Final Project: Mouse Trap Car

CIVL32 / MATH101

Project Overview

This is a joint project between **MATH101** and **CIVL32**. Some components will contribute to your math grade, while others will contribute to your physics grade.

Schedule

- **Week 7**: Project Planning
- **Week 9**: Work Period
- **Week 10**: Race Day
- **Week 13**: Presentation and Report Due

Objectives

Working in groups of 3-4, build a mouse trap car from recycled materials in a team environment. Test and evaluate your design and make improvements. Analyze position data in Excel to quantify performance related to kinematics. Present the car's performance using PowerPoint in an interview setting.

Project Planning:

- Complete the handout with a schedule and project plan.
- Hold at least two project meetings outside of class and keep detailed meeting minutes using the provided template. A PDF of the meeting minute template is available on Blackboard.
- Submit hard copies of your schedule, project plan, and meeting minutes at the start of your lab section in Week 9.

Data

After Race Day, a **.txt file** will be provided with position and time data for your car. Using this data, analyze it in Excel to create position, velocity, and acceleration graphs, as well as other information necessary for the slides detailed below.

Project Deliverables

The following slides are required for your project interview. Be ready to discuss the content of each slide and the data analysis process. You should understand the equations used in your graphs and images and be able to interpret the data and graphs. Analysis must be completed using a central differencing scheme.

Since this is a joint project between math and physics, questions will address both MATH101 and CIVL32 concepts. All group members are expected to participate actively in discussing topics and answering questions, with some questions assigned to specific group members and others open for the group to decide who will answer.

Group members are expected to spend equal amounts of time presenting.

Presentation Tips:

- **Clear Visuals**: Use large, readable fonts and high-quality images and graphs to make your slides easy to understand.
- **Concise Bullet Points**: Emphasize key points with minimal text. Avoid overloading slides with excessive information. If necessary, divide the content across two slides.
- **Logical Organization**: Structure your slides so each topic flows naturally. Keep the slide order that has been provided in this outline.
- **Consistent Style**: Stick to a uniform font, color scheme, and layout across slides to keep your presentation polished and professional.
- **Practice**: Familiarize yourself with the slides and content so you can speak confidently.

Slide Requirements

1. Introduction Slide

- **Team Members:** List all team members.
- **Photo of the Car:** Include a clear image of your car.
- **Car Stats:**
  - **Dimensions:** Include length, width, and area (in cm^2).
  - **Mass:** Specify in grams or kilograms.
  - **Top Speed:** Record the car's highest speed (in cm/s).
  - **Improvement:** Briefly describe the most significant change you made after the initial build. Focus on one specific improvement and why it made a difference (e.g., lighter materials, better wheels).

2. Data Conversion and Validity

- **Plot of Object Area vs. Time:** Generate and display a graph of your car's area (in cm^2) over time.
- **Sample Calculation:** Select a single data point and show how you converted units or values to achieve the area measurement in cm^2. Be sure to include units in your and correct precision in your calculation.
- **Data Validity:** Briefly mention any data points that were corrected or removed (e.g., outliers) to ensure accuracy.

3. Kinematics Forward Motion

- **Position, Velocity, and Acceleration Plots:** Use Excel to create separate graphs for each: position vs. time, velocity vs. time, and acceleration vs. time.
- **Labels and Units:** Ensure each graph is clearly labeled with appropriate units (e.g., cm, cm/s, cm/s^2).
- **Interpretation:** Be prepared to explain the general shape of each graph and what it indicates about the car's performance.

4. Kinematics 2D Motion

- **Total Distance and Displacement:**
  - Calculate the total distance the car traveled (consider both x and y directions).
  - Calculate the displacement (straight-line distance from start to end).
- **Annotated Sketch:** Choose four data points centered around the specified time and create a sketch that shows the path of the car.
- **Sample Calculations:** Show calculations for distance and displacement. Use clear steps and units, especially if converting measurements.

5. Velocity and Bearing

- **Annotated Still Image:** Using the provided still image from the race video. Mark the following:
  - A velocity vector showing the car's direction and magnitude at that time.
  - An acceleration vector indicating the rate and direction of change in speed.
- **Sample Calculations:** Show how you calculated both the velocity and acceleration, including bearing (direction relative to a reference, such as North or 0°).

6. Group Work Slide

- **Project Reflection:**
  - **Improvements:** Briefly describe what you would do differently if given a chance to rebuild the car. Focus on practical changes, such as design adjustments, material choices, or testing strategies.
  - **Teamwork:** Reflect on how your group collaborated. Identify one thing that worked well and one challenge you faced.
  - **Conclusion:** Summarize your group's experience and overall performance, highlighting any major takeaways about the project.