MEMS Controlled Contactless Steering and Locking System For E-Vehicles

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Abstract- The advancing technologies had lead to the automation of every sector, thus reducing the human intervention and providing for the improvised performance and efficiency. One such sector of immense importance is the electric vehicle that have been emerging in both numbers and convolution. To achieve peaks in the automation, the enhancement of the electric devices such as sensors play a critical role. In the present Era due to the advantage of MEMS sensors (Micro- electromechanical system) they find application in wide variety of automotive industries. To design a highly secured contactless steering by sending steering control movement data through RF-Tx. To detect steering wheel movements by MEMS based accelerometer. The proposed system receives RF-Rx data and controls wheel movements through an IC driver. Thus, ensuring security and protection of the vehicle. This proposed system paves way for the contactless controlling of vehicle. The driver can operate the vehicle by sitting anywhere in the car. The contactless steering can be connected and disconnected easily. Thus, makes the proposed system highly secured and theft free. This can be applied to the automation of Electric vehicles, can be employed in unmanned operation of vehicle in the industries and in delivery of goods.

Indexed Terms- MEMS Sensor, Contact-less Controlling, Virtually transmitted, Safe locking system, Remote operational, Highly secured

I. INTRODUCTION

One of the fastest growing industry worldwide is the electric vehicle industry. This is a fascinating area with more probability to explore and invent. As market is expanding wider, the possibilities are being mined at larger scale. This creates an opportunity to explore more in this field through research and innovation. The government and research institutions also encourage such activities through incentives and schemes. One of the most next generation technology implication in the field of electric vehicle is the automation of the vehicle. The recent quantitative and qualitative development in the electronic technologies has allowed the revolution of improvement in the e vehicle. Most of the electronic system rely on the input from the sensors, which convert physical quantity to electrical quantity, finds considerable growing share of such sensors captured by MEMS technology sensor. Such an improvised technology had contributed to the more advantages in the system such as increased safety, reduced fuel consumption, lowered emission. MEMS is the extension of IC micro-fabrication technology they find application in wide variety of the field due to this unique and specific features. The flexibility and possibility for dimension control, device to device con-tactless connectivity, uniformity, small size with mass production volume, reduced manufacturing cost, measure parameters and control ambiance fulfils all the requirements for the product to be employed in automotive field. The integrated use of such sensors provides for the automatic control of the vehicle. MEMS technology can be grouped into accelerometer, gyroscope, inclinometer, flow and pressure sensor. In our proposed system we made use of accelerometer. It is used to measure the direction of acceleration in three axes. It measures acceleration by measuring change in the capacitance. It has mass attached to the spring which is confined to move along one direction and fixed plates. So, when there is acceleration in particular direction mass will move then capacitance between the plate will change. This change in capacitance will be measured and that corresponds to a particular value. Such an accurate input will contribute to the efficient working of the system. In this paper contactless control of steering and wheel was made possible only by application of such sensors. The data are transmitted virtually by radio frequency transmitter and receiver, eliminating the necessary for mechanical contact. The proposed system even gives high level security system for the vehicle thus making more possibilities for the complete automation of e-vehicle easier and viable.

II. LITERATURE SURVEY

1. Geeta Bhatt, Kapil Manoharan, Pankaj Singh Chauhan, Shantanu Bhattacharya, "MEMS Sensors for Automotive Applications", Sensors for Automotive and Aerospace Applications, pp: 223-239, January 2019.
   In this paper MEMS-based sensors and their application in the automotive-like tire pressure and monitoring systems, engine management system, vehicle stability were discussed. The challenges like enhancing the quality/performance of the vehicle, the need to reduce the size of sensors are taken care through the use of MEMS integrated systems.[1]

2. Upesh Mangal prasad Patel, Karishma Subhash Padole, "Overview of MEMS Sensors in Automotive Industry", International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol. 7, Issue 01, January-2018
   This chapter provides an overview of micro electro-mechanical system (MEMS)-based commercial products. The emphasis is on the compatibility issues of the various micro-machining. The paper is concluded with a remark on the upcoming systems that are able to make automobile safer, more fuel efficient.[2]

3. Gaurav Phulwari, Shani Khandelwal, Dhreej Singodia, "Application of MEMS in Automobiles Industry For Increasing The Safety Of Passengers", International Journal of Computer Sciences and Engineering, Volume-5, Special Issue-2, Dec 2017, E-ISSN: pp: 2347-2693.

