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Weight Actuated Electric Skateboard

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ABSTRACT: The 'Last Mile' is an issue most citizens face in the emerging and developing cities of the world. Although public transportation services are fairly straightforward and can get anyone around a city, they rarely take someone to their exact desired location. This poses as a problem for the elderly or disabled and even an inconvenience for the layman in terms of time and effort. Numerous safe, green, portable and convenient micro-mobility solutions have been developed to resolve 'The Last Mile'. An electric skateboard being one such solution, has been upgraded to be more comfortable and user friendly in this paper. The objective is to create a prototype for an electric skateboard that can be actuated without any hand-held, remote control. This paper aims to provide a micro-mobility solution to the 'Last Mile' issue in the form of: WEIGHT ACTUATED ELECTRIC SKATEBOARD. The concept can also be used for many other applications discussed further in the paper.

I. INTRODUCTION

Micromobility mainly focuses on economically viable, convenient and environment-friendly forms of personal transport for trips less than 6 Kilometers. 'In the world's most populous cities, the majority of trips are already taken by walking, cycling, and transit. Many cities in India, for example, have less than 10% of trips taken by car. Elevating the priority of micromobility modes gives travelers another private vehicle alternative, particularly if it is integrated with other modes and affordable for all.' Micromobility is being looked into only recently and holds the potential for saving of time, energy and money for a large demographic. Within the large campuses of schools and colleges, or even within the area of a sizeable manufacturing unit, the Weight Actuated Electric Skateboard is a convenient tool providing functionality, safety and affordability for the user.

A successful prototype would accelerate when weight is applied to the actuation pad, placed ergonomically on the skateboard deck. Some key performance objectives were identified for the electric skateboard, as listed below:

- Reach a top speed of 50 Km/Hr.
- Achieve a range of 20km at a speed of 40km/h on an overall level route.
- To be light enough to comfortably carry – quantified as less than 10kg.

Other additional features outside the scope of this prototype are also discussed further in the paper.

II. PROTOTYPE DESIGN

2.1 Components Used

I. Skateboard Deck- is the actual platform the user stands on. Its design parameters depend on some key features:

- Length – Achieving high speed almost always requires the use of a longboard. The longer the deck is, the more stable the skateboard will be.

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- Wheelbase – The wheelbase is distance between the front truck and rear truck, with a wider wheelbase providing better weight distribution and stability at speed.
- Flexibility – Flexibility is the deck's ability to absorb shocks. Greater flexibility has a negative impact on the unit's stability.

II. Trucks- are the hardware components that connect the wheels to the board. A traditional skateboard generally has two, single-axle trucks, one in the front and one at the back. However, for urban use, this prototype uses four separate trucks to hold bigger wheels.

III. Wheels- Four 9 cm diameter and 3 cm thick rubber-silicon wheels were used in this prototype. The two rear wheels were connected by an axle as they are the ones that are powered by the motor.

IV. Gears- a 1:2 gear ratio is used, using a 10 toothed gear driving a 20 toothed gear at the axle.

V. Timing Belt: A chain is used to connect the 2 gears.

VI. Motor- A 270 KV DC Motor is used to power the Skateboard.

VII. Battery- A 2200 mAh Li-Po rechargeable battery supplies power to the circuit.

VIII. Load Cell (26630501RP2)- A 40 Kg rated load cell is used to sense the weight applied on it as input.

IX. ATMEGA328P-is the microprocessor used to generate PWM.

X. Motor Driver- A 20A motor driver is used as the link between the microprocessor and the motor.

XI. Integrated Circuit- XFW-HX711

XII. Resistors and Capacitors-

Capacitors	2	C3-C4	22p
Capacitors	1	C5	10uf
Capacitors	2	C8-C9	1000uf
Resistors	1	R1	330Ω
Resistors	1	R2	10kΩ

2.2 Construction

2.2.1 Skateboard Construction

Firstly, the trucks are attached to the skateboard deck by placing, marking and drilling for screws. Then the bearings are inserted into the wheels and are secured to the trucks, tightening just enough for unrestricted movement of the wheel. The 20 toothed driven gear is inserted into the axle which is then connected linearly to each of the rear wheels. The

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axle-gear assembly must go through the timing chain beforehand as this step cannot be performed after fixing the axle. The positions of the motor, circuitry, battery and load cell are marked on the underside of the board as shown in the figure. A piece of the deck must be cut and adhered to the load cell, which when placed at the same position will act as the actuation pad. The components are all the fixed and secured in place.

