

UBIQUITOUS, PERVASIVE AND  
CONTEXT-AWARE COMPUTING



# UBIQUITOUS COMPUTING IN SPORTS

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# FENCING

Our aim is to investigate Ubiquitous Computing in fencing as there is no specific literature in this field.



# **SOME THEORETICAL REFERENCES**

Ubiquitous computing technologies penetrate the field of sports. These technologies provide new means for developing systems to **acquire, process and transmit data** during manifold sportive activities.

**Sensors** are either attached to the sports equipment or to the athlete's body or embedded in environment.

## FOUR AREAS OF APPLICATION

COACHING

TRACKING

Quantification/  
qualification of  
physical activities

ENTERTAINMENT



# **EXAMPLES**

**EXAMPLES OF UBIQUITOUS  
COMPUTING IN SOME SPORTS**



## ADIDAS MI-COACH SMART BALL



Thanks to an analysis that comes from this ball, it's possible to **improve one's shooting and passing skills**. Moreover it's possible to analyze strength, impact, effect, and other characteristics that can allow a player to improve his skills.

<https://www.passionemaglie.it/pallone-tecnologico-micoach-smart-adidas/>



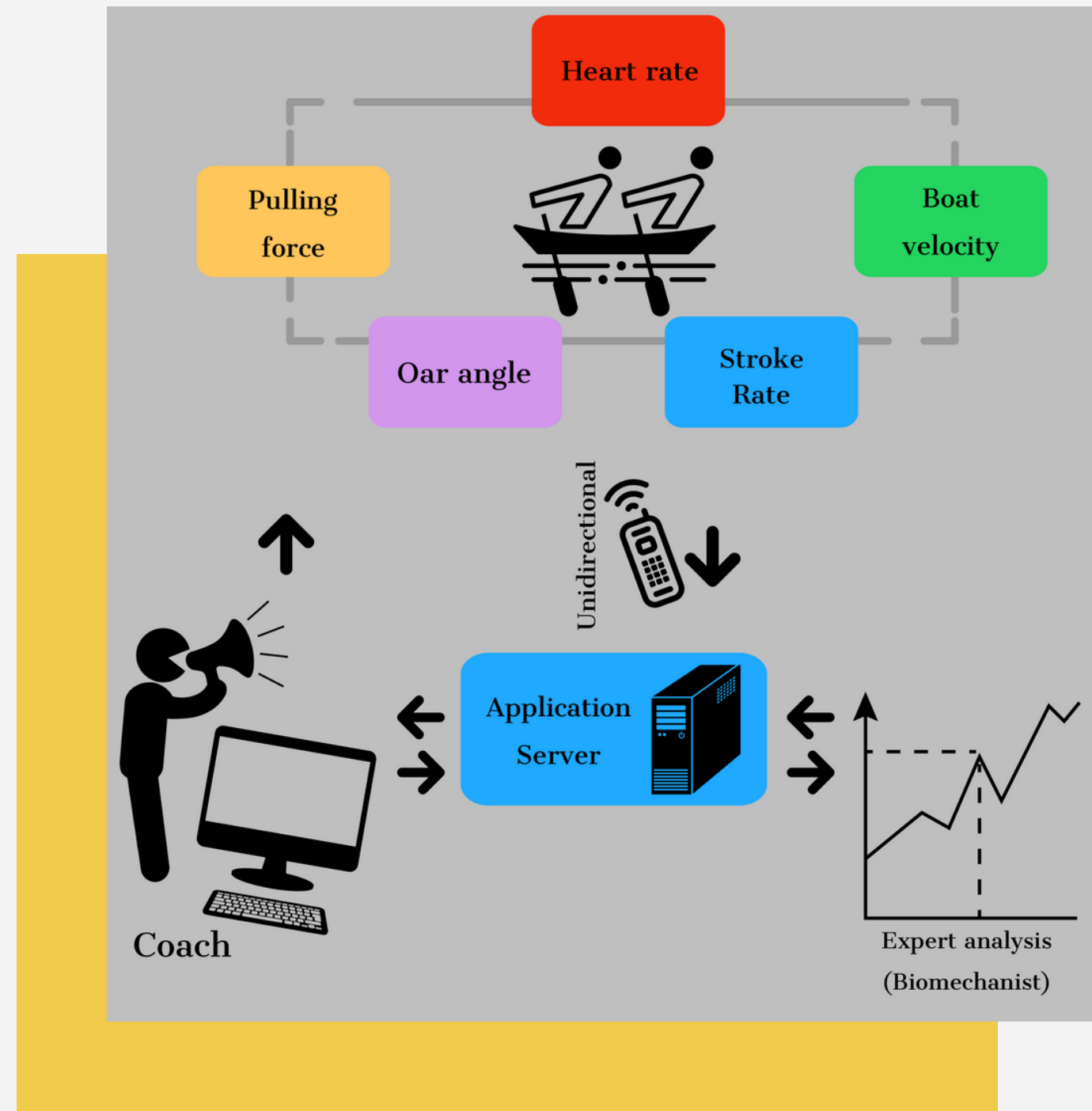
## SMART BASKETBALL & SMART FOOTBALL

Both balloons are composed of IMU (Inertial Measurement Unit) sensors capable of measuring **acceleration** (using accelerometers) and **angular velocity** (using gyroscopes).



<https://sportstechnologyblog.com/2018/08/04/developing-imu-sensors-for-sports/>

## ROWING (ARNOLD BACA)



This is the application of the remote coaching system. During the training session selected values (**force**, **acceleration**,...) are collected and transmitted to the server. Experts analyze the curves online. Their advice enables the coach to direct the rowing technique into the desired direction.



The system consists of a single base station that is connected to a laptop, three judges' scoring handsets and two TrueScore™ SensorHogu wireless body protectors. SensorHogu uses piezoelectric sensors to sense the amount of force that has been delivered to a competitor's body protector, and wirelessly transmits this signal to a computer that scores and displays the point. This system should help judges achieve greater accuracy and help eliminate controversy.



