Functional Decomposition

The purpose of this project is to collect data of sprinters and use that data to enhance the performance of the runner. To make this functional decomposition, we had a team meeting where we discussed what we wanted the system to do and how it can be done. We agreed on using sensors, a camera, and an app in order to make the system meet the requirements of our project in the most efficient way, but we also considered using a website instead of an app if that becomes too unfeasible. The data being collected should be displayed for the user (such as the coach and sprinter) to see quickly so the necessary adjustments can be applied. The system created will have information entered from the user and output the specific data collected during the specified run. The inputs required from the user are the sprinters age, height, weight, distance, and goal time. From this information, the system will be able to display the relevant data regarding specific features. Some of the features will be age predicted maximum heart rate and displaying whether a goal was achieved. The user inputs height, weight, and distance in order to have the system take into consideration how tall, and heavy someone is and how far someone is going when comparing speed, time or calculating the force of the leg drive. Sensors will be used in order to collect specific data about the sprinter. The sensors will be bluetooth in order to quickly output the necessary data and display. There will be two sensor placements: inside the shoe and on the chest. The chest placement will measure heart rate and the body positioning of the runner. There will be a heart rate monitor and gyroscope in order to measure the heart rate and to measure the body angle. For the foot sensor, it will be placed in the shoe and it will measure the pressure of the leg drive. The foot sensor will also measure the ground contact time and stride frequency. The stride frequency will be measured by recording when the foot touches the ground and then when the next foot touches after that. The speed of the runner will be measured using an accelerometer. A camera will be used in order to catch the runner in the takeoff position and it can be used to analyze the more technical aspects of a sprinter such as the stride length and arm positioning. All of the data collected will be displayed to the user quickly and by using an app. This app will have a live display of the runner for the coach to see their form as well as display the current speed of the runner and the time of the run. The app will ask for the user to input their information and the user will then pick the distance they are running (60m, 100m, or 200m). Once that is done the live display will show up and the runner can start their race. At the end of the sprint, the runner's statistics will show up (stride length, stride frequency, ground contact time, heart rate, maximum velocity) and if multiple races are done, the app will average out all the data for the runner to see. The app will also output if the goal time entered was reached or not after each race. The expected outcome for this system will display all of the specified statistics of the sprinter along with their heart rate and speed. This system will be able to efficiently enhance the performance of a sprinter and aid the coaches in correcting the sprinters form.

Level 0: The System

Module	System
Inputs	Biometrics
Outputs	Sprinter analysis
Functionality	Inputs specific data into the system and that data is used to help analyze the form and technique of the sprinter

Level 1: Hardware

Module	Tools for Data Collection
Inputs	Sensor and camera
Outputs	Sprinter data and display
Functionality	Displays the athlete's run and their data that is collected.

Level 1: Software

Module	App display
Inputs	Basic information about the runner (height,weight, distance, age goal time)
Outputs	Displayed and saved on the screen
Functionality	Allows for the user to create a profile and save their basic data

Level 2: Possible data collection

Module	Bluetooth Sensor
Inputs	Feet and chest placement
Outputs	Stride frequency, stride length, maximum velocity, ground contact time, and time of sprint
Functionality	Collects data about the sprinter

Module	Bluetooth Camera
Inputs	Visual of athletes run
Outputs	Video of athlete's run live and playback, stride length
Functionality	Shows athletes run for further analyzation of technique

Level 2: Data Analysis

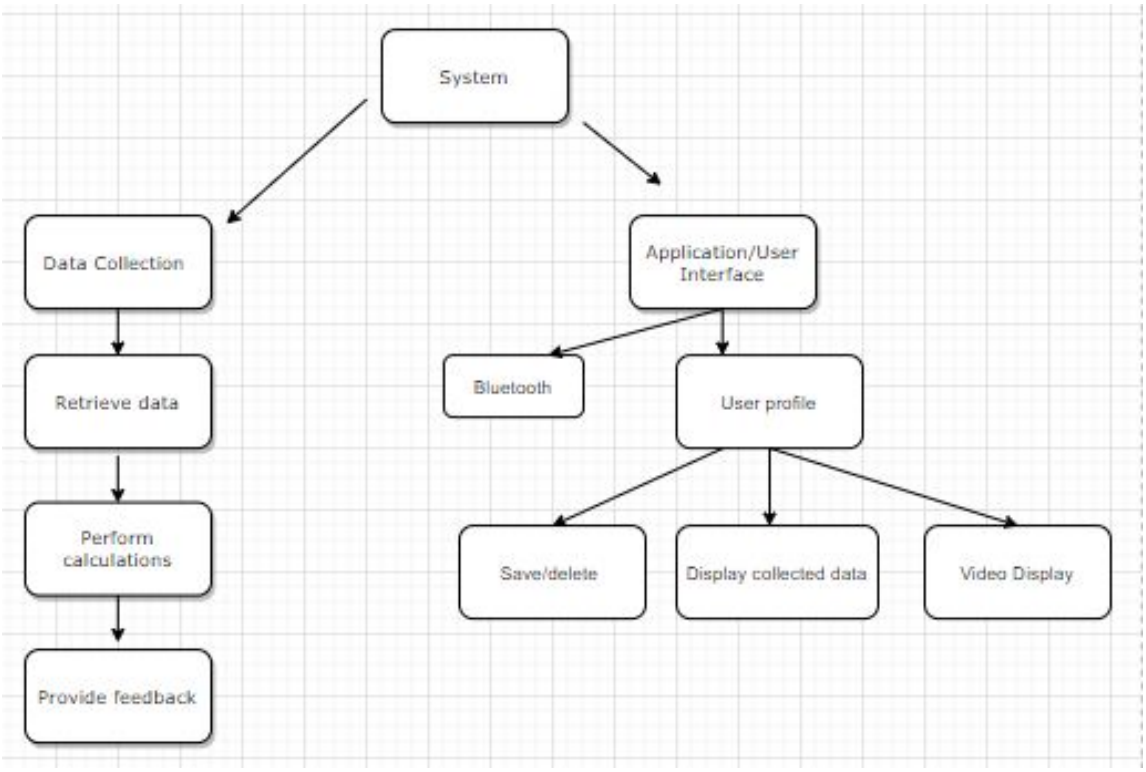
Module	Calculations
Inputs	Stride frequency, stride length, maximum velocity, ground contact time, leg drive, maximum heart rate, and time of sprint
Outputs	Average of the all the data
Functionality	Calculate the data and display it to the screen. If time permits, machine learning algorithms can be used to recommend areas of improvement

Level 3: Further Possible Data Collection

Module	Foot Sensor
Inputs	Force of leg drive
Outputs	Stride frequency, ground contact time
Functionality	Collects data about the sprinter

Module	Chest Sensor
Inputs	Heart beat, body position
Outputs	Display the heart rate and body positioning
Functionality	Collects data about the body positioning, displays the heart rate of the runner and alerts if it is over the age predicted maximum heart rate

Module	Accelerometer
Inputs	Length of athlete’s strides
Outputs	Speed of sprinter
Functionality	Collects the speed of the runner



Summary:

In order to generate our functional decomposition, we first broke down the project into its different components and levels. From there, we determined the specific modules and their functions as well as their inputs and outputs. By decomposing our project into general modules and functions, the main purpose and goals of each sub part or level can easily be determined and the necessary steps in the design phase can be taken. Our project has two major components: the data collection and the application. These two components were then broken down and their functions were determined. We want the system to collect data about the runner and perform calculations for any analysis. For the application, we want the system to be bluetooth for fast data transfer as well as have a user profile that'll be able to display the collected data and video.