Swimming Self-Coaching

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Abstract

In sports, coaching plays a huge role in the performance of the players. The main idea of the proposed project is to have a wearable assistant for the swimmer called "Swimming Self-Coaching". We propose a system that detects and analyzes incorrect behaviors in the swimming movements. This is done with the aid of sensors such as the accelerometer; which enables our proposed system to record the swimming strokes to detect incorrect movements. We will be focusing on creating a system which could assist swimming coaches; specially when coaching multiple swimmers at once. The system notifies both the swimmer and coach when an incorrect movement occurs. Feedback in our system will be done via a vibration sensor for the swimmer and AR(Augmented Reality) for the coach.

1 Introduction

1.1 Background

Nowadays there are many factors which can affect the performance of the swimmer. Only 719 entries out of 2400 entries are qualified to enter the Junior competition of International Swimming Federation (FINA) World Championship (WC)[1]. There is a distinctive theme to the wide plurality of these cases: swimming stroke error. Thus the improvement of the swimming stroke is important to increase the number of entries. Improvement of swimming strokes/movements could be done by enhancement and aiding currently available coaching techniques. Swimming self-coaching is way to focus on the swimming strokes error and notify the swimmer and coach a very specific detail about the error done. This project's target is to help the swimmer to eliminate his swimming stroke errors by a certain methods.These methods could be detecting of :shoulder joint movement , elbow joint movement , wrist joint movement and position of fingers.These project is a real-time so you cannot ask your coach for help or either to record a video for your swimming stroke.

1.2 Motivation

1.2.1 Market Motivation

Coaches have stated that the extreme problem,when more than swimmer starts to swim at the same time so he can find a problem to track the swimming errors of each swimmer.According to the paper Masters Swimmers' Experiences With Coaches [2],by using a self coaching application this could help the coach in :

1. Coaches experience and professional development
2. Preferences for coaches planning/structuring of the practice and program.
3. Preferences for how coaches prepare Swimmers for competitions.

1.2.2 Academic motivation

Our work is motivated by both application domain and previous work. Marc B achlin, Kilian F orster, and Gerhard Tr oster. [3] have developed a proposed system to assist the swimmer to achieve the desired goals. Pekka Siirtola, Perttu Laurinen, Juha Roning in [4] proposed study concentrates on tracking swimming exercises based on the data of 3D accelerometer they divide tracking of swimming exercise into three phases. Meanwhile, Rabee M. Hagem, Steven G. O'Keefe, Thomas Fickenscher, and David Victor Thiel r [5] presents a wrist mounted accelerometer and optical wireless communications to display goggles to give real time feedback to a swimmer during swimming. Huang, K.-C., Chu, C.-P., Chiu, T.-K., Chen, J.-C. set a study [6] to explore the effect of different detection of position on swimming stroke.

2 Project Description

Accurate detection and analysis of the swimmer behavior and check if it's right or wrong and giving real-time feedback using sensors.

2.1 Objectives

The project main objective is to make swimming lifestyle easier for swimmers as it will help them to detect the abnormal behavior of the swimming strokes. There are multiple types of abnormal behaviors in front crawl stroke like hand entry angle, hand entry position, pull through pattern, elbow position during recovery and elbow position during pull through. Several algorithms are performed to recognize the swimming strokes such as DTW according to the paper gesture recognition with inertial sensors and optimized DTW prototypes [7] and R-CNN according to the paper [8].

2.2 Scope

The system will cover several things inside its scope:

1. System will have different users (coach, swimmer and sub coach).
2. Coach can monitor the swimmers swimming behavior.
3. Coach can view the swimmers ratings.
4. System rates individual swimmers based on their average swimming behavior during all their training.
5. System rates each individual training.
6. Alert to the swimmer if there is a wrong stroke.
7. Sub-coach can plan and implement training program including water and based training schemes.

