Bilkent University

Department of Computer Engineering

Senior Design Project

Project short-name: Third Eye

Project Specifications Report

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Contents

1 Introduction

A year ago, most of us did not know about a term which we are using in everyday life nowadays: social distancing. With the emergence of the COVID-19, all our lives had changed, and we had to adapt accordingly [1]. Although the virus itself affected the whole world immensely both in an economical and in a social sense, the world keeps spinning and people keep on living with their lives [2]. With it comes the need for social distancing.

Social distancing, in its most basic form, is to refrain from getting close with other people in crowded spaces. Research about social distancing proved it to be useful in ceasing the spread of the virus to a crucial point. It is believed that 3-4 months of moderate social distancing can save up to 1.7 million lives and $8 trillion or $60,000 per US household [3]. Thus, it is of utmost importance to realize the role of social distancing in fighting COVID-19.

Although the benefits of social distancing are certain, there are still many people that do not care about it and keep on violating the spacing rule and advice in crowded spaces [4] [15]. This brings the need for a regulation system for the crowds and that is where "Third Eye" steps in. With our project, we aim to put this problem on the table and come up with a viable solution that will minimize this issue.

However, "Third Eye" does not only aim to regulate social distancing but to provide useful data to the users as well. It will analyze the crowds and where the people's interest peaks. Then it will inform the users how the crowd moves, and which parts of the market are trending. For example, a shopping center overseer will be able to check out the data that Third Eye offers and see the trending sections of the mall.

In this report, we will provide the overall specification for the system of our project, Third Eye. A brief description of the product will be given, focusing on its most important features. Then, we will compare our product with similar products and technologies that are out on the market. Later, the constraints for including social, economic, and implementation practices along with the professional and ethical responsibilities of the product will be discussed. Finally, the requirements for the project will be listed, including functional, non-functional, and pseudo requirements.

1.1 Description

Third Eye is a smart surveillance tool that uses artificial intelligence, machine learning, and computer vision to make use of the video footage from a surveillance camera. The tool is innovative in the sense that it will have extra features that other commercial products don't have. Such as enforcing social distancing between people by using the footage and giving warnings via sound speakers or flashing some LEDs when social distancing rules are broken. Other than that, Third Eye will also do what many other smart surveillance systems can do. Such as providing data and statistics using surveillance footage.

Advanced Techniques such as machine learning and AI will constitute the backbone of Third Eye. The software will mostly revolve around these topics.

Third Eye will be working on a desktop and the software will need to be installed along with the camera. Third Eye will enable the user to enforce social distancing and gather data about their customer profile.

1.2 Similar Products and Technologies

A similar product had been in the works in the past, but that was strictly for CCTVs and for social distancing usage only [13]. We are extending it to commercial areas and for commercial success as well. There is also AxxonSoft which is very similar to what we aim to do, but with the downside of not providing useful information and statistics to the user [14].

It is also known that human detection in surveillance is on the rise, thus resulting in a great number of libraries and sources for us to use and expand upon [10].

1.3 Constraints

1.3.1 Implementation Constraints

- The project will use a real-time human detection algorithm. Therefore, we will need to use computer vision and artificial intelligence techniques.
- We might use NVIDIA's "Jetson Nano Developer Kit" or any other free human detection development kit for more professional detections.

- A camera will be used for recording images, and a computer will be used for detection, calculating distances, and collecting data.
- Python is planned to be used as the main language of the project.
- Open-source libraries and frameworks will be used. OpenCV or Imutils can be used potentially.
- GitHub will be used for both issue tracking and as our version control system.

1.3.2 Economic Constraints

- Open-source libraries can be used for free implementation.
- For the detection algorithm, there are some free to use source codes on the internet which can be used.
- To do more professional detections with AI, the product of NVIDIA called "Jetson Nano Developer Kit" can be considered. Its value is around 1300₺ [5].
- The website will be GitHub.io-based, therefore, there will not be any extra cost for hosting.
- A suitable domain name for "ThirdEye" is needed for the website of our application.

1.3.3 Time Constraints

- Time is one of the most important concerns of this project. The camera should immediately detect human actions and calculate the distance between them. Therefore, the detection algorithm should work as fast as possible.

1.3.4 Social Constraints

- This project can only be used in areas that have active cameras. Therefore, establishments that will use our product should be permitted to access the camera feed.
- Human detection will detect the humans anonymously, not by identification. This prevents many possible privacy problems for the project.

1.4 Professional and Ethical Issues

1.4.1 Professional Issues

- The source code of the project will be kept private.
- Our team will hold meetings weekly where we will discuss further plans and go over what has been done in the past week.

- The workload for each member of the team will be distributed fairly. The decisions for the future of the project will be made democratically.

1.4.2 Ethical Issues

- We will adhere to the Code of Ethics and General Data Protection Regulation (GDPR) [6].
- Since there will be surveillance through cameras wherever the Third Eye is being used, there needs to be warning signs put up and cameras placed accordingly to the regulations [11] [12].

2 Requirements

2.1 Functional Requirements

2.1.1 System Functionality

The system should:

- receive the camera feed accordingly to where it will be used.
- adjust the "social distancing" distance according to its height.
- actively process the input feed and be ready to alarm the user if the calculated social distancing measurements are violated.
- compare the data if multiple cameras of feed are given.
- store the data daily, and analyze it where the user will be able to see which parts of the mall/workspace is being populated most.
- be able to work with possible external alarming systems (such as a megaphone in a mall).
- work on a Windows OS (Possibly Unix variants etc.).

2.1.2 User Functionality

The main user base of this project will be overseers/owners of shopping malls to track the social distance and collect data about the crowd.

The user can/should:

- see the distance between different human groups.
- collect data about the crowd at specific times.

2.2 Non-functional Requirements

2.2.1 Reliability

The system should:

- correctly identify people and the number of people in a crowd to generate correct outputs.
- work with a variety of different video formats.
- work with different color ranges [7].
- be able to differentiate the human body from the environment in different situations or places [7].
- not collect and store the imagery without the knowledge of the crowd. If saving the data is the case, there should be warnings about the situation or consent from the crowd should be taken.
- not confuse already formed groups (families, couples, etc.) with social distance violations.

2.2.2 Extensibility

The system should:

- be sustainable and maintainable.
- have a flexible infrastructure so that after the Covid-19 pandemic, it could be used for different purposes.

2.2.3 Usability

The system should:

- be user-friendly. Users should be able to perform the actions easily.
- give clear outputs. The outputs should be self-explanatory. Users should not be confused with the results.
- work with different formats of video input or convert given formats into the desired one. This way the user is not bothered with that.

2.2.4 Accessibility

The system should:

- be manually installed to computers according to the needs of the customer.

2.2.5 Efficiency

The system should:

- work in real-time to identify the violations of social distancing in an area so that the authorized people can act on the situation immediately.
- analyze the data and return results in a short time frame so there will be a minimal delay between the results and the real-time.
- use minimum resources. It shouldn't allocate too many resources.

2.3 Pseudo Requirements

2.3.1 Issue Tracking

- GitHub will be used for version control.
- Google spreadsheets will be used for issue tracking. Each member will be equally assigned their tasks through the spreadsheet. Thus, the contribution done by each member will be easily seen.

2.3.2 Testing

- Testing of the project will be done with the already recorded input which is in the dataset.
- Also, testing can be done on the camera recording which is taken by group members in any place.

2.3.3 External Tools and Technologies

- Python will be used for the development of the software.
- NVIDIA's Jetson Nano will be potentially used.
- A camera will be used for input data.

3 References

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