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Experimental Vibration Model of Vehicle with the Help of Vibration Measuring Device

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Abstract: Vibration has become an important consideration in engineering. Development of industries and vehicles make the subject even more important. In today's world every family has a car. There for it becomes essential to study the phenomenon of vehicle vibration and it's effects on humans as well as on vehicle body due to various road conditions. The study of vehicular traffic is essential for modern cities to determine the efficiency of their current roads and to plan new infrastructure that keeps the mobility of its inhabitants. Technologies that provide detailed data of the current situation on the roads are needed to reduce journey times and pollution emissions and consequently improve the quality of life of the people. Smart streets featuring sensor networks offer the possibility to study with high accuracy the traffic conditions on every point of the road. We develop a vibration measuring device which help to determine the various road condition and also gives the indication of vibration act on vehicle in form of HIGH,LOW and MEDIUM .This will help us testing various road condition and vehicle vibration test.
Keywords- Vibration Device, Vibration Test Vehicle, Battery Operated Vehicle, Various Road Profile.

I. INTRODUCTION

The purpose of the project is to investigate which sensor outputs strongly correlate with a road surface features, for the purpose of reliable discrimination between different types of road feature. A data acquisition system, incorporating sensors, amplification, signal conditioning and data recording was fitted to the vehicle.

A. Vibration Act On Vehiclle Due To Road Roughness

1) The roughness in a road is the deviation in elevation seen by a vehicle as it moves along the roa
2) The roughness acts as a vertical displacement input to the wheels, thus exciting ride vibration
3) Most common and meaningful measure of ride vibration is the acceleration produce
4) Roughness should be viewed as an acceleration input at the wheel
5) Assume a speed of travel, convert elevation profile to displacement, differentiate and get velocity, once again differentiate and get acceleration

The motivation behind to select this topic, to determine strengths of vehicle parts such as chassis, suspension, outer body of vehicle.to determine durability of vehicle, road conditions, effect of vibration on human body, wheel balancing, tyre life etc. Resulting from this we know the road condition of different region which help to select the road while driving the vehicle. The recorded data is helpful to send road contractor for reconstruct the road. The product development exercise in the automobile industry can be finished after doing durability calculations. The durability test is known as the life cycle test and is essentially for testing the reliability of vehicle. This test offer important data to determine the life cycle of vehicle through the analysis of cost vs. effect, this test data is used for evaluating and predicting defect of the main part of the vehicle during the life cycle. One of the important test factors in the endurance test is the vibration environments in which the vehicles are operated. The environment affects the reliability of vehicles owing to fatigue. Therefore, the measurement of road profile and the evaluation of profile characteristics are important points to get reliable endurance test results. The actual load in component can only be measured once a prototype is available. Road surface events are the same for all kinds of vehicles and components, only the vehicle responses vary. In this way, the road profiles are independent of the vehicle and have widespread application. Shows a small patch of road surface with longitudinal and lateral profiles. The longitudinal profile provides the pitching effect to the vehicle and the lateral profile is responsible for the rolling effect. The road damage assisment methodology utilizes an artificial neural network that reconstruct road surface profile for measured vehicle accelerations.The motivation behind to select this topic, to determine strengths of vehicle parts such as chassis, suspension, outer body of vehicle.to determine durability of vehicle, road conditions, effect of vibration on human body, wheel balancing, tyre life etc. Resulting from this we know the road condition of different region which help to select the road while driving the vehicle. The recorded data is helpful to send road contractor for reconstruct the road.

B. Testing vehicle

Following are the important parts in our testing model

1) *Suspensions:* The suspension is the system of tires, tire air, springs, shock absorber and linkages that connects a vehicle to its wheels and allows relative emotion between the two
2) *Chassis:* A chassis consist of an internal vehicle frame that supports an artificial objects in its construction and use, can also provide protection for some internal parts
3) *Battery Electric Vehicle:* A battery electric vehicle, battery only electric vehicle that uses chemical energy stored in rechargeable battery packs .It uses electric motor and motor controlles instead of internal combustion engine for propulsion.
4) *Bearings:* Bearing is a machine part in which another part (such as joints or pins) turns or slides.
5) *Axle:* Axle is defined as bar or shaft on which a wheel, pairs of wheel or other rotating members revolves.
6) *Tyre:* Tyre is a thick piece of rubber which is fitted onto the wheels of vehicles such as cars, busses and bicycles.
7) *Requirement:*-Our requirement to determine vibration effect on vehicle body due to different road condition.