2.3 Project Overview

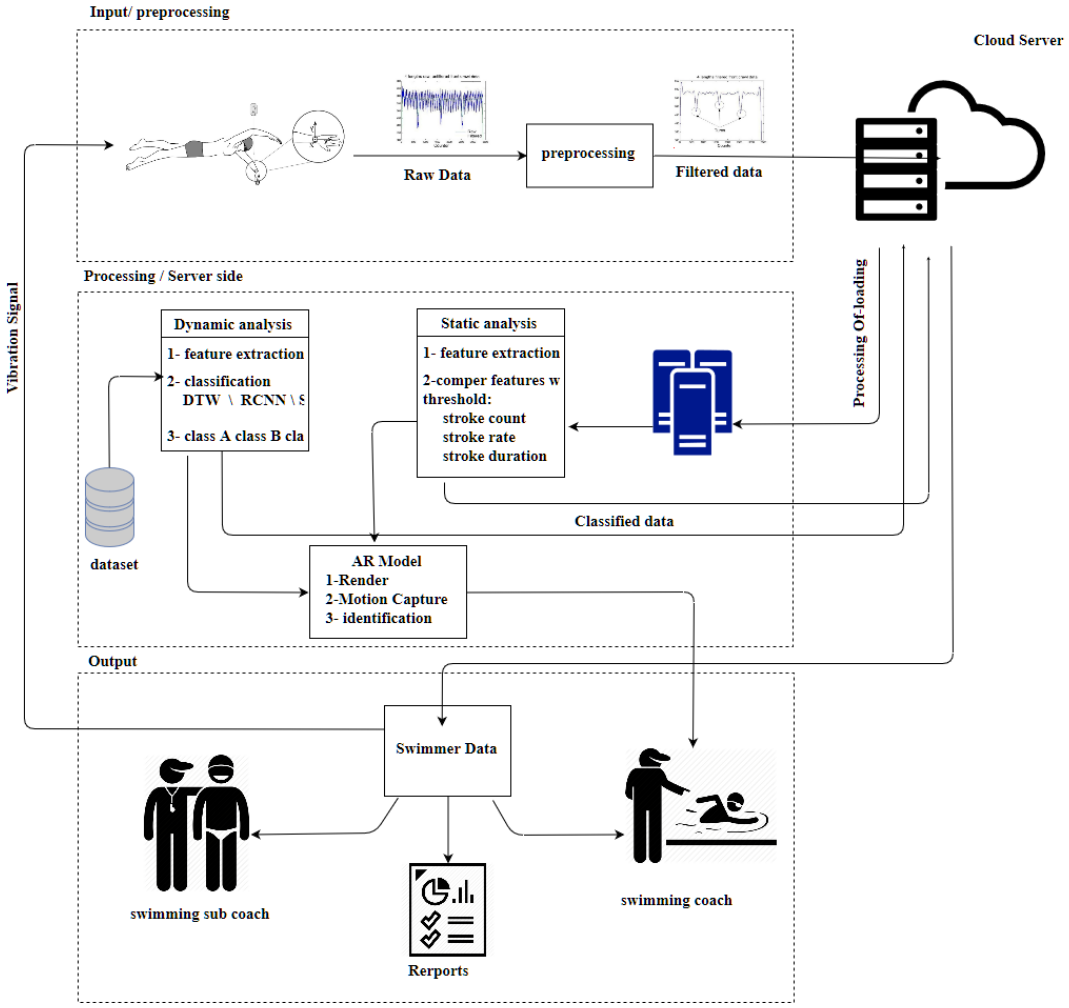


Figure 2: System overview

The proposed system a swimming self-coaching that uses sensors accelerometer and gyroscope to collect readings of swimming stroke. Thereafter, the collected readings is passed through a pre-processing phase that supposedly to get better results by using Kalman filtration. So, the filtered data is passed to the cloud data storage, which then takes the required data to the server side to get the required analysis to compare features and threshold using the feature extraction and classifier algorithms such as DTW and RCNN. After analyzing the data the incorrect behavior is obtained. Eventually, the analyzed data takes two ways, the rating data is always sent to data storage and vibration alert sent to the swimmer when detecting wrong

behavior of the strokes. Also, the coach and sub coach can monitor the ratings of the swimmer by monitor the reports and the AR model that takes three steps which are rendering, motion capture and identification.

