DESIGN AND ANALYSIS OF PNEUMATIC SHIELD ROBOT USING SOLID WORKS 2016 EDITION

Renu Singh , Assistant Professor, Department of Mechanical & Automation Engineering, Delhi technical campus, Greater Noida, U.P.-201308, India.

ABSTRACT

Pneumatic shield robot is a type of shield robot which provide the protection from the obstacle using pneumatic air. It is the analog of tank robot, which provide the protection from the weapons and uses armor to destroy enemies. It is a kind of prototype that uses mechatronic technology to activate pneumatics.

Pneumatic means" the adapted for holding or inflated with compressed air" and shield means "the protection against obstacle and missiles". It works on different types of technologies: Pneumatic technology . Electrical technology:. Mechanical technology:. Computer technology:

. The vehicle design is new and innovative. After going through different analysis such as static, stress and strain we have drawn these conclusions:

Maximum deflections are obtained within limits. Vehicle is rigid and safe. Vehicle can be easily dragged and move on rough terrains .Robot can be dismantled and assembled again with new technologies. Inspection and maintenance become easy with latest mechatronic system. New technologies can be applied to remove wires and adapting WIFI technology.Batteries that can be charged with solar power can also be used to reduce consumptionpower. Latest radar sensors can be used to effectively detect the hidden weapons/obstacles so as to activate the Armor immediately so as to minimize the loss to robot.

Keywords: Audino, pneumatic,

1. INTRODUCTION
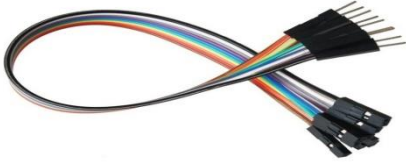
It works on different types of technologies:

- Pneumatic technology: It is a technology that uses compressed air to transmit and control energy.

Example: pneumatic cylinder

- Electrical technology: It is the technology of producing, storing, controlling, transmitting and getting work from the electrical energy.

  Example: Wires

- Mechanical technology: Use of mechanical components such as gears, pulleys, belts, etc. to produce mechanical motion such as translating or rotational motion.

   Example: Gears.

2. LITERATURE REVIEW

A wheel is a circular block of a hard and durable material at whose centre has been bored a circular hole through which is placed an axle bearing about which the wheel rotates when a moment is applied by gravity or torque to the wheel about its axis, wheel and axle thereby making together one of the six simple machines. When placed vertically under a load-bearing platform or case, the wheel turning on the horizontal axle makes it possible to transport heavy loads; when placed horizontally, the wheel turning on its vertical axle makes it possible to control the spinning motion used to shape materials (e.g. a potter's wheel); when mounted on a column connected to a rudder or a chassis mounted on other wheels, one can control the direction of a vessel or vehicle when connected to a crank, the wheel produces or transmits energy. A belt is a loop of flexible material used to link two or more rotating shafts mechanically, most often parallel. Belts may be used as a source of motion, to transmit power efficiently or to track relative movement. Belts are looped over pulleys and may have a twist between the pulleys, and the shafts need not be parallel.

In a two-pulley system, the belt can either drive the pulleys normally in one direction (the same if on parallel shafts), or the belt may be crossed, so that the direction of the driven shaft is . Connectivity are the leaders in shear bolt technology and this range of mechanical connectors offer the flexibility of being range taking. Theseconnectors can be used on copper and aluminium conductors, and if sealed correctly are able to be used on bi-metal connections.

A rod is a long circular bar of raw material. A dipstick is a metal **rod** with marks along one end, used to measure the amount of liquid in a container. The connecting **rod** connects the piston to A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

3. DESIGN AND ANALYSIS

Design analysis is the systematic process of developing a design including all information discovery, planning and communications. This can be applied to any type of design including the design of physical things such as buildings and intangible things such as software, information and processes
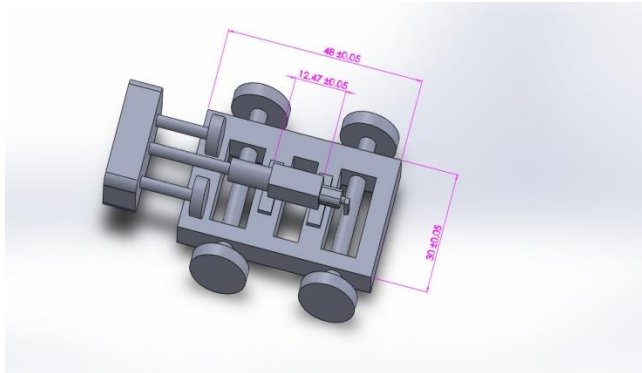
- The length of the robot is 48 cm and the width of the robot is 30 cm. The diameter of the wheels is 7 cm also a belt drive is used over the wheels to increase the friction force so that there will be less amount of deflection in the robot when the piston is in working condition. The bore of the piston is of 2.5 cm and the maximum length of the stroke is of 10 cm.

3.1 Stress Analysis

- Stress analysis is specifically concerned with solid objects. The study of stresses in liquids and gases is the subject of fluid mechanics.
- Stress analysis adopts the macroscopic view of materials characteristic of continuum mechanics, namely that all properties of materials are homogeneous at small enough scales. Thus, even the smallest particle considered in stress analysis still contains an enormous number of atoms, and its properties are averages of the properties of those atoms.

