Ideation and Stakeholder need Analysis

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1. Stakeholder Analysis

1.1 Stakeholder Identification

- Students (especially grades 8-12, learning science/physics)
- Science/Physics Teachers
- School Management / Administrators
- Educational Policy Makers

1.2 Challenges of Stakeholders

- Students often get only theory without practical experiments, which makes it difficult for them to connect physics concepts to real life.
- They need clear, simple, and enjoyable ways to learn; otherwise, they may lose interest.
- Teachers face limited time in class, making it hard to set up and run complex experiments.
- School management has budget limitations, so they cannot afford expensive lab equipment.
- Management worry about maintenance, repairs, and the long-term sustainability of devices.
- Policy makers must ensure safety, standardization, and data privacy when introducing ICT devices in education.

1.3 Supporting Evidence from Studies

- https://www.researchgate.net/publication/371086747_Exploring_Students'_Perceived_Difficulties_of_Learning_Physics
- https://educatia21.reviste.ubbcluj.ro/data/uploads/article/2024/ed21-no28-art36.pdf
- https://infonomics-society.org/wp-content/uploads/ijcdse/published-papers/special-issue-volume-3-2013/How-Do-Students-Perceive-the-Difficulty-of-Physics-in-Secondary-School.pdf

This show that many physics students face serious challenges that go beyond just theory. These include things like difficulty connecting physics to real life, trouble with mathematical parts, lack of motivation, and missing lab resources.

Students need more than theory; they require hands-on interaction, real experiments, visualization, and feedback to truly understand physics. Teachers need tools that are easy to use, reliable, maintainable, and clearly improve student understanding.

These tools must also fit well into the class schedule and syllabus, so they can be used without disrupting teaching or needing too much extra preparation.

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 behaviour.

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. Creative Ideation

Based on the identified challenges and needs of stakeholders, we can propose two ideas:

Idea 1: Newtonia IoT-Enabled Physics Lab Kits

Description: Develop small, low-cost kits with sensors (accelerometer, gyroscope, force sensors) connected to a microcontroller (ESP32). Data is sent wirelessly to a computer or mobile app for real-time visualization of motion, velocity, and force.

ICT Domain: Internet of Things (IoT) and wireless data transfer.

Justification: Students get hands-on interaction and see physics concepts in action. Teachers can demonstrate quickly without setting up heavy lab equipment. Schools benefit from affordable and reusable kits.

Idea 2: Gamified Virtual + Physical Hybrid Platform

Description: Combine real-world experiments (with IoT kits) and a gamified virtual platform where students earn points, badges, or rewards by completing experiments or solving challenges.

ICT Domain: Gamification, cloud-based platforms, and mobile learning.

Justification: Students stay motivated and find learning fun. Parents see positive engagement without extra cost in tuition or private labs. Policy makers and schools' benefit from a solution that is scalable and attractive for modern classrooms.

4. Relevance to ICT domain

The problem of teaching Newton's Laws of Motion only through theory can be solved effectively by applying modern ICT technologies. The proposed solutions align closely with current ICT trends and have direct benefits for both education and the ICT field.

IoT (Internet of Things): Using IoT-enabled devices such as sensors and microcontrollers makes it possible to measure real-time data like velocity, acceleration, and force. This matches the growing ICT trend of smart, connected devices that provide real-time feedback. It allows students to interact with physical objects while teachers and administrators can collect data for analysis.

Gamification and Cloud Platforms: By integrating gamification elements and storing data on cloud platforms, the project connects with ICT trends in e-learning, mobile learning, and cloud computing. This ensures scalability, easy access, and increased motivation for students.

Wireless Communication (5G/Wi-Fi): Real-time transfer of experimental data from devices to computers or mobile applications relies on wireless communication. This supports the ICT trend of fast, reliable connectivity, which is essential for real-time classroom applications.