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DESIGN AND FABRICATION OF RAGGED TERRAIN PALTRY

SURESH BALAJI S[1], JEEVA ARAVINTH J V[2], RAGHUL S M[3], SARATHI S M[4], RASIQ FAREETH S[5]

1 ASSISTANT PROFESSOR 2,3,4,5 UG SCHOLAR

DEPARTMENT OF MECHANICAL ENGINEERING

KNOWLEDGE INSTITUTE OF TECHNOLOGY, SALEM, TAMILNADU, INDIA

Abstract— The main objective of this project is to improve the suspension system and increase the monitoring or surveillance of the rover. In this project the suspension system is modified by using the arm and motor to control the suspension system. Here the rover can able to rotate 360 degree which is controlled by separate motor to rotate the wheel and it leads to rotate the entire rover 360 degree with precise space. This project will lead to use in different applications like Space, Military etc. Also this rover is used to surveillance the army place and attack the terrorist camp using the gun controlled to aim and attack the enemies. This project makes use of an extension arm to recover the rover when there is a stuck in the rover which is controlled to lift the entire rover to recover from slurry, mud etc. This project have future scope to use in applications in space and military to surveillance and improve the collaborative technique of the rover. This helps in reduce the some exploding accidents in the defense.

Keywords— Suspension System, Geared motors, Servo motors, Mobile application, Microcontroller

1. INTRODUCTION

1.1 Suspension System

A suspension system is a set of mechanical connections, springs, and dampers that connect the wheels to the chassis. It has traditionally performed two functions: managing the vehicle's handling and braking for safety, and keeping passengers comfortable from bumps, vibrations, and other factors. It is a mechanical system of springs or shock absorbers connecting the wheels and axles to the chassis of a wheeled vehicle.

It also aids in maintaining proper vehicle height and alignment. It also controls the vehicle's orientation and must keep the steering wheel perpendicular to the ground for maximum grip. The suspension also helps to safeguard the car and its contents from damage and wear. The front and rear suspensions of a car may be designed differently.

1.1.1 Suspension System serves following functions as follows:

- Shock forces are reduced as much as possible
- Maintain the proper ride height of your car
- Maintain proper alignment of the wheels
- Serve as weight support for the vehicle
- Maintain tire contact with the road
- Controls the vehicle's travel direction.
- To eliminate transmission to car component road shocks.

- To maintain a solid grip on the road while driving, cornering, or braking.
- To maintain the correct steering geometry.
- To achieve a specific body structure and height.
- Torque and braking reflexes must be resisted.
- Maintaining vehicle stability while traveling over uneven terrain or turning in order to reduce the tendency for rolling, pitching, or vertical movement.
- To protect passengers from road shocks and give a comfortable ride.
- To reduce the strains caused by road shocks on the motor vehicle's mechanism and offer a cushioning effect.
- While traveling over tough, uneven terrain, keep the body absolutely level. The up and down movements of the wheels should be proportional to the movement of the body.

1.1.2 Shock absorbers or springs:

They are the flexible mechanical components that are put between the linkages (wishbone) to absorb the shock caused by the road condition. Solid axle, multi-links) and the mainframe is designed to reduce road shock before it reaches the vehicle's mainframe. Out of the various types, spring and damper shock absorber, leaf spring, and air spring are the common types. The shocks from the road surface are neutralized by the use of springs. Dampers, also known as shock absorbers, are used to reduce the free oscillation of springs and so increase riding comfort. The purpose of a stabilizer, also known as a sway bar or anti-roll bar, is to keep the car from swaying to the side. The longitudinal and lateral movements of wheels are controlled by a linkage system that holds the above components.

The suspension system is also an essential component in military vehicles, and it plays a critical role in ensuring the safety and effectiveness of military operations. Military vehicles, such as armoured personnel carriers, tanks, and other heavy-duty vehicles, are often required to operate in harsh and challenging terrains, such as deserts, mountains, and rugged terrain.

The suspension system in military vehicles is designed to withstand extreme conditions and absorb shocks from heavy artillery, landmines, and improvised explosive devices (IEDs) that may be encountered in combat zones. The suspension system must also provide maximum stability and traction to ensure the vehicle's mobility and manoeuvrability in challenging terrain.

Furthermore, the suspension system in military vehicles must be designed to carry heavy loads, including personnel, equipment, and ammunition, while maintaining stability and balance. The suspension system's durability and reliability are crucial to ensure the vehicle's operational readiness and effectiveness in combat.

The military suspension system is also required to provide advanced features such as adjustable ride height, adjustable damping, and adjustable stiffness to adapt to different terrains and operational requirements. These features allow the vehicle to maintain stability and mobility while operating in a wide range of challenging conditions.

In summary, the suspension system is a critical component in military vehicles that provides stability, maneuverability, and mobility, while ensuring the safety and effectiveness of military operations. The suspension system's durability, reliability, and advanced features are essential to the vehicle's operational readiness and effectiveness in combat.

1.2 Microcontroller

A microcontroller is a compact integrated circuit designed to govern a specific operation in an embedded system. A typical microcontroller includes a processor, memory and input/output (I/O) peripherals on a single chip. Sometimes referred to as an embedded controller or microcontroller unit (MCU), microcontrollers are found in vehicles, robots, office machines, medical devices, mobile radio transceivers, vending machines and home appliances, among other devices. They are essentially simple miniature personal computers (PCs) designed to control small features of a larger component, without a complex front-end operating system (OS).

A microcontroller is embedded inside of a system to control a singular function in a device. It does this by interpreting data it receives from its I/O peripherals using its central processor. The

temporary information that the microcontroller receives is stored in its data memory, where the processor accesses it and uses instructions stored in its program memory to decipher and apply the incoming data. It then uses its I/O peripherals to communicate and enact the appropriate action. Microcontrollers are used in a wide array of systems and devices. Devices often utilize multiple microcontrollers that work together within the device to handle their respective tasks.

1.2.1 The core elements of a microcontroller are:

The processor (CPU) -- A processor can be thought of as the brain of the device. It processes and responds to various instructions that direct the microcontroller's function. This involves performing basic arithmetic, logic and I/O operations. It also performs data transfer operations, which communicate commands to other components in the larger embedded system.

Memory -- A microcontroller's memory is used to store the data that the processor receives and uses to respond to instructions that it's been programmed to carry out. A microcontroller has two main memory types:

- Program memory, which stores long-term information about the instructions that the CPU carries out. Program memory is non-volatile memory, meaning it holds information over time without needing a power source.
- Data memory, which is required for temporary data storage while the instructions are being executed. Data memory is volatile, meaning the data it holds is temporary and is only maintained if the device is connected to a power source.

I/O peripherals -- The input and output devices are the interface for the processor to the outside world. The input ports receive information and send it to the processor in the form of binary data. The processor receives that data and sends the necessary instructions to output devices that execute tasks external to the microcontroller.

While the processor, memory and I/O peripherals are the defining elements of the microprocessor, there are other elements that are frequently included. The term I/O peripherals itself simply refers to supporting components that interface with the memory and processor. There are many supporting components that can be classified as peripherals. Having some manifestation of an I/O peripheral is elemental to a microprocessor, because they are the mechanism through which the processor is applied.

1.2.2 Other supporting elements of a microcontroller include:

Analog to Digital Converter (ADC) -- An ADC is a circuit that converts analog signals to digital signals. It allows the processor at the center of the microcontroller to interface with external analog devices, such as sensors.

Digital to Analog Converter (DAC) -- A DAC performs the inverse function of an ADC and allows the processor at the center of the microcontroller to communicate its outgoing signals to external analog components.

System bus -- The system bus is the connective wire that links all components of the microcontroller together.

Serial port -- The serial port is one example of an I/O port that allows the microcontroller to connect to external components. It has a similar function to a USB or a parallel port but differs in the way it exchanges bits.

1.3 Internet of Things:

The Internet processing ability, software and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks. Internet of things has been considered a misnomer because devices do not need to be connected to the public internet, they only need to be connected to a network, and be individually addressable.

The field has evolved due to the convergence of multiple technologies, including ubiquitous computing, commodity sensors, increasingly powerful embedded systems, as well as machine learning. Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), independently and collectively enable the Internet of things. In the consumer market, IoT technology is most synonymous with products

pertaining to the concept of the "smart home", including devices and appliances (such as lighting fixtures, thermostats, home security systems, cameras, and other home appliances) that support one or more common ecosystems, and can be controlled via devices associated with that ecosystem, such as smartphones and smart speakers. IoT is also used in healthcare systems.

There are a number of concerns about the risks in the growth of IoT technologies and products, especially in the areas of privacy and security, and consequently, industry and governmental moves to address these concerns have begun, including the development of international and local standards, guidelines, and regulatory frameworks.

The Internet of Military Things (IoMT) is the application of IoT technologies in the military domain for the purposes of reconnaissance, surveillance, and other combat-related objectives. It is heavily influenced by the future prospects of warfare in an urban environment and involves the use of sensors, munitions, vehicles, robots, human-wearable biometrics, and other smart technology that is relevant on the battlefield.