Also determine vehicle motion such as pitching and rolling this model also gives the indication of damaging parts in a vehicle due to excessive vibration. It is design for the purpose of testing various road profile.

This vehicle contain suspension system which activate when vehicle suffering from bump.

When vehicle suffering from any bump the rolling effect observed in vehicle.

It vibrates in two degrees of freedom. It is fully battery operated vehicle gives the concept of electric car which is most demanded in future. It saves the fuel and a economical as well as good for environmental factor.

The vibration device is attached on the testing vehicle which gives the indication of vibration in terms of HIGH, LOW & MEDIUM. It also state the angle of rolling in vehicle. The vehicle is remote operated for easily handling.

II. LITERATURE SURVEY

A. Modelling and Vibration analysis of a Road Profile Measuring System

1) *C. B. Patel , P. P. Gohil, B. Borhade:* In this paper, one of the important test factors in the endurance test is the vibration environments in which the vehicles are operated. The environment affects the reliability of vehicles owing to fatigue. Both tyres and suspensions are represented with spring and damping effect. Both front and rear axle are represented by single masses. Random road profile is considered as road input

B. Effect of vehice Vibration on Human Body

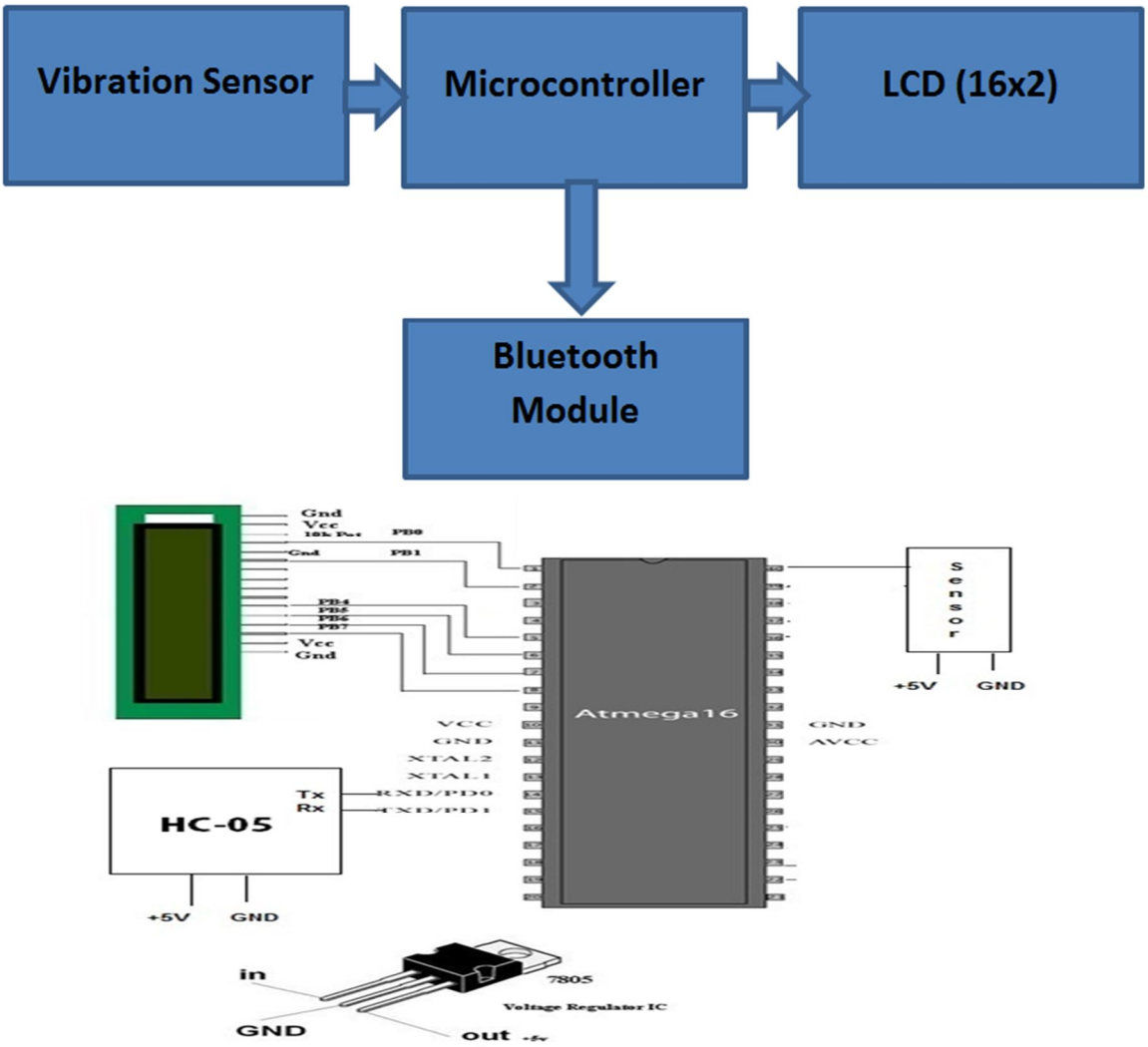
1) *Kattu U.S., Desavale R.G. and Kanai R.A.:* In this research paper , states that damage is produce if the accelerative force are of sufficient magnitude cronic injuries is produce by vibration exposer of long duration .Exposer accepted as arisk factor in development of low back pain minor injuries and rarely to act of blood may appear in urine due to vehicle vibration.Vibration of frequency range 4 to 10 Hz.Procures pain in the chest after backaches to occour very particularly at 8to 12 Hz headache eye strain and irritation in the intestine.

