Project Definition and Scope

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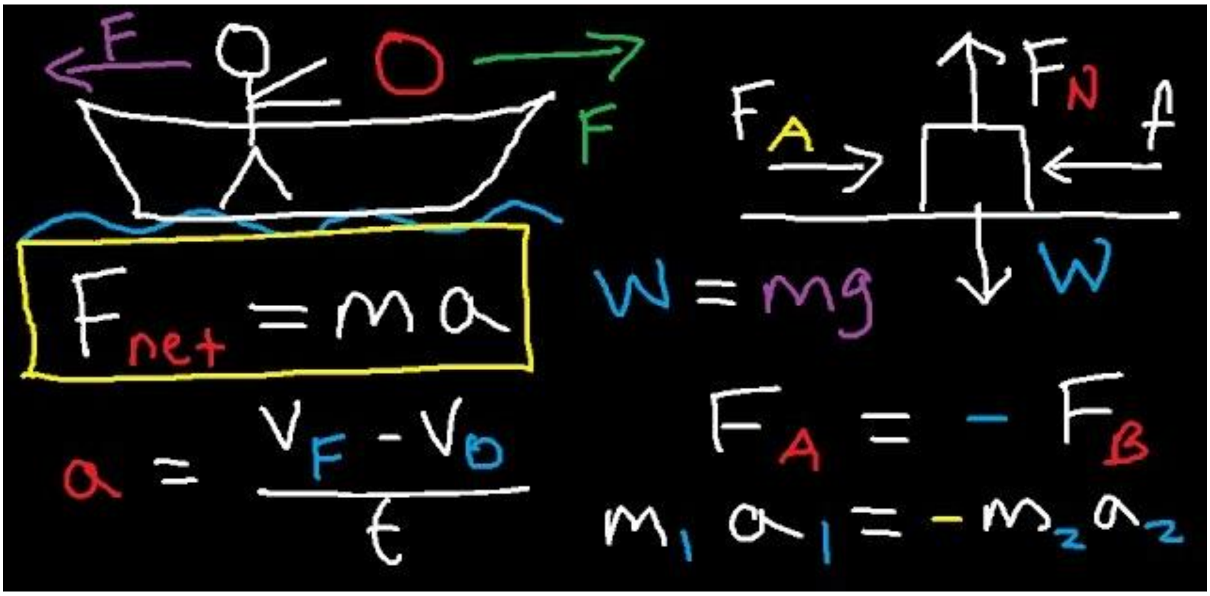
Table Contents

1. Introduction



The **Newton's Laws of Motion** were first introduced by **Sir Isaac Newton** and originally published in 1687. These three laws describe the relationship between **motion and force.** Students typically learn these concepts in classes from grades 8 to 12, especially in physics, where the subject is often taught in a theoretical way—teachers explain the concepts without practical demonstrations that make them easier to understand on the spot.

The **Newtonia Project** aims to bridge this gap by developing **Newtonia devices** that teachers can use to explain these laws, while allowing students to interact with them and gain hands-on experience. Through this approach, learners can engage with various physical quantities and observe them on **Real-time visual displays** while interacting with the Newtonia device. This also helps highlight the difference between ideal physics (theory) and real-world physical behavior.

By using **Embedded system design,** we can implement these concepts in everyday objects like toy cars, balls, or other items. Real-time data such as acceleration, velocity, position which can be measured and transmitted wirelessly from the **Newtonia device** to a computer, where it is shown on an interactive and visually engaging display.

2. Problem Statement

The fundamental concepts of **Newton's Laws of Motion** are often taught in a purely theoretical manner in schools, particularly between grades 8 and 12. While teachers explain the principles of motion and force, students rarely get the opportunity to observe or interact with real-world demonstrations of these concepts. This gap between theory and practice makes it difficult for learners to fully grasp the difference between idealized physics models and real physical behavior.

There is a lack of interactive, hands-on tools that allow students to visualize and experience physical quantities such as **acceleration, velocity, and force in real time**. Without practical exposure, students struggle to connect classroom learning with real-world applications, which limits both understanding and interest in the subject.

