Pedibus - Spring 2015 Update & Changes

Kyle Anderson#1, Stephen Avery #2, Alejandro San Segundo #3, Brett Willenbacher #4

*# Mechanical Engineering Department, FAMU-FSU College of Engineering  
2525 Pottsdamer Street, Building A, Suite A229*

*Tallahassee, Florida; United States 32310-6046*

1kca10@my.fsu.edu

2 sja12@my.fsu.edu

3as10s@my.fsu.edu

4 blw11c@my.fsu.edu

**January 16, 2015**

**Mr. Ronald Goldstein:** Project Sponsor

**Dr. Chiang Shih:** Project Mentor/Mechanical Engineering Chair

**Dr. Scott Helzer:** Project Coordinator/Instructor

**Dr. Nikhil Gupta:** Project Co-Mentor

**Mr. Keith Larson:** Project Advisor

***Acknowledgements***—

**Mr. Ronald Goldstein:** Project Sponsor

**Dr. Chiang Shih:** Project Mentor/Mechanical Engineering Chair

**Dr. Nikhil Gupta:** Project Co-Mentor

**Mr. Keith Larson:** Project Advisor

**Mr. Jeremy Phillips**: Machine Shop Director

**Mr. James Gillman:** Machine Shop Operator

**Mr. Ricardo Aleman:** Project Teaching Assistant

**Mr. Samuel Botero:** Project Teaching Assistant

**Mr. Yuze Liu:** Project Teaching Assistant

***Team Biography***—

**Mr. Ronald Goldstein:** Founder of Capital City Pedicabs, has traveled all around the United States working in a variety of industries including hospitality, imports, real estate and public service. It was during a family vacation in 2005 that the seed was planted for the pedicab business [1].

**Kyle Anderson:** Kyle is a senior seeking his B.S. degree in Mechanical Engieering at the FAMU/FSU College of Engineering. Being involved with SAE his entire college career, Kyle proves to be a key aspect to the vehicle designing and leadership of the project. His experience consists mostly of hands-on builds.

**Stephen Avery:** Stephen is a senior seeking his B.S. degree in Mechanical Engieering at the FAMU/FSU College of Engineering. Being the chassis designer for SAE Baja 2014-2015 vehicle and SAE Senior member, he brings a lot to the table with the structure and safety of the project.

**Alejandro San Segundo:** Alejandro is a senior seeking his B.S. degree in Mechanical Engieering at the FAMU/FSU College of Engineering. With past professional and leadership experience involving fast paced professional environments, his skills bring a strong contribution for the Pedibus project. Alejandro also has a strong background in cycling and ergonomic design, which is a large majority of the Pedibus project.

**Brett Willenbacher:** Brett is a senior seeking his B.S. degree in Mechanical Engieering at the FAMU/FSU College of Engineering. With track courses in both vehicle and machine design, he helps bring the transportation aspect of the project to life.

Table of Contents

I. INTRODUCTION

II. PROJECT OVERVIEW AND CHANGES

[A. NEEDS STATEMENT](#h.2et92p0)

B. PRTOJECT GOALS AND OBJECTIVES

C. SPRING 2015; SEMESTER OBJECTIVE

[III. FALL SEMESTER OUTCOMES](#h.4d34og8)

[A. CHALLENGES ENCOUNTERED](#h.2s8eyo1)

[B. LESSONS LEARNED](#h.17dp8vu)

[IV. PROCUREMENT](#h.26in1rg)

A. WORK SCHEDULE AND GANTT CHART

B. RESOURCE ALLOCATION

V. FINAL CHANGES TO PEDIBUS DESIGN

[REFERENCES](#h.1ksv4uv)

[Appendix A](#h.44sinio)

TABLE OF FIGURES

Figure 1. *Detailed Pedibus team Gantt chart for Fall 2014*

# PROJECT OVERVIEW

In response to the finalized product that was delivered last year, the Pedibus senior design project has been assigned again for the 2014-2015 school year. The sponsor has instructed the current team assigned to this project to design and fabricate another fully functional, multi-user, pedal powered vehicle called the Pedibus 2.0 (v). The scope of the project is to have a fully functional product by Springtime Tallahassee, thus the team received the date of March 14, 2015 as a completion date constraint. The sponsor and owner of Capital City Pedicabs, Ron Goldstein, has given the team minimal design constraints and has allowed the group with almost unrestricted creativity for the design. Mr. Goldstein plans to add the Pedibus to his fleet of pedal powered vehicles, with hopes to increase his exposure.

Several design considerations have been determined from pre-existing models of this vehicle. However, the team plans to integrate numerous new design ideas not seen in the market before. The final product must be simple and rugged in nature to ensure minimal maintenance and optimal functionality. The design and build will be oriented around maximizing potential revenue sources. The potential business model for the implementation of the Pedibus has been discussed wityh the sponsor and the designs have been created in consideration with Mr. Goldstein’s business plan. The Pedibus is planned to serve as an entertainment venue around the city. A modular design will be adopted in order to allow the sponsor freedom to expand the use of the vehicle across many demographics. This modularity will help provide additional revenue and exposure for Capital City Pedicabs.

