Research and Development of Hand Controls for Manual Transmission Car

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Abstract - *The goal of the "Design of hand interface for driving for the disabled" was to design and build a minimally invasive hand control interface that can be used by paraplegics or double leg amputees to control manual transmission automobiles. This control interface can also be used by individuals who describe themselves as car enthusiasts and enjoy driving manual transmission vehicles. The primary components of the control interface are mechanical linkages and a steel cable system to actuate the brake and clutch pedals of an automobile. The team conducted analysis of current assistive driving devices, calculated the dynamics of mechanical linkages and steel cables for the brake and clutch systems, and manufactured a prototype control interface. Compared to earlier control interfaces, the team was able to design and build a mechanical control interface with reduced components that offers a tactile response with a simple installation process.*

1. INTRODUCTION

This project was inspired by those who have a passion for driving, but who have lost function of their legs. With a population of over 1 billion, the prevalence of disability is between 1.85% and 2.19%. Of these, 75% persons with disabilities live in rural areas. Unfortunately there is no information available on the prevalence of spinal cord injured individuals or its incidence. It is recorded that there are approximately between 238,000 to 332,000 people in the United States that are currently living with a spinal cord injury (Brault, 2010). The reasons for the person's handicap can be attributed to many causes including motor vehicle crashes, sport injuries, military service, or acts of violence. Existing assisted driving devices are mostly targeted towards automatic cars and the devices that do exist for manual vehicles limit the driving experience for the user. These devices are very expensive and can more than $15,000. Living with a severe disability can be expensive, one of the team's goals is to keep the cost of these selected technologies to a minimum so there is no additional burden for the person with disabilities.

2. LITERATURE REVIEW

The team researched and reviewed currently available assisted driving devices as well as information concerning paraplegics and their disabilities. Zero leg-input designs currently exist for driving automatic cars, and there are manual transmission solutions, however they lead to a reduced driving experience.

In 2014, Zachary Bornemann, John LaCamera, Leo Torrento implemented a design which uses Accelerator and Brake Rings mounted behind the steering wheel for actuating the Accelerator and Brake pedals respectively.[1]

Mr. Ferdinand Rodrigues of Ferro equip has implemented various customizations to a manual transmission car according to the customer requirements. Many of his designs include electrical actuators for activation of the different pedals used for driving.[2]

3. PROPOSED SYSTEM

In order to create a device that will accomplish our goal, and benefit the end user, design specifications for the device were established.

1. Minimal individual components for simple maintenance and troubleshooting
2. Intuitive use to ensure a licensed driver is able to learn the operation of a vehicle with the system within six months
3. Ergonomic to ensure comfortable operation of system for over two hours of continuous use
4. The brake pedal has an immediate response time
5. The gas and clutch pedals are actuated at the speed required by traditional driving standards
6. Allows for traditional vehicle operation (forward, reverse, and gear change)
7. Competitive market price to ensure affordability for target users

3.1 Implementation

Before, the limitations of combining existing assistive driving devices for a manual transmission vehicle were discussed. It was established that in order for the driver to maintain control of the vehicle, they must always have control of the steering wheel while using the hand controls. Combinations of various existing devices do not allow for consistent steering control while operating the vehicle. In order achieve this control for a manual transmission vehicle, the hand control placement is limited to the steering wheel and the shifting knob. These are the only necessary components for vehicle operation other than the pedals, establishing them as the crucial locations of hand placement.

Accelerator and brake pedals will be operated by levers and linkage mechanism which are ergonomically placed below the steering wheel. The forces required for the pedal to engage will be tantamount to the forces applied on the levers. The Hand controls consist of a Single Lever mounted under the steering which operates the brake and accelerator. It is a Pull and push mechanism, when pulled will accelerate & when pushed will operate the brake. A switch console is also fitted in select models that operate the parking lights, head lights, turning lights horn and an auxiliary accelerator. These modified vehicles are suitable for persons with one or both limb disability. The controls are dual in nature and do not affect the normal foot controls of the vehicle. The fitment of auxiliary accelerator for automatic transmission vehicle. The fitment consist of attachment which is fitted on the pedals below dash board. It helps in operating the accelerator by left leg. All controls are dual in nature and do not interfere with the normal foot controls of the vehicle provided by the manufacturer.