One of the examples of IOT devices used in the military is Xaver 1000 system. The Xaver 1000 was developed by Israel's Camero Tech, which is the latest in the company's line of "through wall imaging systems". The Xaver line uses millimeter wave (MMW) radar, or radar in the range of 30-300 gigahertz. It is equipped with an AI-based life target tracking system as well as its own 3D 'sense-through-the-wall' technology.

The IoT promises to make our environment -- our homes and offices and vehicles -- smarter, more measurable, and... chattier. Smart speakers like Amazon's Echo and Google Home make it easier to play music, set timers, or get information. Home security systems make it easier to monitor what's going on inside and outside, or to see and talk to visitors. Meanwhile, smart thermostats can help us heat our homes before we arrive back, and smart lightbulbs can make it look like we're home even when we're out. Looking beyond the home, sensors can help us to understand how noisy or polluted our environment might be. Self-driving cars and smart cities could change how we build and manage our public spaces.

The Internet of Military Things encompasses a large range of devices that possess intelligent physical sensing, learning, and actuation capabilities through virtual or cyber interfaces that are integrated into systems. These devices include items such as sensors, vehicles, robots, UAVs, human-wearable devices, biometrics, munitions, armor, weapons, and other smart technology. In general, IoMT devices can generally be classified into one of four categories (but the devices are meant to be ubiquitous enough to form a data fabric).

Data-carrying device: A device attached to a physical thing that indirectly connects it to the larger communication network.

Data-capturing device: A reader/writer device capable of interacting with physical things.

Sensing and actuating device: A device that can detect or measure information related to the surrounding environment and converts it into a digital electronic signal or a physical operation.

General device: A device embedded with processing and communication capabilities that can exchange information with the larger network.

2. PROBLEM IDENTIFICATION

Normal wheels will be the drawback in the rocker bogie if any vertical obstacle comes its way wheels will not ride over it. It is not suitable for high speed applications. Due to heavy duty motor battery usage is very high. The rover made with rocker bogie mechanism leads to provide only the particular application of leg movement. If the height of the vertical surface is high then it will not function properly. It will hit the frame and damage the parts. And in the military rover the turning radius is important to surveillance or attacking purposes. The turning radius of this rover equipped with rocker bogie is high. It will not move precise or adapt to the space availability. It had complex joints and the movement of all the legs are dependent. Due to dependent of the legs, if the rover stuck in the mud it will difficult to overcome or recover. It will also leads to damage the wheels.

3. DESCRIPTION OF COMPONENTS

3.1 Frame:

3.1.1 Mild Steel

Mild steel is a type of carbon steel that contains a low level of carbon. Otherwise known as low carbon steel, mild steel contains roughly between 0.05% and 0.25% of carbon by weight. This is opposed to high carbon steel, which can be composed of up to 2.5% carbon by weight. As mild steel doesn't contain large amounts of any elements other than iron and ferrite, it is not an alloy steel.

The combination of materials that create low carbon steel gives the metal particular qualities that make it suitable for a variety of industrial projects and also make it a popular type of steel for steel fabrication companies to work with.

Ductile – The low amount of carbon used to create mild steel and the absence of any alloying elements results in a very ductile product. This means that low carbon steel can be deformed and shaped without losing its toughness, making it a very pliable type of steel that can be used for various purposes.

Machinable and Weldable – The ductile nature of mild steel also means that it is particularly suitable for various steel fabrication processes, including welding. The lower percentage of carbon that is within the steel, the more malleable that the steel becomes. Baker Steel Trading provide mobile welding services that you can request along with your mild steel order, so take a look at our services page for more information.

Affordable – Mild steel requires very few resources and ingredients, so it is a particularly cost-effective type of steel, which many steel fabrication customers use to complete their industrial projects.

Magnetic – A bonus quality that comes from the high amounts of iron and ferrite used to create mild steel bars is that they are magnetic. Keep this in mind when deciding which type of steel to request when ordering from steel suppliers such as Baker Steel Trading.

The simplicity of low carbon steel means it has few alloying elements included in its composition, resulting in less tensile strength than other steels. Still, these alloying elements can be added to improve the chemical properties of the material if required.

You will often find substances like chromium, cobalt, phosphorus, sulphur, and manganese – the choice of which depends on the specifics of your need for the steel. A principal reason for other chemical properties to be required is a desire for corrosion resistance. Steel is prone to oxidising if not prepared accordingly, resulting in rust that damages (and eventually destroys) the steel. Without the addition of any additional elements, mild steel will suffer the same fate. Chromium is a popular addition to low carbon steel due to its reaction to exposure to the atmosphere, resulting in a layer of chromium oxide that protects the steel underneath from further corrosion.

These properties of mild steel leads to use this material in our project for the chassis and leg of the rover.

3.1.2 GI Pipes

Galvanised Iron (GI) Pipes are manufactured using mild steel strips of Low Carbon Steel Coils. The strips are passed through a series of fin rolls to give them a circular shape. The slit ends of the strips are then welded together by continuously passing high frequency electric current across the edges. The welded steel pipes are then passed through sizing sections where any dimensional deviations are corrected. The pipes are then cut into desired lengths by automatic cutting machines. The tubes are then pressure tested for any leaks randomly. The galvanization and varnishing of pipes are done as per specific requirements.

The basic properties of galvanized iron are corrosion resistance, good surface appearance, good formability for meeting the deep drawing requirements, good paintability provided proper pre-treatment is performed, and good weldability. Hardness, ductility, and adherence combine to provide the galvanized coating with very good protection against damage during rough handling. The thickness of the coating is proportional to the coating mass. The thickness of hot dip galvanized coatings is determined by the thickness of the zinc-iron alloy layers which form when the iron reacts with the zinc. Higher coating thickness of galvanized iron results in better corrosion resistance and provides enhanced durability. However, it can lead to low formability of the steel. The tensile strength of the zinc coated layer increases with

increase in thickness. Further, galvanized coatings are slightly thicker at the corners and the edges which is an important advantage over most of the organic coatings which thin out in these critical areas.

In the zinc coating bath, the steel product is conveyed round about a submerge roll and reacts with the molten zinc metal so as to form the adhesive coating, and then withdrawn in a vertical direction. After the removal of the coated steel from the bath, any excess molten zinc is removed using high-pressure air to obtain a coating thickness which can be closely controlled. Finally, the steel is allowed to cool to enable the zinc coating solidify onto its surface. Solidification of the molten metal before it makes contact with another roll is important to avoid damaging or deformation of the zinc coating.

Strength – It is the resistance offered by the sheet when an external load is applied. The strength of the sheet is a function of its ability to withstand external forces. The stress on the steel sheet can be compressive, tensile, compressive and tensional, or shear.

Elasticity – The galvanized steel sheet is to have the ability to return back to its initial position after undergoing deformation when the load is withdrawn. The elastic limit of the galvanized sheet is the maximum stress which it can withstand without permanent deformation.

Plasticity – It is the ability of the galvanized steel sheet to deform permanently to some degree without rupture. Plastic deformation occurs when the elastic limit is exceeded. Normally, plasticity level rises with increasing temperature. Plasticity is one of the material properties to consider during the secondary forming processes. Plasticity enables the transformation of the galvanized steel sheet into different product of desired shape and sizes through the application of heat, pressure, or the combination of heat and pressure.

Ductility – It is the property which enables drawing of the steel on the application of load or force. The base metal of galvanized steel sheet is mild steel which is known to be ductile which enables drawing by extrusion or pulling through hole in a prepared die. The ductility of the steel sheet decreases with increase in temperature. Elongation and reduction are the key measuring parameters for the ductility.

Malleability – It is the flattening ability of the steel into sheet without crack propagation during the cold working and hot working processes. Malleability is a compressive property while ductility is a tensile property. Malleability of a material increases with the rise in the temperature.

Brittleness – The brittleness of the steel sheet is its ability to break without permanent distortion. The mild steel base of the galvanized sheet is less brittle and this enables it not to break after much deformation unlike cast iron.

Toughness – It is the ability of the steel sheet to resist elastic and plastic deformations. The galvanized steel sheet shows sizable degree of toughness due to the presence of some trace elements. The amount of energy the galvanized steel sheet can absorb before fracture is its toughness.

3.2 Rover Suspension System:

The suspension system in our project is designed by our own. Normally the suspension is directly connected to the axle which is attached to the wheel, but here the indirect contact of suspension is used that means the leg is attached separately to the wheels and the suspension is attached to the leg at joint from the ground of the leg.

Fig. 3.1 Frame with Suspension

The spring with axle is used to absorb the shock and provide cushioning effect to the rover to manipulate the surface easily. The movement of leg with the obstacles is reflected to the suspension and spring will contract and then it will come to original position when there is a flat surface. The independent suspension is provided for the each leg and it will make more comfortable for the rover.

Due to the independent suspension system the vehicle's movement will be precise. When rover stuck in the mud the movement of individual leg with suspension is more useful to overcome the obstacle. When the height of the vertical surface is high the independent leg will be moved to take over the height of vertical surface. The leg placed above the surface and the suspension works by contract then the rover moves over the obstacle very easily. It also absorbs the shocks to prevent the effect of shocks to the chassis. The rover independent leg is controlled through the mobile application and the precise movement of the rover will be obtained.

