Project Proposal

Go-Kart for Shane Davis

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Executive Summary

Shane Davis is a 21 year old whom has been diagnosed with cerebral palsy and spastic quadriplegia. His family has asked The University of Connecticut’s Biomedical Engineering program to design and create a custom go-kart for Shane to operate. Shane is unable to use a conventional go-kart because of his weakness in all four limbs; therefore it is our job to assemble a design that will suffice him. To accommodate for his condition, a custom go-kart is going to be designed with certain technical specification to ensure he will be able to operate it. Our group will try to best model Shane’s custom made wheelchair when designing this go-kart. An electric joystick and an arm rest, both of which will be similar to the devices on his wheelchair, will be used to allow Shane to comfortably drive the go-kart.

The key feature on Shane’s specialized go-kart will be the joystick. The joystick will have to be able to complete several different tasks, making it one of the most important components. We expect the joystick to allow Shane to drive in any direction as well as alter his velocity based on the force he is applying to the joystick. It will be our job to completely fix this go-kart and allow Shane to be able to become more active outdoors.

1 Introduction

1.1 Background

The client is Shane Davis, a 21 year old male with cerebral palsy and spastic quadriplegia. Spastic quadriplegia is a form of cerebral palsy in which all the four limbs are affected. The condition is referred to as spastic rather than paralysis because the patient has some movement in all four of his limbs. Spastic is the tightness of skeletal muscle, which leads to imitation of his movements. Spastic quadriplegia can vary in severity. A person with moderate quadriplegia may be able to walk with a walker, unlike a patient with severe quadriplegia. Shane also has very limited hip movement and strength combined with severe quadriplegia which limits his movement to the wheel chair.

Besides his limited movement, Shane is a typical college kid. He is an intelligent and energetic person. Shane wants to experience everything that life has to offer. He currently attends Manchester community college and loves extreme sports. He often visits Colorado during ski using a wheel chair. Shane is a very brave person and loves to push himself to the limit.

1.2 Purpose

This project will provide Shane with a vehicle that he can use recreationally and also allow himself to enjoy the outdoors. In addition to adding amusement, the vehicle will serve as a rehabilitation tool and can increase Shane’s mobility. This go-kart will be customized specifically for Shane in order for him to use the vehicle efficiently. This project will help Shane experience something that other kids his age take for granted and will provide him with safe movement outdoors.
1.3 Previous Work Done by Others

In 2011-2012, three UConn students, Brahmatej Meka, Raymond Songer and Jeff Marcelus, attempted creating a specialized go-kart for Shane Davis. The students were almost successful; however their finished product had some imperfections that need to be fixed. Our group will use their original design and frame, but alter anything that we feel is not correct or up to standards. It will be our job to redesign and reconfigure the project to ensure Shane that will finally have his go-kart.

1.3.1 Products

One of the earliest projects (NSF project) that constructed vehicles for disabled clients started in 1994, by State University of New York-Buffalo. The vehicle was called an Electra-Scooter. The device mounts to a wheelchair and allows it for simple movements such as circular movement and forward and reversal movement. This device allowed the user with very little control once it was secured to the platform. The cost of the Electra-Scooter was approximately $900.

In 2008, and 2001 electric go-karts, named the “E-racer”, were designed so that they could be controlled with an electric joystick. The 2008 E-racer used a steering wheel with switch controls, so the go-kart could be operated completely by a joystick similar to that of an electric wheel chair. Electric go-karts were produced at a much cheaper rate than that of a gas go-kart. The electric go-karts described above were produced at a cost estimated to be around $2,500.

Several products and projects have been designed to meet similar requirements to those stated in this project. Some of these projects have been implemented through the Biomedical engineering department at the University of Connecticut. In 2009, a go-kart was built for a child with restricted mobility. The go-kart was built on three controls, a joystick, a remote control, and a steering wheel. The engine of the cart was gas-powered, and had power steering, power braking and power throttle. The total cost for the design was estimated to be around $7,300.

In 2010, a go-kart was designed and produced for a boy with cerebral palsy and global apraxia. The go-kart has two sets of controls. The first control is responsible for the steering, speed and breaking of the go-kart. The second control consisted of “jellybeans like” buttons in order to ensure easy control for the client. The cart was battery covered and the cost was approximately around $3,000.

