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Motorized Smart Turning Mechanism

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***Abstract*: Production cars are designed to understeer and rarely do they oversteer. If a car could automatically compensate for an understeer/oversteer problem, the driver would enjoy nearly neutral steering under varying operating conditions. Four-wheel steering is a serious effort on the part of automotive design engineers to provide near-neutral steering. Also in situations like low speed cornering, vehicle parking and driving in city conditions with heavy traffic in tight spaces, driving would be very difficult due to vehicle's larger wheelbase and track width. Hence there is a requirement of a mechanism which result in less turning radius and it can be achieved by implementing four wheel steering mechanism.**

The main aim of this project is to turn the rear wheels out of phase to the front wheels. In order to achieve this, a smart mechanism was designed which features an interlinked turning mechanism that uses a single motor to power turning of entire vehicle and all its trailing carts such that the trailing cart follows exact same path of the main cart.

The prototype was tested for its cornering ability. It improves handling and helps the vehicle make tighter turns. This system is used to minimize the turning radius. The performance of the car has been greatly improved by proposed design.

***Keywords*: Frame, Linkage, D.C Motor, Servo Motor, Battery, Arduino, Bluetooth**

1. Introduction

Here we propose a smartly designed turning mechanism that allows for efficient turning in large connected vehicles like, trucks, trailers and long AC buses. The mechanism features an interlinked turning mechanism that uses a single motor to power turning of entire vehicle and all its trailing carts such that the trailing cart follows exact same path of the main cart. The mechanism consists of a motorized cart frame connected to another frame through an interlinked set of connecting rods. The forward frame is fitted with 2 wheel driving motors along with a turning motor. The turning motor when rotates the vehicle frame, involuntarily turns the trailing kart frame so as to align it with the motion and ensures it follows same path. The driving motors are used to drive the front kart and thus allows for smooth motion of the vehicle on roads as if it were following a track.

2. Literature Survey

Turning mechanism is a system employed by some vehicle to improve turning response, increase vehicle stability while cornering at high speed, or to decrease turning radius at low speed. In most active four-wheel steering systems, the rear wheels are steered by a computer and actuators. The rear wheels generally cannot turn as far as the front wheels. Some systems, including Delphi's Quadra steer and the system in Honda's Prelude line, allow for the rear wheels to be steered in the opposite direction as the front wheels during low speeds. This allows the vehicle to turn in a significantly smaller radius sometimes critical for large trucks or vehicles with trailers.

As vehicles have become heavier and switched to front wheel drive, the effort to turn the steering wheel manually has increased often to the point where major physical exertion is required. To alleviate this, auto makers have developed power steering systems. There are two types of power steering systems hydraulic and electric/electronic. A hydraulic-electric hybrid system is also possible.

Rather than this in our system motorized turning mechanism is done by the servo motor and by this mechanism cart of the vehicle can be turned efficiently.

3. Working Principle

The project consists of cart, linkage, dc motor, servo motor, Arduino, Bluetooth and battery.

This smart mechanism features an interlinked turning mechanism that uses a single motor to power turning of entire vehicle and all its trailing carts such that the trailing cart follows exact same path of the main cart. The mechanism consists of a motorized cart frame connected to another frame through an interlinked set of connecting rods. The forward frame is fitted with 2 wheel driving motors along with a turning motor. The servo motor when rotates the vehicle frame, involuntarily turns the trailing kart frame so as to align it with the motion and ensures it follows same path. The servo motor is connected with smartphone via bluetooth for controlling. The driving motors are used to drive the front kart and thus allows for smooth motion of the vehicle on roads as if it were following a track.

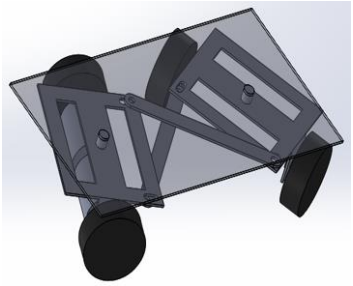

Fig. 1. 3-D Solidworks Model

4. Components

A. Frames and Base Plate

The model consists of a base plate and four frames which are fixed vertical to the base plate. The base plate and the frames are made of mild steel.

Mild steel is lightweight, ductile and malleable metal with appearance ranging from silvery to dull gray, depending on the surface roughness. It is nonmagnetic and does not easily ignite. A fresh film of mild steel serves as a good reflector (approximately 92%) of visible light and an excellent reflector (as much as 98%) of medium and far infrared radiation. The yield strength of mild steel is 7–11 MPa, while aluminum alloys have yield strengths ranging from 200 MPa to 600 MPa.

Mild steel has about one-third the density and stiffness of steel.

It is easily machined, cast, drawn and extruded. Mild steel atoms are arranged in a face-centered cubic (fcc) structure. Mild steel has stacking-fault energy of approximately 200 mJ/m^2.

Mild steel is a good thermal and electrical conductor, having 59% the conductivity of copper, both thermal and electrical, while having only 30% of copper's density.

Fig. 2. Base Frame and Linkage

B. Linkage

A mechanical linkage is an assembly of bodies connected to manage forces and movement. The movement of a body, or link, is studied using geometry so the link is considered to be rigid. The connections between links are modeled as providing ideal movement, pure rotation or sliding for example, and are called joints. A linkage modeled as a network of rigid links and ideal joints is called a kinematic chain. Linkages may be constructed from open chains, closed chains, or a combination of open and closed chains. Each link in a chain is connected by a joint to one or more other links. Thus, a kinematic chain can be modeled as a graph in which the links are paths and the joints are vertices, which is called a linkage graph. The movement of an ideal joint is generally associated with a subgroup of the group of Euclidean displacements. The number of parameters in the subgroup is called the degrees of freedom (DOF) of the joint. Mechanical linkages are usually designed to transform a given input force and movement into a desired output force and movement. The ratio of the output force to the input force is known as the mechanical advantage of the linkage, while the ratio of the input speed to the output speed is known as the speed ratio. The speed ratio and mechanical advantage are defined so they yield the same number in an ideal linkage.

