

To Drive The Vehicle Using Electromechanical Actuator

Prof.S.S. Tambade, Lalit Bachhav, Satyajit Chavan Suraj Gomase and Sumit Holkar

Faculty of mechanical Department, Savitribai Phule pune university, India
Student of BE Mechanical, Savitribai Phule pune university, India
Student of BE Mechanical, Savitribai Phule pune university, India
Student of BE Mechanical, Savitribai Phule pune university, India

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Abstract- It is always a major challenge for the disabled people to drive the car the especially four-wheeler. So, Being able to drive car is always grateful step for people with disabilities, but the conventional driving system installed in car it is not suitable for disabled driver to drive the vehicle. People with lower limbs disabilities cannot operate breaks, acceleration controls. Disabled people who are physically unfit always face some difficulty when it comes to driving. This paper presents the evolution of new driving system by using Arduino board and electromechanical actuator for a disabled driver. In this modification was made to exiting conventional system by using Arduino programming and hand operated Mechanisms for breaking and acceleration system.

Index Terms- Actuator, Arduino Board, Battery, Switches etc.

I. INTRODUCTION

Driving the motor vehicles four wheeler is the big challenge for physically disabled people, especially paraplegic people. The paraplegic need to have mobility. However they are completely dependent on other people to travel or commute. This project aims to enable paraplegics to safely drive and operate an automatic transmission as per census 2011, in India. Out of the 121 crore population about 2.68 crore persons are 'disabled' which is 2.21% of total population. Among the disabled population 56% (1.5cr) are male and 44% (1.8cr) are females. In the total population the male and female population is 51% and 49% respectively. In India 20% of the disabled persons are having disability in movement 16% of disabled population is in the age group 20-29 years and 13% of them are in the age of 30-39 years. Disabled people who are physically incapacitated always face some difficulty at the time of driving for conventional car such as accelerator, brake pedals are usually foot operated.

People with lower limbs disabilities cannot operate such foot controls. There are numerous technologies has been introduced to accommodate different type of disability. This includes:-

- Hand control to operate the acceleration and brake.
- People lifts, wheelchair hoists
- safety belts, seat belts and harnesses

The present work is aimed at adapting a conventional vehicle's driving system for use by people with lower body disabilities. The adaptations that have to be taken into consideration are hand controls to be fitted in a car with automatic

transmission and power steering. There are many different systems that have been reported in the literature for a vehicle designed for drivers with lower body disabilities.

Brief description of this systems are given below

MPD 3500KX Offset Hand

Control produced by company named HDS Specialty Vehicles from USA is one of the designs for drivers with lower body disabilities. In this design both the acceleration and brakes are hand controlled. As such, the driver is forced to drive with just one hand and hence it is difficult to control the steering wheel especially during cornering or high speed.

Guido-Simplex Hand-Control Guido-Simplex hand control's design uses hand accelerator ring to replace the pedal. The hand accelerator is a ring that fits just inside and slightly rises over the steering wheel. The ring can be depressed by the thumb or palm of the hand to activate the accelerator whilst holding the steering wheel in any position. The hand brake operates by way of a handle situated behind and to the side of the steering wheel and can be placed on either side, according to personal preference. The design provides the disabled driver with complete hands-on control from the steering wheel. But although the driver can put both hands on the wheel, it may still be difficult especially during the cornering to control the ring and brake and at the same time rotating the steering wheel.

Existing systems reveals that the disabled drivers are put into trial by forcing them to drive with one hand, which is quiet dangerous. Moreover, most control device used by physical handicapped drivers especially people with lower limbs disability are difficult to install and must be carefully adjusted to provide satisfactory performance. Therefore the main objective of this work is to develop a new system, in a way to modify the existing conventional car driving system so that a person with lower limbs disability can drive safely with minimum cost.

This system majorly includes a liner actuator which would thereafter give the suitable force needed to the accelerator and brake pedal with the help of switches that would be placed at the level of steering wheel which will definitely be suitable of the people with lower limb disability to operate a vehicle with both hands. In this system the linear electromechanical actuator would be used and programmed by Arduino Uno board. The brief description of the system is provided thereafter.

