Damped Harmonic Oscillator

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Table 1: Revision History

Date	Developer(s)	Change
Fri Jan 19	Waqar Awan(s)	Initial Document

1 Problem Statement

1.1 Problem

This project focuses on the physics of a damped harmonic oscillator, a concept in physics and engineering. It involves a mass-spring system, where the mass is subject to both a restoring force from the spring and a damping force. Understanding this system is crucial because it's a simplified model for many real-world phenomena like vehicle suspension systems and building responses to earthquakes.

1.2 Inputs and Outputs

- **Input:**
  1. Mass of the oscillator(m)
  2. Damping Coefficient(b)
  3. Spring constant(k)
  4. Displacement(x)
  5. Velocity(v)
  6. External force(if any)
- **Output:**
  1. Time Evaluation
  2. Displacement and velocity of the mass as a function of time
  3. System response when under damped, critically damped, and over damped

4. Amplitude
5. Frequency

1.3 Stakeholders

- Educators and students in physics and engineering disciplines.
- Developers of simulation software for physical systems.
- Industries dealing with oscillatory and vibration damping systems.

1.4 Environment

- **Hardware:**
  1. **Development Machine:** A computer with sufficient processing power and memory (RAM) to handle development tasks. Ideally, a multi-core processor and at least 4GB of RAM.
  2. **Testing Devices:** Smart devices like laptop and smartphone for testing correctness of the results and software interfaces.
- **Software:**
  1. Involves computational tools for solving differential equations.
  2. Graphical tools for illustrating the system's behavior.

2 Goals

The main goals of this project is to:

- Create a simulation model that accurately represents the behavior of a damped harmonic oscillator in various scenarios.
- Facilitate the understanding of damping effects on oscillatory systems through interactive and visual tools.
- Enhance educational understanding of damped oscillatory systems.
- Simulate real-time data and mathematical derivation.
- Design tools to allow user to create and save custom scenarios, and do comparative analysis.

3 Stretch Goals

- Extend the model to include non-linear damping effects.
- Integrate real-time experimental data for comparison with simulations.
- Develop an augmented reality application to visualize oscillations in a physical environment.