# DESIGN CHANGES

## NEEDS STATEMENT

The Pedibus project is sponsored by Ron Goldstein, owner of the Capital City Pedicabs. The sponsor wants to have a fully functional multi-user bike in order to institute a new business model to the city of Tallahassee (iv). While this project was completed by the previous team, the product that was delivered was not satisfactory. Many of the design objectives originally set in place by Mr. Goldstein, were not met. This led to the sponsor having to hire a third party fabricator in order to complete the vehicle (iv).

*“Currently, the sponsor is without a usable vehicle to support this new business model.”*

## PROJECT DESIGN CHANGES

The Pedibus senior design team plans to deliver a fully-functional and optimized Pedibus to Ron Goldstein by March 14, 2015. The design requirements stated last semester still remain the same. These requirements are listed below:

1. Accommodate a minimum of 10 occupants powering the vehicle
2. Accommodations for additional occupants, other than those powering the vehicle
3. Simple construction for easy maintenance, fabrication, and reproduction
4. Ability to be transported by a standard full-size pickup truck
5. Modular accessories to allow for accessory expansion post-fabrication
6. Able to transverse a 8% grade comfortably

Although the project requirements have remained untouched, three major design changes have been made to the Pedibus throughout the evolution of the project. These changes were made in order to meet all project requirements stated by the sponsor at the beginning of the semester. These design changes, along with a brief explanation for the alterations, are listed below:

1. Frame width alteration; the geometry and dimensions of the Pedibus frame were altered in order to shorten the total width of the vehicle to a magnitude below 102in. This was done because of the Florida Law Statutes for street towing, which states that the vehicle must not surpass 102 inches in width. The team was able to do this by simply altering the dimensions of the frame by a small margin, relocating the positioning of the pedal cranks, and shortening the width of the bar area by two inches. The new design meets the width requirement while still maintaining the ergonomics desired by the sponsor.
2. The team replaced the torsion bar components to a full torsion axle. This will allow for the mounting of electric brakes, which is extremely desired for towing safety purposes. This will also allow for a more robust towing platform which will ensure both safety and long term reliability.
3. The size of the rear brakes have been reduced from the original size of ((())) to a smaller diameter of ((())). This was done in order to accommodate clearance with the ground while the vehicle is being towed. This will ensure that when the torsion axles flex to absorb road imperfections the disc brake assembly will not make contact with the ground under any circumstance and thus keeping the rear brake system undamaged.

### UPDATED PROJECT OBJECTIVES

Though the project objectives and requirements have not altered from last semester, the project work timeline was adjusted in order to accommodate for the challenges faced and resolved last semester. This means that the project specifications and requirements are still the same but the team has had to put in extra hours of double time work in order to maintain the build on schedule. The updated timeline objectives for this semester have changed, now the team expects to have a fully build functional Pedibus by the end of the month of January and complete all mechanical testing on the vehicle by mid February. This gives the team over a month to optimize the design and put the final touches on the build.

# FALL SEMESTER OUTCOMES

## 

## CHALLENGES ENCOUNTERED

Throughout the semester several challenges were encountered, both at a project development and intrapersonal team relations level. The project challenges that the team has encountered have currently been all resolved. These challenges included meeting all the Florida Towing Law requirements while maintaining the vehicle ergonomics and the overall project requirements. These challenges have been resolved and the resolutions are specified in the project design changes section above.

Aside from design challenges the team faced small intrapersonal challenges that we have been able to fully resolve. The main challenge the team overcame was lack of efficient communication. This has been resolved by challenging ourselves to communicate more and learn each other’s styles of leadership and work ethic. This has allowed for more effective communication with higher levels of understanding within the team. Another challenge that the team faced was being able to collaborate as a group and meet consistently despite of our very different rigorous schedules. The team has successfully tackled this challenge by making our entire schedule available to each other via Google Drive. This has allowed us to coincide on meetings times and create a more successful team environment.

## LESSONS LEARNED

Upon overcoming all the challenges the team faced last semester, several lessons have been taken away. Stronger, more direct communication has been put in place, which was noticed to be incredibly important. The design changes the meet all Florida Towing Laws requirements were also a massive challenge and the team learned lessons regarding design evolutions to match law enforcement requirements. The main lessons taken away from last semester was the necessity of an organized team schedule in order to successfully collaborate of the project and the necessity of a rigorous timely in order to keep the project on track for completion in a timely manner.