C. Compact Vibration Measuring System for in-Vehicle Applications

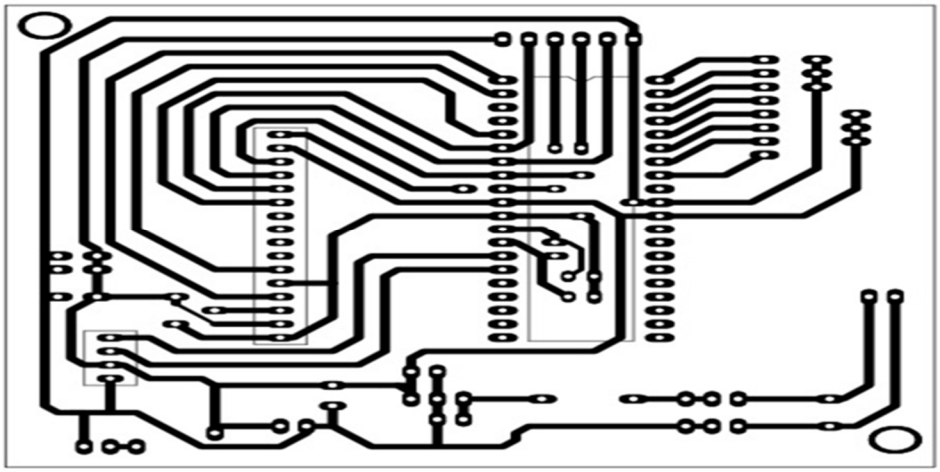
1) *G. J. Stein, R.Chmurny, V .Rosik:* In this paper states that to gather the field vibration data in real time for future used in a seat suspension system simulation research. It also have the means to analyse drivers seat performance in the three mutually perpendicular axis.

   The fitting of apparatus in to the vehicle is fairly easy & straight forward as no cable conection are necessary. Preliminary result demonstrate the feasibility and the capabilities of the described measuring system.

