

Design & Development of an Automated Clutch System for Left Leg Disabled Persons

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ABSTRACT

The aim of this project is to develop a system to efficiently regulate the manual transmission vehicle clutch that can be used by individuals with left leg disabilities as well as others. Those who want the opportunity to drive a manual transmission vehicle due to their interest in recreational driving or because they own a one-of-a-kind car are the inspiration for this project. Although they can afford automatic transmission vehicles, they are costly. The new manual transmission turns this mechanism into a semi-automatic transmission. The current clutch pedal function system is used by the automated clutch operating system. The gears can be modified by inserting this mechanism without working the foot of the clutch pedal.

Keywords: Automated clutch; Left leg disable; Bi-Directional Motor

INTRODUCTION

Automated clutch system is mainly designed for disabled people with minimal or no one leg function. Not only for disabled people can this system be used by others. Automated clutch system is designed to be fixed to the existing vehicle with manual transmission. This system converts the existing manual transmission into semi-automatic transmission. The automated clutch operating system uses the existing clutch pedal mechanism system. That is no modification is made to the original clutch pedal mechanism system in the vehicle. By adding this system the gears can be changed without operating the Clutch pedal by the foot.

The clutch operation completely becomes automatic according to the vehicle, stop and go motion. The disabled person only has to operate the accelerator pedal and the brake pedal in combination with the gear selector. The clutch is controlled by a Microcontroller via electronic actuators. This systems are embedded in extremely expensive and newer high performance sports and luxury cars where a disabled person is unable to afford.

The problem of design project focused on was that disabled drivers with reduced left leg function, who require hand control modifications on their vehicles, in order to drive them, are limited to drive automatic transmission vehicles. Because

automatic transmission vehicles are comparatively expensive and another factor to consider is the situation in which a person may suddenly lose leg function in one leg due to an accident or medical condition.

Some of these drivers may already operate a manual transmission car and suddenly cannot drive it any longer due to no any aiding equipment on the market today for automating the clutch function in a manual transmission cars.

RELATED WORKS

Development of Hand Control Interface for Manual Transmission Vehicles (2019)

Studied the use of ring mechanism for actuation of vehicle clutch control.

Fabrication of Hand Operated Clutch in Four Wheelers (2018)

This system uses a switch at the top of gear lever for the operation of clutch. The clutch is operated by a motor.

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Modifications in the Driving System of a Conventional Car for Paraplegic People (2017)

Installed Clutch actuation system to conventional car without degrading the Vehicle performance & hindering normal driving of the vehicle.

Design & Development of Driving System for Disabled Driver (2015)

Complete steering control of the vehicle is changed.

Development of Zero-Leg Input Manual Transmission Interface (2013)

Clutch is operated with the help of a mechanical lever on gear lever.

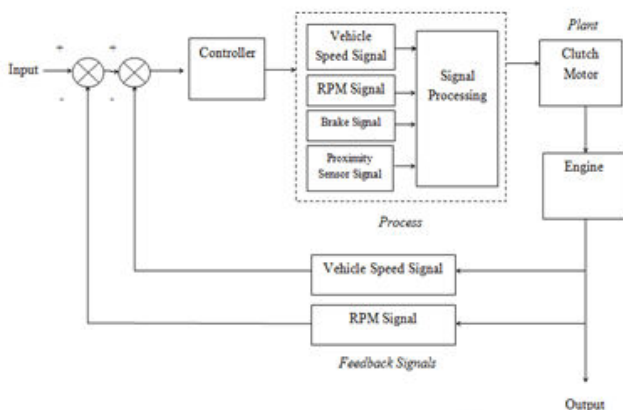
METHADODOLOGY

The first step is to design and make the mechanical components and hardware relevant to the selected vehicle. The clutch engagement position and the disengagement position of the selected vehicle should be identified. The RPM Sensor signal of the vehicle should be identified and isolated. The brake paddle signal should be isolated. Apart from that the vehicle Speed Sensor Signal should be isolated in order to proportionate the clutch engagement and disengagement speed to provide a smoother operation of the clutch.

Next the necessary wiring connections should be designed for the system in order to make the Arduino microcontroller communicate with the sensors and the actuators. When considering about the depression of the pedal it is purely mechanical, that is the clutch pedal is pulled backwards by a cable mechanism in which the end is connected to the Geared motor which is connected to the microcontroller through a motor driver. The full control of the clutch pedal is then done by the microcontroller.

Figure.1. is shown the block diagram with the details about the major parts of the system and connecting with each other.

Figure1: Block Diagram



At the start the operation of the clutch begins when the brake pedal is depressed. That is when the brake pedal is depressed the

brake switch activates, this signal is received by the microcontroller. Finally the microcontroller actuates the motor to depress the clutch paddle. When entering into the first gear, depress the brake paddle first, next shift the gear. While the hand is on the Gear shift knob the proximity sensor on the gear knob detects the hand and sends the signal for the microcontroller for actuating the clutch paddle before entering the gear.

Next after entering the gear the hand is taken off from the gear knob, release the brake paddle. At the moment the clutch paddle releases slightly and the vehicle comes to the clutch balance condition. At this condition the vehicle rolls forward slightly. The rolling speed of the vehicle can be adjusted with the aid of a potentiometer which is connected to the microcontroller. Finally the clutch pedal releases proportionally with the increase of engine RPM.