3.3 Geared motors:

Fig. 3.2 Geared Motor

A geared motor is a component whose mechanism adjusts the speed of the motor, leading them to operate at a certain speed. Geared motor have the ability to deliver high torque at low speeds, as the gearhead functions as a torque multiplier and can allow small motors to generate higher speeds.

A geared motor can also be defined as a gear reducer because essentially, it is a combination of a speed reducer with a motor typically functioning as a gearbox, to reduce speed making more torque available. Geared motor can be classified based on the motor they are paired with, including bevel, helical, hypoid, spur and worm gears.

3.3.1 Inline helical geared motors

The helical gear units are coaxial units where the gear unit output shaft is in-line with the motor shaft. The in-line helical motors are mostly used for slow speed/high torque applications.

3.3.2 Parallel shaft geared motor

This type of geared motor which uses gears to accomplish speed reduction. The motor shaft and the speed reducer shaft are on parallel planes in this specific geared motor.

- Analyse and correct the mechanical noise levels by subjecting them to tests using frequency measurement equipment.
- The optimal torque measurement of starting torque, output torque and rated torque ensures proper transmission of the motion of the machine.
- Energy efficiency is an important factor to bear in mind, as the disposition of the gear train, the characteristics of rolling bearings enhance the performance across the entire system.

Depending on the number and type of gears, different combinations of output RPM and torque can be achieved. With fewer gears, the result is higher RPM and lower torque and vice versa. It can be mounted in any position.

The gear motor structure regulates whether the gear motor is suitable for light, medium or heavy loads and short or long operating periods. Depending on the internal gear structure and the reduction stages, the gear motor varies the speed on the output shaft. The reduction ratio is the ratio between the input speed and the output speed; therefore, it is one of the most important characteristic values of the gearbox. The power and load capacity of a gearbox depends on the maximum torque it is capable of transmitting and it is measured in the physical unit Newton meter [Nm].

3.3.3 Advantages

Multiplies the torque of the motor. This feature is very important because it allows high torque even in a small space.

It reduces the speed of the input motor. Micro Motors gear motors have a variety of reduction ratios to select the appropriate speed for your application.

Availability of multiple combinations of both gearbox and motor at different voltages.

Having an integrated motor + gearbox solution makes it easier for the end user to develop the machinery and allows him to be able to apply it

within his project without wasting time searching for individual parts.

It is a ready-to-use all-in-one solution that requires no alignment work by the end user.

3.4 Servo motors:

Fig. 3.3 Servo Motor

A servomotor (or servo motor) is a rotary actuator 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 a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

Servomotors are not a specific class of motor, although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system. Servomotors are used in applications such as robotics, CNC machinery, and automated manufacturing. A servomotor is a closed-loop servomechanism that uses position feedback to control its motion and final position. The input to its control is a signal (either analog or digital) representing the position commanded for the output shaft.

The motor is paired with some type of position encoder to provide position and speed feedback. In the simplest case, only the position is measured. The measured position of the output is compared to the command position, the external input to the controller. If the output position differs from that required, an error signal is generated which then causes the motor to rotate in either direction, as needed to bring the output shaft to the appropriate position. As the positions approach, the error signal reduces to zero, and the motor stops.

The very simplest servomotors use position-only sensing via a potentiometer and bang-bang control of their motor; the motor always rotates at full speed (or is stopped). This type of servomotor is not widely used in industrial motion control, but it forms the basis of the simple and cheap servos used for radio-controlled models. Servomotors are generally used as a high-performance alternative to the stepper motor. Stepper motors have some inherent ability to control position, as they have built-in output steps. This often allows them to be used as an open-loop position control, without any feedback encoder, as their drive signal specifies the number of steps of movement to rotate, but for this, the controller needs to 'know' the position of the stepper motor on power up.

3.5 Motor Drive:

Fig. 3.4 Motor Drive

Motor drive means a system that includes a motor. An adjustable speed motor drive means a system that includes a motor that has multiple operating speeds. A variable speed motor drive is a system that includes a motor and is continuously variable in speed. If the motor is generating electrical energy rather than using it – this could be called a generator drive but is often still referred to as a motor drive.

A variable frequency drive (VFD) or variable speed drive (VSD) describes the electronic portion of the system that controls the speed of the motor. More generally, the term drive, describes equipment used to control the speed of machinery. Many industrial processes such as assembly lines must operate at different speeds for different products. Where process conditions demand adjustment of flow from a pump or fan, varying the speed of the drive may save energy compared with other techniques for flow control.

Where speeds may be selected from several different pre-set ranges, usually the drive is said to be adjustable speed. If the output speed can be changed without steps over a range, the drive is usually referred to as variable speed.

A motor drive is an electronic device that controls the speed, torque, direction, and position of an electric motor. It provides the necessary power to run the motor and controls its movement and operation according to the desired output. A motor drive typically consists of a power electronic circuit, control logic, and a microcontroller that monitors and regulates the motor's speed and other parameters.

Motor drives are used in a wide range of applications, including industrial automation, robotics, electric vehicles, HVAC systems, and renewable energy systems. They provide precise control and energy efficiency while reducing maintenance and operational costs. Motor drives can be either AC (alternating current) or DC (direct current), depending on the type of motor used and the application requirements.

AC motor drives are used for applications that require high torque and low-speed operation, such as pumps, fans, and compressors. DC motor drives are used in applications that require precise speed control, such as robotics, automation, and electric vehicles.

In summary, a motor drive is an essential component in controlling the operation of an electric motor. It provides precise control of motor speed, torque, direction, and position and offers several advantages, such as improved efficiency, reduced maintenance, and operational costs. Motor drives have widespread use in various industries and applications and will continue to be a vital technology in the future.

Industrial automation: Motor drives are used extensively in industrial automation applications to control the speed, torque, and direction of motors used in conveyor systems, pumps, compressors, and other machines.

Robotics: Motor drives are used in robotics to control the movement and operation of the motors used in robotic arms, grippers, and other actuators. Precise control of motor speed and torque is essential in robotics to ensure accurate positioning and movement.

Electric vehicles: Motor drives are a critical component in electric vehicles, controlling the speed and torque of the electric motors that drive the wheels. They play a significant role in improving energy efficiency and extending the driving range of electric vehicles.

HVAC systems: Motor drives are used in heating, ventilation, and air conditioning systems to control the speed and torque of motors used in fans and pumps. They help reduce energy consumption and improve system efficiency.

Renewable energy systems: Motor drives are used in renewable energy systems, such as wind turbines and solar panels, to control the speed and torque of the generators used to convert the energy into electricity. They help improve energy efficiency and system performance.

3.5.1 L293D Pin Configuration

Features

- Can be used to run Two DC motors with the same IC.
- Speed and Direction control is possible
- Motor voltage Vcc2 (Vs): 4.5V to 36V
- Maximum Peak motor current: 1.2A
- Maximum Continuous Motor Current: 600mA
- Supply Voltage to Vcc1(vss): 4.5V to 7V
- Transition time: 300ns (at 5Vand 24V)
- Automatic Thermal shutdown is available
- Available in 16-pin DIP, TSSOP, SOIC packages

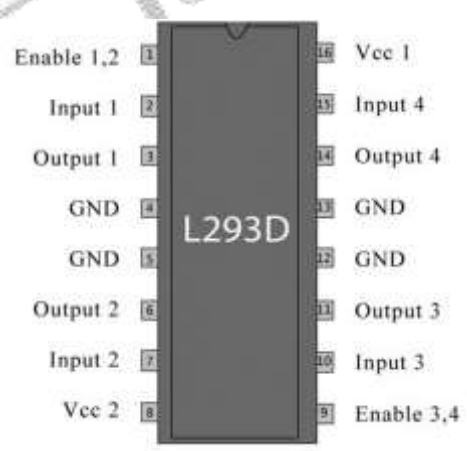

Fig 3.5 Motor Drive IC

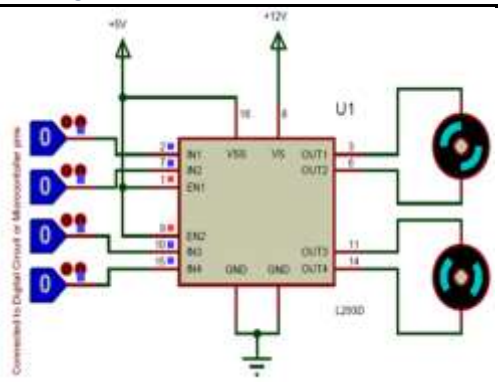

Fig 3.6 Pin Configuration

Input 1 = HIGH(5v)	Output 1 = HIGH	Motor 1 rotates in Clock wise Direction
Input 2 = LOW(0v)	Output 2 = LOW	
Input 3 = HIGH(5v)	Output 1 = HIGH	Motor 2 rotates in Clock wise Direction
Input 4 = LOW(0v)	Output 2 = LOW	

Table No. 3.1 Motor control (Clockwise)

Input 1 = LOW(0v)	Output 1 = LOW	Motor 1 rotates in Anti-Clock wise Direction
Input 2 = HIGH(5v)	Output 2 = HIGH	
Input 3 = LOW(0v)	Output 1 = LOW	Motor 2 rotates in Anti -Clock wise Direction
Input 4 = HIGH(5v)	Output 2 = HIGH	

Table No. 3.2 Motor control (Anti-clockwise)

3.5.2 Applications

- Used to drive high current Motors using Digital Circuits
- Can be used to drive Stepper motors
- High current LED's can be driven
- Relay Driver module (Latching Relay is possible)

3.6 Microcontroller:

A microcontroller (MCU for microcontroller unit, also MC, UC, or μC) is a small computer on a single VLSI integrated circuit (IC) chip. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. Program memory in the form of ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a small amount of RAM.

