinguishes our application from other applications.

PANDETECT will detect if there are people who are not wearing masks and determine their number. With certain algorithms, a ratio or percentage will be given whether the mask rule is followed in a place. At the same time, using the distance values on the image obtained, it will be determined whether the social distance is complied with or not. Tools such as OpenCV, Keras, and Tensorflow will be used for mask and social detection implementation purposes. With the help of GPS locations of the cameras, the obtained data will be analyzed and corresponding information will be provided in the map of the mobile application. With this feature, the public may prefer not to go to the places that do not comply with the COVID-19 rules, which reduces the possibility of the users being affected by the virus. What is more, the state may wish to use this information to increase control in regions it seems necessary.

Although PANDETECT will be developed with COVID-19 in mind, it will be a program that may be used for other pandemics in the coming years. For this reason, the program will not lose its purpose in case COVID-19 ends. As a result, our program can be used for other pandemics we may encounter, including COVID-19, considering the Disease X concept [5].

1.2 Constraints

1.2.1 Ethical Constraints

- The application observes people to determine if they are complying with the rules or not. Thus, the application has to comply with the KVKK [6] as we will be gathering video footage of people.
- The permission of gathering video footage has to be obtained from the places such as restaurants, workplaces etc.
- The permission to share these places' collected data (statistics) publicly has to be obtained.
- These places should accept that if they do not comply with these rules, their brand might be damaged as their statistics will be public.

1.2.2 Health and Safety Constraints

- The application provides the information of the places whether they comply with the rules or not. However, the spread of the virus is not fully prevented even if these rules are complied with. Thus, it is important that the users know this and be cautious everywhere and anytime.
- The actual video footage of the places will not be shared with the public, only the data of the statistics of people who do not comply with the rules will be shared publicly.

1.2.3 Technological Constraints

- A camera device which views all people in the place should be provided.
- The camera device shall support AR libraries.
- In order for a camera device's connection to the application to be continuous, a stable internet connection for the camera device is required.

1.2.4 Environmental Constraints

- Camera devices that will be in use should not affect or harm nature.

1.2.5 Implementation Constraints

- Google Docs will be used for reports to be able to work on the same document simultaneously.

- The website to upload the reports and share updates about the project will be implemented using Github Pages.
- Git will be used for version control and it will be hosted on Github.
- OpenCV library and Python language will be used for mask detection and social distance detection.
- Pytorch or Tensorflow will be used for data set training.
- Client-Server architecture will be used for the project. REST API may also be used.
- The client-side of the project will be implemented in Javascript and HTML.
- The backend will be maintained by FireBase.
- The mobile application will be written in React Native framework.

1.2.6 Language Constraints

- The application will be available in English.
- We are planning to make it available in Turkish, in the future.

1.2.7 Economic Constraints

- The application will be free to use.
- The tools used to develop the application will be free.
- The camera devices used to collect data should be within the range of 1500-2500 Turkish Liras.

1.2.8 Sustainability Constraints

- The health of the camera devices and the image quality will be checked constantly.
- The users' feedback will be taken constantly to make sure the collected data is reliable.
- The application will be improved according to the feedback and suggestions.

1.2.9 Data Constraints

- The video data will be provided from the camera device.
- The dataset will be gathered from Kaggle and possibly other websites. We will collect data by using our camera device in public places, if the existing datasets are not enough.

1.2.10 Usability Constraints

- We will provide a user-friendly interface to make the application easy to use for the users.
- A user manual will be provided to inform the users.

1.3 Professional and Ethical Issues

Since our program will work through cameras, it can be thought that personal data will be violated. However, camera images will only be used to find mask-wearing and social distancing rates. The camera is in no way intended to recognize or tag people. Thus, it is considered ethically appropriate as the camera images will not be shared with the users and will only be used to obtain data.

On the other hand, since we will obtain the necessary permissions by a Terms and Conditions Agreement for the places where we will place the cameras, we will avoid the problem of unauthorized data collection. For example, if we use it in restaurants, we will obtain the approval of the owner of the place, or if we use it on the streets, we will obtain permission from the relevant government unit.

In addition, copyright infringement issues will be avoided by giving priority to open source libraries and data sets. If we need to use copyrighted libraries, we will comply with their license agreements.

2 Requirements

2.1 Functional Requirements

- The application will require a signing up procedure for the business owners, since they will be the ones who can see the stream of their own camera devices.
- The application does not need a signing up and login procedure for other users.
- The business owners may see the stream of the camera devices that have been setup in their business place on the same screen.
- The business owners can select individual camera scenes to display on the screen.
- Any user will be able to see the statistical information about the places' compliance with the regulations.

- The application will produce daily reports showcasing the statistics obtained.
- Users can see previous statistics for the camera device's field of view.

2.2 Non-functional Requirements

2.2.1 Usability

- The application can be used on both iOS and Android platforms.
- The application should provide an easy to use interface.

2.2.2 Cost

- The application will be free for the users but they can only access the statistical information not the camera feed.
- The application will be charged for business owners which use the application.

2.2.3 Reliability

- The application should be stable.
- The application should produce results with probabilistic certainty.

2.2.4 Security

- User credentials will be stored encrypted in a secure database.
- Streaming service for business owners will not be available to the public.

2.2.5 Performance

- Camera devices will analyze the video stream to reduce performance loss and prevent overload on the server.
- The servers should be optimized for live stream features for business owners.

2.2.6 Portability

- Both major mobile platforms will be supported as the front-end will be written in platform agnostic framework React Native, which supports all of the popular mobile operating systems (Android, iOS).

2.2.7 Extendibility

- In future, the application may be extended to involve thermal detection with the help of thermal cameras. That way it can be detected if the people have fever in the corresponding place by the application.
- The application may be extended to involve the detection of coughing.

2.2.8 Marketability

- Business owners may use this product to attract customers when they show they comply with rules.
- Government may use this product to automate the inspections of the places.

3 References

1. “WHO Coronavirus Disease (COVID-19) Dashboard,” World Health Organization. [Online]. Available: https://covid19.who.int/. [Accessed: 10-Oct-2020].

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3. “TÜRKİYE COVID-19 HASTA TABLOSU,” COVID. [Online]. Available: https://covid19.saglik.gov.tr/. [Accessed: 10-Oct-2020].

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5. K. V. Iserson, “The Next Pandemic: Prepare for ‘Disease X,’” The western journal of emergency medicine, 08-Jun-2020. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7390567/. [Accessed: 10-Oct-2020].

6. “Kişisel Verileri Koruma Kanunu“[Online]. Available: https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=6698&MevzuatTur=1&MevzuatTertip=5. [Accessed: 10-Oct-2020].