

# Power Boost Kick Scooter

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## Capstone Design Project Proposal

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**Project:** Develop a collapsible kick scooter for personal urban transportation with electric boost for uphill travel, suitable for use in the Palouse.

Background: Kick scooters can provide practical urban transportation for up to two miles. A compact, portable scooter takes the rider about twice as fast as walking, but not so fast or far as a bicycle. However, a collapsible scooter is much more pedestrian friendly than a bicycle, and much easier to carry on a bus or subway, or to store in a closet or an office. An example is the Xootr Mg, equipped with a lightweight magnesium platform, a hand brake, and polyurethane wheels with extremely low roll resistance. The handlebar collapses and the whole unit folds up nicely.

Some examples of standup scooters currently available are shown below. Kick scooters and electrically powered scooters are shown – gasoline powered scooters are also available.

### Xootr-MG

#### Specifications

Weight, 9.9 lbs

Max load: 250 lb

Folded dimensions: 31.1 in. long x 9.4 in. high x 12.6 in. wide (at handlebar)

Wheel type 7.1 in polyurethane tire

Wheelbase: 28.3 in

Brake: Front hand brake with BMX-style lever. Brake shoe pushes down onto rubber tire.

Price: \$220



### Problems:

- Very stiff ride – doesn't handle bumps or uneven pavement well
- Noisy – rattles on surfaces that aren't perfectly smooth
- Brakes inadequate for the Palouse: my first one wore out in three weeks because of the long, steep downhill sections. Slaloming down hills helps, but is not always practical.
- Ground clearance is low: bottoms out going from driveway to street
- Good on downhill and level, smooth surfaces; needs boost for hills
- Source: [www.xootr.com](http://www.xootr.com)

### Know-ped

Weight: 13 lbs  
Max load: 400 lb  
Folded dimensions: L-34" W-13" H-13"  
Wheel type: 6" solid go-active rubber replaceable tire  
Wheelbase: 28.3 in  
Brake: Front wheel caliper, rear stomp fender  
Price: \$160  
Source: [www.goped.com](http://www.goped.com)



**Problems:** Rolling resistance - unknown. Needs boost for uphill sections.

### IPed 54 – Electric power with Li-Ion battery

Weight: 31 lbs  
Max load: 250 lb  
Folded dimensions: 36"L x 15 1/2"W x 13"H  
Wheel type: "Never flat" shock resistant solid rubber tires  
Wheelbase: 28.3 in  
Brake: Caliper front  
Battery: 16AH Li-Ion battery pack  
Charger: 110v-240v compatible on-board charger  
Range: up to 18 miles  
Price: \$1399  
Source: [www.goped.com](http://www.goped.com)



**Problems:** Heavy. OK for power riding, bulky to carry on bus or store in office.

### Go-Ped ESR75H Hoverboard

Weight: 40-46 lbs (depends on battery pack choice)  
Max load: 250 lb  
Folded dimensions: L-48" W-18" H-17"  
Wheel type: 10" pneumatic, magnesium rims  
Wheelbase: 28.3 in  
Brake: Front disk brake, optional rear brake kit  
Battery: 16-32 AH Li-Ion battery pack  
Charger: 110v-240v compatible on-board charger  
Range: 14-28 miles (8- 20 for large adult rider)  
Price: \$2259-2990  
Source: [www.goped.com](http://www.goped.com)



**Problems:** Expensive, even bulkier than the IPed 54

## This Project

The goal of this project is to produce something between the foot-powered scooters like Xootr-MG and Know-PED, and electric scooters like the IPed 54 and ESR75H. We want a kick scooter that has a small amount of electric energy storage and regenerative braking that can convert momentum into charge. The charge can then be used to provide a power boost for uphill sections of the ride, and maybe for quick bursts of speed. Requirements:

- Light and compact, no more than 20 lb, preferably 15 lb
- Primarily foot-powered, with occasional boost for uphill and acceleration
- Use regenerative braking to charge the energy storage
- Requires storage system that can be charged very quickly, e.g. ultracapacitors
- Brakes must be effective enough for controlled descent on steep hills such as those we have in the Palouse
- Demonstrate a concept of sustainability through efficient energy recovery and re-use
- No external plug-in required

## Challenges and Tasks

- Energy studies:
  - How much energy can we recover through braking on downhill?
  - How much boost do we need to accelerate on level surface or uphill?
- Select an appropriate platform.
  - Modify an existing design such as Xootr or IPed, or develop a new one
- Design or select motor-generator system
- Design clutch-brake mechanism
- Design energy storage system
- Design integrated system
- Build and test prototype