Bowling Assistant

Mechatronics Circus & Mechatronics Symposium 2020

Sampo Laine
Topias Turunen
Martin Guggemos
Contents

• How do we tell a good bowling performance? – Key points
• How does the system work? – IMU, Sensor fusion
• How do you receive feedback? – Web Interface
• How precise is the system? – Reference device, Validation
• What is the takeaway? - Discussion
Some key aspects in bowling

- Swing plane
- Step timings
- Ball-Ankle distance
The application concept

Sensor unit

ESP32 microcontroller
- Core 0: Web service hosting
- Core 1: I²C communication with IMU sensors

SD-card module
- Temporary data storage

IMU
- Digital motion processing

Mobile device browser instance
- Data processing and performance calculation
- Web user interface

WIFI Data transmission
Sensor unit

ESP32 microcontroller

Core 0
- Web service hosting

Core 1
- I²C communication with IMU sensors

SD-card module
- Temporary data storage

IMU
- Digital motion processing

Mobile device browser instance

WIFI Data transmission

Data processing and performance calculation

Web user interface
Wearable Sensor unit

Features:

• Components hidden inside small casing
• Wireless measurement
• Modular design allows for multiple configurations
Sensor unit

ESP32 microcontroller

Core 0
Web service hosting

Core 1
I²C communication with IMU sensors

SD-card module
Temporary data storage

IMU
Digital motion processing

Mobile device browser instance

WIFI Data transmission

Data processing and performance calculation

Web user interface
Inertial Measurement Unit

Things to worry about:

- Multiple sources of data
- Signal drifting
- Data accuracy
Sensor fusion

- The measurement data of from one sensor is insufficient to measure the orientation of the human body
- Combination of multiple sources of data is required
The application concept

Sensor unit

ESP32 microcontroller

- Core 0
  Web service hosting

- Core 1
  I²C communication with IMU sensors

SD-card module
Temporary data storage

IMU
Digital motion processing

Mobile device browser instance

- Data processing and performance calculation
- Web user interface

WIFI Data transmission
User Interface

Instant feedback

- Web user interface
- Performance consuming calculations can be done on the mobile device
- Data from bowling the performance is presented
- Multiple attempts can be stored
Reference Device

• Two degrees of freedom pendulum resembling the elbow joint of a person
• Two rotary encoders capture the reference position
Validation measurements

- Comparison between encoder and IMU rotation data shows good correlation
Discussion

• The system is accurate enough to determine the movement of a human body
• Various performance characteristics can be extracted
• Accurate feedback can be given to user
• More motion tracking use-cases are conceivable
Any Questions?
Thank you!