SPORTS BIOMECHANICS

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Abstract

Biomechanics is the study of the structure, function and movement of mechanical components of biological systems. Biomechanics is responsible for the study of internal structure, function and movement to perform assigned tasks and to deal with the surrounding physics of the environment. It is possible to extract practical information about human organs in the wearable body parts, our new products have useful applications for recording organic movement, biomechanics studies, series of moving lessons, sports lessons, ergonomics courses etc. It allows a person to take on the relationships and interactions that various systems, components, and organs have with each other in order to consider the behavior of the human functional structure. Sports biomechanics include analyzing movement patterns during exercise events. In our project we have developed a prototype that uses nerve endings in different parts of the body that allow one to calculate the appropriate biomechanical parameters.

Keywords: NODE MCU, FSR, Gyroscope, Flex

I. Introduction

Biomechanics in sport incorporates an in-depth analysis of sport movements so as to minimize the chance of injury and improve sports performance. Sport and exercise biomechanics encompasses the realm of science concerned with the analysis of the mechanics of human movement. Mechanics may be a branch of physics that's concerned with the outline of motion/movement and the way forces create motion/movement. Therefore, sport biomechanics is that the science of explaining how and why the frame moves within the way that it does. In sport and exercise, that definition is usually extended to also consider the interaction between the performer, their equipment and therefore the environment.

Biomechanics is traditionally divided into the areas of kinematics and kinetics. Kinematics is that the branch of mechanics that deals with the geometry of the motion of objects, including displacement, velocity, and acceleration, without taking under consideration the forces that produce the motion. Kinetics is that the study of the relationships between the force system engaged on a body and also the changes it produces in body motion.

Gait analysis

Gait analysis using wearable sensors is a reasonable, convenient, and efficient manner of providing useful information for multiple health-related applications. As a clinical tool applied within the rehabilitation and diagnosis of medical conditions and sport activities, gait

analysis using wearable sensors shows great prospects in gait analysis using wearable sensors, motion sensors are worn or attached to varied parts of the patient's body, like the foot and waist. These sensors, which can be accelerometers, gyroscope, force sensors, strain gauges, inclinometers, goniometers, and so on, can measure various characteristics of the human gait

II. Literature Review

1]This article reviews developments within the use of computing (AI) in sports biomechanics over the last decade. It outlines possible uses of Expert Systems as diagnostic tools for evaluating faults in sports movements ('techniques') and presents some example knowledge rules for such an expert system. It then compares the analysis of sports techniques, within which Expert Systems have found little place to this point, with gait analysis, during which they're routinely used. Consideration is then given to the utilization of Artificial Neural Networks (ANNs) in sports biomechanics, specializing in Kohonen self-organising maps, which are the foremost widely employed in technique analysis, and multi-layer networks, which are much more widely utilized in biomechanics normally

2]Heartbeat Sensor is an device that's wont to measure the center rate i.e. speed of the heartbeat. Monitoring temperature, rate and pressure level are the fundamental things that we neutralise order to stay us healthy. so as to live the blood heat, we use thermometers and a sphygmomanometer to observe the blood pressure or force per unit area. pulse rate is monitored in two ways: a technique is to manually check the heartbeat either at wrists or neck and therefore the other way is to use a Heartbeat Sensor. Pulse oximetry is employed during this project to detect the heartbeat using

fingers. When the guts expands (diastole) the degree of blood inside the fingertip increases and when the center contracts (systole) the quantity of blood inside the fingertip decreases. The resultant pulsing of blood volume inside the fingertip is directly proportional to the guts rate and if you'll somehow count the quantity of pulses in one minute, that is the rate in beats per minute (bpm).

3]This paper describes tilt measurement by means of an Accelerometer-Gyro pair to regulate a two-wheeled, self-balancing vehicle. the employment of accelerometers and gyros to live angle is well-known to entail high levels of unwanted signals of high and low frequency, thus the filter techniques are essential for his or her improvement. The Kalman Filter decreases measurement noise through the sensor's discrete state model.

4]The paper presents the concept of a replacement, simple, non-invasive sensor supported a force sensitive resistor (FSR) which is ready to live shortening.It is applied on the skin through a rigid dome, senses the mechanical force exerted by the underlying contracting muscles.

5]This paper has proposed and implemented a sensible healthcare application employing a IoT system supported AD8232 pulse rate sensor interfaced with Arduino UNO and further connected to Cloud using an ESP8266 Wireless LAN Module.