There are also many viable go-karts available for children with disabilities. Mobility4Kids makes customizable go-karts (berg go-karts) for kids with a many disabilities. Another product designed by Mobility4Kids is called The Boss. This car is used for a dirt track racing and uses a joystick as its primary steering. The cost of the two karts described above is between $5000 to $7000.

Child’s Vehicle by Tetra Society of North America makes go-karts use joystick for primary steering. This joystick is designed for kids with very limited hand movement such as cerebral palsy.

1.3.2 Patent Search Results

In 2002, Keith Alan Robert patented a go kart design and it combines the throttles, brake and steering into one column. This design allows for a single handed control of the vehicle (Handi-
Driver), which allows people with even the most severe disabilities to drive with ease. The design includes a kill switch that can stop the go-kart in case of an emergency.

2 Product Description

2.1 Objective

The following limitations/preferences must be met by this project based on preliminary interviews with the client:

1. There should be a unique seating system in-order to help Shane have an easy access to the go-Kart.
   
   A. Seat must contain a five-point harness to support and stabilize Shane.
   
   B. Seat must have armrests with a joystick on the right side and shifting throttle on the left side.

2. Joystick of the go-kart should be similar to one on Shane wheel chair.
   
   A. The joystick must be able to control and move the car like a traditional steering wheel.
   
   B. The joystick must be controlled by using an electric motor similar to the one on Shane’s wheel chair.

3. The go-kart should have a hand brake system rather than a leg brake system and a kill switch in case of emergency.

4. Go kart must have a roll cage.

5. Go-kart must have wide-ranging suspension system and tires capable of operating off-road.

6. There must be a top speed of the go-kart must be at-least 35 plus, so a 150cc gas engine must be used.

2.2 Methods

Shane’s go-kart will have many specialized features that one will not find on a normal go-kart. Our job, it to examine and test the current go-kart and modify anything that the client does not believe is up to their standards. There is already a pre-existing go-kart design, and the vehicle is able to drive. However, the client has deemed it too unsafe for himself and it will be our job to make him feel safe. We will add any more specifications or requirements that the client wants, as well as, alter or get of rid any pre-existing features they do not want. The following will describe each major aspect of the cart that has to be taken into consideration when building this go-kart.
Engine

The go-kart will be equipped with a 150cc 4-stroke gas powered engine. The engine is of single cylinder arrangement and will have a maximum horsepower of 8.5 at 7500 revolutions per minute. This engine can reach a maximum speed of 35MPH and it will also be air cooled. The starting system for the engine is electric and will have a fuel capacity of .95 gallons. The oil capacity of the engine will be 20oz.

The go-kart will need this type of engine because the modifications that will add a considerable amount of weight to the go-kart. The engine will need to have enough power to pull the weight of the go-kart and driver and also allow the client to drive as fast as his heart desires.

Chassis

The chassis will be made up of high strength tubular steel ranging in size from .75 inch diameter tubes up to 1.5 inch diameter tube for the main structure. The brakes will be controlled by a hand unit on the left side of the cart. Both the front and rear brake assemblies will be identical with single piston calipers gripping a 6 inch disc. This setup will allow the cart to slow down and come to a complete stop quickly and safely. The kart will be equipped with full suspension to keep the ride as smooth as possible for Shane. The front wheels will be completely independent with 4-6 inches of travel, with the live rear axle having about the same amount of movement. The tires will be large and wide allowing for off-road travel. Front and rear tire dimensions will be the same at 18 inches tall and 8 inches wide, giving the go-kart a solid footprint.

The dimensions of the go-kart are very important. It needs to be long enough and wide enough to minimize the chance of a roll over, but it also needs to have a full roll cage assembly built around the cockpit. Final dimensions will have the kart at approximately 87 inches long and 60 inches wide with a wheel base of 64 inches. The roll cage will be built around the entire cockpit and will make the kart 58 inches tall when complete. When all is said and done the go-kart will have a load capacity well exceeding our clients’ needs and will weigh in at about 600 pounds.

Seats

The seat that will be used for this project has to comply with our clients current needs. It needs to be well cushioned and form fitting to maximize the comfort of our client while also maximizing safety. On either side of the seat there will be arm rests. The left arm rest will house all of the controls for the go-kart while the right arm rest will have a padded loop to keep his right arm stable. The seat will also include a five-point safety harness to keep the client in the proper driving position while operating the vehicle.