In this paper, the newest and most important applications of the MEMS technology in the automotive industry have been introduced. It has been shown that many of the previous sensors can be simply replaced by the more cost-effective, safer, and smaller MEMS sensors, and hundreds of million MEMS sensors have been used in the cars. [3]

III. EXISTING SYSTEM

In the existing vehicles, there is a mechanical contact between the steering and the wheel. The mechanical contact may fail at times becoming the major reason for accidents to occur. It takes longer time for the manufacturing of the vehicles. A large number of trained and skilled person are required for manufacturing of the vehicle. Understanding of mechanical system is also tougher for the users. In case of any fault, they are unaware of the source of the fault and needs the aid of the skilled person to repair such systems. The system also can be operated only by trained and licensed person, if not it may lead to accidents and injuries. In the existing vehicle the space occupied by the driver seat is too large. This in case reduces the total space available in the vehicle. The increased manufacturing cost and increased operating cost adds to the demerits of the existing system. Such vehicle cannot be connected to the IoT or other automation systems thereby decreasing the scope for automation. They lack behind the advanced emerging technologies that are being implemented worldwide. No scope for unmanned operation of the vehicle. The security implied in this existing system is also medium. Once the key is duplicated then becomes easy to steal the vehicle, increasing the chances for the theft of the vehicle. The locking system employed is much traditional and can be hacked easily. Although the vehicles are produced at high cost, the above-mentioned drawbacks clearly shows the need for the advancement and new technology to be employed in the electric vehicle to make it more viable and efficient.

IV. PROPOSED SYSTEM

In this proposed system there is no mechanical contact between steering and wheel. They are connected wirelessly, so can be controlled efficiently. The probability for the failure of the system is much reduced. The accidents can also be reduced. It needs only lesser time to produce large quantity of vehicles.

The working of the vehicles can be understood even by layman easily no specially trained skilled person required to operate the vehicle. Hence, the manufacturing cost is reduced and operating cost also lowered, since can be operated from any place in the the vehicle, not necessarily the driver seat. The more space in the vehicle can be utilized for other purposes it is much friendly to connect to IoT by simply implicating and connecting electronic devices. The scope for the automation is very high in the system by implementing such advanced system, we will be in the global competition and can meet up their technological requirements. To this system provided with wide range of high level security system, the opportunity for the theft of the vehicle will be brought down. Apart from the locking, it is uncomplicated to remove steering so the chances of stealing vehicle becomes less. In this method the vehicles can be replicated at low cost, but its safety standards are not compromised. The block diagram of the proposed system is shown in fig.1 and fig.2

