

POLITECNICO DI TORINO

Master's degree
in Computer Engineering

Master's Degree Thesis

Title



**Politecnico
di Torino**

Supervisor

prof. Maurizio Morisio
firma dei relatori

Candidate

Domenico Gagliardo
firma del candidato

Academic Year 2023-2024

Contents

Introduction	2
1 Health and Well Being	3
1.1 Guidelines	4
1.1.1 Physical Activity Guidelines	4
1.1.2 Healthy Diet Guidelines	5
1.2 Technology Role in Health	6
1.2.1 Smartphone Application	6
1.2.2 Wearable Devices	6
2 System Design and Technological Stack	6
2.1 System Requirements	6
2.2 System Design	6
2.3 Technological Stack	6
3 Results	6
Bibliography	7
List of Figures	8

Introduction

The work that is being presented in the next pages is based on two main arguments: the importance of following a healthy lifestyle and how technology can help in achieving this goal. Infact, our project work along with my colleagues concerned the implementation of an application suited for achieving a good lifestyle. The application, composed both by a frontend part and a backend one, allow the users to track their data regarding nutrition, as well as physical activity, sleep and stress data. These data can be either inserted manually or collected through a wearable device, appropriately connected to the application. The application still requires the user to insert his basics information, such as username, age, weight, height. They are then all available in the profile settings, where the user can eventually change them. The application also integrates a gamification approach through a specific section of the app, that allow the users to learn and deepen their knowledge about the topic, granting a form of reward when users complete a specific task. Finally, the application also involves the usage of recommendation as a way to provide suggestion about health and lifestyle to the user and improve his healthy journey. The thesys is then structured in 5 chapters: the first one deepen the health and well being topic, considering the guidelines that literature has found over the years of studying the topic. It then focuses on how technology can help us in achieving a better lifestyle, by considering which are the main software and hardware tools that can be used, such as smartphone application and wearable devices that allow to collect data and share with application to create a more complete picture of the user's health. The second chapter then moves into more tecnical aspects, by considering the technology stack that has been used to develop the application, starting from the used programming languages and automating tools, moving then to the IDE (Integrated Development Environment) and to the backend related aspect. The third chapter then talks about the overall implementation of the application, by focusing on my particular contribution. The fourth chapter then moves to the performance analisys of the application, by considering the different testing devices that have been used to test the application performances. Finally, the fifth chapter concludes the work by considering the results that have been achieved and the future work that can be done to improve the application.

1 Health and Well Being

Health is one of the most important, if not the most important aspects of a person's life. For this reason, over the years, different organisations have established different guidelines on how to stay healthy, thus increasing people's life expectancy and quality of life. Among these, the most widely worldwide recognized is the World Health Organization (WHO) [1] that provides several guidelines not only in term of physical activity, covering also other health aspects.

As far as concerns the physical activity, the WHO estimates that 1 in 3 adults and 4 in 5 adolescents do not do enough physical activity, with adolescents girls less active than adolescents boys and with inactivity levels that increases after 60 years of age. This level is expected to rise due to country economic development (more use of technology, change of cultural values and more sedentary behaviour). This trend sadly keep going in the wrong direction, despite the fact that physical activity has countless benefits, like reducing the risk of heart disease, cancer, diabetes, hypertension and depression.

- Children and Adolescents:
 - **Regular physical activity** enhances fitness, cardiometabolic health, bone strength, cognitive and mental health while reducing body fat.
 - **Sedentary behavior** leads to increased adiposity, poorer cardiometabolic health, behavioral issues, and reduced sleep duration.
- Adults and Older Adults:
 - **Active adults** experience lower body fat, risks of all-cause mortality, cardiovascular diseases, hypertension, specific cancers, and type-2 diabetes. They also enjoy improved mental health, cognitive function, and sleep quality.
 - **Sedentary lifestyles** are associated with higher mortality rates and increased incidences of chronic diseases like cardiovascular issues and cancer.
- Pregnant and Post-Partum Women:
 - **Engaging in physical activity** decreases the risks of pre-eclampsia, gestational hypertension, gestational diabetes, excessive weight gain, newborn complications, and postpartum depression, while having no negative effects on birth weight or stillbirth risk.