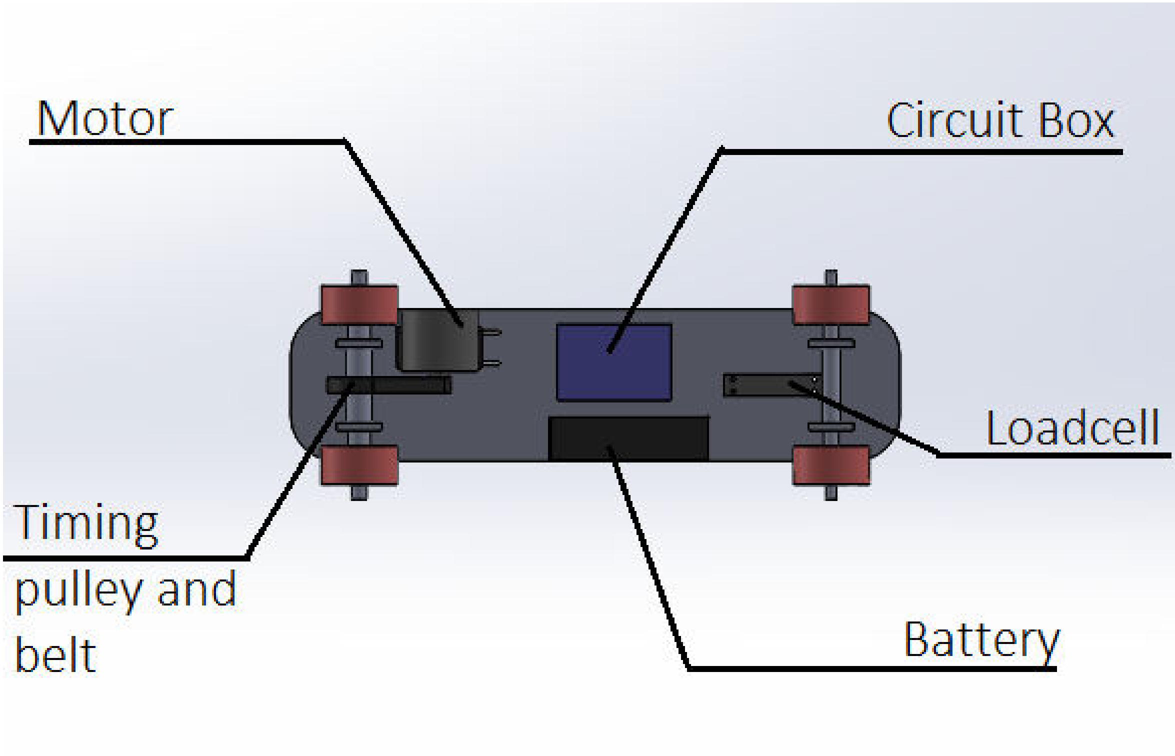

Figure 1 Construction of Skateboard

2.2.2 Drivetrain

Drivetrain refers to the assembly consisting of the axle of the motor, the driven and the driving gears, the axle of the wheels and the timing chain connecting them. The drivetrain is responsible for the actual power transmission and hence the efficiency of the skateboard itself. It is very important that the drivetrain must be well lubricated to prevent loss of power due to friction.