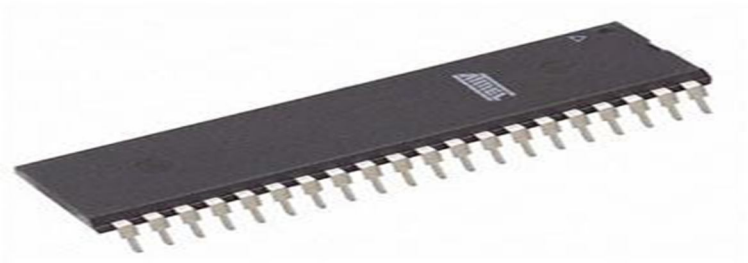
D. Block Diagram



PCB Design



Microcontroller AVR ATMEGA16

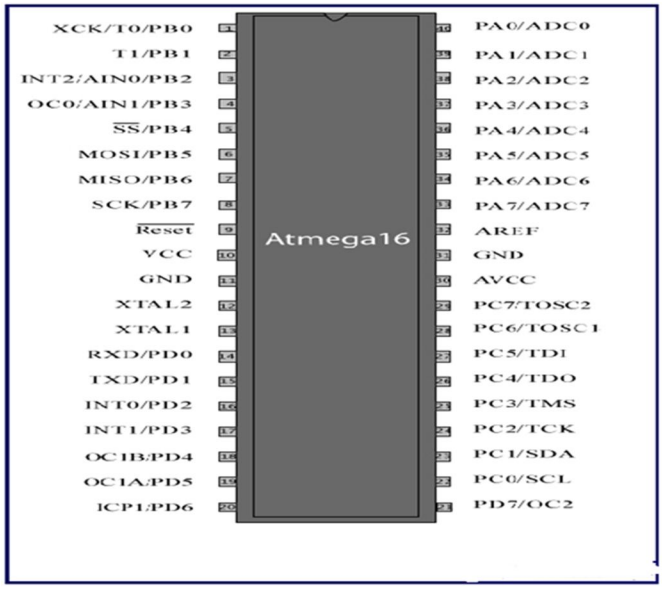


AVR microcontroller

All output signals generated from flex sensors are in analogue form and these signals need to be digitized before they can be transmitted to encoder. Therefore microcontroller ATMEGA 16 is used as the main controller in this project. It has inbuilt ADC module, which digitizes all analogue signals from the sensors and inbuilt multiplexer for sensor signal selection. It supports both serial and parallel communication facilities. ATmega16 is an 8-bit high performance microcontroller of Atmel's Mega AVR family with low power consumption. Atmega16 is based on enhanced RISC (Reduced Instruction Set Computing) architecture with 131 powerful instructions. Most of the instructions execute in one machine cycle. Atmega16 can work on a maximum frequency of 16MHz.

E. ATMEGA 16 devices are available in 40-pin

1) It is 8-bit Microcontroller
2) System is RISC Architecture
3) It has Small set of Instruction set
4) It has 131 powerful Instructions
5) Compatibility avail 28/40 Pin Ics
6) Operating Speed Max 16 MHz, Voltage 2-5.5 v
7) Memory: Flash Program-16KB, RAM-1 KB, EEPROM Data Memory- 512 Bytes
8) Low power, High speed Flash/EEPROM Technology
9) It has on chip Timers. 2 Timers are avail
10) It has in built Analoge to Digital Converter, USART, Analoge Comparator, SPI JTAG etc
11) In built Multiplexer availability for signal Selection
12) It has serial as well as Parallel Communication facilities
13) In built Capture, Compare and Pulse width modulation
14) It has four 8 bit Ports designated as PORT A,PORT B,PORT C, PORT D for Internal and External usage



Pin diagram of microcontroller ATMEGA 16

F. Description of Microcontroller Pins

*1) VCC :*Digital supply voltage.

*2) GND :*Ground.