BASIC WORKING OF THE VEHICLE:

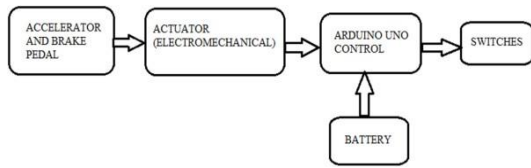


Fig 1: Block diagram of the system.

The vehicle system that is designed for people with lower limb disability consist mainly of following parts

- Accelerator and brake pedal (present in the vehicle itself but is regulated by the actuator)
- Electromechanical Actuator
- Arduino Uno controller
- Switches
- Battery, let's have a look at all the parts briefly

II. ACCELERATOR AND BRAKE PEDALS

The **Accelerator** is worked by the right foot. It is linked to the carburetor, which supplies the correct mixture of air and petrol which runs the engine, thereby controlling the power output of the engine. The further the pedal is pressed down, the greater the power output and the faster the car goes. When you let the pedal up, or take your foot off altogether, the opposite happens and the car begins to slow down. The accelerator pedal is very sensitive and new drivers usually find it difficult to get just the right amount of pressure on it.

The **Brake** pedal is placed immediately to the left of the accelerator and should be worked with the ball of the foot. Training in using the brake pedal include not only the application of the brake, but also practice in moving the right foot freely and accurately from the accelerator to the brake and back again without looking down at the pedals. This can be practiced while sitting in the driving seat without the engine running. Under normal driving conditions, only this brake should be used. The harder the pedal is pushed down, the greater the braking effect and the more quickly the car will lose speed. In most situations, only light pedal pressure is needed to brake safely and smooth.

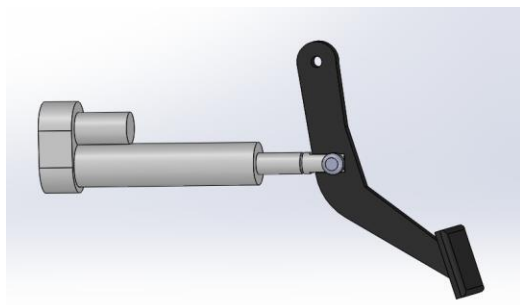


Fig 2. brake pedal

1. Electromechanical Actuator

As seen before an electromechanical actuator is a device which converts the electrical energy into the mechanical motion, here two electromechanical actuators are placed in front of the accelerator and brake pedals and operates them. The motor motion is mechanically converted to linear displacement. The design of actuator consists of the lead screw and the nut. The basic principle of operation in most of electromechanical actuator is based on the inclined plane concept. The threads of the lead screw are used as a ramp that transforms a small rotational force by magnifying it over a long distance to enable a large load to be moved over a short distance.

Fig 3: Electromechanical Actuator



Why electromechanical actuator?

Electromechanical actuator is selected as it has many advantages over the other types of actuators such as

- If one uses hydraulic actuator there is always a chance of oil leakage
- The use of hydraulic actuator will increase the storage space for vehicle i.e. the space would be required for the oil reservoirs.
- If we use pneumatic actuator the load capacity would be less that it won't fulfill the load requirements.
- In pneumatic actuators there will always be chances of air leakage which would intently break the whole system
- In pneumatic actuators the need of more storage space for compressor will be required also there will be need of lubrication.
- Also electromechanical actuators improve machine performance owing to their accurate and smooth delivery of force.
- Easy set up and installation, they save more than 50% of running costs.
- Electro-mechanical actuators possess high speed and acceleration capabilities with excellent load bearing capacity
- They are designed ruggedly utilizing the best of raw materials to can be run continuously without affecting performance.
- Risk of contaminating the environment is minimal as there are no hydraulic fluid leaks.
- They guarantee quieter operation compared to their counterparts such as pneumatic and hydraulic actuators.