6]To demonstrate the real-world applications of VdWLM strain sensors. To demonstrate the real-world practical ability of our VdWLM based strain sensors, SnS2 based strain sensors were wont to monitor tiny vibrations caused by sound and to capture a spread of human motion, including facial, wrist, standing-sitting, and walking movements.

7]Technological advancements have enabled athletes, coaches, and physicians to trace functional movements, workload, biomechanical and bio-vital markers utilising wearable sensors to maximise performance and minimise the potential for injury.1–3 Wearable monitoring systems can provide continuous physiological data thus permitting the event of accurate treatment plans and player-specific training programs to potentially mitigate and alleviate injuries.

8]Pedometers can act as an everyday exercise progress

monitor and motivator, can encourage individuals to compete with

themselves in getting fit ADXL series is used for that specifically ADXL 345 accelerometer in a very full-featured pedometer which will

recognize and count steps, further as measure distance, speed,

and to an extent calories burned.

9]To demonstrate the real-world applications of VdWLM strain sensors. To demonstrate the real-world practical ability of our VdWLM based strain sensors, SnS2 based strain sensors were wont to monitor tiny vibrations caused by sound and to capture a variety of human motion, including facial, wrist, standing-sitting, and walking movements.

III. Methodology

A. Components:

1. Pulse Oximeter (MAX30100)

2. Gyroscope Sensor

GSR, standing for galvanic skin response, could be a method of measuring the electrical conductance of the skin. Strong emotion can cause stimulus to your sympathetic systema nervosum, leading to more sweat being secreted by the sweat glands. Grove – GSR allows you to identify such strong emotions by simple attaching two electrodes to 2 fingers on one hand, a remarkable gear to make emotion related projects, like sleep quality monitor
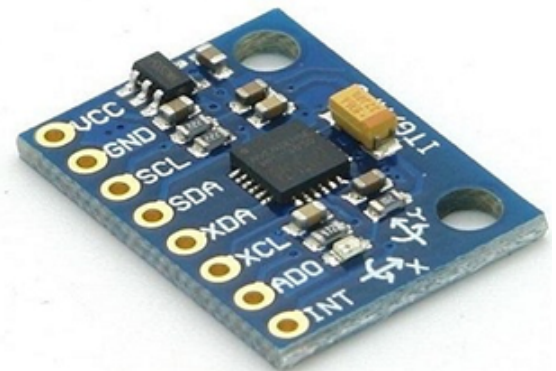
3. UV Light Sensor (GYHL 8511)

UV sensors measure the facility or intensity of incident ultraviolet (UV) radiation. this kind of electromagnetic wave has shorter

wavelengths than visible light, but remains longer than x-rays. UV sensors are used for determining exposure to actinic ray in laboratory

or environmental settings.

4. Flex Sensor

5. FSR Sensor

A Force sensitive resistor could be a polymer thick film device which changes its resistance in line with the force applied to its active surface. The resistance is inversely proportional to the applied load. Allow you to detect physical pressure, squeezing and weight.

6. ECG Sensor

During an ECG ,sensors (electrodes) are attached to the chest and limbs. The electrodes are sticky patches with wires that connect with a monitor. They record the electrical signals that make the heartbeat. A computer records the data and displays it as waves on a monitor or on paper. AD8232 : ECG Monitor Sensor Module is predicated on AD8232 Analog Device IC. this can be a cheap ECG Sensor wont to measure the electrical activity of the center. This electrical activity is charted as an ECG or Electrocardiogram and output as an analog reading. it's opamps to assist clear noise of the output and

Can interface with both Arduino Uno and raspberry pi.

B.Block Diagram

All the info are going to be stored within the specific database.

3. Filtering , Analysis and data comparing operations are going to be done on the collected data using ml ,data analysis and algorithms

4. Peak detection has been in deep trouble sensor data from AD8232 (ecg sensor) in 4 steps which are using filters for removing low frequency components , finding the local maxima employing a windowed filter, storing all the numerous values and removing the opposite values and eventually filtering the scale for two to three times.

