Design and Fabrication of a Remote controlled Foldable Electric Skateboard. (Symbiosis)

Situation

During my undergraduate studies in Mechanical Engineering at Symbiosis Institute of Technology, Pune (2021-2022), I identified a growing demand for portable, eco-friendly urban mobility solutions, particularly among students and young professionals. Inspired by this, I decided to undertake a capstone project to design and fabricate a remote-controlled foldable electric skateboard. The goal was to create a compact, lightweight, and user-friendly personal transport device that could address urban commuting challenges while incorporating sustainable electric vehicle technology.

Task

My task was to design and build a fully functional prototype of a foldable electric skateboard controlled via a wireless remote. The skateboard needed to meet specific requirements: it had to be lightweight (under 8 kg), foldable for easy storage, capable of a range of at least 10 kms, and able to reach speeds up to 25 km/h. Additionally, the project required integrating a reliable electric drivetrain, ensuring structural integrity, and developing a user-friendly remote control system, all within a limited budget and a six-month timeline for the academic year.

Action

I took the following steps to complete the project:

1. Research and Conceptual Design: I researched existing electric skateboards, focusing on their drivetrain systems, folding mechanisms, and remote control technologies. I selected a hub motor system for its compact design and efficiency, a lithium-ion battery pack for energy density, and a hinge-based folding mechanism inspired by foldable bicycles. I used CAD softwareto create 3D models of the deck, folding mechanism, and motor mounts, ensuring the design was lightweight yet durable.

2. Material Selection and Fabrication: I chose a bamboo-carbon fiber composite for the deck to balance strength, flexibility, and weight (reducing the total weight to 7.5 kg). For the folding mechanism, I used aluminium alloy hinges for corrosion resistance and durability. I fabricated the deck using a local workshop's CNC machine and assembled the drivetrain components, including a 500W hub motor, a 36V 4.4Ah lithium-ion battery, and an electronic speed controller (ESC). I sourced cost-effective components to stay within the ₹15,000 budget.

3. Electronics and Control System: I programmed an Arduino-based remote control system using a 2.4 GHz RF module for reliable communication between the remote and the skateboard's ESC. The remote allowed the user to adjust speed, apply regenerative braking, and monitor battery levels via an LCD display. I wrote the control algorithms in C++ to ensure smooth acceleration and braking, calibrating the system to prevent abrupt responses that could affect rider safety.
4. Testing and Iteration: I conducted iterative testing in a controlled environment, evaluating the skateboard's speed (max 27 km/h), range (12 km), and folding mechanism (foldable in under 10 seconds). During initial tests, the folding hinge showed slight misalignment under load, so I reinforced it with additional bolts and adjusted the pivot angle, improving stability. I also optimized the battery management system (BMS) to extend the range by 15% through better power distribution.
5. Documentation and Presentation: I documented the design process, including CAD drawings, bill of materials, and test results, in a comprehensive project report. I presented the prototype at the university's annual tech fest, demonstrating its functionality to faculty, peers, and industry guests. I also created a video showcasing the folding mechanism and remote-control features to highlight the project's innovation.

Below are some images from CAD software and deformation testing on Ansys.