Figure.2. is shown the structural layout of the system and

Figure2: Structural Layout

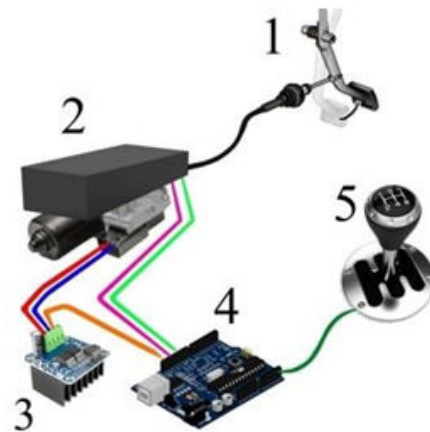
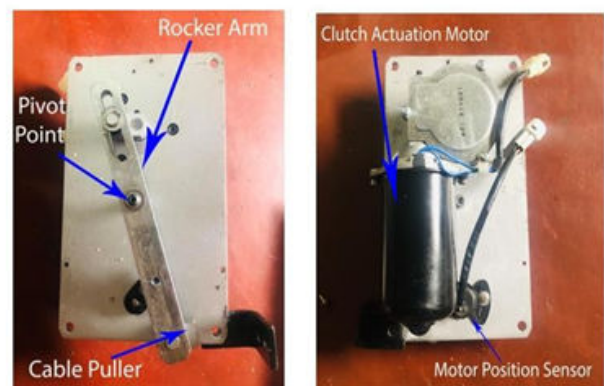


Figure 3. is shown the clutch plate pedal actuator.

Figure3: Clutch pedal Actuator



RESULTS

The developed device was extensively tested after the concept was manufactured & under different conditions. In all types of road conditions, the device was tested.

In Figure.4, it shown the Initial Condition of the Clutch Pedal. The released position of the clutch pedal that is not actuated by the clutch pedal actuating motor and sends a signal value of 4.50V as input to the motor position sensor. When the brake paddle is pushed down or the touch sensor is triggered, the clutch actuating motor initially activates.

Figure4: Results when clutch pedal Released

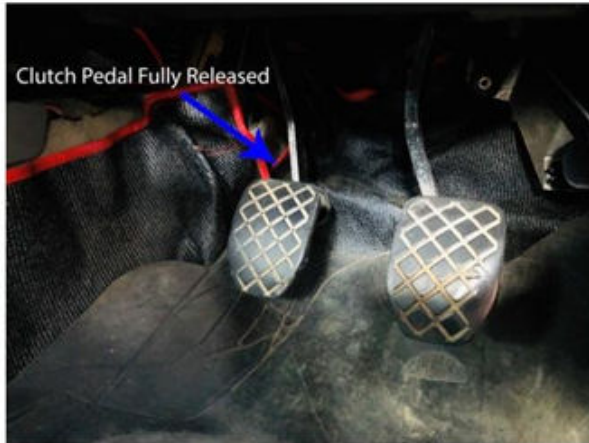


Figure.5. is shown the Condition of the Clutch Pedal when touch sensor activated. When the brake paddle is pushed down or the touch sensor is triggered, the clutch actuating motor initially activates. The microcontroller receives a signal from the motor position sensor as a feedback when the clutch is fully depressed.

It is not only used as feedback to safeguard the over- revolution of the clutch actuating motor. Next, according to the signals provided to the microcontroller, the RPM signal and the Vehicle Speed Signal, the clutch is slowly released. According to the received signals, using a motor controller, the microcontroller controls the clutch actuating motor. The activation and deactivation of the clutch is thus carried out

Figure5: Condition of the Clutch Pedal when touch sensor activated



Figure.6. is shown the balance condition of the clutch pedal. The balanced position of the clutch pedal, which is the

actuating motor of the clutch pedal, is triggered and kept in a balanced position. When the brake paddle is pushed down or the touch sensor is triggered, the clutch actuating motor initially activates.

Next, the clutch pedal becomes balanced when the brake pedal is released or the touch sensor is deactivated. The microcontroller receives a signal from the motor position sensor as a feedback, with values of 2.16V on a flat surface and 2.45V on a hill start state. According to the signals obtained by the microcontroller, that is, the RPM signal, Vehicle Speed Signal, the clutch is then slowly published.

Figure6: Balanced condition of the clutch pedal



CONCLUSION

The aim of this research was to develop and produce a device to enable individuals with left leg disabilities to completely control the manual transmission vehicle clutch pedal. Those people who have left leg disabilities are inspired by this initiative. There are several devices and frameworks that fulfill the objectives were set for in this project that are present on the market today. But during real operations, all these methods have certain drawbacks. The main drawback is that they are not automated. Pedal control and even, together with that, steering mechanism control at the same time. Current devices on the market do not work on two- handed simultaneous pedal and steering wheel control and involve a higher actuating force.

In the final design of this research project, Arduino Uno Microcontroller, Motor Controller, Touch sensor, etc was used. Apart from that a geared DC motor was used. They should also be reliable and robust for safety and convenience. The main advantage of this system is that the user does not have to manually actuate the clutch pedal, which is fully automated and easy to operate. When the touch sensor is energized, clutch control is achieved.

There are few areas where this enterprise can be further developed in the future. This is also regulated according to the driving pattern of the gear selector. Finally, a more functional and trendy structure would need to be provided for all the systems. It will also be important over time to integrate certain forms of driving assistance into heavy vehicles as well.

Because of the complexities of these heavy vehicles, there is a certain gray area where modifiers normally do not join. However, these items can be easily done with a deeper sense of awareness as well as with the perfect modifications to have a total sense of driving experience even for people with disabilities in the left leg.

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