Since our requirement is such that a high torque is required to be output by the board, the gears are in a low driving-high driven arrangement. This means that the driving gear connected at the motor end has a lower number of teeth (10) and the gear at the wheelbase end has a higher number of teeth (20). Therefore, the gear ratio is 1:2. Although there is a compromise in the effective speed, a high torque output is observed. The timing chain is looped around the gears such that it is fairly taut, but not exerting excessive force in the axles.

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2.2.3 Circuit Diagram

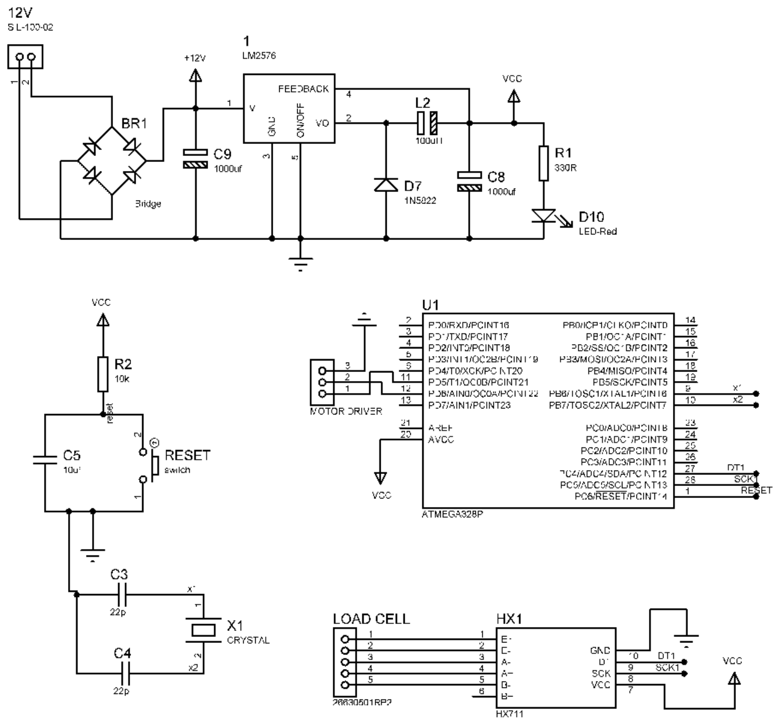

Figure 2 Circuit Diagram

III. RESULT

The result is an electric powered skateboard, which accelerates when weight is applied on the actuation pad by the leading foot of the user. The prototype can be improved in many ways such as: making it more lightweight for ease of portability, better quality trucks can be used for better steering, the same methodology can be repeated to add the function of deceleration. However, the prototype was able to achieve a top speed of 50 Km/Hr. The prototype would also be able to travel for 20 Km in a single charge at an average speed of 40 Km/Hr on a level surface. Moreover, it poses as an upgrade to the mainstream electric skateboard which requires a hand-held remote control.

IV. CONCLUSION

The desired goal of creating a solution for the ‘Last Mile’ issue was achieved in the form of Weight Actuated Electric Skateboard. A working prototype of the same was successfully created and tested bearing a fruitful result. The project is environment friendly as it is electrically powered. It is a convenient method of travelling short distances for the user.The project also succeeded in the goal of exploring a previously unexplored human interface device. With some more input and aid of available technology, the project can be made as an economically viable addition in the micromobility sector and the concept can be used in various other application.

V. FUTURE SCOPE

5.1 Additional features

Certain additional features that could be added in tandem with making the project more polished were brainstormed and are as follows:

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- A second actuation pad at the rear of the skateboard for deceleration.
- Off-Road trucks for better suspension and steering.
- Lights for visibility purposes.
- Lighter materials to be used for ease of portability.

5.2 Other Applications

- Load cells can be used as input devices in a wide range of man equipped machinery including off location control (mining), Medical instruments, Interactive technologies.
- A similar working principle can be used to construct equipment aiding disabled people in movement in smaller areas that may be difficult to maneuver.
- Clean micro transportation systems can be used over petroleum powered vehicles.
- The same basis can be used for internal transportation of raw materials or finished packages inside manufacturing units or smart inventories.