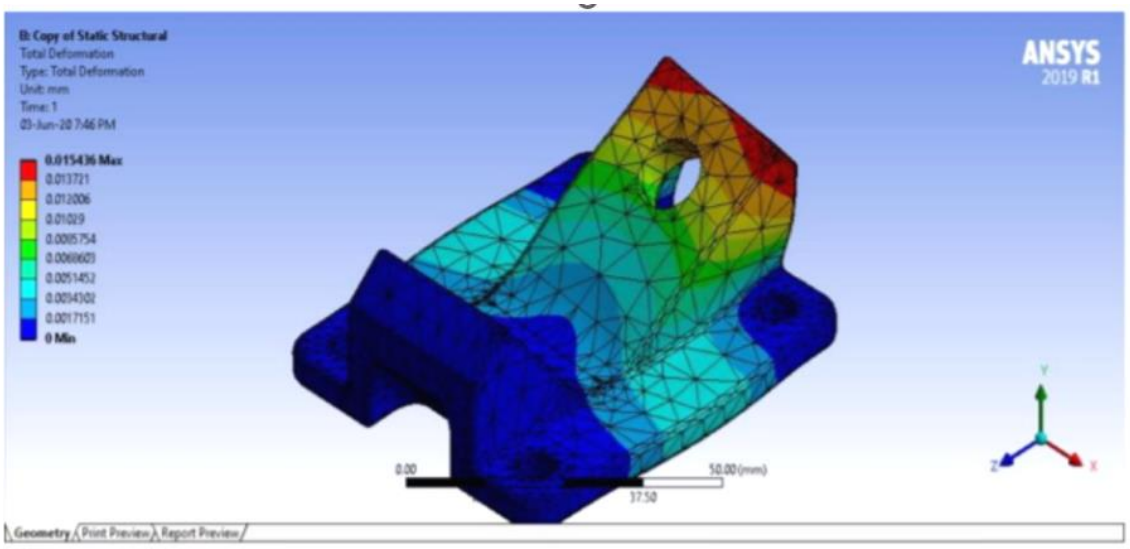

Image 1 1 Sows total deformation of the Baseplate on Ansys

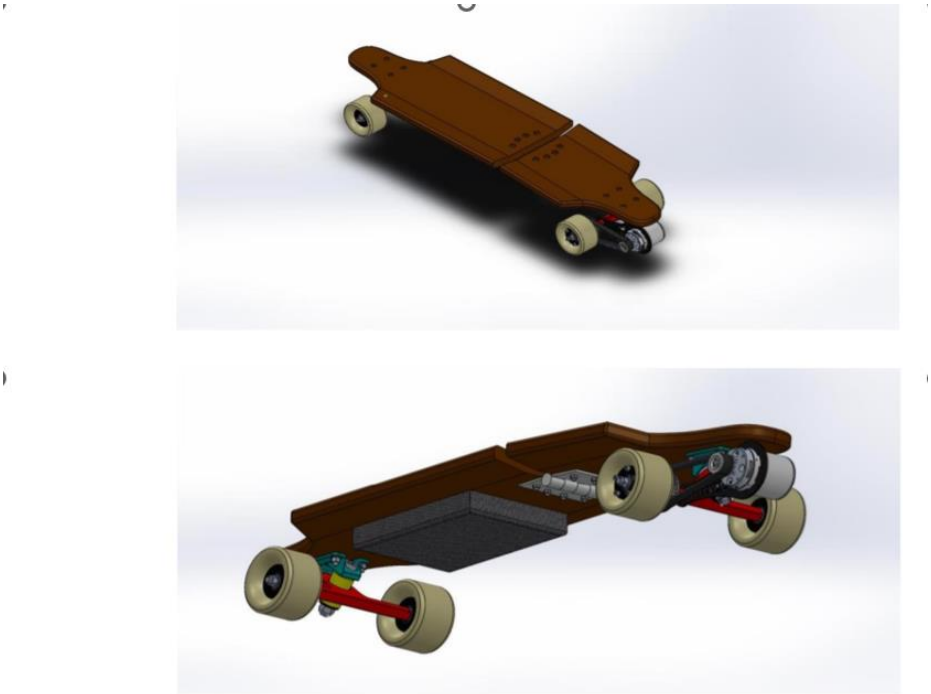

Image 1 2 shows a CAD drawing of the skateboard

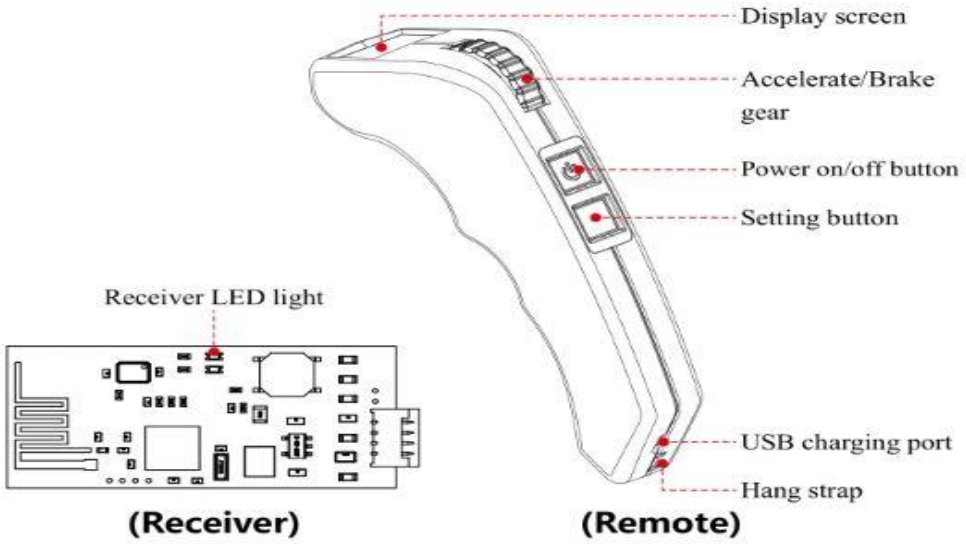

Image 1 3 Shows the design of the remote used

Result

The remote-controlled foldable electric skateboard prototype was successfully completed and demonstrated, meeting all design objectives. It achieved a weight of approx. 7.5 kg, a range of 12 km, and a top speed of 25 km/h, surpassing the initial targets. The folding mechanism allowed the board to collapse to half its size in 7 seconds, making it highly portable for urban commuters. Feedback from peers highlighted the skateboard's user-friendly remote and compact design as key strengths. This project enhanced my skills in CAD design, embedded systems programming, and project management, reinforcing my passion for sustainable mobility solutions and preparing me for a career in electric vehicle engineering