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DESIGN AND FABRICATION OF STEERING SYSTEM USING SERVO MOTORS

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I. ABSTRACT: *The growth of technologies requested higher performance machine in order to fulfil human needs and market. This system is implemented to make human work easier and can reduce the human power because of its potential applications. This system can replace hydraulic steering system has the highest predominance as it has least number of components and compact, more accurate and closed loop system. This project helps to turn tires with more accuracy and less effort. While turning, it can be used for parking purpose and it increases efficiency of steering system as there are no mechanical linkages. It forwards a kind of operation that can activate by rotating rotary encoder so that it can send signals to Arduino, through Arduino servo motors are activated and turn according to the coding given by the programmer. This apparatus has many useful improvements and any driver can drive vehicle without many efforts. The main objective of this system is to attach this to an automobile so that the driver can turn vehicle with less effort and by this we can eliminate the problem during turning and parking purpose by using more accurate steering system installed with closed loop feedback and that can provide desired turning radius for less than conventional vehicles.*

II. KEYWORDS:

Rotary encoder, Arduino Board, Servo motors, DC motors, Bread Board.

III. INTRODUCTION:

Steering system is the collection of components, linkages which allows any vehicle (car, motorcycle, bicycle) to follow the desired course. The primary purpose of the steering system is to allow the driver to guide the vehicle. In this project, steering system is completely operated and controlled by servo motors and it will work according to the coding given by the user. In mechanical steering system we require many components to turn the vehicle. So, the design and fabrication of the parts required for mechanical steering system consume lot of time and it also increases the weight of the car and which will affect the efficiency of the vehicle and fuel consumption. If the alignment of the components gets mismatched then it creates problem like non-uniform wearing out of tires and needs frequent maintenance because of wear and tear of components. As we know that electrical components are less bulky and of low cost. We can reduce many problems by implementing the system as we are placing servo motor, we can predict exact turning angle according to our requirements. Motors are placed on the top of the servo motors and directly connected to the wheel. We can attain zero camber angle and this can reduce wear and tear of tire. As servo motor has a capability of turning 90 degrees so it helps in parking purpose to provide very less turning angle during parking.

IV. EXISTING SYSTEM:

With the continuous improvement of the steering system, the effort required to steer the vehicle has been reduced from the last decades. There are many steering systems available to us in the different automobiles. The power steering system uses hydraulic or electric actuators which will add the controlled energy to the steering system. The electric power steering system uses electric motors to assist the driver of the vehicle by the help of sensors which detect the position and torque of steering column, and a computer module applies assistive torque through the motor which is connected to steering gear or column. The speed sensitive steering system is the outgrowth from the power steering, where the steering is heavily assisted at low speed and lightly assisted at high speed. The next one is four-wheel steering. All four wheels will turn at the same time when the driver steers. The rear wheels will be turned with the help of computer and actuators in the most of the four-wheel steering. All the mentioned steering systems involves many complex linkages in between the steering wheel and the tires. The disadvantages involved are costly, time taking for design and fabrication, no feedback to the driver, oversensitive, home repair is not possible.

V. PROPOSED SYSTEM:

The purpose of this system helps to overcome the problems that have been raised in the conventional steering systems. As we use rotary encoder, Arduino

board, Servo motors, DC motors, Bread board and Jumper wires to steer vehicles, we can decrease the weight of the vehicle which will increase the efficiency of the steering system. The Rotary encoder is directly connected with steering wheel which will send signals to the Arduino board. It will analyze the value given by the encoder and send signals to the servo motors which will turn according to the coding given to the Arduino. So, there will be no mechanical linkages in the proposed steering system. So, the complexity reduces and also the space occupied by the steering system can be used for some other purposes.

