Final Report:
Travel Computer Mount

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Project for NSF

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Abstract
The travel computer mount is specifically designed to safely secure the Dynavox Vmax computer into a vehicle. The system attaches to the front passenger seat headrest bars using a unique vice system. The vice is connected to a steel frame to put the computer in view of the user and to distance the computer from the seat. The Daessy folding quick release base will be attached to the framework to connect the computer to the mounting system. The base will allow the computer to be tilted to the optimal viewing angle for the user. The computer is easily detachable from the mounting system to ensure easy usage and portability. There are no other devices on the market to adequately secure the Dynavox computer while traveling in a vehicle. Therefore, this system will allow for the computer to be used during travels and thus guarantees communication for the user during this time.

The production of the device will be funded by The National Science Foundation Engineering Senior Design Projects for Persons with Disabilities (NSF).

1 Introduction

1.1 Background
The various assistive devices on the market are making it easier for those challenged with physical disabilities to be active. Assistive communication devices such as the Dynavox Vmax allow people to express themselves, whom otherwise could not. An individual’s communication skills may be affected by a number of conditions including cerebral palsy. The communication device works great when the user is sitting at a desk; however, it remains very difficult to travel with the Dynavox.

The client has a severe case of cerebral palsy and expressed a need for a travel mount in order to have access to his Dynavox Vmax while in the car, thus enabling him to communicate away from his desk. There remains no product on the market, which would support the Dynavox in a moving vehicle. A Dynavox Vmax vehicular mount would help the client and others. The mount design could also be modified to support other electronic devices.

1.2 Purpose of the project
This mount will allow for the use of the Dynavox Vmax in a vehicle. The device will keep the computer stable, so that Sean can use his assistive communication software to help him communicate with others during travel in a car. Safety in the event of an accident is a major concern and will therefore be a key factor in the design. The device will also allow for adjustment of the position of the Vmax so that the user can place it into the best location for use. This mount will also be versatile by being able to be used in any type of motor vehicle. This will be accomplished by using an attachment point for the mount, which is present in all types of motor vehicles. The device will also allow for easy detachment of the Dynavox Vmax upon arrival of destination. This device will completely meet our client’s needs by allowing Sean’s Vmax to be safely and effectively used in any type of vehicle.
1.3 Previous Work Done by Others

1.3.1 Products

There have been many products made to support computers, televisions, GPS systems, etc. in the car; however, mounting an assistive communication device presents a new set of challenges. First, the mount must be set up so that a passenger in the back seat of the car could use it. Also, the mount must sufficiently secure the Dynavox Vmax, but it should still be easy for the user to detach and reattach it. Finally, because Sean sits in a supported seat in the car, there is less space for the computer mount, so the design should be compact.

The RAM Mounts company (which stands for “Round-A-Mount”) offers a wide variety of vehicle mounts for electronic equipment. The name comes from the ball and socket joint which gives the mount such versatility. The RAM laptop tray utilizes the passenger seat rail bolts for points of attachment, and can be positioned for the driver’s use. The tray is specifically designed to absorb shock and vibration. The ‘RAM tough dock’ has a trademarked design, and is built with either high-strength composite or light-weight aluminum. There is also a tamper-free lock built into the mount for theft prevention1.

The Chevrolet Astro Jotto Desk Mobile Computer Mount is very similar in design to the RAM laptop tray. The Jotto Desk also fastens to the passenger front seat bolts specifically in the Chevy Astro van (models 1997-2007). The laptop can be secured to the mount with the patented Cable Dock(R) mechanical lock down mechanism.

The tablet computer mounts available by RAM Mounts are designed for flat screen computers, like the Dynavox Vmax. These mounts include a cradle for the computer with a ventilation system to keep the computer cool, and a specialized design to avoid ports. These mounts can also be attached the passenger seat rail bolts like the laptop trays, or come with large clamps to attach to a larger variety of places, such as the back of the passenger’s seat1.

Headrest LCD screens such as Sony’s 6.25” Widescreen LCD Headrest Monitor, on the market are compact and allow easy access by the passengers in the back seat of the car. The product is comprised of headrest housing and a mounting plate. They are designed for the permanent placement of a screen, and professional installation is recommended. This product can be purchased from electronic stores for $250-300.

The registered Insignia-Mobile DVD Player with 9.5” Overhead LCD Monitor, can be flipped up to be housed along the roof of the car, and down so that the screen is visible to the passengers of the vehicle. This product is also meant for permanent installation and professional installation is strongly recommended. The device (including the LCD screen) is sold at Best Buy for approximately $500.

The only design made specifically for an assistive communication device seems to be the NSF project designed by Norman Haidous of Wayne State University. This was designed for a communication device with the same physical measurements as the Dynavox Vmax, and allowed the user to access the communication device while lying or sitting in bed. The device employed an adjustable camera tripod arm to reach over the bed, and a traditional hospital over-the-bed table as a support. Camera
tripod and communication device brackets were used to stabilize the device. The design uses relatively inexpensive materials (including wood) and overall costs were under $300.

Another noteworthy NSF project designed by Nicolas Buraglia and David Franklin of Duke University was a mount for a Dynavox that could be attached to a saddle, for access while horseback riding. The design implemented a Daedalus quick release base, specifically designed for the Dynavox. A commercial cymbal stand was modified to hold the device and clamps were used to secure the device in place on the saddle⁶.

Other NSF projects dealt with the stabilization of communication devices but were less relevant. A communication device for an automobile must be able to endure higher stresses considering its environment, than traditional mounts.

### 1.3.2 Patent Search Results

The Daessy Total Quick Release Base by Daedalus Technologies, Inc. is a quick release device made specifically for the mounting of communication devices. The Dynavox Vmax is made to support Daessy mounting plates. The quick release mechanisms secure the device in place, and allows for a quick detachment. The quick release mechanism is extremely useful given the nature of the communication device. The device makes traveling with the communication device much easier and communication during travel possible for those who require it.

