A Report on

WAVE SIMULATION

Submitted in Partial Fulfillment of the Requirements for

**SIMULATION AND MODELING**

Submitted By:

**Ashutosh Poudel**

201752

Submitted To:

**RESHA DEO**

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**Department of Software Engineering**

**NEPAL COLLEGE OF**

**INFORMATION TECHNOLOGY**

Balkumari, Lalitpur , Nepal

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# Introduction

A wave is a fundamental concept in physics, representing a disturbance or oscillation that propagates through space and time. What distinguishes waves is their ability to transfer energy without the need for the physical transfer of matter. Waves exhibit various characteristics, including amplitude, frequency, wavelength, velocity, and period. These parameters describe the size, speed, and periodicity of the wave.

Waves come in different types and are observed in diverse contexts. Mechanical waves, such as transverse and longitudinal waves, require a medium for propagation. Electromagnetic waves, on the other hand, consist of oscillating electric and magnetic fields and can travel through a vacuum. Sound waves, a familiar example of mechanical waves, propagate as compressions and rarefactions in a medium, conveying auditory information.

In addition to sound waves, other examples include water waves, seismic waves generated by geological activities, and electromagnetic waves encompassing radio waves, microwaves, visible light, and more. Waves play a crucial role in our understanding of the natural world and find extensive applications in science, technology, and daily life. The provided code appears to visualize a sine wave, a specific type of oscillatory wave, using HTML5 Canvas and JavaScript, providing a practical demonstration of wave properties.

***y*(*x*,*t*)=*a*⋅sin(*T*2*π*​⋅(*t*−*vx*​))**

**Where:**

* **y((*x*,*t*) is the y-coordinate of the wave at position *x* and time *t*,**
* ***a* is the amplitude,**
* ***T* is the period,**
* ***π* is the mathematical constant Pi (approximately 3.14159),**
* ***v* is the velocity or speed of the wave.**

# Objective

The objective of the simulation is to provide an interactive and visual representation of wave phenomena, specifically focusing on sine waves and other related oscillatory patterns. The simulation aims to allow users to dynamically explore and understand the fundamental parameters that characterize waves, such as amplitude (a), period (T), and velocity (v). By manipulating these parameters through interactive input fields, users can observe the immediate effects on the shape, frequency, and velocity of the displayed wave.

# Functionality

he functionality of the wave simulation encompasses a range of interactive features designed to provide users with an engaging and educational experience. Here's an overview of the key functionalities:

1. **Dynamic Wave Rendering:**
   * The simulation dynamically renders various types of waves, including sine, sawtooth, triangular, and square waves.
   * The wave's appearance and motion are visualized on an HTML5 canvas element, offering users a graphical representation of wave behavior.
2. **Parameter Control:**
   * Users can interact with input fields to control essential wave parameters:
     + Amplitude (**amp**): Controls the wave's maximum displacement from the equilibrium position.
     + Period (**prd**): Determines the duration of one complete cycle of the wave.
     + Velocity (**vel**): Influences the speed at which the wave propagates.
   * Real-time updates occur as users modify these parameters, providing immediate visual feedback on the impact of changes.
3. **Start/Pause Animation:**
   * The simulation incorporates a "Start/Pause" button, enabling users to initiate or halt the animation loop.
   * This button's state toggles between "Start" and "Pause" based on the current animation status.
4. **Real-time Information Display:**
   * The screen displays real-time information about the simulation, including the current time of the animation (**t**).
   * This information helps users track the progression of the wave simulation.
5. **Reset Functionality:**
   * A "Reset" button allows users to return the simulation to its initial state, clearing the canvas and resetting all parameters.
   * This functionality facilitates experimentation and exploration without the need to refresh the entire page.

By combining these functionalities, the wave simulation offers an interactive platform for users to manipulate and observe the behavior of different types of waves, promoting a deeper understanding of wave physics and principles.

## Conclusion

In conclusion, the wave simulation project successfully achieves its objectives of providing an interactive and educational platform for users to explore the characteristics of various wave types. The implementation integrates dynamic wave rendering, user-controlled parameters, and real-time visual feedback to create an engaging experience. The simulation allows users to observe how changes in amplitude, period, and velocity impact the behavior of sine, sawtooth, triangular, and square waves. The project serves as an effective tool for learning fundamental wave concepts in a hands-on and interactive manner. Whether used for educational purposes or personal exploration, the simulation offers a dynamic and visually appealing environment for users to deepen their understanding of wave physics.

In summary, the wave simulation project not only meets its goals but also provides a robust foundation for potential expansions and improvements. It stands as a testament to the effective combination of interactive web technologies and educational content.

## References

[Programiz: Learn to Code for Free](https://www.programiz.com/)

[ChatGPT - OpenAI](https://openai.com/chatgpt)