# PROCUREMENT

## COMPONENT PROCUREMENT

With the progress of design for the Pedibus, many components are constantly being sourced. With the time constraints of the project the components are sourced and ordered using Amazon.com to help bundle buy parts and avoid individually sourcing from separate companies. The site also proves to have the best price over competitors. With the completion of the Pedibus, a list of local vendors for each component will be provided to the sponsor to eliminate shipping costs and time. There have been no issues with the sourcing, ordering, and acquisition of the components. As seen below in Table ???, the total price, order date, and delivery date is recorded for each part. As the semester continues, some other components such as wheels/tires, axles, and benching components will need to be ordered.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Part | Brand | Price Per Unit | Quantity | Shipping Price | Total Price | Order Date | Delivery Date |
| 2x4x1/8 Construction Box Steel (A500) | N/A | $84.48 | 3 | $5.00 | $258.44 | 11/19/14 | 11/21/14 |
| 2x1x1/8 Construction Box Steel (A500) | N/A | $58.56 | 8 | $5.00 | $473.48 | 11/19/14 | 11/21/14 |
| 6 Speed Transaxle | Peerless | $697.00 | 1 | $39.00 | $736.00 | 11/25/14 | 12/3/14 |
| Floor Mount Brake Pedal | Wilwood | $59.27 | 1 | $0.00 | $59.27 | 11/19/14 | 11/24/14 |
| 1" Bore Master Brake Cylinder | Wilwood | $48.05 | 1 | $0.00 | $48.05 | 11/19/14 | 11/24/14 |
| 5-Hole Brake Drum | AL-KO | $34.95 | 2 | $20.25 | $90.15 | 11/19/14 | 11/24/14 |
| 10" Trailer Electric Drum Brake (Left & Right) | TruRyde | $67.90 | 2 | $0.00 | $135.80 | 11/19/14 | 12/6/14 |
| Rubber Torsion Trailer Axle | Reliable | $249.99 | 1 | $50.70 | $300.69 | 11/19/14 | 11/25/14 |
| Trailer Spindle (#84) | Shadow | $44.33 | 2 | $9.50 | $98.16 | 11/19/14 | 11/28/14 |
| Spindle Bearings | Western Prime | $12.95 | 2 | $3.50 | $29.40 | 12/3/14 | 12/6/14 |
| 10" Trailer Disc Brake Assemblely (1 Axle Kit) | Kodiak | $237.95 | 1 | $26.50 | $264.45 | 11/19/14 | 11/24/14 |
| Bicycle Crank | Retrospec | $35.99 | 10 | $0.00 | $359.90 | 11/19/14 | 11/26/14 |
| Bicycle Pedal | Coromose | $11.31 | 10 | $1.00 | $114.10 | 11/19/14 | 1/12/15 |
| Bicycle Bottom Bracket | Sunlite | $15.20 | 10 | $0.00 | $152.00 | 11/19/14 | 11/26/14 |
| Bicycle Free Wheel | Shiamno | $24.65 | 10 | $0.00 | $246.50 | 11/19/14 | 11/25/14 |
| Bicycle Chain | KMC | $7.37 | 12 | $0.00 | $88.44 | 11/19/14 | 11/25/14 |

|  |  |
| --- | --- |
| **Total Price** | **$3,454.83** |

## PROGRESS

Since the fall semester, our team has made much progress on both the design and fabrication factors of the Pedibus. The entire steel frame of vehicle has been cut and welded. This includes the base, flooring, bench posts, and bartop. To ensure precision in the fabrication of the frame, custom jigs were built to hold the cut steel parts while being tacked in place.

While the frame was being fabricated, further Solidworks design on the project also took place. The ergonomic bench design was finalized to ensure comfortable and safe riding for the passengers. The steering system of the Pedibus was also finalized using the vehicle design background knowledge from our team members and it is currently under fabrication. Finally, the drivetrain system of the project was carefully analyzed and designed to bring an efficient torque to the transaxle. The entire design has been fully completed and it is now under the fabrication stage.

1. SPRING WORK SCHEDULE

# CONCLUSION

Senior Design Team #22 has made significant progress on the Pedibus project. Many design changes to the various subsystems have been implemented throughout the fabrication process of our project. The team has finalized the design and has taken a large step into the fabrication process.

At this point a schedule for completion has been determined and tasks have been assigned in order to move forward on the project. This methodology is set in place in order to make sure that the project is completed, affectively, by the deadline of March 14th, 2015.

For the remainder of the project duration, the team plans to not only complete the fabrication process but also finalize all testing and optimization for the vehicle. All subsystems for the vehicle have been sourced and purchased. Final touches on the fabrication process will take place over the next couple of weeks. The Pedibus team expects to have the entire project completed by the end on the month and which point mechanical testing will begin. Upon completion of the product, the team will utilize the rest of the spring semester to compile a complete fabrication packet that will be handed to the sponsor by the end of the semester. This packet will contain all necessary specifications needed in order to recreate the vehicle at any external, third party machine shop. The project is currently on schedule for timely completion despite the setbacks and design changes that have been encountered throughout the project.

# REFERENCES

# **Appendix A**