One relevant patented design is the “Flat thin screen TV/monitor automotive roof mount”, US Patent: D467562. This design allows for the screen to be flipped up so that it lies along the roof of the car, or down so that it is visible to the passengers of the car. The screen can rotate 180 degrees about the z-axis, and another 60-90 degrees about the y-axis. Self-tensioning hinges are implemented to hold the screen in the desired position. This patented design is similar to other overhead television consoles; the main difference is the 180 degree rotation. This element makes the product safer in the case of an accident. In the event that a passenger is thrown into the screen, it will easily rotate upwards to lie flat along the roof.

Another patent for a “Notebook computer with height adjustable display unit”, US Patent: 7400498, may also be useful in the implementation of the Dynavox mount design. This design utilizes two saw tooth arms and a locking mechanism to allow the user to adjust the height of the laptop screen, and then to secure it in place. A similar mechanism would secure the Dynavox Vmax in place, but still allow the viewer to adjust it to a desirable position⁴.

One last noteworthy US Patent is number: 6466278, for attaching flat-screen appliances to the underneath of a cabinet or similar structure. The appliance allows the screen to be flipped up to lie underneath the cabinet, and utilizes a universal pivot mechanism so that the screen can be tilted to the desired position. The screen is able to make a full rotation around the y-axis. The screen is held in the desired position by the frictional force, which is variable in the design.
The following report will provide a detailed description for the travel computer mount. It will discuss three generated possible options for the device including a system attached to the user’s car safety seat, a system attached to the metal framework under the actual seat of the car, and a design to connect the mount to the front passenger seat headrest. The designs were created based on the specifications of the project but also to fit many constraints such as economic, environmental, social, political, ethical, health, safety, manufacturability and sustainability. From the alternative designs, an optimal design was chosen based off the third possible design and altered to create the best design possible.

1.4 Map for the rest of the report

The following report will provide a detailed description for the travel computer mount. It will discuss three generated possible options for the device including a system attached to the user’s car safety seat, a system attached to the metal framework under the actual seat of the car, and a design to connect the mount to the front passenger seat headrest. The designs were created based on the specifications of the project but also to fit many constraints such as economic, environmental, social, political, ethical, health, safety, manufacturability and sustainability. From the alternative designs, an optimal design was chosen based off the third possible design and altered to create the best design possible.
The final optimal design is further discussed in great detail. The subunits of the device are pictured, described, and proven to work through mathematical force analysis as well as material strength calculations.

In addition to the design of the device, the budget is discussed. The prices and quantity of the parts of the system are laid out.

The report also includes a complete list and description of the realistic constraints and safety issues of the device. Additionally, the impact of engineering solutions and life long learning of new material while creating this device are discussed.

A Microsoft Project time line is also incorporated into the report. This lists a timeline of task completion. There is also a list of individual contributions to the project from each of the team members.

2 Project Design

The various assistive devices on the market are making it easier for those challenged with physical disabilities to be active. Assistive communication devices such as the Dynavox Vmax allow people to express themselves, whom otherwise could not. The client has a severe case of cerebral palsy and expressed a need for a travel mount in order to have access to his Dynavox Vmax while in the car, thus enabling him to communicate away from his desk. There remains no product on the market, which would support the Dynavox in a moving vehicle. A Dynavox Vmax vehicular mount would help the client and others. The optimal design was compiled from three possible alternative designs, but was based from the third alternative design.

The first alternative design for the travel computer mount will utilize the user’s car seat as a point of attachment. It will also consist of an adjustable arm to position the computer in the best view for the user. Since the user will always be placed in the car seat while traveling in a vehicle, the mount will be attached to the seat itself. A flat surface will be placed under the seat and be secured to the bottom. Since there is padding on the car seat itself, this will not be uncomfortable for the user while sitting in the seat. The surface will be shaped similar to the bottom of the car seat so there is no excess surface protruding from under the seat. However, there will be an extension to the surface on the left side of the car seat. The user’s seat is located in the second row (back seat) of the car to the right of the driver. Therefore, since the user will be getting in and out of the vehicle to the right side of the seat, the extension must be on the left side to not put it in the way.

The arm of the mount will be attached to the extended surface under the seat. The arm will allow for the user to reposition the computer to the best viewing location. It will also allow the mount to be folded and pushed aside when the user is getting in and out or when the user is not in the vehicle. The arm will be made of two metal poles. The material must be sturdy enough to withstand the weight of the computer at all possible angles of usage. The two poles will be connected by a hinge located at one end of each. The hinge will allow the entire arm to bend and stay at the desired angle.
At the other end of one pole (the non-hinge side), a connection will be made to the extended surface under the seat. This will attach the arm to the seat. This connection will connect the arm to a swivel mount that is already on the extended surface. With this attachment, the arm can swing in front of the user or to the side as well as to show the computer screen to other passengers in the car.

The final unattached end of the other pole will be attached to the mounting system for the computer. This end of the arm will enable the user to change the viewing angle of the screen in addition to providing a place of connection from the arm to the computer. The open end of the arm will be connected to a rotating base and tube mount. The Deassy quick release mounting system will be attached to the tube mount. From there, the computer has a quick release plate already located on the back to connect the computer to the quick release mechanism.

The computer is controlled by the user’s head. Therefore, the mount must also be accompanied with a button to use the computer system. The button will be placed in the car seat located near the user’s head while sitting in the seat. However, the installation of the button to the car seat will be permanently placed. It will be embedded into the seat and surrounded by the fabric of the seat for safety.