# Reached goals

**Easy to use**

**Accurate**

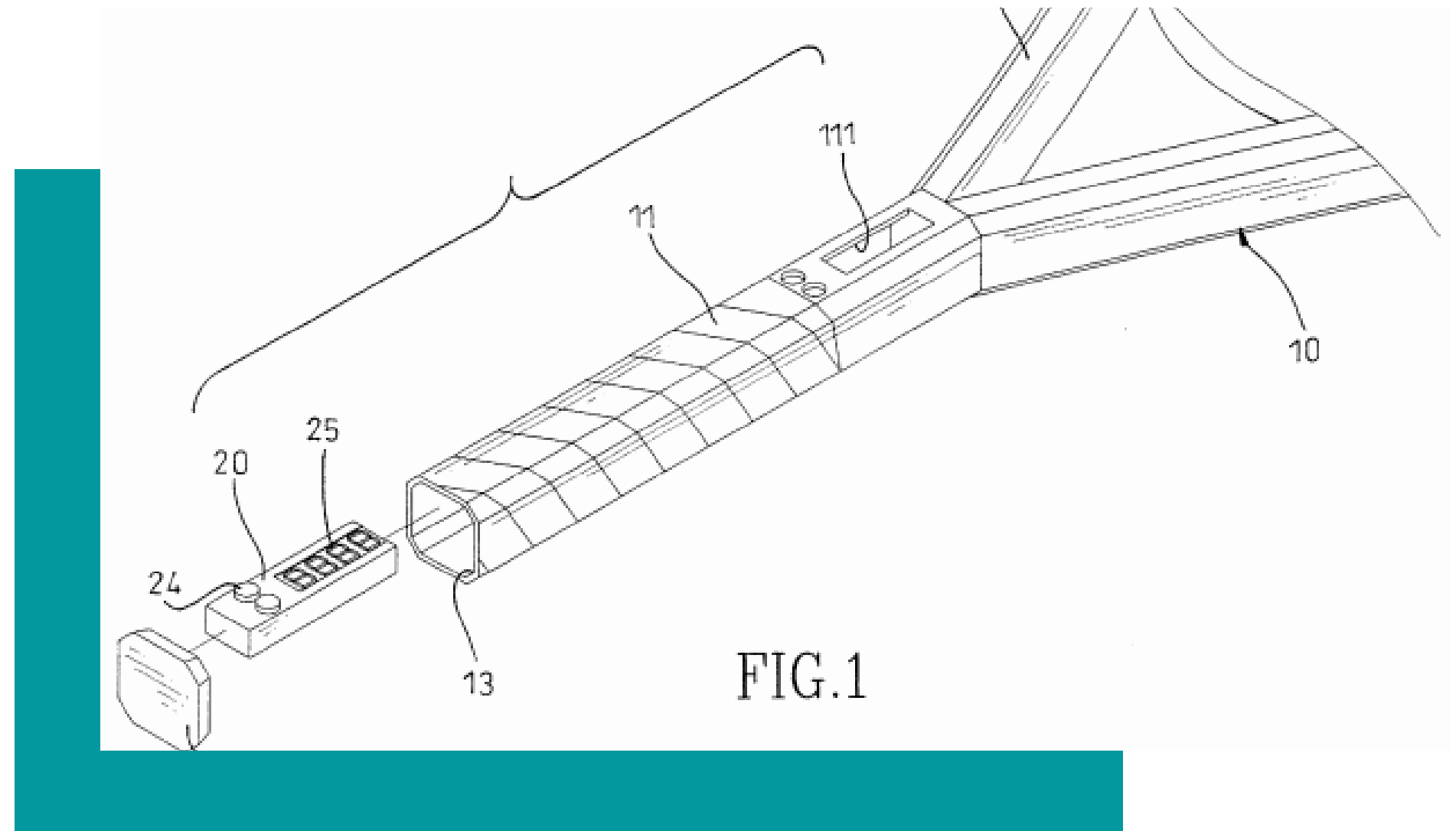
**Rugged**

**Low-cost**

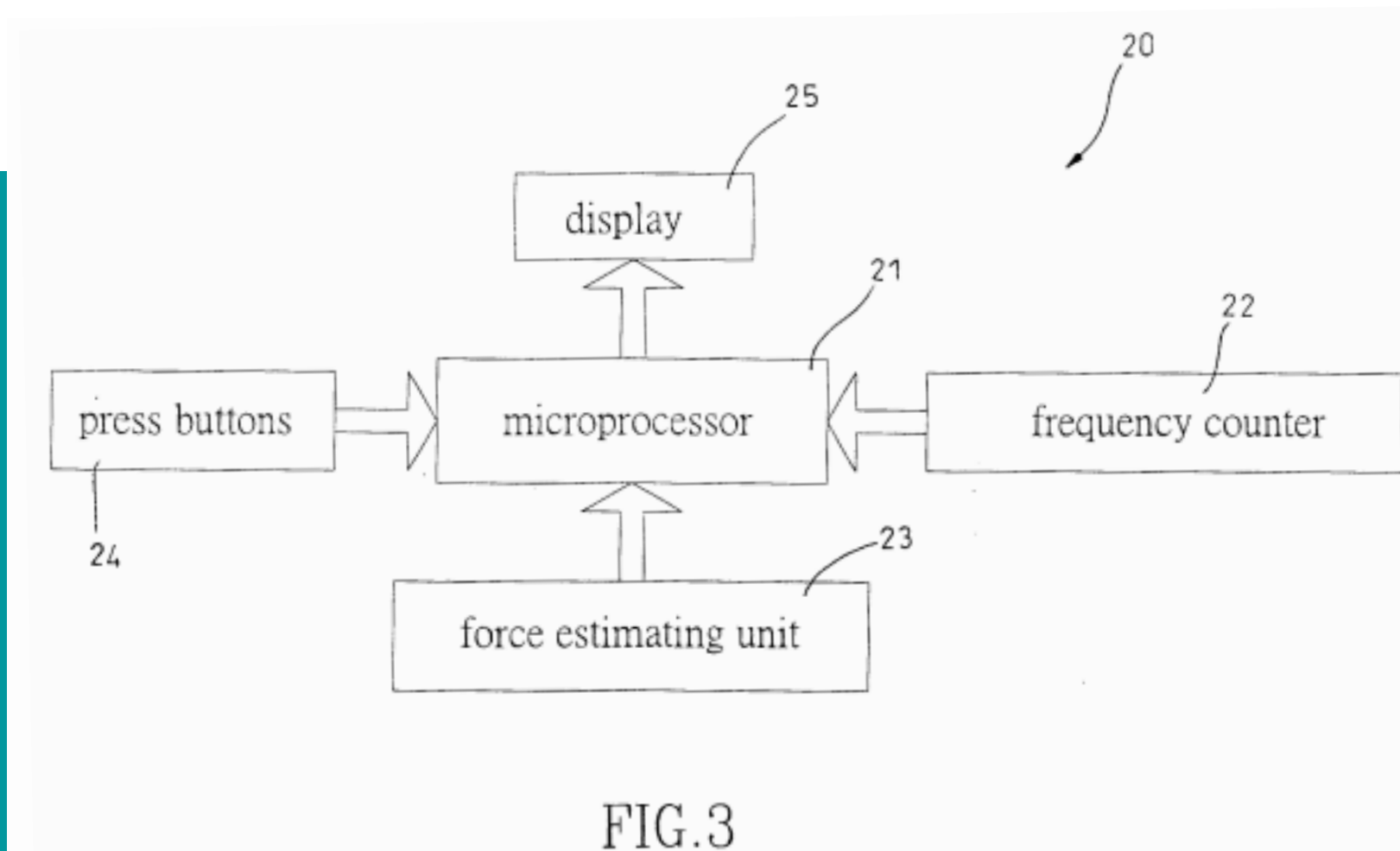
**Low-powered**

**MODULAR!**

This calorie counting racket has a skeleton (10) with a hollow grip (11) and a counter unit (20) secured inside the grip (11) with multiple press buttons and a display (25) protruding from a side surface of the grip (11).







The counter unit (20) has a **microprocessor** (21), a **frequency counter** (22) to record numbers of swings of the racket, a **force estimating unit** (23) to detect acceleration of the skeleton (10), a set of **press button** to control the microprocessor (21), and a **display** (25) to show calorie data. So that the calorie counting racket determine the burned calories immediately and precisely in accordance with different users.

## TENNIS

A set of motion sensors (IMUs) are **strapped on the athlete's limbs** near the joints (eg wrist, elbow, knee, ankle) and they **capture all the movements**.

The sensors track: power, spin, impact location, number of shots hit, shot types, spin types, swing speed, ball speed.



<https://sportstechnologyblog.com/2019/03/23/a-review-of-smart-tennis-sensors/>

## SMART RUNNING SHOES



For those who run there is a sensor placed **under the insole** of running shoe which measure the gait, distance, duration and calories burnt during training.

It can provide **real-time feedback** via an iPod, smartphone or smartwatch while listening to music.

<https://www.maxisport.com/ap/cos-e-come-funziona-nike-2-a.htm>



## SMART RUNNING SHOES



[https://www.youtube.com/watch?v=bK\\_KPdlLE3E](https://www.youtube.com/watch?v=bK_KPdlLE3E)

## BEACH VOLLEYBALL

Tracking of **ball and players** in Beach Volleyball using camera.

The tracker distinguishes the players from the ball and memorizes their movements for later analysis.



<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4245102/>

## BEACH VOLLEYBALL



Determination of players' positions:  
background and foreground algorithm.