Harness/Safety

In the go-kart there will be a number of added safety features for the comfort and well-being of the client. The original go-kart will come shipped with a two-point restraint system but we plan on changing it to a five-point safety belt. Also, since the client has very little to no use of his legs, the go-kart will be modified in such a way to stabilize his legs and torso in order to keep them from freely moving during the driving of the go-kart. Another safety feature that will be added and modified is the roll bar feature on the go-kart. This feature is needed in order to protect the driver in the case of the go-kart flipping over or even protect the driver from any type of collision. The roll bar
feature will be an added level of making sure the client stays inside the go-kart while driving after the restraint system.

**Electrical**

In order for the cart to run properly, major changes will need to be made to the electrical system. The gasoline engine will employ an electric start feature so the client can run the kart on his own without being worried about stalling and not being able to restart the motor on his own. In place of a conventional steering wheel an electric motor with a torque converter will be tied in to the steering column and operated by a joystick. This motor will need its own battery source, so an additional battery will be placed onto the go-kart. A kill switch will also be used to shut down the entire kart in the event of an emergency. All controls will be within range on the left side of the kart.

**Steering System**

The steering system is very unique. Instead of a steering wheel, there will be an electric motor attached to the steering column. There will also be a torque converter used in conjunction with the motor that will allow for a controlled left/right steering movement. The motor will be controlled by a conventional joystick which can be found on most electric wheel chairs. When the client pushes the joystick to the left, the front wheels will turn to the left and vice versa for a push to the right. This motor will be constantly moving back and forth so its durability is extremely important. It will also need its own power source, i.e. another battery, to make sure that there is no chance of the steering failing on the client due to no power.

**On-board Control Panel**

The control panel will be as simple as possible. The main three features will include a joystick for steering; a throttle modulator to control speed, and a hand controlled braking system to slow the go kart down. In addition to that there will be a kill switch to shut the kart down in the event of an emergency along with a starter button to start the motor. A transmission switch will also be available to shift the go-kart from drive to reverse.

**Arm Rests**

The armrests are a very important feature of the seat. The client is confined to an electric wheel chair with armrests that pivot at the attachment point. The left armrest has the joystick, which controls the movement of the chair. The armrests that are going to be employed on the go-kart are going to be very similar. All of the controls will be housed on the left armrest and the right arm rest will have a padded loop for the client to brace his right arm in. Unlike the wheel chair the go kart will have a locking mechanism on each arm rest to keep them secure while in use. The armrests will also be much sturdier and made out of heavier materials.
**Joystick**

The joystick used on the current go-kart models the joystick on Shane’s specialized wheelchair. The joystick needs to be able to move the go-kart in the positive and negative X and Y axis. Also, the ability to control the speed of the vehicle should be dependent on the force applied to the joystick. The current joystick use on Shane’s vehicle is too sensitive for the user and we need to lower the sensitivity to ensure safety.

**Drive Train**

The transmission will be automatic and will also allow the driver to go into reverse. The engine’s power will be transferred to the go-karts wheels by the way of chains connected to the rear axle, thus making this go-kart rear wheel drive. The chain will be connected to a live rear axle and final gearing will allow us to maintain a proper top speed so that the client does not injure himself.

3 **Budget**

For this project, there are no needed materials. As of now, we already have all the parts and specifications that are required and it will be our job to use all the previous parts to make the go-kart work properly. However, as we begin to work more in depth, our group may have to purchase products that we feel may be damaged or are not working properly anymore.

4 **Conclusion**

Shane Davis is diagnosed with cerebral palsy and spastic quadriplegia. Everyday Shane faces numerous challenges that most of us take for granted ad we do not realize how fortunate we are. The client has asked the UConn Biomedical Engineering program to create a specialized go-kart for Shane to use recreationally. This vehicle is going to have to be more advanced than a normal go-kart in order to meet the specifications given by the client. The budget for this project should not be an issue because our group plans on using all existing materials and components.

Last year a go-kart was designed and built for Shane, however it was deemed unusable by the client. Our group will take this existing go-kart and make any necessary changes until the vehicle meets the client’s requirements. Shane will have a specialized go-kart to drive for the summer of 2013. It will be our pleasure to ensure that he will be able to have fun outdoors as well as being completely safe.

5 **References**