5. Getting the R-peak heart beats are calculated for its further analysis.
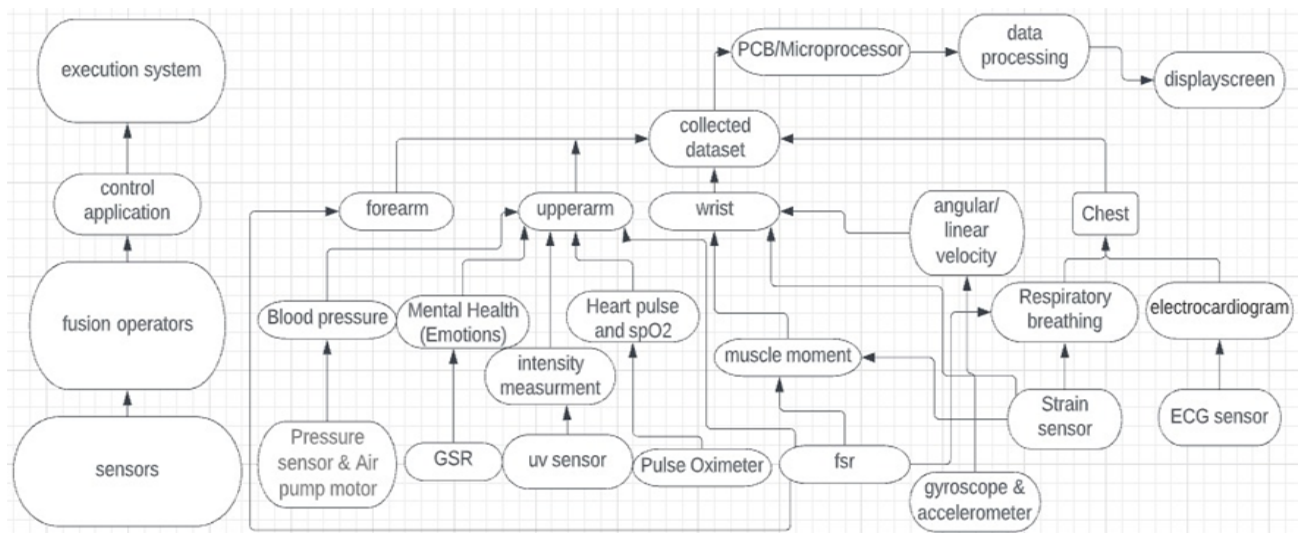
C. Methodology

1. Sensor reading are recorded by mounting sensors on different body parts. The position of every sensor is shown briefly within the diagram.

2. The fusion operations are going to be done per the data provided by the sensor. For the vital details of the body Pulse oximeter and vital sign are going to be analysed together to work out most optimum vital information of the athlete.

6. Fsr sensor is employed for

7. Sensors are going to be mounted on the breadboard and can be integrated with one another.

8. Useful information are going to be conveyed via wireless technology like WSN (IOT) and display it on the computer screen .

9. utput are going to be displayed on the serial monitor furthermore.