The second alternative design will allow the user to attach the mount via a heavy metal clamp to the rail underneath the seat in the rear of the car. This will give a backseat passenger full access to the device, while allowing him the freedom to reposition the mount to optimize the viewing angle. The space efficient design will also allow the user to easily fold the mount to lie on the floor of the car while it is not in use.

The mount design will utilize the rails underneath the back seat of the car as a point of attachment. The mount will be secured to the rails with a vice-like clamp that will make attaching and detaching the mount easy. The clamp will be fixed to a metal arm that lies along the floor of the car, which is
attached to a vertical metal arm via a hinge joint. The vertical metal arm will house a telescoping pole that connects to a cylindrical rod that holds the Daessy Quick Release Base for attaching the Dynavox. Figure 2 shows the device installed in a vehicle.

Two sliding links attach the horizontal and vertical arms of the mount. The links will slide in grooves in each of the arms and then lock into place at notches along each groove. The sliding joints allow the user to lift the mount so that it is perpendicular with the floor of the car during use, and to lie the mount flat while not in use. Figure 3 shows the mount in the folded position.

The telescoping poles allow the user to adjust the height of the mount in order to achieve the optimum viewing angle. The poles will be locked in the desired position with a spring-loaded pin. Springs will also be incorporated into the design to absorb shock in the joints of the mount. The poles are shown in figure 3.

The cylindrical rod holding the Daessy Quick Release Base will fit into tight rubber tubing attached to the vertical arm. This rubber tubing will allow the user to reposition the angle of the device via the rod, but will provide enough friction to maintain the mount position in the moving vehicle.

Finally, the Daessy Quick Release Base attached to the cylindrical rod will allow the user to quickly attach and detach the Dynavox. The base fits into the back of the Dynavox and is secured with a spring-loaded pin.

This design therefore satisfies all of the project specifications and should be further investigated.

Figure 7. The Dynavox computer mount on the floor between the passenger seat and the back seat of the vehicle.
Finally, the third alternative design, and similar to the optimal design chosen, will use the passenger seat of a car as a point of attachment. The mount will allow for adjustment of the viewing height of the computer. This design will also allow for a secure attachment which will withstand the forces necessary to keep the computer stable during car travel. This device will be designed specifically for the Dynavox Vmax.

The metal attachment rings seen in Figure 5 will attach the rest of the travel mount to the metal posts of the head rest of the passenger’s seat. The metal rings will be strong to ensure proper function of the device since they will not bend or break. The rings will be easily detach and reattach and will work in any vehicle since head rests are a common feature in all vehicles. The attachment rings will then be attached to the adjustable upper straps. The straps will be a strong fabric material which will
have adjustable buckles. The top end of the straps will have a reinforced loop which will allow the metal rings to fit through it. This part of the device will be responsible for bearing the load of the computer and therefore must be strong enough to support it. There will also be the component which allows for the adjustment of the viewing height. The lower end of these straps will be securely attached to the mounting bar base and will also be responsible for securing the mounting bar. There will be slots between the straps and the mounting bar base which will be approximately the diameter of the mounting bar.

The mounting bar base will serve the purpose of holding key components of the computer mount. The base will be made out of a stiff material in the middle such as a metal or a high-density plastic. This will then be surrounded by padding and fabric, which will take care of any safety concerns associated with the strong-stiff interior. The lower ends of the upper straps will be attached to the front of the base as well as the mounting bar. The lower straps will also be attached to this component. The mounting bar base will be a key component in the device in that it will serve as a point for attaching all of the other device components.

One other key component which will be attached to the backside of the mounting bar base will be springs as seen in Figure 6. The springs will act as a shock absorber for the device. The springs will have to be the appropriate strength for the device and will be selected accordingly. They will have to be attached to the interior of the base and not the fabric to ensure a secure connection. There will be more than one spring and there will be a block on the side of the springs facing the seat which will allow the springs to act as one unit and not individually. There will also be padding on the seat side of the block to protect the seat and further absorb vehicle vibrations.

The adjustable lower straps will be crucial in securing the entire device. Without these straps the mount would swing toward and away from the seat. The straps will made of the same type of fabric as the upper straps and will also have a reinforced loop, which will be at the bottom of the straps as opposed to the top. The loops will allow for attachment of hooks which will be able to attach to the bottom of the seat. The hooks will be chosen since they will allow for easy attachment to the underside of the seat. The adjustable straps on the bottom will allow for securing of the mount without changing the viewing height. This strap adjustment will also allow for adjustment of the force on the springs, which will allow the user to secure the computer mount in an optimal manner for withstanding vehicle vibrations.

The mounting bar is vital to the proper functioning of the device. This bar will be metal and will have to have a diameter which will be compatible for attachment of the Daessy quick release base. The bar will need to be strong enough to hold up to the weight of the Dynavox Vmax and should not bend or deform due to regular use. The quick release base will attach to the Daessy mounting plate, which is attached to the back side of the Dynavox Vmax. These two components will allow for the attachment of the Vmax to the mounting bar and consequentially to the rest of the mount. These parts will be purchased from Daessy. The quick release base will remain on the mounting bar and allow for a quick and easy removal and reattachment of the Vmax upon leaving and entering the vehicle. The quick-release system is featured in figure 7.
Figure 10. Frontal View of Travel Mount

Figure 11. Side View of Mounting Bar Base.
The optimal design was chosen from the previous three options. The first option (see Figure 6) was decided to be an inconvenience to the user and their helper upon entering and exiting the car. The system was also very bulky and might possibly be hard to remove. There is also an issue with the clamping system to the bars under the vehicle’s seat and the possibility of using the mount in another car. The fit would have to be made to the current car and may not possibly fit into another vehicle.