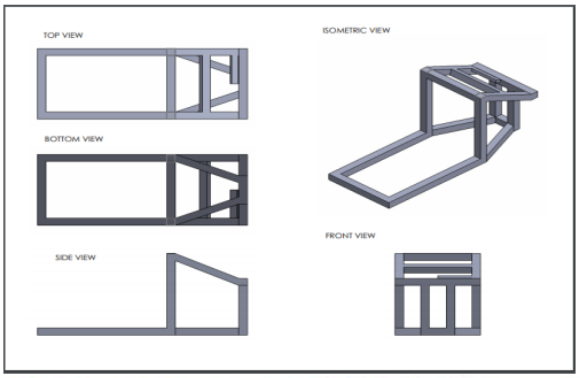
To achieve a tactile response, the team chose to use a bike brake cable, Bowden cable, to actuate the clutch. The Bowden cable, has a steel cable within a housing cable, If the housing cable is fixed, the steel cable inside can move transnationally, no matter the orientation. A picture of a bicycle brake cable may be seen in Figure below

Figure 19 Example of a Bowden Cable (Dave's Motors)

Starting from the clutch pedal, the cable is attached at the lowest point of the pedal and travels straight back and along the wall. The cable travels along the console, up and to the shifting lever.

3.2 Project Inputs and Outputs

Chassis Design



OUTPUTS achieved

1. Able to be installed in the majority of compact vehicles
2. Installation of device requires minimal tooling.
3. Does not need a trained technician
4. Inexpensive installation

The system must be able to actuate a 20-pound force with a 4-inch actuation distance. The hand control can be seen below in Figure below.

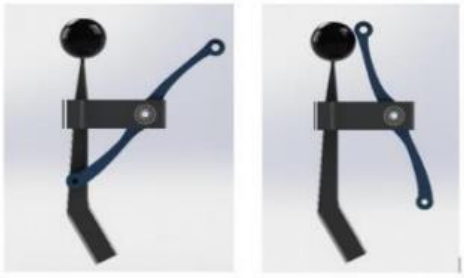


Figure 21 Hand Clutch Control (Left: Relaxed) (Right: Actuated)

In order to obtain the required mechanical advantage with the system cable, the cable must be oriented downwards. By attaching the outer shell of the Bowden cable system to the shifting knob, it will allow tension to be maintained in the inner steel cable no matter the gear the shifting knob is in. This system does not clutch may still be actuated with the left foot pushing on the pedal.

4. CONCLUSION AND FUTURE SCOPE

4.1 Conclusion

Our design prototype will give respite to the paraplegics and the people who have lost the functions of their legs. The goal of the "Design of hand interface for driving for the disabled" was to design and build a minimally invasive hand control interface that can be used by paraplegics or double leg amputees to control manual transmission automobiles. This control interface can also be used by individuals who describe themselves as car enthusiasts and enjoy driving manual transmission vehicles. The primary components of the control interface are mechanical linkages and a steel cable system to actuate the brake and clutch pedals of an automobile.

4.2 Future Scope

By a few enhancements in the design while keeping the principle of model, the project can be made to increase its performance via modern methods such as pressure sensor buttons for acceleration which can be accessed by application of just a finger behind the steering wheel is a great way towards hand interface driving control system. Introduction of less expensive hence affordable car driving mechanism for the disabled will increase occupation as the less privileged ones can become drivers and earn an income for their own self as well as people who once thought that the passion of driving has left them can once drive again. Both the above-mentioned points are from the view for a future development and are not within the current scope.

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