IV. *Results*

Data from akl the sensors are displayed in an interactive manner for the user and therefore the insights also are provided to the user for his or her better experience.
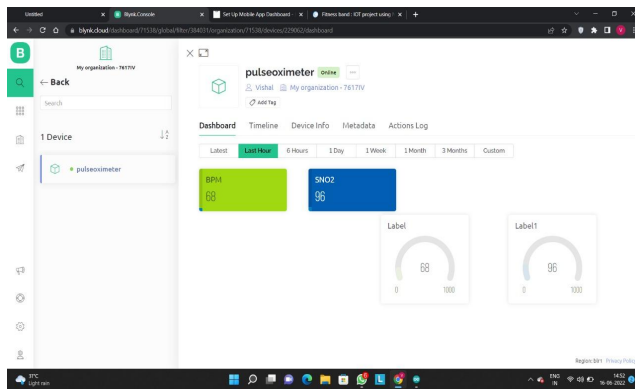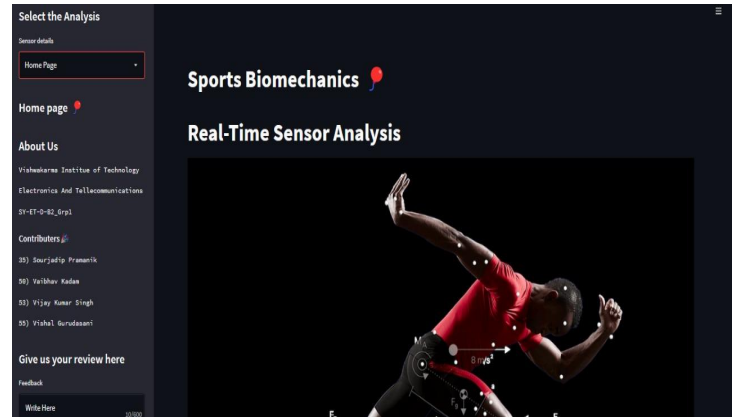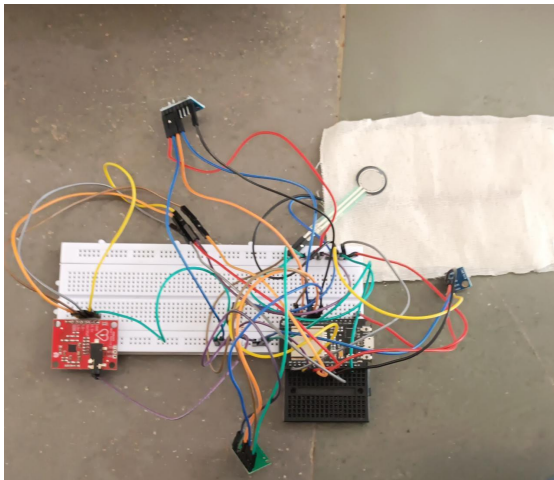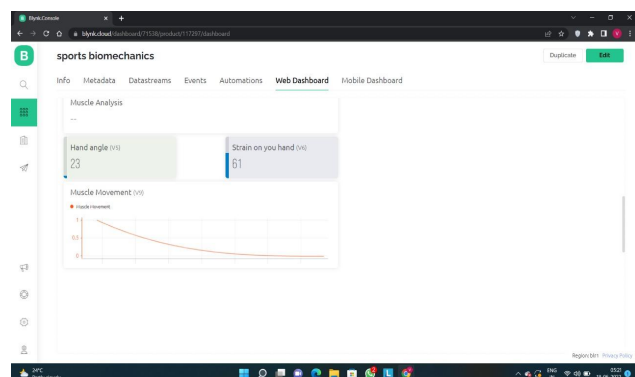

Fig2

V. Limitations

The accuracy of the sensor's reading isn't upto the mark. Prototype is bulky and requires expensive electronics. Flexibility are going to be lacking since assessment is assembled through wire.

VI. Acknowledgments

VII. References

1) JOUR Bartlett, Roger 2006/12/01 474 479 Artificial Intelligence in Sports Biomechanics: New Dawn or False Hope?Journal of sports science & medicine.
2) JOUR Prakash, Ved pandey, manoj 2018/05/01HEART RATE MONITORING SYSTEM
3) Pasaye, J. & Valencia, J. & Perez, Felix. (2013). Tilt measurement based on an Accelerometer, a Gyro and a Kalman Filter to control a self-balancing vehicle. 2013 IEEE International Autumn Meeting on Power, Electronics and Computing, ROPEC 2013. 1-5. 10.1109/ROPEC.2013.6702711.
4) Daniele Esposito, Emilio Andreozzi, Antonio Fratini, Gaetano D Gargiulo, Sergio Savino ,Vincenzo Niola and Paolo Bifulco
5) Wearable Sensors in Sports for Persons with Disability: A Systematic Review, v Lorenzo Rum, Oscar Sten, Eleonora Vendrame, Valeria Belluscio
6) Wearable sensors for monitoring the internal and external workload of the athlete, Dhruv R. Seshadri , Ryan T. Li , James E. Voos , James R. Rowbottom
7) Wenjie Yan , Huei-Ru Fuh, Yanhui Lv, Ke-Qiu Chen, Tsung-Yin Tsai, Yuh-Renn Wu,Tung-Ho Shieh, Kuan-Ming Hung, Juncheng Li, Duan Zhang, Cormac Ó Coileáin, Sunil K. Arora, Zhi Wang, Zhaotan Jiang, Ching-Ray Chang & Han-Chun Wu
8) Clemes, Stacy & Biddle, Stuart. (2013). The Use of Pedometers for Monitoring Physical Activity in Children and Adolescents: Measurement Considerations. Journal of physical activity & health. 10. 249-62. 10.1123/jpah.10.2.249.
9) Okmayura, Finanta & Jefiza, Adlian & Ramadhani, Witri. (2020). The calorie burning calculation system in jogging using a thresholding-based accelerometer sensor. Kinetik: Game Technology, Information System, Computer Network, Computing, Electronics, and Control. 5. 10.22219/kinetik.v0i0.1005.