VI. BLOCK DIAGRAMS

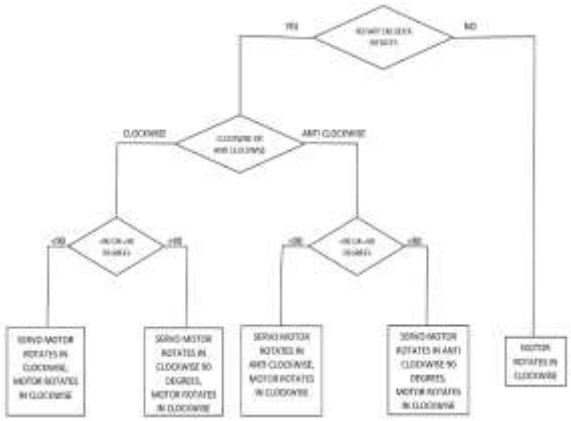

Fig-1: Flow chart of steering system using servo motors

LOGICAL DIAGRAM

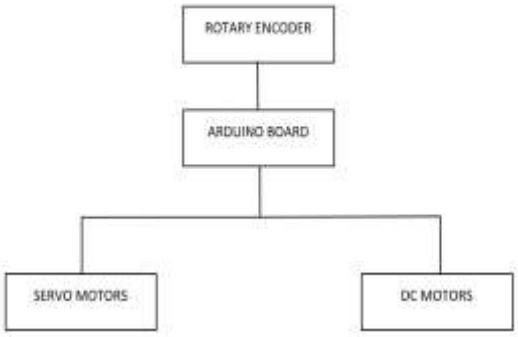

Fig-2: Logical Diagram

VII. HARDWARE REQUIREMENT

A. ROTARY ENCODER:

It is also called as shaft encoder. It is an electro-mechanical device that converts the angular position or motion of a shaft or axle to an analog or digital signal. One of the types is incremental encoder. This provides information about the motion of the shaft, which is typically further processed elsewhere into information such as speed, distance and position. The KY-040 model of incremental encoder is used in this system.

Rotary Encoder Module Specifications:

- Model: KY-040
- Type: Incremental Encoder
- Cycles per revolution (CPR): 20
- Working voltage: 0 – 5V
- Material: PCB + Brass
- Dimension: 32 x 19 x 30mm

Fig-3: Rotary Encoder and specifications

B. SERVO MOTOR:

A servo motor is a rotary or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires relatively sophisticated controller, often a dedicated module designed specifically to use with servomotors.

1. Voltage : 4.8V - 6V DC max (5V works well).
2. Average Speed : 0.2sec/60degree (@ 4.8V), 0.16sec/60degree (@ 6V).
3. Weight : 39 gm (1.37 oz).
4. Rotation angle : ~180°.
5. Torque : At 5V, 5.5kg-cm (76oz-in, and at 6V 6.5kg-cm (90oz-in.

Fig-4: Servo Motors and specifications

C. DC MOTOR:

A DC motor is a rotary electrical machine that converts electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electro-mechanical or electronic that periodically changes the direction of current flow in the motor. The speed can be controlled by varying the supply voltage or by changing the strength of current in its field windings.

Fig-5: DC motor and specifications

D. BREAD BOARD:

A Bread board is a solderless device for temporary prototype with electronics and test circuit designs. Most electronic components in electronic circuits can be interconnected through by inserting their leads or terminals into the holes and then by making connections through wires appropriate. The Bread board has strips of metal underneath the board and connect the holes on the top of the board.

Fig-6: Bread Board and specifications

E. ARDUINO BOARD:

Arduino is an open source computer hardware and software company and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control the objects in the physical world. This board design uses a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output(I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. This board offers serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming language C and C++.

Fig-7: Arduino board and specifications

F. JUMPER WIRES:

A jumper wire is an electrical wire or group of them in a cable with connector or pin at each end which is normally used to interconnect the components of a bread board or other prototype or test circuit, internally or with other equipment or components, without soldering. Individual jumper wires are fitted by inserting their end connectors into the slots provided in a bread board, the header connector of a circuit board, or a piece of test equipment.

Fig-8: Jumper wires

VIII. SOFTWARE REQUIREMENT:

A. ARDUINO IDE:

The Arduino Integrated Development Environment (IDE) is a cross platform application (Windows, mac OS, Linux) that is written in the programming language. It is used to write and upload programs to Arduino compactible boards. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE

supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution.

B. C++

C++ is a general-purpose programming language and widely used now-a-days for competitive programming. It has imperative, object oriented and generic programming features. C++ runs on lots of platforms like Windows, Linux, Unix, mac. It is used to create sophisticated high-performance applications.