Fig. 3.7 Microcontroller

Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications consisting of various discrete chips. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems. In the context of the internet of things,

microcontrollers are an economical and popular means of data collection, sensing and actuating the physical world as edge devices.

Some microcontrollers may use four-bit words and operate at frequencies as low as 4 kHz for low power consumption (single-digit milliwatts or microwatts). They generally have the ability to retain functionality while waiting for an event such as a button press or other interrupt; power consumption while sleeping (CPU clock and most peripherals off) may be just nanowatts, making many of them well suited for long lasting battery applications. Other microcontrollers may serve performance-critical roles, where they may need to act more like a digital signal processor (DSP), with higher clock speeds and power consumption.

The distinction between microcontrollers and microprocessors has gotten less clear as chip density and complexity has become relatively cheap to manufacture and microcontrollers have thus integrated more "general computer" types of functionality. On the whole, though, microcontrollers can be said to function usefully on their own, with a direct connection to sensors and actuators, where microprocessors are designed to maximize compute power on the chip, with internal bus connections (rather than direct I/O) to supporting hardware such as RAM and serial ports. Simply put, coffee makers use microcontrollers; desktop computers use microprocessors.

Architecture: Microcontrollers can have different architectures, such as Harvard or von Neumann, depending on how they access memory. They can also have different instruction sets, such as RISC (Reduced Instruction Set Computing) or CISC (Complex Instruction Set Computing).

Memory: Microcontrollers typically have three types of memory: program memory (also known as flash memory), data memory (also known as RAM), and non-volatile memory (such as EEPROM or flash memory). Program memory is used to store the code that runs on the microcontroller, data memory is used to store temporary data, and non-volatile memory is used to store data that needs to be retained even when the power is off.

Peripherals: Microcontrollers can have various peripherals, such as analog-to-digital converters (ADCs), timers, PWM (Pulse Width Modulation) modules, UARTs (Universal Asynchronous Receiver/Transmitter), SPI (Serial Peripheral Interface) modules, and I2C (Inter-Integrated Circuit) modules. These peripherals allow the microcontroller to interact with other devices and systems.

Power consumption: Microcontrollers are designed to consume very little power, making them ideal for battery-powered devices. Many microcontrollers have low-power modes that allow them to operate on very little power while still monitoring and controlling the system.

Real-time operating systems: Microcontrollers can run real-time operating systems (RTOS), which provide a more sophisticated way to manage tasks and resources. An RTOS can handle interrupts, manage multiple tasks, and provide scheduling and synchronization mechanisms.

Debugging: Microcontrollers can be debugged using various methods, such as in-circuit debugging, JTAG (Joint Test Action Group) debugging, or simulator debugging. These methods allow developers to test and debug code running on the microcontroller.

3.7 Battery:

3.7.1 How Do Lead Acid Batteries Work?

Lead Acid batteries have changed little since the 1880's although improvements in materials and manufacturing methods continue to bring improvements in energy density, life and reliability. All lead acid batteries consist of flat lead plates immersed in a pool of electrolyte. Regular water addition is required for most types of lead acid batteries although low-maintenance types come with excess electrolyte calculated to compensate for water loss during a normal lifetime.

3.7.2 Battery Construction

Lead acid batteries used in the RV and Marine Industries usually consist of two 6-volt batteries in series, or a single 12-volt battery. These batteries are

constructed of several single cells connected in series each cell produces approximately 2.1 volts. A six-volt battery has three single cells, which when fully charged produce an output voltage of 6.3 volts. A twelve-volt battery has six single cells in series producing a fully charged output voltage of 12.6 volts.

A battery cell consists of two lead plates a positive plate covered with a paste of lead dioxide and a negative made of sponge lead, with an insulating material (separator) in between. The plates are enclosed in a plastic battery case and then submersed in an electrolyte consisting of water and sulfuric acid.

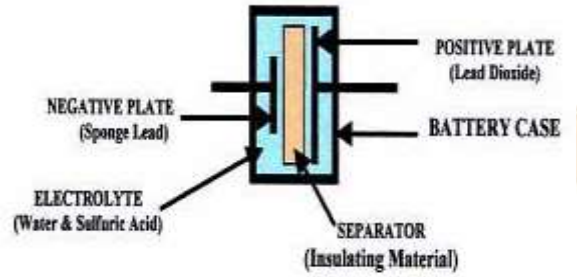

Fig 3.8 Battery Construction

Fig 3.9 Battery inside

In order for lead acid cell to produce a voltage, it must first receive a (forming) charge voltage of at least 2.1-volts/cell from a charger. Lead acid batteries do not generate voltage on their own; they only store a charge from another source. This is the reason lead acid batteries are called storage batteries, because they only store a charge. The size of the battery plates and amount of electrolyte determines the amount of charge lead acid batteries can store. The size of this storage capacity is described as the amp hour (AH) rating of a battery. A typical 12-volt battery used in a RV or marine craft has a rating 125 AH, which means it can supply 10 amps of current for 12.5 hours or 20-amps of current for a period of 6.25 hours. Lead acid batteries can be connected in parallel to increase the total AH capacity.

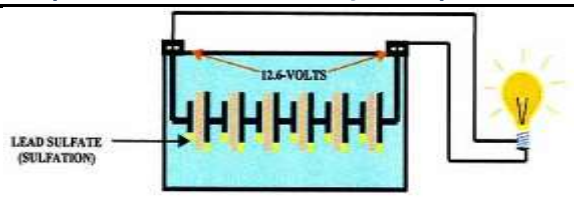

Fig 3.10 six single 2.1-volt cells

3.7.3 Lead Acid Batter Discharge Cycle

In figure 3.10, above a fully charged battery is connected to a load (light bulb) and the chemical reaction between sulfuric acid and the lead plates produces the electricity to light the bulb. This chemical reaction also begins to coat both positive and negative plates with a substance called lead sulfate also known as sulfation (shown as a yellow build-up on plates). This build-up of lead sulfate is normal during a discharge cycle. As the battery continues to discharge, lead sulfate coats more and more of the plates and battery voltage begins to decrease from fully charged state of 12.6-volts (figure 4.9).

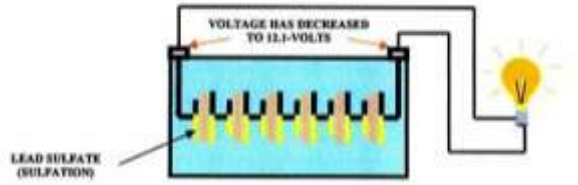

Fig 3.11 State of 12.6-volts

In figure 3.11 the battery is now fully discharged, the plates are almost completely covered with lead sulfate (sulfation) and voltage has dropped to 10.5-volts.

NOTE: Discharging a lead acid battery below 10.5 volts will severely damage it!

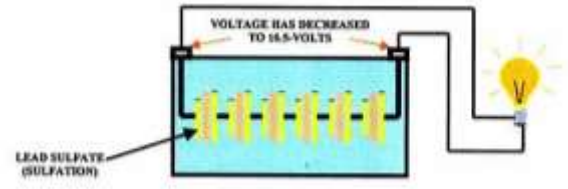

Fig 3.12 Battery Fully discharged

Lead sulfate (sulfation) now coats most of the battery plates. Lead sulfate is a soft material, which can is reconverted back into lead and sulfuric acid, provided the discharged battery is immediately connected to a battery charger. If a lead acid battery is not immediately recharged, the lead sulfate will

begin to form hard crystals, which can not be reconverted by a standard fixed voltage (13.6 volts) battery converter/charger.

NOTE: Always recharge your RV or Marine battery as soon as possible to prevent loss of battery capacity due to the build-up of hard lead sulfate crystals!

3.7.4 Lead Acid Battery Recharge Cycle

The most important thing to understand about recharging lead acid batteries is that a converter/charger with a single fixed output voltage will not properly recharge or maintain your battery. Proper recharging and maintenance requires an intelligent charging system that can vary the charging voltage based on the state of charge and use of your RV or Marine battery. Progressive Dynamics has developed intelligent charging systems that solve battery problems and reduce battery maintenance.

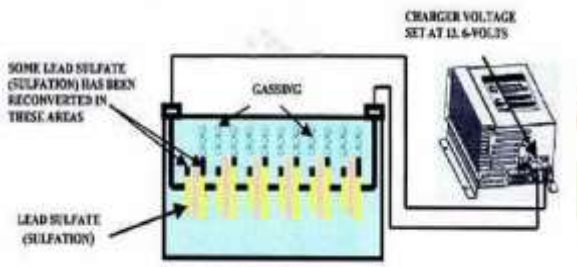

Fig 3.13 Connected to converter

The discharged battery shown in figure 3.13 on the next page is connected to a converter/charger with its output voltage set at 13.6-volts. In order to recharge a 12-volt lead acid battery with a fully charged terminal voltage of 12.6-volts, the charger voltage must be set at a higher voltage. Most converter/chargers on the market are set at approximately 13.6-volts. During the battery recharge cycle lead sulfate (sulfation) begins to reconvert to lead and sulfuric acid.