3. Objectives

- To help students understand Newton's Laws of Motion in a simple and practical way.
- To show the difference between theory taught in class and real-life physics.
- To create devices that can measure things like speed, force, and acceleration.
- To display these measurements on a screen wirelessly in real time.
- To develop small embedded systems to collect and send data wirelessly.
- To make physics more interesting and easier for students to learn.

4. Relevance to ICT domain

Newtonia Project is very relevance to ICT domain because it use ICT technology. The project applies embedded systems, sensors, and wireless communication to collect real-time data such as speed, force, and acceleration. This data is then sent to a computer or mobile and shown on the screen through a visual display.

In this way, ICT tools like data processing, wireless transfer, and visualization are used to make physics more practical and interactive for students. The project shows how ICT can be applied in the education field to create smart learning systems.

5. Feasibility Analysis

5.1 Technical Feasibility

The Newtonia Project can be built using Embedded System. For Hardware, we can use ESP32 Microcontroller with BLE & Wi-Fi, Accelerometer & Gyrometer MPU6050, Motor Encoder, Position Sensor, Inertia Sensor, 3.7V Battery & PCB. For Software, we can use HTML, CSS, Python or Node.js to display basic visualization frameworks.

5.2 Economica Feasibility

The overall cost of the project is a little bit expensive. Hardware like sensors, microcontrollers, and models can be purchased at a moderate price. Most of the software tools are open-source and free, so there is no extra cost for licenses. However, during testing and experimenting, the cost may increase slightly because of making new versions or new modules to get the result.

5.3 Ethical Feasibility

The project does not deal with sensitive personal data, so privacy risks are minimal. However, care must be taken to ensure the system is safe for students to use (no electrical hazards or unsafe devices). The project also promotes education and has a positive impact on society by making learning easier. To handle ethical concerns, safety testing of devices and responsible use of collected data will be followed.

6. Market/ User Needs Analysis

- Smart Classrooms: How Sensors and AI Are Shaping Educational Paradigms
- NEWTON Virtual Labs: Introduction and Teacher Perspective | IEEE Conference Publication | IEEE Xplore
- AI meets physics: a comprehensive survey | Artificial Intelligence Review
- Frontiers | Use of wearable devices in the teaching-learning process: a systematic review of the literature
- Application of New Sensor Technology in the Field of Education in the Era of Internet of Things - Chen - 2021 - Journal of Sensors - Wiley Online Library

Supported by academic and professional sources, it is evident that students require more than lecture-based theory. They benefit greatly from hands-on interaction, visualization, experiments, and feedback to better understand physics concepts.

Similarly, teachers need tools that are easy to use, reliable, and maintainable, while also ensuring they clearly improve students' understanding. For long-term adoption, such tools must also integrate smoothly into existing class time and curriculum requirements.

7. Novelty

Many existing approaches in physics education rely on simulations, virtual labs, or traditional demonstrations, which are helpful but often lack real-world interaction. Similarly, sensor-based platforms have been explored in science education, but many are either too complex for teachers to manage or not affordable for schools.

The Newtonia Project introduces originality by combining embedded systems, real-time sensors, and wireless data transfer into simple physical models (such as toy cars or balls). Unlike virtual-only systems, this approach allows students to both play and experiment with real objects while simultaneously seeing real-time data visualization of physical quantities like velocity, acceleration, and force.

8. Conclusion

The Newtonia Project provides an innovative solution to make learning physics more interactive, practical, and engaging. By combining embedded systems, sensors, and real-time data visualization, students can see and experiment with physical quantities like acceleration, velocity, and force in real time. This bridges the gap between theory and real-world experience, helping students understand concepts more deeply.

The project is technically feasible, economically reasonable, and ethically safe, while also being relevant to the ICT domain through the use of technology for data collection, wireless communication, and visualization. Its novelty lies in offering hands-on experimentation combined with visual feedback, making it easier for teachers to explain concepts and for students to learn actively.