IX. 2D DESIGN OF VEHICLE

Fig-9: Back view of chassis of prototype

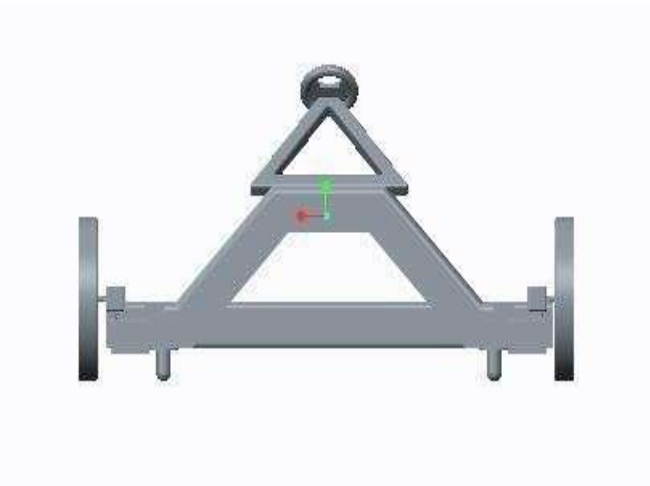

Fig-10: front view of chassis of prototype

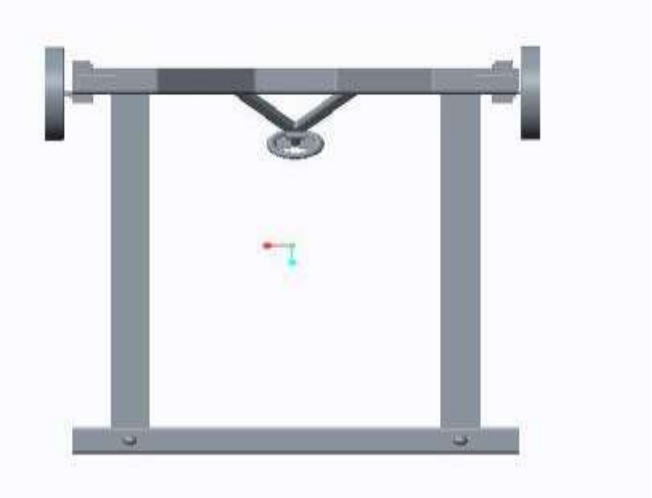

Fig-11: bottom view of chassis of prototype

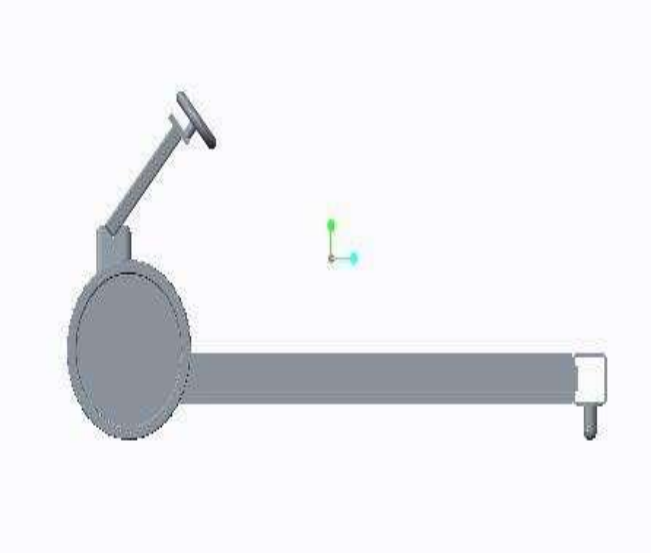

Fig-12: Side view of chassis of prototype

X. ALGORITHM:

- The Rotary encoder is connected to the steering wheel. When the steering wheel is rotated then the rotary encoder also rotates and send the signals to the Arduino board where the signals are processed further.
- The coding should be uploaded to the Arduino board.
- The Arduino board then process the input by the Rotary encoder and analyse it according to the coding.
- The Arduino then send signal to the servo motors. The servo motors are directly connected on the top of the DC motors.

- If the servomotors are rotated then DC motors will also rotate.
- The DC motors are connected to the DC Battery which will rotate the motor continuously.
- If the Rotary encoder is rotated then the wheels are turned to about 90 degrees from 0 degrees and if we rotate further then the tires will return to 0 degrees with the help of servo motors.
- The servo motors will rotate only according to the coding given by the user.

XI. ADVANTAGE:

- Less cost when compared to electric steering system.
- Repairs can be done if we have a basic knowledge about them.
- Turn tires to 90 degrees.
- Zero maintenance.
- Less complexity.
- No mechanical linkages.
- No wear and tear of components.
- Feedback can be given using display module.

XII.FUTURE SCOPE:

The practical application domains where steering technology is most likely to be used are

- Medium load transmission vehicle systems.
- Various speed transmission vehicle system.
- Small type of car like toys, mini race cars.

XIII. CONCLUSION:

This project can replace complete steering system with servo steering system in most effective way. Initially the Rotary encoders is connected to the Arduino as an input source through Arduino, servo motors and DC motors are controlled effectively. It helps to park the vehicles very easily as the tires will turn to 90 degrees.

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