The second design (see Figure 7) was again very bulky and could possibly be an inconvenience to the other passengers in the car as it would take up the room of the middle back seat. It could also potentially be in the way of the driver’s view if moved into certain locations. The optimal design was chosen based upon option three (see Figure 10) because of the removability and the compactness of the system’s design. It was also decided to be the safest for the user and the other passengers of the vehicle. The system was altered to further increase the benefits of the travel computer mount and is described in further detail in the next section. The figures below show the back of the seat optimal design.

Figure 12. Daessy Quick Release Base and Mounting Plate

Figure 13: Travel computer mount. (Left) Front view. (Middle) Angled front view. (Right) Side view.
2.1 Optimal Design

2.1.1 Objective

The design of the travel computer mount must accomplish several important goals in order to fulfill the requirements needed of the device. First of all, the mount must fully support the Dynavox Vmax computer. It must completely secure the computer in place during travels and therefore must withstand vibrations and large stresses in the event of an accident. Furthermore, the user must be able to remove the computer from the mount easily upon exit of the car while still being able to easily attach the computer back onto the mount when entering the car. The computer mount must be able to fit into the user’s vehicle as well as a variety of different car models to add versatility of the design. In addition, the mount must be properly positioned to the best position for the user. This includes the height of the mount and the viewing angle of the computer. Most importantly, the computer mount must be safe to both the user, the other passengers in the vehicle, and the driver.

To implement these goals, the computer mount’s physical dimensions were measured to ensure proper fit. The mount (see Figure 1) will be located on the back of the front passenger seat and will be secured from the head rest of the seat. This will not restrict the view of the road for the driver nor will it be in the way to the other passengers while it provides for the proper viewing angle for the user. The mount will use an adjustable mounting system to attach the mount to the car but still allow for the mount to be removable. This will also provide for the mount’s placement in different vehicles. The framework of the mount will be made of steel to hold the system’s shape during traveling and in the case of an accident. The two side poles of the framework will hold the Daessy bar as well as the Daessy quick release mounting plate. The mounting plate will be able to swivel about the rod to change the viewing angle of the computer. It will also provide an attachment mount for the computer to the frame of the mounting system. Since the mounting plate is made specifically for the Dynavox computer, the attachment will be firmly fit together. Each of the parts of the system will be further described in detail in the next section.

2.1.2 Subunits

Dynavox VMax Computer

The Dynavox VMax computer provides a way to communicate for disabled people. This is the computer the mount will be made especially to fit. The user is able to work the computer with a head controlled button. There is a speaker which allows the user to comprise words, sentences, and commands and the system will output the sounds the user needs to say.
The Daessy Folding Quick Release base allows for rotation, and will thus allow the user to alter the angle of the Dynavox to achieve the optimal viewing angle. The base provides for the device to be attached to a horizontal tube with six locking positions for quick adjustment of the device’s angle. There is a retractable, spring loaded pin to secure the folding quick release base at the chosen angle.

Daessy Folding Quick Release Base

The 13 in cylindrical rod passing through the Daessy base will be purchased from the Daessy company to ensure a perfect fit, and sufficient mechanical properties. The free body diagram below shows the forces acting on the cylindrical rod holding the Folding Quick Release Base and the Dynavox. The weight of the Dynavox, the quick release base and the bar are labeled Wd, Wqb, and Wbar respectively. The reaction forces at each of the supporting elbows are labeled Rex and Rey.

Cylindrical Rod
Elbow joints

These elbow joints from Daessy are custom made to fit the stainless steel tubing. The elbows will align the cylindrical rod to be perpendicular to the two vertical L bars. The elbows can be easily taken on and off with an Allen wrench. The elbows secure the bars firmly, and eliminate the need for welding or bending. The L bars are 4in tall and 6in wide. The free body diagram figure 17 below shows the stresses acting on the bars. The weight of the upper portion of the bar will be denoted as "Wubar". The weight of the lower portion of the bar is "Wlbar", and the reaction forces at the end of the bar proximal to the headrest are Rbz and Mrb. The height and width of the bars are denoted by hbar and wbar respectively. Figure 18 shows features an elbow joint in the completed design.

\[
Wd = 6.875\text{lbs}
\]
\[
Wqb = 1\text{lb}
\]
\[
\sum F_x = 0 = Re \cdot x - Re \cdot x
\]
\[
\sum F_y = 0 = 2 \text{Rey} - (Wd + Wqb + Wbar)
\]
\[
\text{Rey} = \frac{Wd + Wqb + Wbar}{2}
\]

Figure 16: Cylindrical Rod with Force Equations
\[ \sum M_{rb} = 0 \]
\[ M_{rb} = W_{ubar} \left( \frac{W_{bar}}{2} \right) + W_{lbar} \left( \frac{h_{bar}}{2} \right) + R_{by} y_{h} \]
\[ \sum F_{y} = 0 = -(R_{by} y + W_{lbar} + W_{ubar}) + R_{by} \]
\[ R_{by} = Re \ y + W_{lbar} + W_{ubar} \]
\[ R_{by} \leq 30lbs = 0.294N \]
\[ \sum F_{z} = 0 = R_{bz} \]

Figure 17. Forces acting on the L bars on each side of the mount.

![Image of forces acting on L bars](image)

Figure 18. Close-up of the elbow joint on the lower right corner of the mount.

With the calculated reaction forces at the connection between the L bars and the attachment plates, the corresponding stresses can be analyzed to ensure sufficient strength of materials.

**Attachment Point**

The mount will be attached to the back of the passenger’s seat headrest. This position makes the screen easily viewable to a back seat passenger, without being obtrusive to the other passengers in the car.

