Vellum: Requirement Specifications

This document lists the user-, engineering- and regulatory requirements that Vellum Proto2 must satisfy.

User Requirements

User requirements are requirements imposed on the vehicle as a result of user/usecase constraints or preferences.

1. The vehicle will be offered in [three variants](https://docs.google.com/document/d/1Icx896DVNmdFlhwHmlaiS47BrOLeUMcJMGxw5Bz4J9E/edit).
2. The dimensions of the vehicle must be 2000mm L x 800mm W. The height H must be no more than 1500mm.
3. The vehicle must use 135/70-R12 tires (the same tires as the Nano and the Bajaj Qute).
4. Front track width = Rear track width = (800-135) = 665 mm. Wheelbase = 1400 mm.
5. Must have two seats in tandem configuration. Each seat must be at least 16” wide.
6. Top speed: Must have a top speed no more than 70 kmph.
7. Acceleration: Must go 0-60 kmph in at most 10 secs. We are not sure how much power in KW would be needed to meet this with say max load.
8. Charging time: Must take no more than 6 hours for a full recharge.
9. Charger type: Must support at least [Level 1 charging](http://www.evtown.org/about-ev-town/ev-charging/charging-levels.html). Level 2 (fast charging) is optional, might be offered on higher-end variant.
10. Turning radius: 2.5m (equal to Maruti Alto)
11. Must have no more than two doors.
12. The door(s) must not be the standard design (hinged at the front edge). The doors should allow entry/exit in tight spaces and therefore could be either [scissor](https://en.wikipedia.org/wiki/Scissor_doors), [butterfly](https://en.wikipedia.org/wiki/Butterfly_doors) or [canopy](https://en.wikipedia.org/wiki/Vehicle_canopy) type.
13. The doors must have windows that either slide open or a go up/down via a hand crank. Power windows are optional.
14. Kerb weight: No more than 250 kg.Can we reduce this to 200 Kg?
15. Ground clearance: No more than 160 mm (this is the clearance of Maruti Alto), no less than 150 mm (~6 inches). Floor height: The height of the vehicle floor from the ground should be no more than 200 mm.
16. Must have a steering wheel (as opposed to a handlebar, or joystick).
17. Must have a 7” digital instrument cluster and display (as opposed to physical dials, gauges).
18. Must have a rear-facing camera that activates in the display in front of the driver while the vehicle is in reverse gear. This is to help the driver see better while backing up.
19. The digital instrument panel/display must show the following information:
    1. Instantaneous speed
    2. Instantaneous battery charge level
    3. (Predicted) distance that the vehicle can travel before the battery discharges.
    4. Cumulative miles travelled
    5. Trip meter (miles traveled since last reset)
    6. Map with vehicle location
20. Must have an air cooler/blower (need not have an AC) with a knob for fan speed control.
21. Must have a transparent roof of perspex (or equivalent) with a dark, reflective tint.
22. Must have a front windshield with one wiper, and a rear windshield.
23. The side panels of the vehicle behind the doors must also have additional windows that don’t open (similar to those on a coupe).
24. Should have a keylock to the entry door and second key for starting the car. The starting key will connect battery to load to ensure that battery is not discharged while the vehicle is parked.
25. An immobiliser may be added to car which will be powered by an auxiliary supply and may report theft, report location and immobilise the vehicle.

Engineering Requirements

Engineering requirements are those requirements that affect the design/building of the vehicle, but are not user-facing, and are also not regulatory requirements.

1. Must be a rear-wheel drive with an electric powertrain.
2. Must use Li-ion batteries. Batteries must have an integrated battery management systems to prevent overheating, over charging, over discharging.
3. Must use hub motors (in-wheel motors).
4. The CG of the unloaded vehicle must be at a height of no more than 254 mm (10 inches) from the ground.
5. The h-point of the driver when seated (ie, the CG of the driver) must be no higher than 500 mm from the ground. This will keep the overall CG no higher than 333 mm. This will ensure that *t/2H > 1*, where *t* is the track width = 665mm, and *H* is height of CG from ground.
6. Must have a steel space frame (for lightness, strength reasons).
7. Must have a skin and interior made of FRP or CFRP (for lightness/cost reasons).
8. Suspension requirements: ?
9. Brake requirements: (Disk/drum, etc.)?
10. Vehicle usage data storage: Each vehicle usage with date time stamp will be stored in memory that can be read by authorized service center by wire or wireless. All maintenance records will also be kept in this storage.

Regulatory Requirements

1. Brakes: Should have one pedal brake near the left foot of driver which will act on both wheels simultaneously as well cut power to motors. In addition, a parking hand brake must also be provided.
2. Throttle or Accelerator: Foot pedal situated near right foot of driver. Should have some initial dead zone so that vehicle does not start moving for first 10% operation.
3. Harnesses (look up AIS standards): The vehicle should preferably use a 4-point harness, if allowed.
4. Airbags (look up AIS standards)- for this category of vehicle, it may be optional
5. Headlights (White or colourless) - a certain diameter such as 4” or 6” - two lamps, both in front with reflector and lens. May use an incandescent or LED bulbs.
6. Brake lights (Red )- two lamps, both in back , with separate lamp or filament indicating brake pedal is pressed. May use an incandescent or LED bulbs.
7. Turn Indicator lights (yellow) - two left side lamps - front and rear , similarly two right side lamps. Must blink at regulation rate. Should have a matching buzzer sound near driver. Under distressed condition, both side lamps must be activated.
8. Reversing Indicator Lights (White)- both in back , one on each side to be on as long as direction switch is in REVERSE.
9. Steering must be collapsible type.
10. EMI/ EMC Requirements: battery pack, motor controller etc should be housed in a compartment which has proper shielding so that it does not emit any significant EM noise.