2. Arduino Uno Controller

Arduino is an open-source electronics platform based on easy-to-use hardware and software. [Arduino boards](#) are generally used to read inputs and turn it into an output. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. This is done by the [Arduino programming language](#) (based on [Wiring](#)), and the [Arduino Software \(IDE\)](#), based on [Processing](#). This arduino uno controls the motion and load of the actuators by sensing the amount of pressure that is to be given to the accelerator and brake pedals.

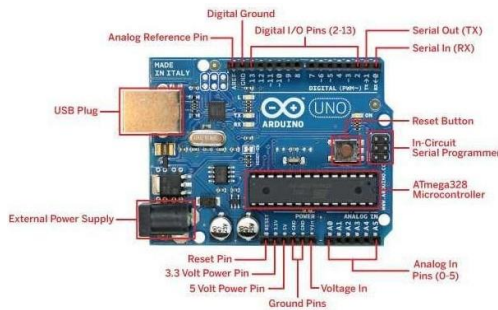


Fig 4: Arduino Uno Controller

This arduino uno gives controls to the actuator by programming the proper sequence of the load or the pressure by sensing the input. Here the input to the arduino is the load or the pressure given to the switches to drive the vehicle and the programming done on the octave software gives direction of operation and the output delivered is the proper amount of motion to process the actuator which further operates the accelerator and brake pedal.

Arduino uno controller is easy to use software and hardware controller also the libraries of the board are easily available, also it provides simple and clear programming environment which makes it easy to adapt.

3. Switches

A [switch](#) operated by the motion of a machine part or presence of an object. They are used for controlling machinery as part of a [control system](#), as a safety [interlocks](#), or to count objects passing a point. A switch is an electromechanical device that consists of an actuator mechanically linked to a set of contacts. When an object comes into contact with the actuator, the device operates the contacts to make or break an electrical connection.



Fig 5. Steering wheel with switches.

These were the main parts of the system modification; this modification includes operation of accelerator and brake pedal by the electromechanical actuator. The electromechanical actuator with the help of the lead screw and nut operates the pedals by the input the sensed by the arduino uno controller which is programmed by octave to sense the amount of the pressure that is given by the driver on the switches. The greater the pressure applied so would be the speed of the vehicle.

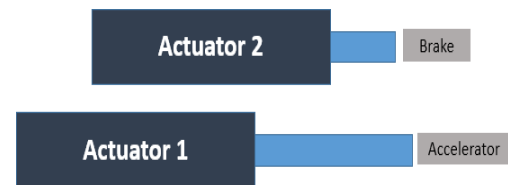


Fig 6: Two actuator system

The switches that will be sensing the amount of pressure will be placed at the steering level which can be easily operated by the people with lower limb disability without using their hands. This system also makes the vehicle fully automated.

III. CONCLUSION

This paper presents the system which is useful for the people with lower limb disability, since we all know it is very much difficult for people with disability to drive the vehicle, this vehicle gives an accomplishment for such people to be free and drive by themselves. This system majorly consists only a single difference than that of the conventional vehicle, i.e. the actuators are placed to operate the accelerator and brake pedal. This is done by the control of the arduino uno which senses the amount of the pressure that is to be given to the accelerator or brake pedal in order to run the vehicle. The arduino uno is directed by proper programming to take the actions; this programming is done by the octave software. This system enhances the fully atomization of the vehicle with low costs and low maintenance providing high accuracy and efficiency. It is not that only physically disabled people can use this vehicle, it can rather be used by every person who is also physically fit by taking proper training.

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AUTHORS

First Author – Prof.S.S. Tambade, Faculty of mechanical Department, Savitribai Phule pune university, India
Second Author – Lalit Bachhav, Student of BE Mechanical, Savitribai Phule pune university, India
Third Author – Satyajit Chavan, Student of BE Mechanical, Savitribai Phule pune university, India
Fourth Author – Suraj Gomase, Student of BE Mechanical, Savitribai Phule pune university, India
Fifth Author – Sumit Holkar, Student of BE Mechanical, Savitribai Phule pune university, India