The mount will be secured to the metal posts connecting the headrest to the seat. The design will include two metal plates that will clamp down on the headrest post via wing nuts. The L bars of the mount will be welded right to the front clamping plate. The free diagram below shows the stress acting on the front plate of attachment. This stress analysis was necessary to determine the whether the spacing between the pins was small enough to ensure that the system would not fail. The diameter of the pins will be 0.25 in (0.635 cm), the width of the bar \( w \) will be 2.5 cm, and the thickness \( t \) will be 0.635 cm. The maximum calculated shearing stress in the pins was far smaller than the maximum tensile strength of stainless steel, which proves that the system would not fail. The shear force in each of the pins will be denoted as \( V_{pin} \), while \( F_{pin} \) will represent the compressive force of each pin.
Since the plates on either side of the headrest posts are made of the same material and undergo the same stresses as shown in the free body diagram below, the second plate will also be sufficient to hold the Dynavox securely in place.
The bolts will secure the two plates around the headrest posts by wing nuts. Each plate will have this layer of rubber lining the face touching the headrest posts. This rubber layer will maintain a firm grip on the headrest posts with a high coefficient of friction. It will also offer some shock absorption as well as protection between the metal of the headrest posts and the attachment plates. Since the attachment plates use the pressure of the two plates to clamp the unit to the headrest, the mount will be able to fit in all vehicles (providing they have a removable front passenger seat headrest). This allows the mount to still be used if the user purchases a new vehicle as well as provide the mount to be used by all people in a range of cars.

The plates will be different lengths in order to better suit the Stenglein’s vehicle. The front plate is 14in long with rounded edges. There are circular pockets 7/8in in diameter at each end of the plate to fit the L bars into for proper welding. The second plate is only 10in in length, and also has rounded edges. The shorter plate will be facing the passenger. It is shorter so that it is not in the way of the passenger. Three 0.25in holes are drilled in each plate to fit the screws. The holes are centered on the shorter plate, and of-center on the larger plate to accommodate for a “thumb” on the passenger seat. However, the hole aligning will still work in other vehicles. Figure 19 shows the finished attachment plates.

![Figure 19. Attachment plates with circular pockets.](image)

The attachment plates are the final component of the design. Upon completion of the assembly and welding, we were prepared to test the mount in a vehicle.
2.1.3 Prototype

Computer Mount Testing with Simulated Weight
The computer mount was tested in a vehicle to make sure that it would be able to hold the weight of a computer mount while in motion. We needed to determine whether vibration or jerking of the car would compromise the safety of the mount. The mount was tested in Blaine’s vehicle. Figure 20 shows the mount installed on the headrest posts of the passenger seat in Blaine’s car. The mount was very easy to install in the car, and even while driving, the mount stayed securely in place.

![Image 20](image20.jpg)

Figure 20. Travel computer mount testing in vehicle.

At this point we suspended a 10lb weight to the mount, to see whether adding a load would affect its performance. This load is much greater than the weight of the Dynavox Vmax. The mount remained securely fixed to the headrest posts even with the added weight. Neither the movement of the car, or heavy load affected the mount much. Figure 21 shows the test set-up.

![Image 21](image21.jpg)

Figure 21. Travel computer mount tested with added weight.

The trials were deemed a success because the mount remained stationary and was able to secure a load while driving. These tests show that the mount is both sufficient and safe to use with the Dynavox Vmax.
Client Trial
The computer mount was then tested with Sean’s Dynavox Vmax in the family’s vehicle. The mount was quickly and easily assembled in the Stenglein’s car, shown in figure 22. We then secured the Vmax onto the quick release base. By manipulating the base it was easy to tilt the screen and to re-lock it into place. The screen was positioned at the optimal viewing height for Sean.

Figure 22. Dynavox Vmax secured by travel computer mount in client’s vehicle.

The family was eager to get the mount and begin using it. Since the project was completed early, we decided to give them the mount, and have them report any issues. The best way to determine whether the mount works was to have the family use it for a while and then report to us. They have been using the mount for several weeks now, and have assured us that it is working great. Therefore, our work on the project is complete. Figure 23 shows Sean using his Vmax in the car, with the help of the travel computer mount.

Figure 23. Sean using his Dynavox Vmax which is supported by the travel computer mount in the family’s vehicle.

3 Realistic Constraints
The development of the car mount will be limited by many factors. Since this project is funded by the National Science Foundation Engineering Design Projects to Aid Persons with Disabilities (NSF) they will have to approve all budget appropriations. The family will be responsible for any future maintenance costs. The availability and costs of materials will affect the overall design. The metal piping in the framework will consist of stainless steel for durability and easy maintenance. There are
also some parts manufactured by Deassy will be utilized. These parts include the quick release mount and two securing rods to allow the computer screen to attach to the mount.

Aside from economic constraints, other restrictions in the design of the device remain. The computer mount must fit within the back seat of the car and still allow the user and others to sit comfortably and safely. The placement of the mount on the back of the front passenger seat will provide for the optimal viewing placement for the user to see the screen. It will be located immediately across from him. The mount will also have the option to adjust the height with the poles to change the location of the screen in preparation for future growth of the user.

The mount must also be able to hold the weight of the computer and withstand repetitive use. The materials of the framework will ensure the systems durability. Since the computer connection pieces are being purchased from Deassy, the company will insure the durability of the product. It will also guarantee that the computer will fit the mounting parts because they were made specifically for the computer. The quality of the materials and the warrantee of the clip will increase the quality and allow for the repetitive uses during the user’s travels in the vehicle.

The mount should not be obtrusive or dangerous to Sean and the other passengers in the car. The design will also be attached to the front passenger seat headrest. The connection will be flush between the seat and the headrest and will not create any discomfort to a passenger in the front seat. The mount should be safe during operation of the vehicle as well as in the event of a car accident, and it should also be clear of any airbags in the vehicle. As a result, it was found to be best placed behind the front passenger seat. This will avoid all airbags in the current vehicle owned by the user. In the future, it would also avoid most airbags with the only possible contradiction being a side backseat airbag on the door of the car. In which case, it would still avoid impacting the mount to the computer user.