<https://www.youtube.com/watch?v=-EOgwRF6eEk>

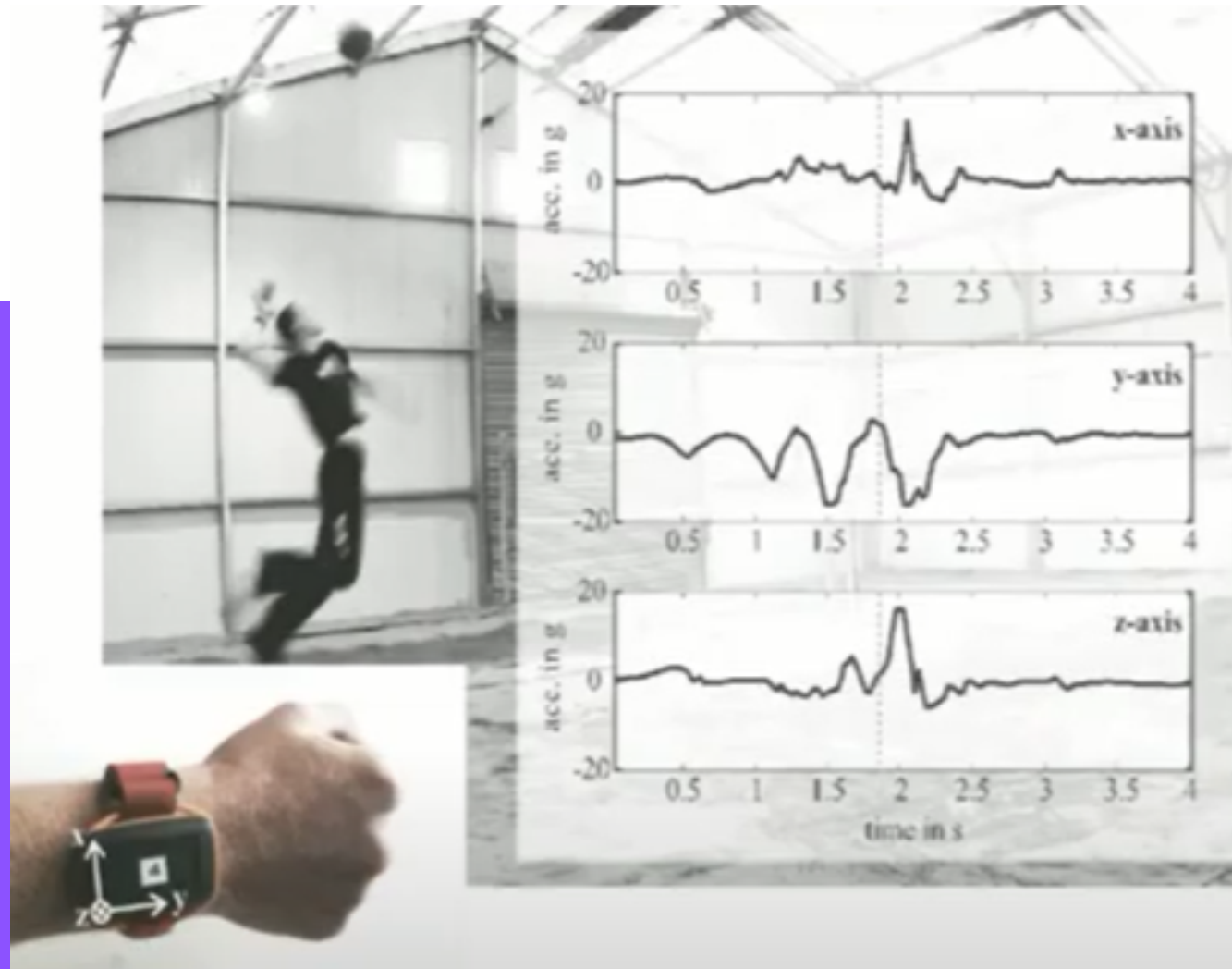


Determination of ball's trajectories:  
parabolic flight equations.

<https://www.youtube.com/watch?v=WrBgkKmKbqA>



## BEACH VOLLEYBALL



The tracker associated with a smartwatch allows the **detection and classification** of player's movements, strength, direction and height off the ball when it's hit.

Activity recognition takes place through a deep convolutional **neural network**.

<https://www.youtube.com/watch?v=-EOgwRF6eEk>



# Conclusion

Sport is an extremely exciting field to apply pervasive computing technologies. These technologies do not only provide innovative and effective support to coaches and athletes, but are also applicable in mass and health sport and may be useful to referees.

# References

Chi, E. H. (2008). Sensors and ubiquitous computing technologies in sports. WIT Transactions on State-of-the-art in Science and Engineering, 32.

Kranz, M., Spiessl, W., & Schmidt, A. (2007, March). Designing ubiquitous computing systems for sports equipment. In Fifth Annual IEEE International Conference on Pervasive Computing and Communications (PerCom'07) (pp. 79–86). IEEE.

Novatchkov, H., & Baca, A. (2015). Pervasive computing in sport. In Encyclopedia of Information Science and Technology, Third Edition (pp. 6905–6914). IGI Global.

Il pallone tecnologico miCoach Smart Ball di adidas, Passione Maglie



# References

**Wearable Computing Systems and Machine Learning for Sports Science.. – Prof. Eskofier (M.Sc. Gradl)**

**A Review Of Smart Tennis Sensors – Sports Technology Blog**

**Developing IMU Sensors For Capturing Motion In Sports**

**Cos'è e come funziona Nike+? – Maxisport**

**Tracking of Ball and Players in Beach Volleyball Videos – Gabriel Gomez, Patricia Herrera López, Daniel Link, and Bjoern Eskofier, Ke Lu, Editor**