During the recharging process as electricity flows through the water portion of the electrolyte and water, (H2O) is converted into its original elements, hydrogen and oxygen. These gasses are very flammable and the reason your RV or Marine batteries must be vented outside. Gassing causes water loss and therefore lead acid batteries need to have water added periodically. Sealed lead acid batteries contain most of these gasses allowing them to recombine into the electrolyte. If the battery is overcharged pressure from these gasses will cause relief caps to open and vent, resulting in some water loss. Most sealed batteries have extra electrolyte added during the manufacturing process to compensate for some water loss.

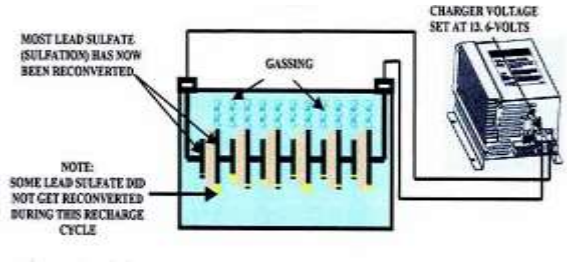

Fig 3.14 Fixed charging voltage of 13.6-volts

The battery shown in figure 3.14 above has been fully recharged using a fixed charging voltage of 13.6-volts. Notice that somelead sulfate (sulfation) still remains on the plates. This build-up will continue after each recharging cycle and gradually the battery will begin to loose capacity to store a full charge and eventually must be replaced. Lead sulfate build up is reduced if battery is given an Equalizing Charge once every 10 discharge cycles or at least once a month. An Equalizing Chargeincreases charging voltage to 14.4 volts or higher for a short period. This higher voltage causes gassing that equalizes (re-mixes) the electrolyte solution.

Since most RV and Marine craft owners seldom remember to perform this function, Progressive Dynamics has developed the microprocessor controlled Charge Wizard. The Charge Wizard will automatically provide an Equalizing Charge every 21 hours for a period of 15 minutes, when the battery is fully charged and not in use. Our 2000 Series of Marine Battery Chargers have the Charge Wizard feature built-in.

One disadvantage of recharging a lead acid battery at a fixed voltage of 13.6-volts is the recharge time is very long. A typical 125-AH RV or Marine battery will take approximately 80 hours to recharge at 13.6 volts. Increasing the charge voltage to 14.4-volts will reduce battery recharge time for a 125-AH battery to 3-4 hours. Once a battery reaches 90% of full charge, thevoltage must be reduced from 14.4-volts to 13.6-volts to reduce gassing and water loss. The optional Charge Wizardautomatically senses

when a battery has a very low state of charge and automatically selects its BOOST MODE of operation.BOOST MODE increases the voltage of a PD9100 Series converter/charger to 14.4 volts. When the battery reaches the 90% charge level, the Charge Wizard automatically reduces the charge voltage down to 13.6 volts to complete the charge. Again, this is a standard feature on our Marine Chargers.

Another disadvantage of recharging a lead acid battery at a fixed voltage of 13.6-volts is that once it is fully charged, 13.6 volts will cause considerable gassing and water loss. To prevent this from occurring the charging voltage must be reduced to 13.2-volts. The Charge Wizard will automatically select its STORAGE MODE of operation (13.2-volts) once the battery reaches full charge and remains unused for a period of 30 hours. This feature is standard on all of Progressive Dynamics Marine Battery Chargers.

At a charging voltage of 13.2 volts, the converter/charger will maintain a full charge, reduce gassing and water loss. However, this lower voltage does not provide enough gassing to prevent a battery condition called Battery Stratification. Battery Stratification is caused by the fact that the electrolyte in the battery is a mixture of water and acid and, like all mixtures, one component, the acid, is heavier than water. Therefore, acid will begin to settle and concentrate at the bottom of the battery (see figure 4.13).

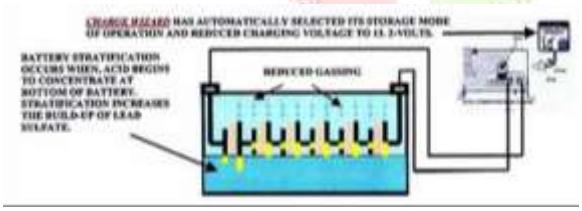

Fig 3.15 Bottom concentration of battery

This higher concentration of acid at the bottom of the battery causes additional build-up of lead sulfate (sulfation), which reduces battery storage capacity and battery life. In order to prevent Battery Stratification, an Equalization Charge(increasing charging voltage to 14.4-volts) must be applied periodically. The Charge Wizard automatically selects itsEQUALIZATION MODE (14.4 volts) every 21 hours for a period of 15 minutes. This Equalizing Charge feature is standard on our Marine chargers.

As you have learned, in order to properly charge and maintain a lead acid battery you must use an intelligent charging system. Progressive Dynamics, Inteli-Power 9100 Series RV converters with a Charge Wizard installed, or one of our Inteli-Power Marine Battery Chargers will provide the intelligent charging system your battery needs for a long life, with low maintenance.

3.8 Power Supply:

3.8.1 BASICS POWER SUPPLIES

The present chapter introduces the operation of power supply circuits built using filters, rectifiers, and then voltage regulators. Starting with an ac voltage, a steady dc voltage is obtained by rectifying the ac voltage, then filtering to a dc level, and finally, regulating to obtain a desired fixed dc voltage. The regulation is usually obtained from an IC voltage regulator unit, which takes a dc voltage and provides a somewhat lower dc voltage, which remains the same even if the input dc voltage varies, or the output load connected to the dc voltage changes.

A block diagram containing the parts of a typical power supply and the voltage at various points in the unit. The ac voltage, typically 120 V rms, is connected to a transformer, which steps that ac voltage down to the level for the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit can use this dc input to provide a dc voltage that not only has much less ripple voltage but also remains the same dc value even if the input dc voltage varies somewhat, or the load connected to the output dc voltage changes.

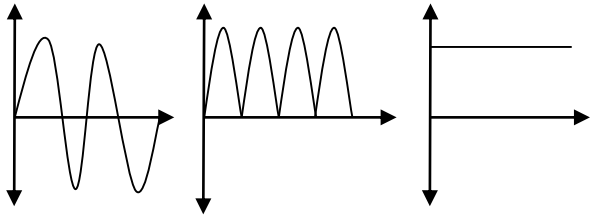

Fig 3.16 Power supply and Voltage at various points

3.8.2 Working principle

Transformer

The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op–amp.The advantages of using precision rectifier are it will give peak voltage output as DC, rest of the circuits will give only RMS output.

Bridge rectifier

When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners. Let us assume that the transformer is working properly and there is a positive potential, at point A and a negative potential at point B. the positive potential at point A will forward bias D3 and reverse bias D4.The negative potential at point B will forward bias D1 and reverse D2. At this time D3 and D1 are forward biased and will allow current flow to pass through them; D4 and D2 are reverse biased and will block current flow.

The path for current flow is from point B through D1, up through RL, through D3, through the secondary of the transformer back to point B. this path is indicated by the solid arrows. Waveforms (1) and (2) can be observed across D1 and D3.

One-half cycle later the polarity across the secondary of the transformer reverse, forward biasing D2 and D4 and reverse biasing D1 and D3. Current flow will now be from point A through D4, up through RL, through D2, through the secondary of T1, and back to point A. This path is indicated by the broken arrows. Waveforms (3) and (4) can be observed across D2 and D4. The current flow through RL is always in the same direction.

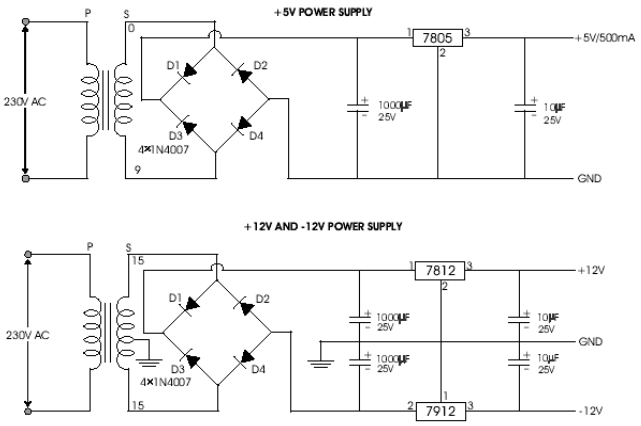

Fig 3.17 +5V and +12V & -12V Power supply

In flowing through RL this current develops a voltage corresponding to that shown waveform (5). Since current flows through the load (RL) during both half cycles of the applied voltage, this bridge rectifier.One advantage of a bridge rectifier over a conventional full-wave rectifier is that with a given transformer the bridge rectifier produces a voltage output that is nearly twice that of the conventional full-wave circuit.

The maximum voltage that appears across the load resistor is nearly-but never exceeds-500 v0lts, as result of the small voltage drop across the diode. In the bridge rectifier shown in view B, the maximum voltage that can be rectified is the full secondary voltage, which is 1000 volts. Therefore, the peak output voltage across the load resistor is nearly 1000 volts.