Also, the mount must be able to withstand and remain unaffected by temperature changes in the car. The metal of the mounts will not melt or contort by the temperature fluctuations in a vehicle. These temperatures not only include the changes that occur daily but also as the seasons change. It must withstand the hot temperatures of summer and the cold winter brings.

Throughout the day, the shifting sun will cause the computer screen to be viewed from different angles at different times. This brings about the need for the computer screen to be able to tilt up or down to the appropriate viewing angle. To accomplish this, a rod from Deassy will be purchased that allows the mount to rotate about the horizontal mounting pole. This will ensure the user’s proper view of the computer screen to aid in the communication taking place.

Since the assistive jumping device is being built for a disabled clientele, it is extremely important to keep safety a priority. The people designated to use the system will not be able to support or protect themselves if something were to go wrong with the system. There may also be a difficulty in communication, hence why the mount was to be built, and therefore may not be able to explain a problem with the unit. It would be extremely unethical to take advantage of this situation in any form.

In addition to these considerations, there are political issues that must be addressed. The many misconceptions about Sean’s condition cause a stereotypical view of those with cerebral palsy.
Certain doctors and most of the educational system have their own ideas of Sean’s abilities and possible improvements. The school system’s concern for their own legal liabilities causes them to limit Sean’s movement while he is in their custody. There are also some doctors that agree with this limited movement strategy claiming that there is no hope for improvement in Sean’s condition. On the other hand, there are doctors that agree with the family’s beliefs in keeping Sean active to increase his independent movements.

4 Safety Issues

The basis behind mounting the computer in the car is to allow for full communication while traveling in the vehicle. The computer is essential for the user to speak to others in the car and portray his or her needs. Without the ability to communicate in the car, the user’s safety is at risk. It also is risky to the safety of the driver and other people in the car if the driver constantly needs to turn around or look in the rear view mirror in order to understand what the disabled person in the back seat is trying to say. The mount will allow the client to safely communicate with others in the car without being a distraction to others.

Safety also played a large role in the design of the computer mount. The main concern was the potential for the vehicle to be in an accident, both collisions and in the event of stopping fast. In such cases, the mount needed to be safely secured to the location point. This attachment point was decided to be the front passenger seat headrest. The car’s safety features will most likely secure the seat to the car and not allow the seat to move if the car were to stop fast.

There will also be a solid framework structure of the entire unit so the computer will not “flap” as the car moves and the screen will be at the same location at all times. Since the solid structure will not “flap” as the car travels,

The user of the mount must be able to safely get into the car. Since there is major impairments to the motor skills of the user, getting in and out of the vehicle is not a simple task and requires the help of an additional person. With the mount against the front seat, it will not be a safety hazard while getting into the vehicle. The mount will also be detachable and further ensures the mount will not be an obstacle while entering or exiting the vehicle.

An additional safety concern of the mount was to not obstruct the driver’s view. Again, the location of the mount will not be in the way of the driver’s view. The unit will also not protrude enough from the seat to limit any view of the user in the back seat either. This is a necessity in the case of our client that the driver is able to see child in the back seat as the computer is being used and to make sure the child is safe and content in the back seat.

5 Impact of Engineering Solutions

Overall, this device may not have a profound impact on the general population. For them, average computer stands and DVD players have already been created and distributed mainstream. These mounts are designed to fit the standard computer screen or television screen. The designs are located in the front of the car for the driver to use (in the case of a police vehicle) or on the inside roof of the car for the people in the backseat to watch a movie while traveling. However, the production of this device will have a profound impact on the large group of people using the computer to communicate
with others. The mount places a needed device for communication on the optimal position while traveling in a vehicle. It accommodates their needs while providing safety for the users as well as others in the car. There will finally be a system to allow for full communication of computer users while travelling in a vehicle.

Since the mounting system is compatible with a popular brand of a communication computer, there is certainly a market for the product. This could possible be distributed on a larger scale by the company and thus creates the ability for the company to make a significant amount of money. It could be sold on the website as an accessory for the computer and be introduced to a wide range of people. There would be a large economic incentive for the company to carry this product. Each of the computers they have previously sold as well as each computer they will sell in the future will now be able to become portable during travels with an adequate mounting system to allow for proper usage.

While the number of people injured and disabled only increases daily, so does the demand for product adaption. The awareness for such products had grown, but there is still a lot more to do. There needs to be an increase in awareness to allow the disabled to participate in everyday activities taken for granted by those able to use the product. While there have been many products on the market to help the disabled in necessary tasks, most end there. There must be further research done with these products and accessories to further allow the use of these products. Not only will the adaptations promote the acceptance and normality of those disabled into the average community, but it will help make life easier to those around them. By now being able to communicate with others in a car, it can lead to a boost in self-confidence and encourage those who are disabled to strive to accomplish anything they wish.

6 Life-Long Learning

While working on the assistive jumping device, there were many new techniques and material was acquired in the process. These new concepts are one that will be remembered and utilized numerous times in the future.

Since the client has cerebral palsy, it was necessary to learn information on the condition. It came as a surprise to find out the mental capabilities of those with cerebral palsy. Many have normal brain activity and would be able to perform the schoolwork of someone the same age if it weren’t for the limited communication skills. It was also interesting to find out that only the connection between the brain and the muscles were problematic and that the muscles had the capability of normal function. It was also learned that cerebral palsy is a condition that is a result of a form of traumatic injury, usually at birth, but those affected are not born with it (i.e. it is not a genetic defect but rather a result of oxygen loss to the brain usually from the birthing process). Furthermore, there are many different types of cerebral palsy each resulting in different limitations and causing a range of severity levels of the condition.