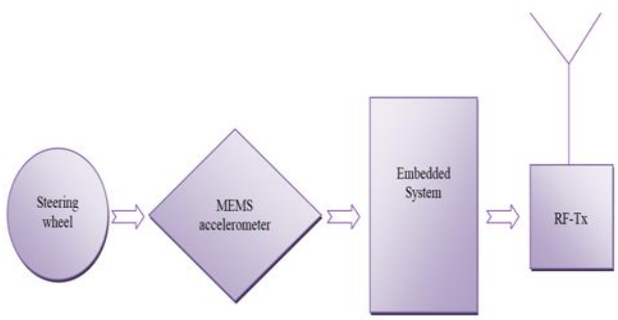

Fig 1: Block Diagram of Steering side

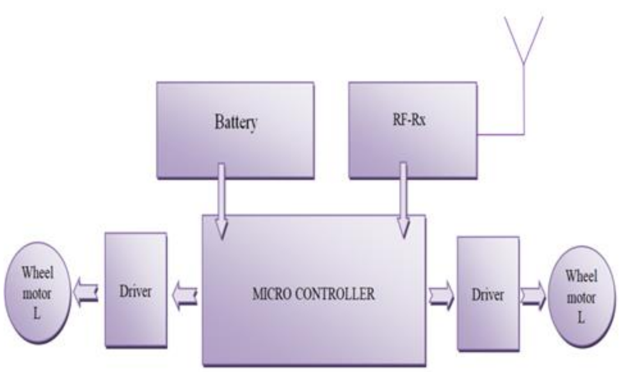

Fig 2: Block diagram of vehicle side

V. WORKING

The battery of the system is turned on to power the system. Now to operate the system it is necessary to confine the direction of movement of the wheels. This can be done by giving direction through the steering. To change the direction of the vehicle, the direction of the steering has to be changed. This data given as physical quantity to the steering is converted to analog data through MEMS sensor. The MEMS sensor detects, analyses the direction of movement in three axes and produce the vehicle's direction of movement as output. The output from the MEMS fed to the micro-controller PIC 16F877A which has inbuilt analog to digital converter. This data will be processed by the controller and gives appropriate direction as input to the radio frequency transmitter. The transmitter transmits the data wireless to the RF receiver that is attached to the wheels of the vehicle. The frequency of the RF is 433 MHz that can cover a range of few kilometers. The RF receiver receives data and gives it to the micro-controller depending on the input received from the steering side, controller gives data to the driver connected. The driver in turn powers the DC gear motor that is attached to the wheels of the vehicle. As such the direction and motion of the vehicle can be controlled contactlessly. When vehicle is parked, the steering can be disconnected and kept in safer place making vehicle theft impossible to occur.

VI. HARDWARE DESCRIPTION

A. PIC MICROCONTROLLER

It is a 10-bit, up to 8-channel Analog-to-Digital Converter (A/D), Brown-out Reset (BOR), Analog Comparator module with: Two analog comparators, Programmable on-chip voltage reference (VREF) module, Programmable input multiplexing from device inputs and internal voltage reference, Comparator outputs are externally accessible.

B. RF TRANSMITTER AND RECEIVER MODULE

RF Transmitter 433MHz Features:

- Frequency Range: 433.92 MHZ
- Supply Voltage: 3~12V
- Output Power: 4~16dBm

- Circuit Shape: Saw
- Temperature Range: - 40 degree C ~ + 80-degree C.

RF Receiver 433MHz Features:
- Receiver Frequency: 315 / 433.92 MHZ.
- Typical sensitivity: -105dBm.
- Supply Current: 3.5mA.
- IF Frequency:1MHz

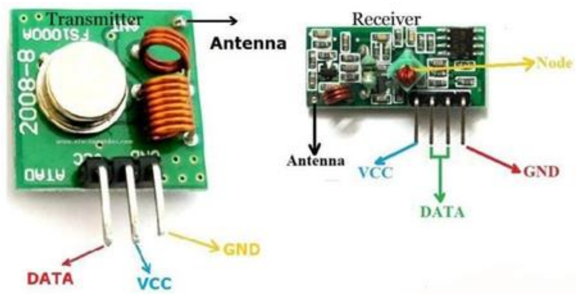

Fig 3: RF Module

C. MEMS ACCELEROMETER ADXL320
Features:
- Small and thin
- 4 mm × 4 mm × 1.45 mm LFCSP package
- 2 mg resolution at 60 Hz
- Wide supply voltage range: 2.4 V to 5.25 V
- Low power: 350 µA at VS = 2.4 V (typ)
- Good zero g bias stability
- Good sensitivity accuracy
- X-axis and Y-axis aligned to within 0.1° (typ)
- BW adjustment with a single capacitor
- Single-supply operation
- 10,000 g shock survival
- Compatible with Sn/Pb and Pb-free solder processes

The ADXL320 is a low cost, low power, complete dual-axis accelerometer with signal conditioned voltage outputs, which is all on a single monolithic IC. The product measures acceleration with a full-scale range of ±5 g (typical). It can also measure both dynamic acceleration (vibration) and static acceleration (gravity).