3 Similar System Information

SwimMaster [3] is a system proposed to perform continuous swim performance evaluation. They used acceleration sensors with micro-controllers and feedback interface modules that swimmer wear while swimming. They detect some parameters such as time per lane, the swimming velocity and the number of the strokes per lane. SwimMaster assist the swimmer to achieve the desired exercise goals constantly monitoring his/her swim performance and providing the necessary feedback to achieve the desired workout goals. They used specific factors like body balance and body rotation to reduce the resistance and increase the propelling force. The system can differentiate between a good and a bad body balance. The data read from the acceleration sensor is not yet processed online at this early stage but stored for off-line processing.

This paper [9] is validation trial of an accelerometer-based sensor platform for swimming. The tri-axial accelerometer devices were used to record swimming motion information. sensor platform for swimming applications presents significant packaging challenges, as it is required to be comfortable to wear. This paper demonstrates the utility of the sensor platform as a means to extract these parameters from training sessions where expensive equipment and or a dedicated coach are unavailable. Thus the platform can potentially provide the athlete with detailed performance measures that otherwise would only be available from a personal coach and or specialized training camps. The accelerometer data are passed on filtering to identifying the type of the stroke.

This paper [5] is self contained adaptable optical wireless communication system for stroke rate during swimming. Also presents a wrist mounted accelerometer and optical wireless communications to display goggles to give real time feedback to a swimmer during swimming. Experiments are conducted in air and under water for this system to optimize the link availability. Algorithms are used for finding the absolute maximum of the y-axis acceleration for each stroke cycle and the goggles display decision are implemented at the transmitter and the receiver.

Sander Ganzevles , Rik Vullings , Peter Jan Beek , Hein Daanen and Martin Truijens in [10] proposed study that examine the reliability and practical usefulness of tri-axial accelerometers for monitoring lap time, stroke count and stroke rate in swimming, help elite swimmer in his/ her training practice also to avoid human monitoring errors. They tri-axial accelerometers use sensor paced on swimmer upper back and synchronized video recordings. This is what we will do in our system but t for intermediate swimmer we will not use

video recordings also will two tri-axial accelerometers in wrist and upper back to detect the abnormalities in swimming behaviors to provide real feed-back

Pekka Siirtola, Perttu Laurinen, Juha Roning in [4] proposed study concentrates on tracking swimming exercises based on the data of 3D accelerometer they divide tracking of swimming exercise into three phases. First the swimming style, second count the number of strokes, third the intensity of swimming is estimated. They compare between two different sensor placements like our system sensor placements (wrist and upper back) then they find that upper back is more accurate in swimming style recognition but in second phase of tracking the two sensors give approximately equally accurate results.they have 6 different datasets three for upper back sensors and three for wrist sensor each seniors stored the data w 3 different frequencies (5 Hz ,10Hz ,25Hz).They used only linear and quadratic classifiers (LDA and QDA).

3.1 Similar System Description

3.2 Comparison with Proposed Project

Points of Comparison	Method	Accuracy Achieved	Stroke Type	Feedback	Sensor Placed	Training Samples
SwimMaster	Sensor readings	Not mentioned	Front Crawl, Breast	Offline	Upper, Lower back and right wrist	Not mentioned
Sensor platform for swimming	Sensor readings and video camera	95%	Freestyle, Backstroke, Breaststroke, Butterfly	Offline	Right and left hand	Up to 40 datasets
Self-Contained Adaptable Optical Wireless Communications System	Sensor readings	95%	Freestyle, Backstroke, Breaststroke, Butterfly	Online	Wrist	4 datasets
Tri-Axial Accelerometry in Daily Elite Swim Training Practice	Sensor readings and video camera	Not mentioned	Freestyle, Backstroke, Breaststroke, Butterfly	Offline	Upper back	Not mentioned
Efficient Accelerometer-Based Swimming Exercise Tracking	Sensor readings	Back : 86 % - 87% Wrist : 86-90.4	Freestyle, backstroke	Not mentioned	Wrist and upper back	6 datasets
Our Proposed System	**Sensor readings**	**-**	**Front Crawl**	**Online**	**Right wrist, Upper back.**	**-**

