Project Proposal
Team 3- Go-kart for Shane Davis

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Executive Summary

The goal of the project is to design and assemble a custom go-kart for 20-year-old Shane Davis, who has cerebral palsy and spastic quadriplegia. His is unable to use a conventional go-kart due to his lack of movement in his four limbs. To accommodate for his condition a custom go-kart is going to be designed using an electric joystick and an arm rest that models his wheel chair joystick and armrest. The joystick is going to be specialized in order to provide all the movements of a conventional steering wheel. A throttle modulator will also be included to help the client change speeds. A handbrake is going to be used rather than a leg brake and a kill switch will be installed in order to stop the vehicle in case of an emergency.

To ensure safety a roll cage will be installed on the cart in order to prevent injury in case of an accident The go-kart also would have 5-point harness system and adjustable seating for easy access to the client. The client requested a multi-terrain vehicle for off road driving. In order to make a durable vehicle, a gas motor will be used along with an electric starter to ensure an easy start of the vehicle. A gas motor will reduce the torque while increasing the power of the vehicle as the client requested. The final product will provide a go-kart that is more customized for our clients needs in-order to ensure a safe and fun vehicle.

1. Introduction

1.1 Background

The client, Shane Davis, is a, 20-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 does have some movement in all 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 even with his condition.

1.2 Purpose of the project

The go-kart can increases the mobility of our client. This project will provide a vehicle that can help him go off-road and experience the outdoors like never before. This go-kart will be a very durable vehicle and in order to do so, a gas engine will be used. This gas engine will reduce the torque of the vehicle and increase the power. This go-kart will be customized specifically for Shane unlike a traditional go-kart in order to attend his needs and provide him the best possible experience. To conclude, this project will help Shane experience something that other kids his age take for granted and will provide him with safe mobility outdoors.

1.3 Previous work done by others

1.3.1 Products

One of the earliest project (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 for the Electra-Scooter was about $870.
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 Roberts patented a go-kart design and it combines the throttle, 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 sever disabilities, drive with ease. The design includes a kill switch, which can stop the go-kart in case of an emergency.

2. Project 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

The go-kart will have many different components, which will not be found in a normal go-kart. During this project we will not be building a go-kart from scratch but rather we will buy a specific go-kart and modify it to meet all of our clients needs. There will be changes made to all major aspects of the go-kart including the mechanical, electrical, and physical components. These components have been partitioned into subgroups below where explanations of these modifications will be in more detail.

Due to Shane’s limited mobility the go kart that will be built shares all the major aspects of a regular go kart with major modifications to the throttle, steering, and braking controls. The undertaking of this project is huge, so instead of designing and building the chassis and working parts of the go-kart, one will be purchased and modified. All the work that will need to be done to achieve a working final product has been divided into groups, which will allow our team to work methodically and efficiently. (Something I threw together)

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.
**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 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.

**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 axel 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 more sturdy and made out of heavier materials.

**Joystick**

Due to the forces that the joystick will need to endure, i.e. hard turning and pulling, a beefed up unit will need to be used. It is still unclear how much the joystick will need to do. If it is just for steering the unit can be modified for a linear left to right movement, which will in turn allow the front wheels to turn left and right. If the joystick is used for the throttle there will need to be more adjustments made to allow the joystick to handle the beating.

**Budget:**

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<th>Product</th>
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Conclusion:

This project will help the client explore the outdoors like never before. This will help him become more active and enjoy things that other kids take for granted. The go-cart is going to be designed by using a gas motor along with a electric starter to increase the power of the go-kart. The cart will be designed with adjustable seating so Shane can access the kart easily. The cart will be designed using three controls, the joystick as a steering wheel, throttle for speed changing and a hand brake. It will also include safety measures to ensure that Shane is protected during an emergency. A roll cage is going to be installed incase of roll over’s and a kill switch will be added to stop the car in case of an emergency. A five-point harness will also be installed so that Shane is stabilized during the ride.

The go-kart will be specialized especially for Shane so that he can enjoy the go-kart to the fullest. It will also include suspensions so Shane can go off-road and the 150 cc gas engine can help the go-kart reach speeds of 35 plus. This kart will go beyond what Shane has been used to and it will change his life for the better.