Active vs Sedentary lifestyle[2].

Food is also crucial in order to be healthier. Having a healthy diet helps to prevent several diseases (like heart disease, diabetes and cancer) and also malnutrition in all its forms. However, care has to be taken in choosing the right food sources that have good quality and avoid processed foods. Eating noble foods like fruits, vegetables, legumes, nuts, and whole grains, while limiting the intake of salt, sugar, and fats, is the key to a healthy diet. For all these reasons, both physical activity and diet are strongly promoted by the WHO through his global action plan, by calling international partners, private sector and also civil society to take action in order to support them.

1.1 Guidelines

1.1.1 Physical Activity Guidelines

As far as concerns the physical activity, the WHO gives some recommendation based on the age group [3]:

- 5-17 years:
 - Should do at least 60 minutes of physical activity with moderate/vigorous-intensity daily (of course more than 60 minutes provides additional benefits), as well as bone-strengthening and muscle-strengthening activities.
- 18-64 years:
 - Should do at least 150 minutes of physical activity with moderate-intensity in a week or at least 75 minutes of physical activity with vigorous-intensity in a week or an equivalent combination of both (increasing moderate-intensity will provide additional benefits), but also muscle-strengthening activities by involving major muscle groups.
- 65 years and above:
 - Should do at least 150 minutes of physical activity with moderate-intensity in a week or at least 75 minutes of physical activity with vigorous-intensity in a week or an equivalent combination of both (increasing moderate-intensity will provide additional benefits), recruiting major muscle groups with muscle-strengthening activities but also including exercises to enhance balance and prevent falls in case of poor mobility.

1.1.2 Healthy Diet Guidelines

Regarding having an healthy diet, also here the WHO gives some guidelines, emphasizing that a good diet includes legumes, fruit, vegetables, animal sources foods (like meat, fish, eggs, and milk), cereals (like wheat and barley) and also tubers (like potato and yam). It also gives some further recommendations[4]:

- Babies and young children breastfeeding:
 - Breastfeeding promotes healthy growth, as well as having long-term benefit, like reducing the risk of developing noncommunicable diseases, overweight, obesity. From birth until 6 month of life is important to feed the baby only with breastmilk, while from 6 month to 2 years of age is important to introduce also additional complementary foods, while still breastfeeding.
- Eat lots of vegetables and fruit:
 - These foods are rich in vitamins, minerals, dietary fiber, antioxidants and plant protein, which help to prevent heart disease, stroke, diabetes, obesity and some cancers.
- Eat less fat:
 - Fats and oils are concentrated source of energy, so it is important to limit them, especially saturated and industrially-produced trans-fat that can increase the risk of stroke and heart disease. To avoid gaining weight in an unhealthy way because of them, care has to be taken in using unsaturated vegetable oils (like olive oil) instead of animal fats or oils high in saturated fats (like butter or palm) and in any case fat consumption should not exceed 30% of total energy intake.
- Limit sugars:
 - Sugar consumption should be the 10% of total energy intake. This should be achieved by limiting soft drinks, soda and other drinks high in sugars (fruit juices or yogurt drinks) and also by avoiding the consumption of processed foods high in sugars (like cookies, cakes, chocolate). Better to choose fresh fruits instead of them.

The WHO also suggests to limit the intake of free sugars, salt, and saturated fats, as well as to avoid the consumption of processed foods.

1.2 Technology Role in Health

1.2.1 Smartphone Application

1.2.2 Wearable Devices

2 System Design and Technological Stack

2.1 System Requirements

2.2 System Design

2.3 Technological Stack

3 Results

Bibliography

- [1] World Health Organization (WHO), <https://www.who.int/> [3].
- [2] WHO Physical Activity Benefits, <https://www.who.int/en/news-room/fact-sheets/detail/physical-activity> [3].
- [3] WHO Physical Activity Guidelines, <https://www.who.int/publications/i/item/9789240015128> [4].
- [4] WHO Healthy Diet Guidelines, <https://www.who.int/initiatives/healthy/healthy-diet> [5].

List of Figures