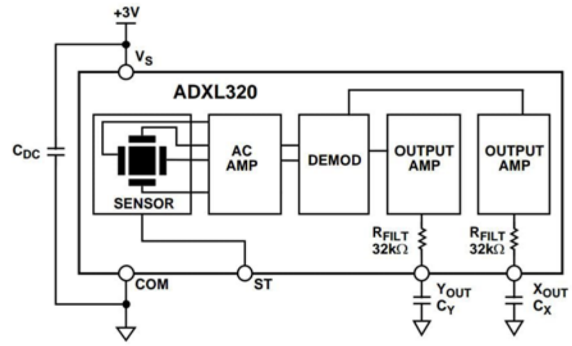

Figure 4: ADXL320

D. DC GEAR MOTOR
Features:
- High torque density delivers class- leading torque from compact frame size.
- 8 pole motor
- high torque at low speeds.
- High load capacity.
- Low heat generation.
- Low noise & High efficiency

Figure 5: DC Gear motor

VII. RESULTS AND DISCUSSION

The proposed system is implemented successfully. The prototype proposed can be implemented in real time e-vehicle after making notable testing in industry. In this system the movement of the vehicle is controlled completely. Thus by employing more such sensors we can move ahead for the complete automation of the vehicle. This system can be integrated with the GPS and can be operated from any place by looking into the real time traffic monitoring. This can also be incorporated with IoT for the easier data transmission and analyzing. This system can be easily implemented in the electric vehicle other than that of fuel powered vehicles. Now there is increase in use of electric vehicle due to the number of disadvantages of IC engine vehicle such as increasing fuel economy, higher emission levels, disaggregate impact on the environment favours the usage of electric vehicle by wide range of people. This result in the higher market for the e-vehicle. Any advancement in the e-vehicle will enhance the efficiency and improvise performance of the vehicle. That further adds to the increasing market possibility for the electric vehicle.

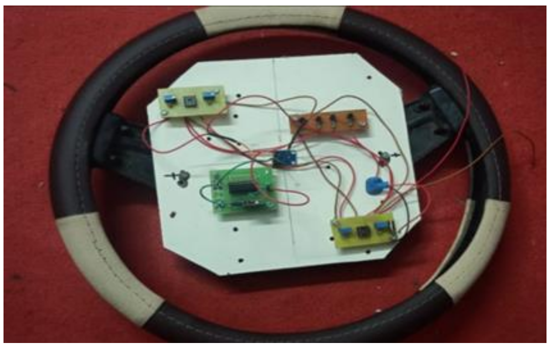

Figure 6: Transmitter side

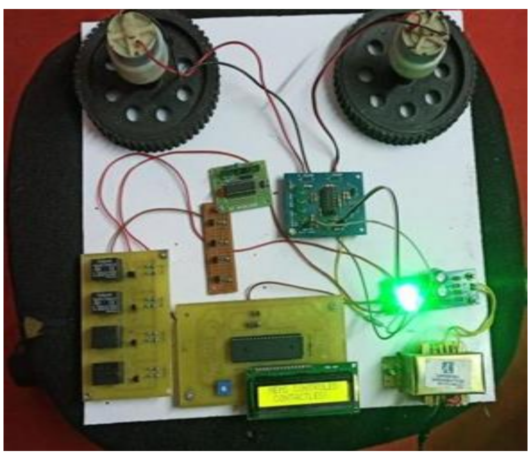

Figure 7: Receiver Side

CONCLUSION AND FUTURE SCOPE

This proposed system paves way for the contact-less controlling of vehicle. The driver can operate the vehicle by sitting anywhere in the car. It leads to reduce in the space occupied by the driver and the vehicle becomes more spacious. This system enables virtual transmission of data, decreased physical contact between wheel and steering and fast manufacturing. The steering is remote operational. The contactless steering can be connected and disconnected easily. To protect the vehicle it is possible to remove the steering when not in use. Thus makes the proposed system highly secured and theft free.

The future scopes are as follows:

1. This system can be applied to the automation of e–vehicle.
2. By connecting it to the IoT it can be used to promote the labour-less delivery of goods.
3. It can be used in industries for the intra movement of mass goods.

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