



Bilkent University  
Department of Computer Engineering

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# Senior Design Project

*Gymtor*

## Project Specifications Report

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## **1 Introduction**

Sports is an inevitable part of life, and one of the requirements of a healthy body. According to the U.S. Bureau of labor statistics, especially engineers, drivers, lawyers, accountants, and people from similar jobs spend most of the working hours sitting [1]. Less than 5% of adults participate in 30 minutes of physical activity each day; only one in three adults receive the recommended amount of physical activity each week. A survey conducted in 2019 has shown that 26.8% of Americans aged six and older are physically inactive [2].

In the background research, we have seen that 60% of Americans who join a fitness center drop out within the first year and the major reasons for dropping out are schedule issues, lack of accountability, unrealistic expectations, and boredom [3]. With this project, we are aiming to create a product as a solution to these main dropping out reasons.

The main motivation of this project is to make it easier to do sports at home by making people capable of using their smartphone as a motivator and a sport assistant. With this application, people who do not have the motivation, time or budget for sports activities can easily be on track and while doing sports, they can have feedback regarding the correctness of their moves. The major goals of this project are assisting users to do fitness activities in the proper way using image recognition techniques, recording pulse rate of users using smartwatches, monitoring the progress of the users and creating periodic reports, and motivating users to do sports at home while making this activity enjoyable using the state-of-the-art machine learning applications.

## **1.1 Descriptions**

Gymable is a mobile application that will assist users to do sports at home. Major difference of Gymable is the image recognition technology it will use. Before starting a sport session, the user needs to select exercises for the current session or she/he can select one of the available exercise plans. The application will ask the user to place the phone with a proper viewing angle. Then, the application will give the instructions for pre-selected exercises, like push-ups, crunches, dumbbell curls etc. Then, while the user is doing the exercise, the application will watch the user's movements using the phone camera and it will push the user to do the exercises better. To do this, image recognition and machine learning techniques will be applied. This process will be repeated until the sports session ends. The application will give exercise scores for exercises in each session in different categories such as number of repetitions, stability in the movements, and equipment heaviness which will be provided by the user depending on whether an equipment is used or not. These scores will be used for tracking the body improvement of the user. Besides, if the user has a smartwatch that is able to track its pulse rate, optionally, the user will be able to include pulse rate statistics in these reports. The reports will be created periodically and they will include pulse rate statistics, detailed exercise session score analysis, time spent exercising each day and optionally, short video clips from these exercises.

Before sports sessions, Gymable will send notifications to remind pre-scheduled sports hours. Optionally, it may show video clips or statistics from previous exercises to motivate the user.

## **1.2 Constraints**

### **1.2.1 Implementation Constraints**

- GitHub will be used for version control.
- Keras and OpenCV will be used for training the neural networks.
- React Native will be used for the development of the mobile app.
- MySQL will be used as the database management system.

### **1.2.2 Economical Constraints**

- There is a required fee to publish the mobile app on Google Play Store and Apple App Store.
- The libraries and frameworks that will be used for implementation are free to use.
- The app will be free to download and use.

### **1.2.3 Language Constraints**

- The app will be launched in only English initially. However, support for other languages will be added gradually.

### **1.2.4 Ethical Constraints**

- The video clips from a user's exercise session will not be shared with other users and only short clips of the session will be stored for motivational notifications only.
- Any private data of the user, such as body measurements, will not be shared with other users.

### **1.2.5 Social Constraints**

- If users want, they can share their exercise routines with others.
- Users can follow other users and view the leaderboard where the weekly total exercise durations of the users they follow appear, which can motivate them to exercise more.

- The users will be able to rate other users' exercise routines.

### **1.2.6 Sustainability Constraints**

- There will be basic exercise sessions available in the app initially. However, users will be able share their favorite exercise routines with others, which will result in a rich collection of exercises.

