SD 309: Sprinter Data Collection

2. Concept Generation

2.1 Brainstorming

2.1.1 Accelerometer

Accelerometers are used to detect transducers that give an output related to acceleration. With an accelerometer, we will be able to keep track of the acceleration of the sprinter during the race. Measurement of this acceleration aids us in comprehending the dynamic characteristics of the sprinter during the race. Acceleration can help coaches analyze the performance of their sprinters. The accelerometer is used for collecting acceleration but the data will be used to find velocity and deduce stride frequency, increasing its level of importance for our project.

- Analog output
- An Analog to Digital Converter (ADC)
- Digital accelerometers
- SPI (Serial Peripheral Interface)
- I2c communication protocols

2.1.2 Sensor Position

Sensor position is where the accelerometer will be placed. Sensor placement on the human body is very important because it will determine the precision of our data. Sprinting is a complex form of motion that utilizes all the major structures in the human body. In order to determine where to place our sensors we need to understand the biomechanics of running which will be discussed further in our concept selection. Factors considered for placement selection are closeness to the center of mass of the body, level of constraint contributed to body motion, comfort, and versatility (can this area provide us with other information.

- Waist
- Ankle
- Wrist
- Chest

2.1.3 Camera system

The camera system is what we will use to capture the movement of the sprinter in time. We are interested in using a camera system to detect the stride length of the runner. It is our goal to find a camera system that is compatible with the concept we choose to use for image processing. With the video captured from our selected camera system, we will be able to identify the length of each stride and provide this information to our user as an output in out program. Although we are on a budget, we feel that the device we use to capture the image of the sprinter in motion should not be cheap. We are looking for a reliable camera system at a reasonable cost. We are focusing on factors such as depth sense, resolution, frame rate, adaptability to lighting changes, size, and accuracy.

- Intel RealSense Depth Camera D435
- 1MP Mono Stereo Camera Module Depth Sensor IMU ROS
- MYNT EYE 3D Stereo Camera Depth Sensor
- SID 3D Camera
- YI 360 VR Camera Dual-Lens 5.7K
- iPhoneX

2.1.4 Accelerometer, Image, and Data Processing

Data processing is a key function in the operation of our project. As we obtain data from our accelerometer we are responsible for the processing of the data into valuable visual output to our user. Our operating system must be able to make instantaneous calculations in order to transform the data received by the accelerometer and obtain velocity. There are a few different ways that the data from an accelerometer may be processed.

Along with the data processed from the accelerometer the images are also important for collecting our data. There are several factors that are introduced when collecting data from the video we are using. This goes down to the camera system that we are using as well as the software and method of analyzing the frames we capture. The frame rate is an important factor in selecting an image processor. Our image processor must be able to properly detect the instances that the runners legs make contact with the ground. The image processing is vital for us to determine the stride length.

Filters and processes

- Use of Kalman filter
- Use fourier transform of impulses representing steps (stride frequency)
- Low pass filter to reduce noise

Programs

- MATLAB
- Python
- C-Code
- Energia

2.1.5 Program

In order for us to compile and organize the data capture it is clear that a program is a crucial part for the project. The program would need to take in certain inputs, such as video footage from camera, sensor data, and user input (such as height, weight, and name). Outputs would have to be along the lines of what the customer requires, such as stride length, stride frequency, time in relation to distance, speed, and acceleration.

To determine the best way to implement these inputs and outputs different softwares must be considered for both the benefits and downfalls regarding these restraints for input and output and what seems plausible. In addition, the method of implementing this program into a user interface is important as well, as it will ensure that the user will be able to interact with the program and the data provided.

Programming Language/Software

- C++
- Python
- C
- OpenCV
- CISCOR

User Interface

- Computer oriented
- Phone application
- Display through sensor