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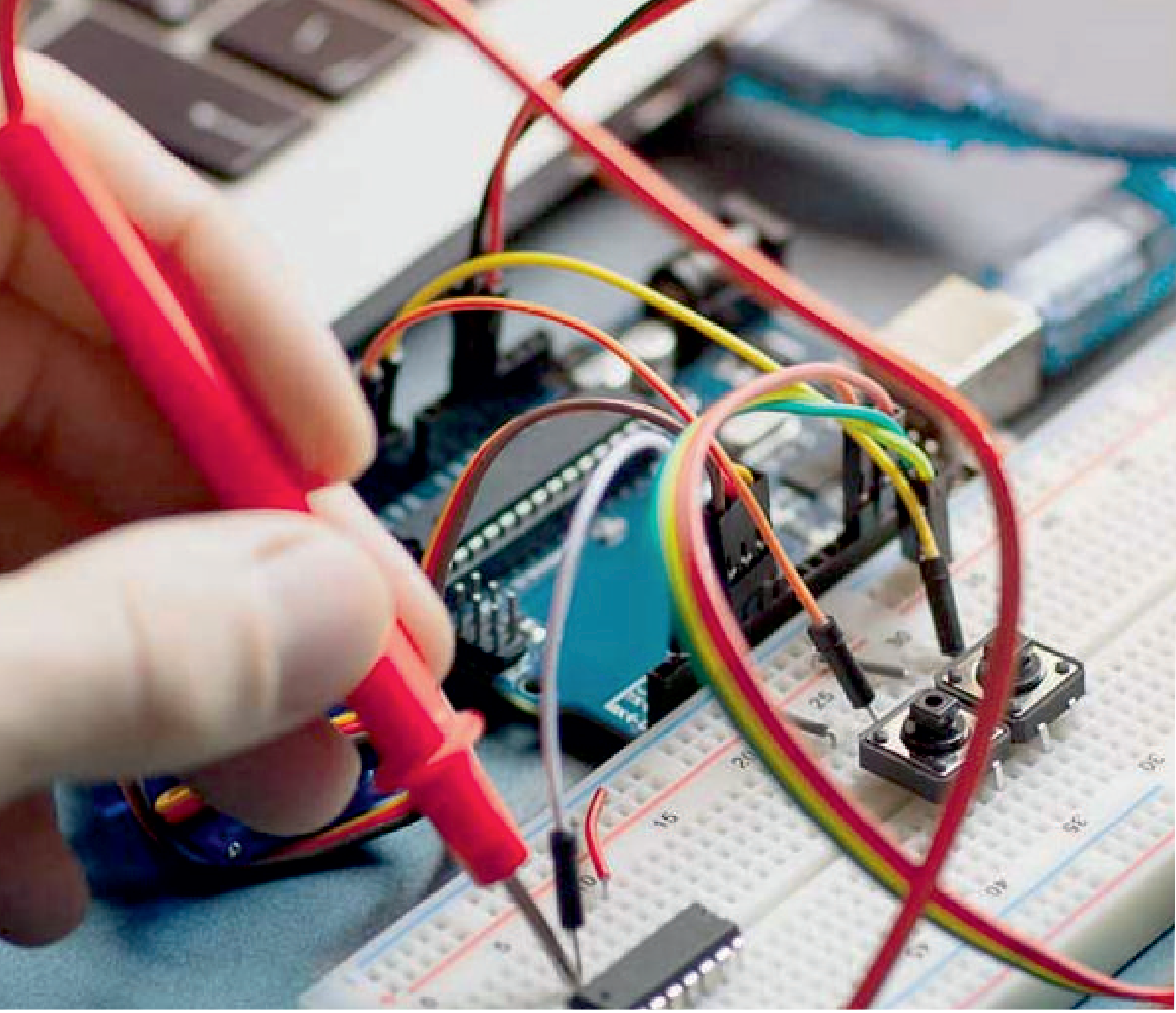

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