3) *Port A (PA7..PA0):* Port A serves as the analog inputs to the A/D Converter. Port A also serves as an 8-bit bi-directional I/O port, if the A/D Converter is not used. Port pins can provide internal pull-up resistors (selected for each bit). The Port A output buffers have symmetrical drive characteristics with both high sink and source capability. When pins PA0 to PA7 are used as inputs and are externally pulled low, they will source current if the internal pull-up resistors are activated. The Port A pins are tri-stated when a reset condition becomes active, even if the clock is not running

4) *Port B (PB7..PB0):* Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running

5) *Port C (PC7..PC0):* Port C is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port C output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running. If the JTAG interface is enabled, the pull-up resistors on pins PC5(TDI), PC3(TMS) and PC2(TCK) will be activated even if a reset occurs.

6) *Port D (PD7..PD0):* Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.

G. RESET

Reset Input. A low level on this pin for longer than the minimum pulse length will generate a reset, even if the clock is not running. Shorter pulses are not guaranteed to generate a reset.

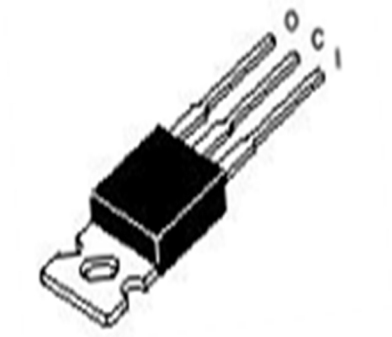
1) *XTAL1:* Input to the inverting Oscillator amplifier and input to the internal clock operating circuit.

2) *XTAL2:* Output from the inverting Oscillator amplifier.

3) *AVCC:* AVCC is the supply voltage pin for Port A and the A/D Converter. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter.

4) *AREF :* AREF is the analog reference pin for the A/D Converter.

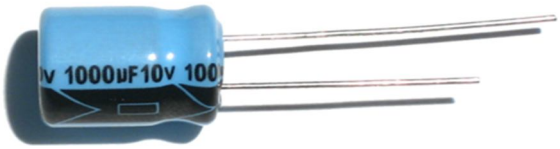
5) *Voltage Regulator :* A Voltage Regulator is an electrical regulator designed to automatically maintain a constant voltage level. A voltage regulator may be a simple "feed-forward" design or may include negative feedback control loops. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages. Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. A basic voltage regulator LM7805 has three legs, converts varying input voltage and produces a constant regulated output voltage. The most common part numbers start with the numbers 78 or 79 and finish with two digits indicating the output voltage. The number 78 represents positive voltage and 79 negative one.



Voltage regulator IC

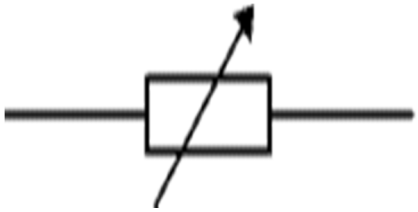
6) *Necessity Of Regulated Power Supply:* The DC level of an ordinary power supply changes due to the following reasons. Variations in AC mains voltage: the permissible variation in the mains voltage as per Indian electricity rules is +/- 6% of its rated value. But in India the variation in voltage is much more than its rated value. That is why the DC voltage of an ordinary power supply changes to such an extent that the electronic device refuses to work satisfactorily. Voltages drop in internal resistance: the internal resistance of an ordinary power supply is very large. Therefore output voltage changes to an extent when load is connected across it. Some it reduces to very low extent due to which the electronic component refuses to work.

7) *Capacitor:* A capacitor (formerly known as condenser) is a passive electronic component consisting of a pair of conductors separated by a dielectric (insulator). When there is a potential difference (voltage) across the conductors, a static electric field develops in the dielectric that stores energy and produces a mechanical force between the conductors. An ideal capacitor is characterized by a single constant value, capacitance, measured in farads. This is the ratio of the electric charge on each conductor to the potential difference between them. Capacitors are widely used in electronic circuits for blocking direct current while allowing alternating current to pass, in filter networks, for smoothing the output of power supplies, in the resonant circuits that tune radios to particular frequencies and for many other purposes. The effect is greatest when there is a narrow separation between large areas of conductor, hence capacitor conductors are often called "plates", referring to an early means of construction. In practice the dielectric between the plates passes a small amount of leakage current and also has an electric field strength limit, resulting in a breakdown voltage, while the conductors and leads introduce an undesired inductance and resistance.



