Competitive cycling over 5G

Video Optimization techniques

One of the major problems that was identified in 360 video streaming is high bandwidth requirement. To address this problem, four categories of solutions were proposed by researchers at the moment.

They are,

- Dynamic adaptive HTTP streaming (DASH) – Adaptive bitrate streaming technique that streams high quality media content over HTTP
- Tiling – Divides the Video frames into multiple sectors. Multiple Tiling schemes available named clus Tile, Pano, MiniView, OpCash etc.
- Viewport adaptive streaming – Identifying and transmitting the current viewport content and predicted viewport corresponding to the user's head movement
- Machine Learning – viewpoint Prediction, reduce bandwidth requirement by running deep learning models at the client end to enhance the video quality.

❖ We have to review all the above techniques and find out what are the most suitable techniques that will suits with our application.

Communication protocols that can be used for video steaming

❖ Following video streaming protocols were identified for video streaming purpose. We have to review those and find most suitable protocols for our purpose.

- HLS
- MPEG-DASH
- RTMP
- RTSP
- SRT
- WebRTC

Communication protocols that can be used to data communication (Sensor data)

❖ We have identified following as Sensor data communication protocols so-far.

- MQTT
- ANT+
- Smart Bluetooth
- BLE

Related to the bicycle and the user

1. **Heart rate measuring techniques**

We hope to measure the heart rate by a heart rate sensor whose data is directly processed by the server. We can use suitable protocols to send data to the raspberry pi or cloud database.

2. **VR Headset**

If we consider human eye as a camera, then the eye sensor is capable of detecting 60 pixels per degree at the fovea. So, we need to achieve the 60 pixels per degree requirement in order to recreate the real world inside a VR headset. Resolution, pixels per degree, Field of view, Refresh rate should be considered when choosing a VR headset.

3. **Bicycle speed measuring techniques**

We have found 3 methods to measure the wheel speed or pedaling rate(cadence) of the bicycle.

- Hall effect sensor
- Gyroscope based speed sensor
- Using encoders

5G technology to minimize latency

As the fifth generation of wireless data network, 5G has 3 key abilities compared to 4G. They are High Bandwidth, Low Latency and Dense Connections. In our case, we want similar or less than 1ms of response time for virtual reality. 5G offers 1ms response time while 4G has a 100ms of latency. As well, 5G uses "Beamforming" trick to efficiently aim transmissions rather than just spray everything everywhere. We can use this with more effectively because 5G used as URLLC. (Ultra-Reliable Low Latency Communication)

Cloud Technology

We are planning to process, stream the video clips and store all the data records in a cloud environment. We are searching for a better cloud environment which offers VR related cloud services among AWS, IBM, Azure and google. Another approach that we have identified is using a cloud service for video streaming and processing while using a hosting service such as firebase to store other sensor and statistical data.

3D object positioning

Still, we are observing methods and techniques through the research papers. We found important details.

- Positioning an animated static object in the real 360 VR video
- Catching a real ball object in virtual reality

These are the two topics of research papers which we read until now. First one explains how the animated object positioning in real world video. But the object is static object. We want dynamic object to achieve our task. Catching a real ball object in virtual reality paper explains how dynamic object(ball) positioning in the VR animated video. But we want to achieve our task using real world 360 VR video.

We feel that it can be easy to approach the task using animated 360 video. Then VR environment fully game developing part. But still, we are searching.

There are few problems come to our mind and some solutions,

- How to position two riders? We will try to initially position two riders on two separate trails. It's like left side rider and right-side rider. Then we will need same video record on two times into two separate trails.
- There are two riders who can see each other. Sometimes opponent may ride lead or lag. Everything depends on the rider's speed and head rotations as well. We have to consider about scaling the objects when they away from different distances.

These are our present perspectives about this part.

Mobile App and Web Dashboard

Since the video is streamed through mobile phone, we have to develop a mobile application. Flutter, Android studio can be used to do that. We can put some authentication method for it. In order to deliver user statistical data in useful manner, we hope to develop web-based dashboard. Tool and frameworks such as Angular, React, Nodejs, Django and spring boot will be helpful to archive this.