



UNIVERSITAS GADJAH MADA
FAKULTAS TEKNIK
Departemen Teknik Elektro dan Teknologi Informasi

Project Title

Analysis of Body Balance and Walking Patterns Using Gyroscope Sensors on Smartphones

Objectives

1. Measure body balance while standing still and performing specific movements.
2. Analyze walking patterns (gait analysis) to assess step symmetry, stability, and body coordination.

Tools and components

1. Smartphone with gyroscope and accelerometer sensors.
2. Gyroscope application (e.g., Sensor Kinetics, Physics Toolbox, or the smartphone's default app).
3. Tripod, belt, elastic strap, or any other setup to secure the smartphone (optional).
4. Notebook for recording data.
5. Computer with data analysis software (optional, e.g., Excel or Python).

Procedure

Start recording gyroscope data on a straight path using the following steps:

Static

1. Stand still for 20 seconds.
2. Lift one leg (right or left) for 20 seconds.
3. Stand still for 20 seconds.

Dynamic

1. Stand still for 20 seconds.
2. Walk normally for 30 seconds.
3. Run normally for 1 minute.
4. Walk normally for 30 seconds.
5. Stand still for 20 seconds.

A. [LO2] Modelling 20%

Based on each student's height, weight, and BMI, **write the mathematical model on the exam answer sheet** to estimate:

1. The coordinates of the Center of Mass (COM) based on the following body segments assumption.

Body Segment	Mass (%)	Segment COM Position (from proximal end)
Head	8%	50% (midpoint of head)
Torso	50%	40% (closer to the pelvis)
Upper Arm (each)	2.5%	50% (midpoint of upper arm)
Lower Arm (each)	1.5%	50% (midpoint of lower arm)
Thigh (each)	10%	40% (closer to the hip)
Lower Leg (each)	4.5%	40% (closer to the knee)
Foot (each)	1.5%	50% (midpoint of foot)

2. Illustrate how the smartphone is placed on the body along with the x, y, and z coordinates.
3. The linear momentum occurs at the foot against the ground.
4. Estimate the energy at the foot (Normal Force) for each procedure.

B. [LO2] Experiment 30%

1. Body Balance Experiment

Preparation:

Install an application that supports data reading from the gyroscope.

Place the smartphone on your waist using a belt or pouch.

Ensure the smartphone is stable and aligned with the body.



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Experiment Steps:

Stand on a flat surface with both feet close together.
Start recording data on the gyroscope application.
Lift one leg (right or left)
Start recording data on the gyroscope application.

Data Recorded:

Rotation angles (roll, pitch, yaw).
Acceleration changes on the three axes (x, y, z).

2. Walking and Running Pattern Experiment

Preparation:

Place the smartphone at the center of mass of your body.
Ensure a straight and safe path (e.g., 10 meters).

3. Export Data After the Experiment

Data Recorded:

Oscillation patterns of roll, pitch, and yaw.
Average speed while walking and running.
Acceleration changes when the foot strikes the ground.

4. Data Analysis

Data Visualization:

Use graphs to observe the body movement patterns.
Analyze balance stability by examining the fluctuations in gyroscope data.

Body Balance:

The fluctuation values of angles and acceleration indicate the level of stability.
A more stable position results in smaller angle changes.

Static and Dynamic Patterns:

Identify step symmetry from the oscillation patterns of pitch and roll.
Evaluate foot coordination with the acceleration change patterns.

5. Results and Discussion

Explain the differences in stability in various positions.
Compare walking patterns at different speeds.
Discuss the factors that affect body balance and walking patterns.

6. Conclusion

Conclude how the smartphone gyroscope can measure and analyze body balance and walking patterns.

C. Submit a project report and upload it to ELOK on Monday, December 9th, 2024, at the latest at 22.00 WIB with the following format.

1. No title page is needed.
2. Write your full name, student ID, and class.
3. Use simple, clear, and non-cliché language (one of the skills of an engineer is effective communication).
4. The body text should be in Times New Roman, size 10, with 1.15 spacing and 2.5 cm margins on all sides.
5. Number the pages at the bottom right corner.
6. A maximum of 10 pages.