C. D.C Motor

In this vehicle one DC motor are provide in each wheel to move forward and backward direction. The specification of motor used is 12 V, with 60 rpm. When power supply from battery to DC motor then DC motor rotate in clockwise direction and when reverse current supply from battery to DC motor then DC motor will anticlockwise direction. Which will forward and backward movement of vehicle. An electric motor uses electrical energy to produce mechanical energy. In any electric motor, operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. As you are well aware of from playing with magnets as a kid, opposite (North and South) polarities attract, while like polarities (North and North, South and South) repel. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion.

Fig. 3. D.C Motor

D. Battery

Fig. 4. 12V Battery

Battery is one of the important parts of this mechanism. Which is connected to DC motor by electric wire. It is store electrical energy and supply to DC motor so vehicle will move forward and backward direction. Batteries operate by converting chemical energy into electrical energy through electrochemical discharge reactions. Batteries are composed of one or more cells, each containing a positive electrode, negative electrode, separator, and electrolyte. Cells is to be divided into two major classes primary and secondary. Primary cells are not rechargeable and must be replaced once the reactants are

depleted. Secondary cells are rechargeable and require a DC charging source to restore reactants to their fully charged state.

E. Servo Motor

The servo motor is actually an assembly of four things: a normal DC motor, a gear reduction unit, a position-sensing device and a control circuit. The DC motor is connected with a gear mechanism which provides feedback to a position sensor.

Fig. 5. Servo Motor

F. Arduino-UNO

It is a microcontroller board developed by Arduino.cc and based on Atmega328. Microcontrollers are widely used in embedded systems and make devices work according to our needs and requirements. Arduino Uno is a very valuable addition in the electronics that consists of USB interface, 14 digital I/O pins, 6 analog pins, and Atmega328 microcontroller. It also supports serial communication using Tx and Rx pins. In this project Arduino- UNO is used to give command to servo motor. The direction of the servo motor is controlled by Arduino.

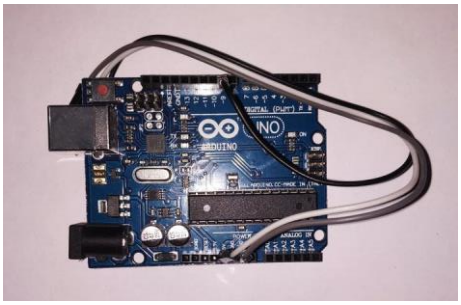

Fig. 6 Arduino-UNO

G. Bluetooth

Bluetooth is a wireless technology standard for exchanging data between fixed and mobile devices over short distances using short-wavelength UHF radio waves in the industrial, scientific and medical radio bands, from 2.400 to 2.485 GHz, and building personal area networks (PANs). In this project bluetooth is used to connect project to mobile phone for controlling motion and direction.

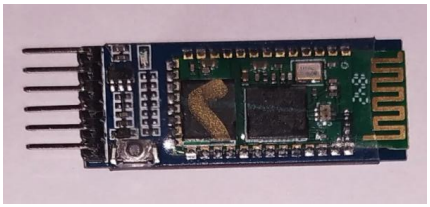

Fig. 7. Bluetooth

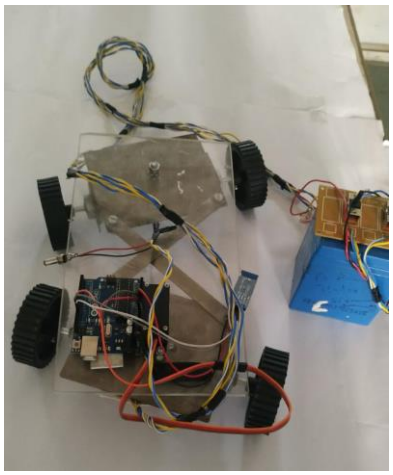

Fig. 8. Actual Picture of the project

5. Advantage and Application

A. Advantage

1. Easy Turning
2. Efficient Turning for Long Vehicle
3. Increase vehicle stability
4. Decrease turning radius at low speed
5. Improve handling and helps vehicle to make tighter turn.

B. Application

- *Parallel parking:* Due to smaller turning radius the parking and un parking of vehicle is easily performed towards the right or left side.
- *High speed lane changing:* In this is less steering sensitive this does require a lot of concentration from driver since he has to judge the space and vehicles behind them.
- *Slippery road surfaces:* Due to the rear wheel steering operation on low friction surfaces occurs hence vehicle direction easier to control.
- *Narrow Roads:* Due to rear wheel steering on narrow roads with tight bends, counter phase steering reduces the turning radius.
- *U-Turns:* By minimizing the vehicle's turning radius and counter phase steering of rear wheels enables U-Turns to be performed on narrow roads.

6. Conclusion

With reference to our base paper, our proposed method proved efficient in terms of turning without slip and speed

accuracy. This method is suitable even when the track has inclined or declined slopes. It is believed that autonomous navigating cars will be the next big thing of the future. So this smart turning mechanism with its robust line following will come in handy. It is planned to incorporate wireless protocol for communication between the cars which will serve greatly to avoid collision and also to share the relative information about one another thereby helping in traffic management.

Acknowledgement

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