3.8.3 IC voltage regulators:

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC.

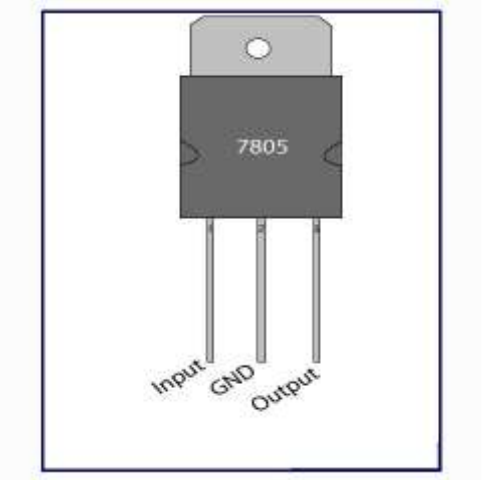

Fig 3.18 IC Voltage regulator

Although the internal construction of the IC is somewhat different from that described for discrete voltage regulator circuits, the external operation is much the same. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage.

A power supply can be built using a transformer connected to the ac supply line to step the ac voltage to desired amplitude, then rectifying that ac voltage, filtering with a capacitor and RC filter, if desired, and finally regulating the dc voltage using an IC regulator. The regulators can be selected for operation with load currents from hundreds of Milli amperes to tens of amperes, corresponding to power ratings from mill watts to tens of watts.

3.9 ARDUINO:

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

Fig 3.19 ARDUINO

3.9.1 What Does it Do?

The Arduino hardware and software was designed for artists, designers, hobbyists, hackers, newbies, and anyone interested in creating interactive objects or environments. Arduino can interact with buttons, LEDs, motors, speakers, GPS units, cameras, the internet, and even your smart-phone or your TV! This flexibility combined with the fact that the Arduino software is free, the hardware boards are pretty cheap, and both the software and hardware are easy to learn has led to a large community of users who have contributed code and released instructions for a huge variety of Arduino-based projects.

For everything from robots and a heating pad hand warming blanket to honest fortune-telling machines, and even aDungeons and Dragons dice-throwing gauntlet, the Arduino can be used as the brains behind almost any electronics project.

3.9.2 What's on the board?

Every Arduino board needs a way to be connected to a power source. The Arduino UNO can be powered from a USB cable coming from your computer or a wall power supply (like this) that is terminated in a barrel jack. In the picture above the USB connection is labeled (1) and the barrel jack is labeled (2).

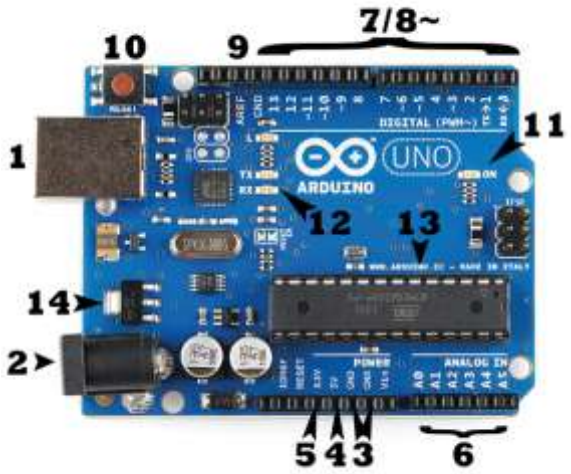

Fig 3.20 Parts description

Power (USB / Barrel Jack):

The USB connection is also how you will load code onto your Arduino board. More on how to program with Arduino can be found in our Installing and Programming Arduino tutorial.

NOTE: Do NOT use a power supply greater than 20 Volts as you will overpower (and thereby destroy) your Arduino. The recommended voltage for most Arduino models is between 6 and 12 Volts.

3.9.3 Pins (5V, 3.3V, GND, Analog, Digital, PWM, AREF):

The pins on your Arduino are the places where you connect wires to construct a circuit (probably in conjuction with abreadboard and some wire. They usually have black plastic 'headers' that allow you to just plug a wire right into the board. The Arduino has several different kinds of pins, each of which is labeled on the board and used for different functions.

GND (3): Short for 'Ground'. There are several GND pins on the Arduino, any of which can be used to ground your circuit.

5V (4) & 3.3V (5): As you might guess, the 5V pin supplies 5 volts of power, and the 3.3V pin supplies 3.3 volts of power. Most of the simple components used with the Arduino run happily off of 5 or 3.3 volts.

Analog (6): The area of pins under the 'Analog In' label (A0 through A5 on the UNO) are Analog In pins. These pins can read the signal from an analog sensor (like a temperature sensor) and convert it into a digital value that we can read.

Digital (7): Acr Across from the analog pins are the digital pins (0 through 13 on the UNO). These pins can be used for both digital input (like telling if a button is pushed) and digital output (like powering an LED).

PWM (8): You may have noticed the tilde (~) next to some of the digital pins (3, 5, 6, 9, 10, and 11 on the UNO). These pins act as normal digital pins, but can also be used for something called Pulse-Width Modulation (PWM). We have a tutorial on PWM, but for now, think of these pins as being able to simulate analog output (like fading an LED in and out).

AREF (9): Stands for Analog Reference. Most of the time you can leave this pin alone. It is sometimes used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins.

Reset Button

Just like the original Nintendo, the Arduino has a reset button (10). Pushing it will temporarily connect the reset pin to ground and restart any code that is loaded on the Arduino. This can be very useful if your code doesn't repeat, but you want to test it multiple times. Unlike the original Nintendo however, blowing on the Arduino doesn't usually fix any problems.

Power LED Indicator

Just beneath and to the right of the word "UNO" on your circuit board, there's a tiny LED next to the word 'ON' (11). This LED should light up whenever you plug your Arduino into a power source. If this light doesn't turn on, there's a good chance something is wrong. Time to re-check your circuit!

TX RX LEDs

TX is short for transmit, RX is short for receive. These markings appear quite a bit in electronics to indicate the pins responsible for serial communication. In our case, there are two places on the Arduino UNO where TX and RX appear – once by digital pins 0 and 1, and a second time next to the TX and RX indicator LEDs (12). These LEDs will give us some nice visual indications whenever our Arduino is receiving or transmitting data (like when we're loading a new program onto the board).

Main IC

The black thing with all the metal legs is an IC, or Integrated Circuit (13). Think of it as the brains of our Arduino. The main IC on the Arduino is slightly different from board type to board type, but is usually from the ATmega line of IC's from the ATMEL company. This can be important, as you may need to know the IC type (along with your board type) before loading up a new program from the Arduino software. This information can usually be found in writing on the top side of the IC. If you want to know more about the difference between various IC's, reading the datasheets is often a good idea.

Voltage Regulator

The voltage regulator (14) is not actually something you can (or should) interact with on the Arduino. But it is potentially useful to know that it is there and what it's for. The voltage regulator does exactly what it says – it controls the amount of voltage that is let into the Arduino board. Think of it as a kind of gatekeeper; it will turn away an extra voltage that might harm the circuit. Of course, it has its limits, so don't hook up your Arduino to anything greater than 20 volts.

3.9.4 The Arduino Family

Arduino makes several different boards, each with different capabilities. In addition, part of being open source hardware means that others can modify and produce derivatives of Arduino boards that provide even more form factors and functionality. If you're not sure which one is right for your project, check this guide for some helpful hints. Here are a few options that are well-suited to someone new to the world of Arduino:

3.9.5 Arduino Uno (R3)

The Uno is a great choice for your first Arduino. It's got everything you need to get started, and nothing you don't. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a USB connection, a power jack, a reset button and more. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

3.9.6 LilyPad Arduino

This is LilyPad Arduino main board! LilyPad is a wearable e-textile technology developed by Leah Buechley and cooperatively designed by Leah and SparkFun. Each LilyPad was creatively designed with large connecting pads and a flat back to allow them to be sewn into clothing with conductive thread. The LilyPad also has its own family of input, output, power, and sensor boards that are also built specifically for e-textiles. They're even washable!

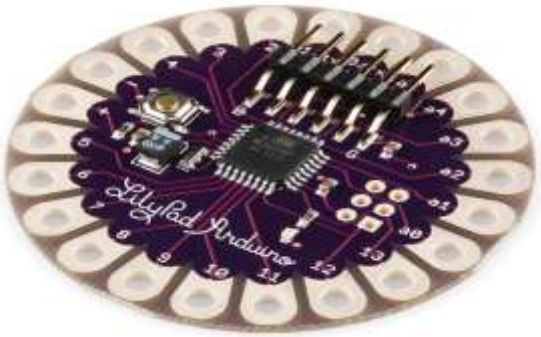

Fig 3.21 Lilypad Arduino

3.9.7 RedBoard

At SparkFun we use many Arduinos and we're always looking for the simplest, most stable one. Each board is a bit different and no one board has everything we want – so we decided to make our own version that combines all our favorite features.

The RedBoard can be programmed over a USB Mini-B cable using the Arduino IDE. It'll work on Windows 8 without having to change your security settings (we used signed drivers, unlike the UNO). It's more stable due to the USB/FTDI chip we used, plus it's completely flat on the back, making it easier to embed in your projects. Just plug in the board, select "Arduino UNO" from the board menu and you're ready to upload code. You can power the RedBoard over USB or through the barrel jack. The on-board power regulator can handle anything from 7 to 15VDC.

