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Pedibus Development

Project plans and product scope



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**Problem Statement:**

The purpose of this project is to build a full size working model of a pedibus, being powered by passengers via bicycle pedals. The end goal is to have a working model that is a base product for later manufacturing of pedibusses by the capitol city pedibus company. The final product may include a power storing inertia device as well as lights and digital advertising if the budget permits. The ideal design will be lightweight, yet sturdy, with smooth transition of power from the passenger pedals to the wheels. The success of this project will provide Tallahassee with affordable and pollution free means of transportation throughout the city.

**Project Goal:**

The over all goal of the project is to have a working and ready to ride prototype by the end of April 2014. The development of this first prototype will provide information on the cost for different parts and features which will be provided to the sponsor. The pedibus prototype is expected to be efficient enough that one or two people could move the vehicle with light to moderate pedaling force. The team is hopeful that the prototype will be cost effective to reproduce, and easy to maintain.

**Project Objectives:**

The objective of this project is to design a pedal powered multi passenger vehicle that can eventually be reproduced for sale. To accomplish this objective the project will include:

* Developing a number of price points relating to the size of the vehicle and number of passengers vs. material and construction costs so that a final frame size can be chosen based on cost. Time constraints will also be taken into account for the final frame size so that a working prototype can be built before the end of the 2013 spring semester.
* Picking a base frame structure for optimal strength and minimum weight.
* Designing a power drive system, including the linkages from the pedals to the drive shaft.
* Designing a steering and braking system, with minimal cost.
* Integration of a power generation system to charge a battery which powers vehicle lights.

All aspects of the design are to have safety and ease of maintenance as high priorities.

**Methodology:**

Before in depth design of the pedibus is undertaken, research on material costs and construction costs must be done so that the team can generate some estimates for the build cost of a pedibus based on its size and the number of pedaling stations. Once these estimates are available the team will contact the sponsor and consult with him on a general size and cost for the prototype. The time constraint of having a working prototype by spring 2013 will also be taken into consideration when choosing the size of the vehicle. After a general size has been chosen the following systems will need to be designed.

**Structural design:**

* Design a structural frame for the pedibus
* Examine stress concentration points with COMSOL, and tweak structure to optimize strength accordingly
* Design a “peddling station” where passengers sit and peddle. Design should account for ergonomic concerns and comfortable peddling
* Determine the spacing requirements and placement of each peddling station and driver station
* Draw up the design on pro-engineer to display as visual aid to the sponsor

**Steering/Breaking system design:**

* Decide on a steering method and design
* Decide on a breaking system
* Decide on type of brake to be used and with which components
* Decide on the need to include brake and signal lights to make the pedibus street legal

**Power system design:**

* Develop a method for taking the power input from passengers peddling and using it to move the pedibus
* Develop a motor assisted power system to assist in driving the pedibus uphill or when no passengers are present.
* Possibly developing a method for storing extra peddling power generated while the bus is at rest for later use.

All of these once these systems have been designed we can order parts and begin building a prototype.

**Constraints:**

* Starting budget of $2000.00
* Manufacturing costs must be low enough that it is cost effective to produce for sale
* The finished pedibus prototype must have a low enough total weight that it can be powered by one or two people peddling.
* The pedibus must be designed so that maintenance is simple and inexpensive
* All design efforts should be undertaken to make the pedibus street legal and safe to operate on public roads.

**Assign Resources:**

Following are all the task we plan to accomplish before the end of the semester. This information is laid out visually in a Gantt chart attached to this report. Each task has the name of the team member responsible for that task next to it. Though one person will be listed as the person responsible for an individual task, all team members will help each other in accomplishing all tasks.

* Develop different size designs…………………………………………………….Whole Team
* Develop cost estimates based on designs……………………………………Whole Team
* Discuss with sponsor and make decision on final design……………..Whole Team
* Design Website……………………………………………………………………………John Hassler
* Prep for midterm presentation…………………………………………………..Whole Team
* Structural frame
  + Research different framing methods, welds, styles, etc….Andrew Galan
  + Design several frames…………………………………………………….Whole team
  + Perform stress strain calculations……………………………………James McCord
  + Build 3d model and cad diagrams……………………………………John Hassler
* Prep for midterm presentation 2………………………………………………..Whole Team
* Design pedal station
  + Study normal bike ergonomics……………………………………….Andrew Galan
  + Design ergonomic seating……………………………………………….John Hassler
  + Build 3d model and cad diagrams…………………………………..Onyewuchi Ebere
* Design Steering Mechanism
  + Research different steering control methods…………………James Mccord
  + Design sdeveral control methods …………………………………..Whole Team
  + Decide on a method……………………………………………………….Whole Team
* Design Braking System
  + Research different breaking systems……………………………..John Hassler
  + Decide on breaking method……………………………………………Whole Team
* Design Power linkages
  + Design linkage between pedals and drive shaft………………James Mccord
  + Perform torque analysis on drive shaft…………………………..Andrew Galan
  + Pick drive shaft material …………………………………………………Onyewuchi Ebere
  + Build 3d model and cad diagrams…………………………………..John Hassler
* Prepare for Final Design Presentation…………………………………………Whole Team

**Product Specifications:**

**Structural:**

There are several important aspects to the structural frame of the vehicle. The frame must be strong enough to support the weight of all the passengers. The frae

must also be light weight to keep the overall weight of the pedibus to a minimum. The pedibus needs to be light enough that it can be powered by a limited number of drivers. The material chosen for the structural frame must be durable and weather resistant. To keep the total weight and cost down the structural frame must also be designed to use a minimal amount of framing material. The passenger seats will be fixed to the structural frame and have pedals at the base for powering the pedibus. Pedals will be placed in a location that makes pedaling while sitting comfortable. There will be a handle or table top in front of the seat to help support the passenger while they pedal. The seats must be comfortable to sit in and pedal. The number of passengers, and thus the number of seats, has not been finalized at this point. The seat will however be placed a certain distance apart so that passengers are comfortably spaced.

**Steering and Braking :**

Steering of the pedibus will be controlled and operated by a driver at the leading end of the vehicle. The driver will be in control of the initial start of the gear system and overall control of the gear speed. Once the pedibus is in motion its main source of stopping will be due to a connected braking system. Each axle on the system will contain an individual braking system that will contribute to the overall connected system. This will allow the pedibus to come to a smooth and complete stop once the driver initiates the braking levers. One important criteria not to leave out is the lighting system that will notify the surrounding public of these actions. The lighting system will be powered by a small rechargeable battery that will be located at the tailing end of the vehicle. Rear brake taillights and turning lights will be idle to promote the awareness of these actions and also abide by street transportation regulations.

**Power Linkage:**

Power to propel the pedibus will be supplied completely by human passengers via bicycle pedals at the base of each seat. Transmission of power from the pedals to the drive shaft will be accomplished by bicycle chains and sprockets at each pedaling station and corresponding sprockets for each pedaling station on the driveshaft. In addition to having pedals at each of the passenger seats there will also be a pedal station at the driver’s seat so that the driver can drive the pedibus to the passenger pickup location. Due to the weight of the vehicle there will be a gear system much like that on a mountain bike so that the driver can achieve the necessary torque to propel the vehicle with no other power aid. This gear system will also be useful when driving the pedibus up hills with passengers. Transmitting the power from the driveshaft to the gear system will require a universal joint that can relay the spinning of the drive shaft going down the length of the vehicle perpendicularly to the mountain bike gear system, which will deliver torque to the rear axle via chains and sprockets. The rear axle will be rigidly connected two the two rear tires to spin the tires and propel the vehicle forward.