Capacitor

8) *Variable Resistor:* This type of variable resistor with 2 contacts (a rheostat) is usually used to control current. Variable resistor is used to control the duty cycle Examples include: adjusting lamp brightness, adjusting motor speed, and adjusting the rate of flow of charge into a capacitor in a timing circuit.



Diode IN 4007

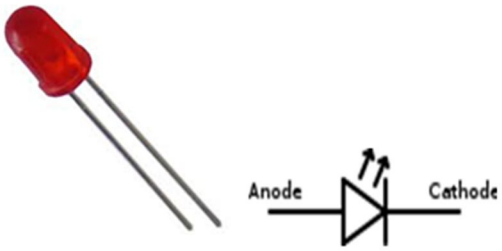
In electronics, a diode is a two-terminal electronic component that conducts electric current in only one direction. The term usually refers to a semiconductor diode, the most common type today. This is a crystalline piece of semiconductor material connected to two electrical terminals. A vacuum tube diode (now little used except in some high-power technologies) is a vacuum tube with two electrodes: a plate and a cathode. The most common function of a diode is to allow an electric current to pass in one direction (called the diode's forward direction) while blocking current in the opposite direction (the reverse direction). Thus, the diode can be thought of as an electronic version of a check valve. This unidirectional behavior is called rectification, and is used to convert alternating current to direct current, and to extract modulation from radio signals in radio receivers.

9) *Features of IN4007*

a) High reliability
b) Low leakage
c) Low forward voltage drop
d) High current capability

Diode

10) LED (light emitting Diode)



LED

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices, and are increasingly used for lighting. Introduced as a practical electronic component in 1962, early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet and infrared wavelengths, with very high brightness. When a light-emitting diode is forward biased (switched on), electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the color of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor. An LED is often small in area (less than 1 mm2), and integrated optical components may be used to shape its radiation pattern. LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved robustness, smaller size, faster switching, and greater durability and reliability. LEDs powerful enough for room lighting are relatively expensive and require more precise current and heat management than compact fluorescent lamp sources of comparable output. Light-emitting diodes are used in applications as diverse as replacements for aviation lighting, automotive lighting (particularly brake lamps, turn signals and indicators) as well as in traffic signals. The compact size, the possibility of narrow bandwidth, switching speed, and extreme reliability of LEDs has allowed new text and video displays and sensors to be developed, while their high switching rates are also useful in advanced communications technology. Infrared LEDs are also used in the remote control units of many commercial products including televisions, DVD players, and other domestic appliances.

11) Advantages

a) Vibration determination at low cost.
b) Road profile easily determine.
c) Ease of operation.
d) Vibration device can be apply on any vehicle.
e) Battery operated, less pollution emission

II. CONCLUSION

A complete half car model has been discussed for a road profile measuring system. After the simulation of a complete half car road profile measuring system, the outcome was a good agreement between input and output road profile. The static, strain and vibration has been discussed on the chassis design to develop the chassis structure according to specifications. The static and dynamic analysis is done to determine whether the natural frequency of the chassis is in the suitable range. Vibration of the chassis of the vehicle can be reduced by installing suitable suspension to the chassis structure which could absorb the shock from external factor

such as bumpy road. As a result of the analysis, test-stand measurements and road tests, it was stated that interferences caused by road surface irregularities have a significant influence on vibrations of the sprung mass of the car body. Therefore, an early detection of unbalanced wheel by means of the measurement of the sprung mass of the car body may be subject to interferences caused by road surface irregularities. Moreover, it was found that road surface irregularities lead to accelerations both in the vertical direction as well as in the longitudinal direction.