From the start of the project and after talking with the family of the client, there has been an increased awareness of adaptations provided for the disabled. These include ones that have been created to aid those in need as well as for the neglect of those revisions neglected. While the number of these
adaptive products has grown, a massive need for more still remains present. The introduction to products designed to aid the disabled to perform daily tasks has brought about a curiosity towards other designs to aid and research to help those incapable of certain tasks.

This curiosity was furthermore extended to the idea of how things work and how they are manufactured together. There has been more noticing of how everyday objects like chairs, desks, and lamps, are set up and structured. These ideas were not only related to the project at hand but also to a general knowledge of item construction. It allowed for the generation of free body diagrams on actual objects at hand, rather than from a textbook or a homework question. The concepts learned in mechanics classes as well as materials classes were able to be applied to real-life examples.

The design and creation of the assistive humping device has led to a formation of many interpersonal skills. These skills will not only aid in the project but improve the skills needed in the workplace as a future engineer. Most importantly, learning to work as a team will be a life skill used very often, especially as an engineer. Compromising to combine ideas and standing up for the ones believed to be right are essential to coming up with a final solution in any problem solving situation. It also helped learn time management and responsibility of completing the tasks assigned to oneself. Furthermore, the project taught many new techniques in technical report writing, computer aided drawings, and presentation making. In addition to the creation of the presentation, the project taught actual presenting skills when speaking to a group of people and getting clear and precise ideas across. It also allowed for the practice to persuade others to agree with the ideas at hand and to endorse those ideas with funding or support. Working on a budget and competing the task within a limited amount of time set standards consistent with those a workplace would endorse and allowed for a sample of what was to come in a career as an engineer.

### 7 Budget and Timeline

#### 7.1 Budget

Table 1: Pricing Chart for Travel Computer Mount Parts

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Subunit</th>
<th>Part Name</th>
<th>Item Number</th>
<th>Unit Price</th>
<th>Quantity</th>
<th>Items Total Price</th>
<th>Shipping Cost</th>
<th>Total Price Per Vendor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Parts, Inc</td>
<td>Clamp</td>
<td>Stainless Steel Type 440C</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASTM-A582 Rectangular Bar</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1/2&quot; Thick x 1&quot; Wide</td>
<td>ZRT4X-08/16-24</td>
<td>$50.00</td>
<td>2</td>
<td>$100</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clamp</td>
<td>Neoprene 3/16in Rubber Sheet, 12in x 24in</td>
<td>NP60S-0187-F</td>
<td>$33.90</td>
<td>1</td>
<td>$33.90</td>
<td></td>
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</table>

Subtotal: $14.99

Daedalus Technologies Inc

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Subunit</th>
<th>Part Name</th>
<th>Item Number</th>
<th>Unit Price</th>
<th>Quantity</th>
<th>Items Total Price</th>
<th>Shipping Cost</th>
<th>Total Price Per Vendor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Base</td>
<td>Folding USB Quick Release Base</td>
<td>USBF</td>
<td>$206.00</td>
<td>1</td>
<td>$206.00</td>
<td>N/A</td>
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</tbody>
</table>

Total: $133.90
### 7.2 Timeline *(MICROSOFT PROJECT)*

Table 2. Timeline of Tasks

<table>
<thead>
<tr>
<th>Task Name</th>
<th>Duration</th>
<th>Start</th>
<th>Finish</th>
<th>Predecessors</th>
<th>Resource Names</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Assigned</td>
<td>1 day</td>
<td>Mon 9/2/2023</td>
<td>Mon 9/2/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meet with client and family</td>
<td>1 day</td>
<td>Mon 9/1/2023</td>
<td>Mon 9/1/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statement and Specifications Due</td>
<td>1 day</td>
<td>Mon 9/5/2023</td>
<td>Mon 9/5/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Update Website</td>
<td>1 day</td>
<td>Mon 9/5/2023</td>
<td>Mon 9/5/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research Daeesy Components</td>
<td>4 days</td>
<td>Wed 10/10/2023</td>
<td>Fri 10/17/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design vice for headrest connection</td>
<td>4 days</td>
<td>Wed 10/7/2023</td>
<td>Fri 10/13/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decide on Subunits-objective of each</td>
<td>4 days</td>
<td>Wed 10/10/2023</td>
<td>Fri 10/17/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Force/Material Equations and Free body diagrams</td>
<td>4 days</td>
<td>Wed 10/3/2023</td>
<td>Fri 10/10/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autodesk Pictures of Subunits</td>
<td>4 days</td>
<td>Wed 10/9/2023</td>
<td>Fri 10/16/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constraints/Safety issues/Impact of Engineering Solution</td>
<td>4 days</td>
<td>Wed 10/9/2023</td>
<td>Fri 10/16/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optimal Design Due</td>
<td>1 day</td>
<td>Fri 10/24/2023</td>
<td>Fri 10/24/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Update Website</td>
<td>1 day</td>
<td>Mon 10/17/2023</td>
<td>Mon 10/24/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Order Daeesy Parts</td>
<td>1 day</td>
<td>Mon 11/3/2023</td>
<td>Mon 11/3/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Order Custom Vice Parts</td>
<td>1 day</td>
<td>Mon 11/1/2023</td>
<td>Mon 11/1/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Map Rest of Project</td>
<td>1 day</td>
<td>Mon 11/17/2023</td>
<td>Mon 11/17/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Map Budget</td>
<td>1 day</td>
<td>Mon 11/17/2023</td>
<td>Mon 11/17/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final Report</td>
<td>1 day</td>
<td>Wed 11/19/2023</td>
<td>Wed 11/19/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Update Website</td>
<td>1 day</td>
<td>Wed 11/19/2023</td>
<td>Wed 11/19/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create Final Powerpoint Presentation</td>
<td>1 day</td>
<td>Wed 11/19/2023</td>
<td>Wed 11/19/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final Powerpoint Presentation</td>
<td>1 day</td>
<td>Mon 12/1/2023</td>
<td>Mon 12/1/2023</td>
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<tr>
<td>Update Website</td>
<td>3 days</td>
<td>Mon 12/3/2023</td>
<td>Mon 12/3/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior Design Day</td>
<td>1 day</td>
<td>Fri 12/15/2023</td>
<td>Fri 12/15/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Begin to build vice</td>
<td>8 days</td>
<td>Wed 12/15/2023</td>
<td>Fri 12/28/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test connection of Daeesy bars and elbows</td>
<td>1 day</td>
<td>Mon 2/22/2024</td>
<td>Mon 2/22/2024</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contour the attachment bars</td>
<td>4 days</td>
<td>Tue 3/3/2024</td>
<td>Fri 3/6/2024</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modify and trim horizontal bars</td>
<td>2 days</td>
<td>Mon 2/29/2024</td>
<td>Tue 3/4/2024</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weld the elbow bars to the front attachment plate</td>
<td>3 days</td>
<td>Wed 2/11/2024</td>
<td>Fri 2/13/2024</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test unit in with computer of similar weight</td>
<td>2 days</td>
<td>Mon 2/19/2024</td>
<td>Tue 2/21/2024</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paint the attachment bars</td>
<td>1 day</td>
<td>Thu 2/19/2024</td>
<td>Thu 2/19/2024</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trim and modify the L bars for proper height</td>
<td>1 day</td>
<td>Thu 2/19/2024</td>
<td>Thu 2/19/2024</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finish building of mount</td>
<td>1 day</td>
<td>Mon 2/19/2024</td>
<td>Mon 2/19/2024</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial run in vehicle with computer</td>
<td>1 day</td>
<td>Wed 2/26/2024</td>
<td>Wed 2/26/2024</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Write a operation manual</td>
<td>15 days</td>
<td>Tue 2/17/2024</td>
<td>Mon 3/2/2024</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Update the final report</td>
<td>3 days</td>
<td>Mon 2/23/2024</td>
<td>Wed 2/23/2024</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepare sign Day presentation</td>
<td>1 day</td>
<td>Wed 4/24/2023</td>
<td>Fri 4/24/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior Design Day</td>
<td>1 day</td>
<td>Fri 4/24/2023</td>
<td>Fri 4/24/2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepare presentation for Student Union</td>
<td>5 days</td>
<td>Mon 4/27/2023</td>
<td>Fri 5/1/2023</td>
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</tr>
</tbody>
</table>