3.10 RELAY

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches.

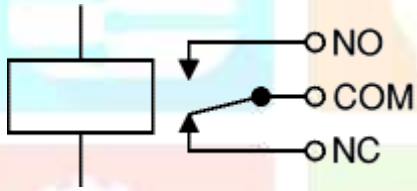

Fig 3.22 Relay

Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits, the link is magnetic and mechanical.

The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification.

Relays are usuallly SPDT or DPDT but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available. For further information about switch contacts and the terms used to describe them please see the page on switches.

Most relays are designed for PCB mounting but you can solder wires directly to the pins providing you take care to avoid melting the plastic case of the relay.

The supplier's catalogue should show you the relay's connections. The coil will be obvious and it may be connected either way round. Relay coils produce brief high voltage 'spikes' when they are switched off and this can destroy transistors and ICs in the circuit. To prevent damage you must connect a protection diode across the relay coil.

3.10.1 Choosing a relay

You need to consider several features when choosing a relay:

1. Physical size and pin arrangement

If you are choosing a relay for an existing PCB you will need to ensure that its dimensions and pin arrangement are suitable. You should find this information in the supplier's catalogue.

2. Coil voltage

The relay's coil voltage rating and resistance must suit the circuit powering the relay coil. Many relays have a coil rated for a 12V supply but 5V and 24V relays are also readily available. Some relays operate perfectly well with a supply voltage which is a little lower than their rated value.

3. Coil resistance

Relay coil current = supply voltage / coil resistance

The circuit must be able to supply the current required by the relay coil. You can use Ohm's law to calculate the current:

4. For example: A 12V supply relay with a coil resistance of 400 passes a current of 30mA. This is OK for a 555 timer IC (maximum output current 200mA), but it is too much for most ICs and they will require a transistor to amplify the current.

5. Switch ratings (voltage and current)

The relay's switch contacts must be suitable for the circuit they are to control. You will need to check the voltage and current ratings. Note that the voltage rating is usually higher for AC, for example: "5A at 24V DC or 125V AC".

6. Switch contact arrangement (SPDT, DPDT etc)

Most relays are SPDT or DPDT which are often described as "single pole changeover" (SPCO) or "double pole changeover" (DPCO). For further information please see the page on switches.

3.11 Gun:

The gun is connected with servo motor and it is controlled by the mobile applications. The gun is controlled and rotated for 360 degree to attack the camp or troops. The aiming, targeting and movement of the gun is completely controlled by the mobile application. The microcontroller is used to send the data to the servomotor and the movement is controlled with the microcontroller precisely.

3.12 Mobile application:

Embedded coding (using Bluetooth electronics app)

```
#include <SoftwareSerial.h>;
#include <Servo.h>
SoftwareSerial bluetooth(0,1); // RX, TX
Servo myservo1;
int BluetoothData;
int led1 =2;
int led2 =3;
int led3 =4;
int led4 =5;
int led5 =6;
int led6 =7;
int led7 =8;
int led8 =9;
int led9 =10;
int led10 =11;
int led11 =12;
int led12 =13;
int led13 =A0;
void setup()
{
 bluetooth.begin(9600);
myservo1.attach(A0);
 pinMode(led1, OUTPUT);
 pinMode(led2, OUTPUT);
 pinMode(led3, OUTPUT);
 pinMode(led4, OUTPUT);
 pinMode(led5, OUTPUT);
 pinMode(led6, OUTPUT);
 pinMode(led7, OUTPUT);
 pinMode(led8, OUTPUT);
 pinMode(led9, OUTPUT);
 pinMode(led10, OUTPUT);
 pinMode(led11, OUTPUT);
 pinMode(led12, OUTPUT);
 pinMode(led13, OUTPUT);
 }
void loop()
{
 if (bluetooth.available())
 {
 BluetoothData=bluetooth.read();
 if(BluetoothData=='F')
 {
digitalWrite(led1, HIGH);
```

```
digitalWrite(led2, LOW);
 }
if(BluetoothData=='B')
 {
digitalWrite(led1, LOW);
digitalWrite(led2, HIGH);
 }
if(BluetoothData=='U')
{
digitalWrite(led3, HIGH);
digitalWrite(led4, LOW);
}
if(BluetoothData=='u')
{
digitalWrite(led3, LOW);
digitalWrite(led4, HIGH);
}
if(BluetoothData=='V')
{digitalWrite(led5, HIGH);
digitalWrite(led6, LOW);
}
if(BluetoothData=='v')
{
digitalWrite(led5,LOW);
digitalWrite(led6, HIGH);
}
if(BluetoothData=='W')
{
digitalWrite(led7, HIGH);
digitalWrite(led8, LOW);
}
if(BluetoothData=='w')
{
digitalWrite(led7, LOW);
digitalWrite(led8, HIGH);
}
if(BluetoothData=='X')
{
digitalWrite(led9, HIGH);
digitalWrite(led10, LOW);
}
if(BluetoothData=='x')
{
digitalWrite(led9, LOW);
digitalWrite(led10,HIGH);
}
if(BluetoothData=='Y')
{
digitalWrite(led11, HIGH);
digitalWrite(led12, LOW);
}
if(BluetoothData=='y')
{
digitalWrite(led11, LOW);
digitalWrite(led12, HIGH);
}
 if(BluetoothData=='y')
{
digitalWrite(led11, LOW);
digitalWrite(led12, HIGH);
}
if(BluetoothData=='Z')
```

```
{
 myservo1.write(60);
 delay(100);
 }
 if(BluetoothData=='z')
{
 myservo1.write(0);
 delay(100);
 }
 if(BluetoothData=='S')
{
digitalWrite(led1, LOW);
digitalWrite(led2, LOW);
digitalWrite(led3, LOW);
digitalWrite(led4, LOW);
digitalWrite(led5, LOW);
digitalWrite(led6, LOW);
digitalWrite(led7, LOW);
digitalWrite(led8, LOW);
digitalWrite(led9, LOW);
digitalWrite(led10, LOW);
digitalWrite(led11, LOW);
digitalWrite(led12, LOW);
digitalWrite(led13, LOW);
}
}
}
```

Bluetooth Electronics:

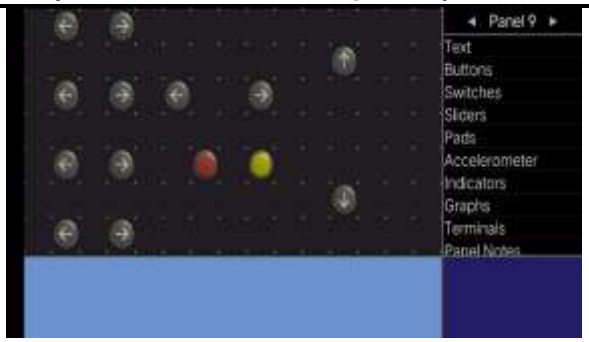

Fig 3.23 Mobile Application

4. WORKING METHODOLOGY

The main application of our rover is to provide wide range of application in the military and space. The Rover is completely connected with internet of things and controlling its movement through the application. The servomotor is used to connect with controlling of gun movement and the geared motor is used to control the speed of the entire rover and movement of each independent leg. These above motors are connected to the motor drive to separate the required torque, speed and angular rotation of the motor. The movement of information is getting input by the microcontroller by the application and that output is reflected in the rover.

The application have speed control of the motor by the bar which will move right and left to control the speed. When the bar is in full right the speed of the motor and river speed is high. While decreasing from the right the motor speed gradually decreases and rover speed is decreasing. When the bar is in full left hand side, the motor rotates at its minimum speed.

The suspension system is installed with the arm to take up the movement from the arm and its works to contract and retract to provide the suspension effect. One end of the suspension is connected to chassis and other end is connected to arm leg. The arm is directly connects the chassis and the wheel. The wheel is attached to the geared motor and that motor is connected to another motor with perpendicular to each other. The motor which is placed perpendicular to wheel motor, is rotated to rotate the motor with attached wheel to move the wheel at an angle to propel the rover in particular angle. At the end of the rotated angle the rover is

able to rotate through 360 degree and the precise movement of the rover at the limited space is possible by this mechanism. The movement of the rover is especially independent leg to move the joint to manipulate the required movement.