### **1.3 Professional and Ethical Issues**

- Our application should not store any pictures or videos of users without their consent.
- The Code of Ethics and General Data Protection Regulation will be obeyed
- Data protection and privacy requirements must be satisfied.
- If their consent is obtained, user information and his/her progress will be shared with users to motivate them to do more sport. This data will be stored in our application's database rather than storing locally. With that our application will provide a more secure environment versus cyber attacks to mobile devices.
- Since our application will be benefited by the Deep Learning and Machine Learning researches all of the benefited articles and sources will be credited on resources at the proceeding reports
- The requirements of ACM's "Code of Ethics and Professional Conduct"[4] and IEEE's "Code of Ethics"[6] will be satisfied.
- In each week team members will do meetings to share information related to work done by each member and discuss what should be done next.
- The work will be shared fairly among team members.

- When people do sports, having breaks is crucial [5]. So our application will give notifications to warn users if they did not spend enough time between sets of the training.
- Giving break days is also crucial [5]. So our application will give notifications if the users do sports instead of resting on break days.

## **2 Requirements**

### **2.1 Functional Requirements**

- Smart Watch usage functionality should be optional and convenient to use.
- Users should be able to access their past usage data and statistics.
- Users should be able to create exercise sessions and view them.
- Users should be able to start and finish these exercise sessions, and select a session from already existing ones.
- Notifications and video clip features should be turned on/off by the user.
- Users should easily sign in and sign up to the system. Social media accounts should also be allowed to be used as an account.
- Users should be able to easily perceive application feedback.
- Sports which require additional equipment such as dumbbells, should be specified by the user.
- Users should be able to specify their age, weight, height and gender in order to be informed on better information related to calories burned.
- Overtraining must be warned by giving notifications if the user does not give break between sets or the user does not have days off.

- The user should be motivated when he/she has done sports regularly.

## **2.2 Non-functional Requirements**

### **2.2.1 Efficiency**

- System response time should not exceed 30 seconds.
- The app should not lag behind when communicating with the server. In case of a lag, there should be a time-out event, possibly 5 seconds, that leads to server roll-back.
- The neural network should generate the output about correctness of the exercise in less than 5 seconds.

### **2.2.2 Scalability**

- More than 20000 users should be able to use the application at the same time.
- Application should be easily extendable to implement Virtual Reality technology.

### **2.2.3 Security**

- Confidential data of the user should not be accessible to third parties.
- The app must ensure that the user data, such as the additional images and the background image, is not stored in the server-side unless the user gives permission.
- Servers should use RSA-256 encryption keys to SSH into with.
- The app should be resistant to adversarial cyber-attacks on the server-side. Methods such as hashing, signing and encrypting can be used to ensure data confidentiality and integrity.



#### **2.2.4 Usability**

- Users should be able to start using the application with at most 3 touches.
- The app should be clear in terms of display and language when prompting.
- The app should present a neat and well-organized user interface.
- The app should require the absolute minimum exercise knowledge from users.

#### **2.2.5 Reliability**

- Application should detect human motion from the camera at a high accuracy, with at most 5° of error acceptable.
- The app should roll-back in case of a failure in the server communication. To be clearer, delete any data that is not completely processed.
- The app should be able to generate realistic, reliable movement feedback by tracking the user body.

### 3 References

- [1] "Standing or walking versus sitting on the job in 2016 : The Economics Daily: U.S. Bureau of Labor Statistics," Mar. 01, 2017. <https://www.bls.gov/opub/ted/2017/standing-or-walking-versus-sitting-on-the-job-in-2016.htm> (accessed Oct. 10, 2020).
- [2] "2020 Physical Activity Council's Overview Report on U.S. Participation." [https://eb6d91a4-d249-47b8-a5cb-933f7971db54.filesusr.com/ugd/286de6\\_c28995b76cf94de2a22ac7a0a4d5264d.pdf](https://eb6d91a4-d249-47b8-a5cb-933f7971db54.filesusr.com/ugd/286de6_c28995b76cf94de2a22ac7a0a4d5264d.pdf) (accessed Oct. 10, 2020).
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- [4] "IEEE Code of Ethics." <https://www.ieee.org/about/corporate/governance/p7-8.html> (accessed Oct. 11, 2020).
- [5] U. G. Schjøberg and N. Bazilchuk, "Why is it so important to take breaks when you train?," Jan. 06, 2020. <https://partner.sciencenorway.no/workout/why-is-it-so-important-to-take-breaks-when-you-train/1567864> (accessed Oct. 11, 2020).