**Subtotal:** $451.00  
**Total Price:** $584.90

### 8 Team Member Contributions to the Project

**Kelly Valentine:**
- Website
  - Formatting
Introduction on front page

Hyperlinking:
- Project Statement/Specifications
- Project Proposal Presentation
- Alternative designs
- Optimal Design

- Alternative Design
  - Under car seat mount
  - Diagram

- Optimal Design
  - Introduction
  - Realistic Constraints
  - Safety Issues
  - Impact of Engineering Solution
  - Life-Long Learning

- Final Report
  - Collective Organization of previous papers
    (table of contents/copy sections already done)
  - Abstract
  - Map for Rest of Project
  - Project Design compilation and additions
  - Objective compilation and additions
  - Individual Member contribution
  - Acknowledgements

- Microsoft Project Timeline

Caitlin Martin:
- Proposal
  - Background
  - Purpose of project
  - Previous work done by others
    - Products
    - Patents
  - Objective
  - Methods
  - Conclusion

- Alternative Design
  - Under seat rail attachment mount
  - Pictures

- Optimal Design
  - Subunits

- Final Report
  - Subunits
  - Formatting

- Computer Mount Fabrication
Mounting plate milling
  o Modified lengths of L-bars and horizontal bar
  
- Updated Final Report
- Updated the Microsoft Project timeline
- Pg.1-5 of the operator’s manual

Blaine Ericson:

- Proposal
  o Previous works research
  o Prepared Powerpoint presentation
- Alternative Design
  o Back of seat strap mount
  o Pictures
- Optimal Design
  o Autodesk Inventor diagrams
- Final Report
  o Autodesk Inventor diagrams
- Computer Mount Fabrication
  o Mounting Plate Milling
  o L-Bar to Mounting Plate Welds
  o Mounting Plate Painting
  o Vehicle Testing with Simulated Weight
- Operators Manual
  o Technical Description
  o Trouble Shooting

9 Conclusion

While the travel computer mount is similar to other travel electronic holders, the system is specifically designed for the Dynavox VMax computer. With the mount, the user will be able to communicate efficiently with other passengers in the vehicle, something that was unable to be done prior to the mount’s creation.

The travel computer mount will enable the user to safely and securely use the Dynavox VMax computer in a vehicle. The mount will be attached to the front passenger seat headrest with a dual screw vice. The system will be a solid frame work of stainless steel tubing to ensure structure of the device during traveling in the vehicle. The computer will connect to the mount via the Daessy quick release folding base. This will enable the user to easily attach as well as remove the system from the mount in addition to being able to tilt the computer screen to an ideal viewing angle.

The production of the device is funded by NSF.

10 References
11 Acknowledgements

The team would like to extend their appreciation to the following people for their help and support in the design and completion of the assistive jumping device:

- The National Science Foundation Engineering Senior Design Projects for Persons with Disabilities (NSF)
- Dr. Enderle
- David Price
- Sean Stenglein and the Stenglein Family
- Rich and Serge of UConn Machine Shop

12 Appendix

12.1 Updated Specifications

There have been no updated specifications at this time.

12.2 Purchase Requisitions and Price Quotes

In order to purchase parts for the travel computer mount, the following purchase order requisition form was completed for each vendor used. At the current time, all of the parts for the mount have been ordered. The finalized prices were included in the budget.