We had successfully find out the vibration acting on the vehicle due to road irregularities. We distributed some value of vibration and termed it into HIGH, MEDIUM and LOW categories. We fulfil our requirement and need to find out road surface.

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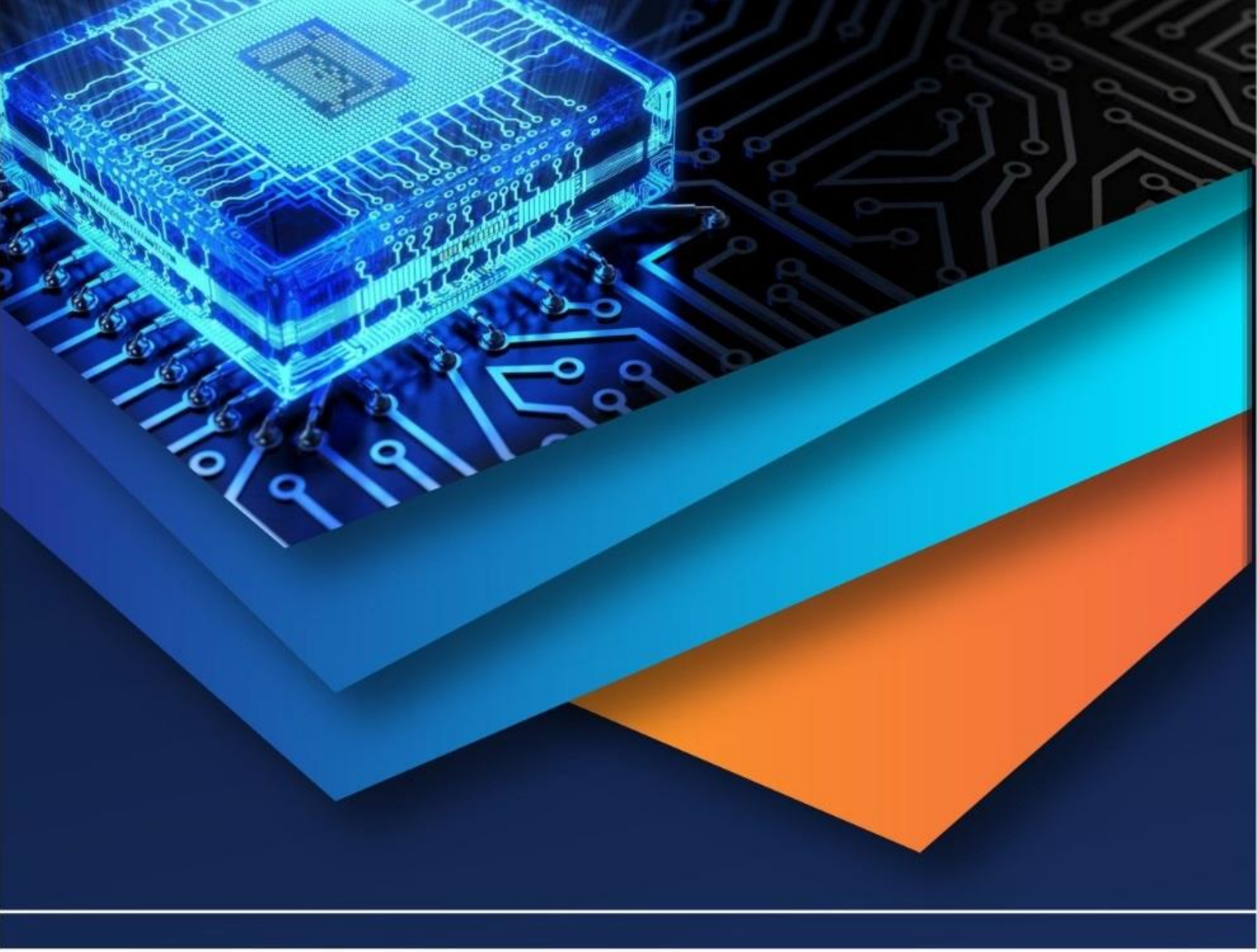

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