5. DESIGN OF MODEL / PRODUCT:

5.1 Tools Applied:

5.1.1 Software used for Modelling – SolidWorks

Fig 5.1 Front View

Fig. 5.2 Right Side View

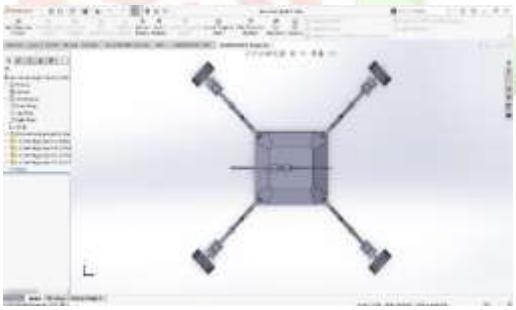

Fig. 5.3 Top View

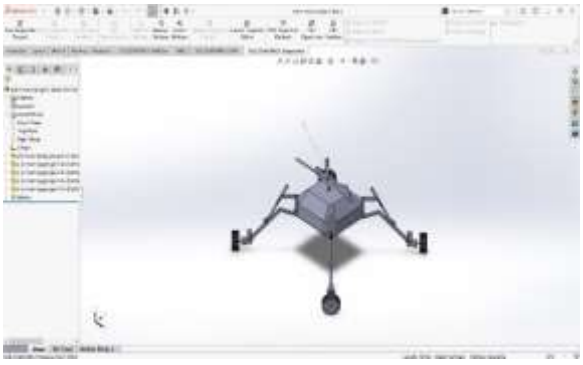

Fig. 5.4 3D View

6. BILL OF MATERIALS & COST ESTIMATION:

Table No.6.1 Bill of materials & Cost estimation

7. RESULTS AND DISCUSSION

As a result, from this project we have defined a result to be provide wide range of application in military and space. By modifying the rover it will be used in multiple dimensions and provide multiple applications. In the future scope of the project the rover will be modified with Ni-Ti wheel to act as a suspension system. In traditional, the wheel is provided with the spring to absorb the shock and provide cushioning effect. But here in the future the suspension system is developed by replacing the spring with the Ni-Ti wheel, which act as a super elastic material to absorb shocks from the below contact surface.

The Wi-Fi camera is used to surveillance the military space. The camera is connected by IoT technology and it is monitored routinely. The military space will be monitored and taking videos and photos of the abnormalities in the space. The Ground penetrating radar sensor is used to detect the landmine which is buried under the ground at any distance. This sensor is suitable to detect the landmine which is made of both plastic and metal.

Due to the usage of the camera this rover is also useful for the attacking purposes. The gun or missile is placed above the camera in the rover. By using the view or vision of the camera the missile or gun is moved to aiming, targeting and attacking the troops of enemies. In innovative the missile is used with the blades without using any radioactive materials. Due to usage of nuclear power the radiation affects the civilians and it will damage the nearby natures. So, the missile with the extended blades are used to attack the enemies. The controlling of the missile is done by application. After set the target of attack, the missile is triggered. While trigger the blades in the missile contract only inside the slot of the missile. But after some point of release the missile blades are exploded and rotates

continuously which attack the enemy's troops and destroy the particular targeted area.

By developing these kind of rovers will save most of the soldier's life in the field of military with improved suspension and surveillance. The rover will be modified with different components and used for variety of applications.

S.NO.	MATERIAL NAME	SPECIFICATION	QUANTITY	AMOUNT (in Rs.)
1	Rover frame	Mild Steel	2×1000	2000
2	Suspension axle	Galvanized iron	1×200	200
3	Suspension System	Own designed	4×1500	6000
4	Motor	Geared Motor	10×450	4500
5	Motor	Servo Motor	1×650	650
6	Wheel	Rubber wheel	4×150	600
7	Motor drives	Microcontroller-4 channel driver	4×250	1000
8	Microcontroller	Micro 5V 16M Mini development board	1×2000	2000
9	Mobile Application	Bluetooth electronics	1×1000	1000
10	Fasteners	-	15×10	150
11	Gun	Toy gun with arrow	1×200	200
12	Battery	Lead acid battery (48V)	1×1000	1000
13	Journal Publication	-	1	800
			Total Amount	**20,100**

8. APPLICATION:

- This rover provide wide range of applications in both military and space technology. In military and space, the majority of the problem is to damaging of the wheels and it will only survive for the particular period and there is no multiple application rover available.
- The main disadvantage of the rover with rocker bogie mechanism is not able to overcome the high vertical surface in front of the rover. This problem is overcome by using the independent leg in the rover to move the leg individually and move over the different height and it is useful to overcome the any height of the vertical surface in front.
- This rover is useful to surveillance in the area where the humans cannot enter. Due to the movement of wheel with an angle the rover will take turn with low turning radius. Normally in traditional rover the turning radius is very high and it will restrict the rover to manipulate in the limited areas. But this rover helps to manipulate in the restricted area very easily.
- This rover helps for attacking purposes in military domain. The rover is provided with gun for attacking at the top of the rover. The gun is connected with servomotor and it is controlled by the mobile. The mobile application is used to control, aim and targeting the point where enemies troops to destroy.
- The independent suspension leg provide application in space technology also. The rover which is used in space is more concentrated on suspension system. By improving the suspension system instead of rocker bogie mechanism is demanded one. So, this rover helps to provide that effect of suspension even in the ragged terrain also.

That's why the project name called "Ragged Terrain paltry".

- The rover integrated with IoT will be the future in different fields. IoT technology improve the surveillance from any distance to extend the application wherever it is used. IoT technology drastically increases in the application of both space and military technology to improve the communication system.

9. ADVANTAGES

The main advantage of this rover is manipulating or surveillance the military areas easily by using 360 degree wheel rotation. The movement of the rover will be more precise and have low turning radius to turn the rover at limited area of space.

- The movement of each leg is attached with the separate motor and it is used to move the leg independently.
- The rover will be light weight while it is made of mild steel to carry out the task very easily.
- The rover can able to rotate 360 degree for attacking the enemies continuously by rotating and installation of gun.
- The rover consists of slot above it to install any type of attacking weapons.
- Due to the independent leg of the rover, the rover can able to move its leg separately and easily overcome the vertical obstacles in front of it.
- The suspension also minimizes rover tilt as it drives, keeping it more stable.
- When driving over the uneven Martian terrain, the suspension system maintains a relatively constant weight on each of the rover's wheels.
- It also designed and subjected to carry a payload up to 4kg and it will used to carry the medicines or kit to the particular spot where humans cannot enters.

10. CONCLUSION:

Taking into consideration that the rovers used in the military and space mostly depend on the suspension system to manipulate in the terrain areas. The need of rover with more surveillance and improvised suspension is more important. By this problem we have done a project to improve the surveillance and suspension system to sort out the problems. And then the wheels used in the traditional rovers were damaging due to lack of suspension effect. It will be controlled by using the independent controlled legs to provide cushioning effect. The rover will be modified in the future with new technologies to improve the wide range of applications in military and space. The rover with IoT technology will going to be the future to control the rover from any distance and easy to communicate with the signals. The step to step monitoring is done by using the IoT. Hope this project will provide the rover to manipulate in the military and space technology. Military rovers are advanced vehicles designed for a range of military applications. They are equipped with advanced technologies such as sensors, cameras, and autonomous systems that enable them to navigate and operate in challenging environments. Military rovers can perform a variety of tasks such as reconnaissance, surveillance, transportation, and even combat operations. These vehicles offer several advantages over traditional military vehicles, including increased safety, reduced manpower requirements, and improved situational awareness. They can also be deployed in hazardous environments that would be too dangerous for human soldiers. Overall, military rovers represent a promising technology for future military operations, and continued research and development in this field are likely to result in further advancements in their capabilities and effectiveness.

11. REFERENCES:

[1] Devi R, Dharrun B, Gokul Raj P, Gowtham C, "Unmanned multipurpose all terrain rover using rocker bogie mechanism". IEEE 10.1109/ICCES51350.2021.948898902, August 2021.

[2] Bickler, Donald B., "Improved All-Terrain Suspension System". NASA Tech Briefs, ISSN: 0145-319X, Volume: 18, Issue: 3.

[3] Bill Bluethmann; Ed Herrera; Aaron Hulse; Josh Figuered; Lucien Junkin; Mason Markee; Robert O. Ambrose, "An active suspension system for lunar crew mobility". IEEE 10.1109/AERO.2010.5446895, 15 April 2010.

[4] Pulkit Kapur, Department of Mechanical Engineering, Punjab Engineering College, Chandigarh, India. "Design and Development of Low Cost Rolling Cylinder Rover".

[5] Roshan Sharma, Rajesh Jaiswal, Ankit Yadav, Subash Roy,"Design and Fabrication of Rocker Bogie Mechanism Automated Combat Rover",IJRASET September 2020.

[6] Karl Iagnemma, Adam Rzepniewski, Steven Dubowsky & Paul Schenker, "Control of Robotic Vehicles with Actively Articulated Suspensions in Rough Terrain".Springer Link.

[7] Jai Prakash Prasad, Virupaksha V. Sahukar, M. Suresh, K. R. Shreyas Shetty & N. Vinay Kumar, "Multi-Terrain Rover Based on Rocker-Bogie Mechanism". LNEE,volume 783, 09 November 2021.

[8] M.Vishnu Vardhan, G.Sankaraiah, M.Yohan, Effect of cryogenic treatment of tungsten carbide tools on cutting force and power consumption in CNC milling process, Production & Manufacturing Research, 6, 149–170, (2018).

[9] C. K. Xia, H. A. Yang, L. C. V. Rojas and Q. Guo, Dynamic rocker-bogie:a stability enhancement for high-speed traversal, IAES International Journal of Robotics and Automation (IJRA), 3, 212– 220, (2014).

[10] Suojun Li, Haibo Gao and Zongquan Deng, "Mobility performance evaluation of lunar rover and optimization of rocker-bogie suspension parameters, 2nd International Symposium on Systems and Control in Aerospace and Astronautics, 1–6, (2008).