Figure 2: Comparison

4 Project Management and Deliverable

4.1 Tasks and Time Plan

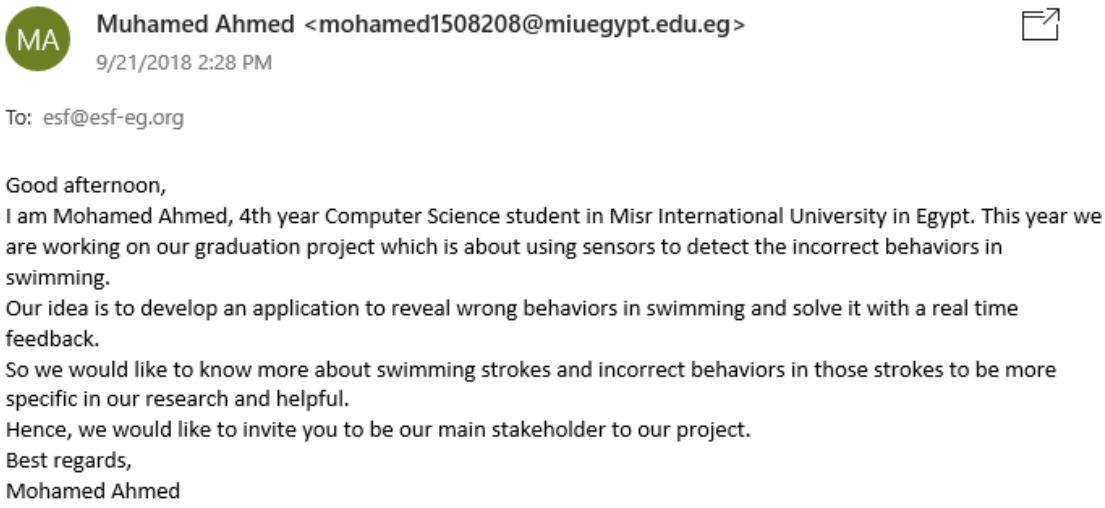
Task	Start Date	End Date
Idea discussion	26-7-2018	11-8-2018
Idea research	11-8-2018	11-9-2018
Survey and proposal	12-9-2018	26-9-2018
Proposal presentation	26-9-2018	26-9-2018
Implementing prototype	26-9-2018	30-9-2018
Designing application	30-9-2018	3-10-2018
Implementing GUI design	4-10-2018	7-10-2018
Designing database	8-10-2018	11-10-2018
Dataset collection	12-10-2018	17-10-2018
Dataset classification	17-10-2018	22-10-2018
SRS writing	22-10-2018	9-11-2018
SRS presentation	9-11-2018	9-11-2018
Implementing application	25-11-2018	22-12-2018
SDD writing	23-12-2018	16-1-2019
SDD presentation	19-1-2019	19-1-2019
Validation and testing	31-1-2019	27-3-2019
Writing paper	30-3-2019	10-4-2019
Deliver the paper	12-4-2019	12-4-2019
Writing thesis	21-4-2019	31-5-2019
Final presentation	26-6-2019	26-6-2019

Figure 3: Time plan

4.2 Budget and Resource Costs

- Any mobile device but must have those sensors:
  - Accelerometer.
  - Gyroscope.
  - Magnetometer.
- Google glass used in AR application.

4.3 Supportive Documents



MA

Muhamed Ahmed <mohamed1508208@miuegypt.edu.eg>

9/21/2018 2:28 PM

To: esf@esf-eg.org

Good afternoon,
I am Mohamed Ahmed, 4th year Computer Science student in Misr International University in Egypt. This year we are working on our graduation project which is about using sensors to detect the incorrect behaviors in swimming.
Our idea is to develop an application to reveal wrong behaviors in swimming and solve it with a real time feedback.
So we would like to know more about swimming strokes and incorrect behaviors in those strokes to be more specific in our research and helpful.
Hence, we would like to invite you to be our main stakeholder to our project.
Best regards,
Mohamed Ahmed

Figure 4

References

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