- In stress analysis one normally disregards the physical causes of forces or the precise nature of the materials. Instead, one assumes that the stresses are related to strain of the material by known constitutive equations.
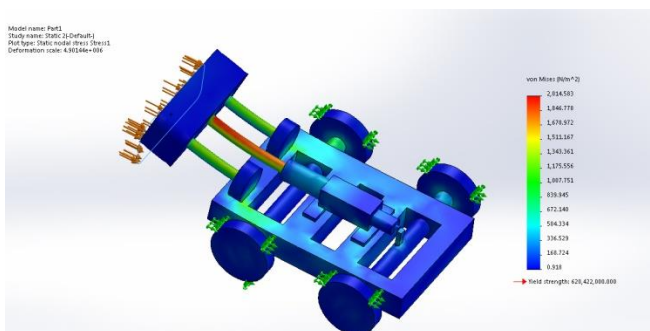

3.2 Strain Analysis

- We apply strain gages to the product to determine the stresses acting on the part. Components can be subjected to static or dynamic loading or other environmental stresses, such as load, torque, pressure,

vibration, or temperature. Our strain analysis services help you make informed decisions about your product's performance including strength, load limits, useful life and operational performance parameters.
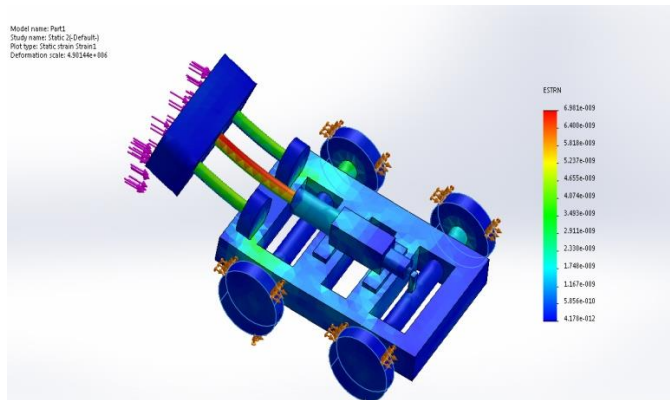
3.3 Displacement Analysis

- A displacement is a vector whose length is the shortest distance from the initial to the final position of a point P. It quantifies both the distance and direction of an imaginary motion along a straight line from the initial position to the final position of the point. Here in our case we can clearly see the displacement in the front end of the pneumatic shield robot. Thus, in order to reduce this displacement, we should use more rigid bodies inside the system and the front end of the robot must be made up of aluminium alloy to decrease stresses and other displacements.
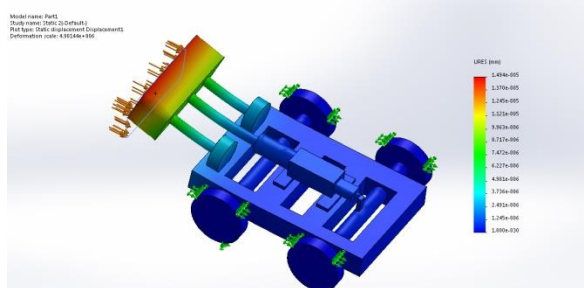
4.WORKING PRINCIPLE

Working principle involves the working of these components as follows:

- ➢ Working of IR sensor and Arduino
- ➢ Working of compressor
- ➢ Working of solenoidal valve
- ➢ Working of pneumatic cylinder

4.1 WORKING OF IR SENSOR AND ARDUINO

- An infrared light emitting diode (IR LED) emits light of Infrared range 700 nanometres (nm) to 1 mm. This light is not visible by naked eyes but can be seen by a camera (that is why these are also used in night vision cameras.
- A photo diode gives response in term of change in resistance when light falls on it. That change is measured in terms of voltage.

An IR LED and a Photo diode are used in a combination for proximity and color detection. An IR LED (transmitter) emits IR light, that light gets reflected by the object,

5.PROCEDURE

➢ Following are the steps/procedure to make a prototype of this robot. They are:

- 1st an IR sensor is programmed up to a range we want the obstacle to be stopped.
- Then the Arduino is connected to relay, IR sensor and the relay is connected to electric solenoidal valve.
- A compressor generating 60 psi is used for sending compressed air to cylinder.
- Connections are done as per the circuit and then the robot is activated to work as guided / programmed by the Arduino.
- Battery is used for the working of electric solenoidal valve and compressor can be run on battery or powered by ac source too.

6. RESULTS

After doing the design, market and methodology analysis we came across some results. These are:

- Static design analysis is under the tolerance limit but for practical work this prototype has to go several analyses such as:
- ✓ Thermal stress analysis
- ✓ Vibration analysis
- ✓ Computational fluid dynamic analysis
- ✓ Dynamic analysis
- Material used is as per conventional technology. New advancement in materials can lead to efficient results.
- As compressor is energy consuming device, its energy consumption can be reduced by using energy efficient batteries.
- Market survey gives the overall approximate cost and helps to reduce the cost by using the substitute of the material with same strength and lesser cost.
- Defining the working principle and procedure has helped to reduce assembling and machining time.
- Inspection time is reduced by applying all above before making a prototype.
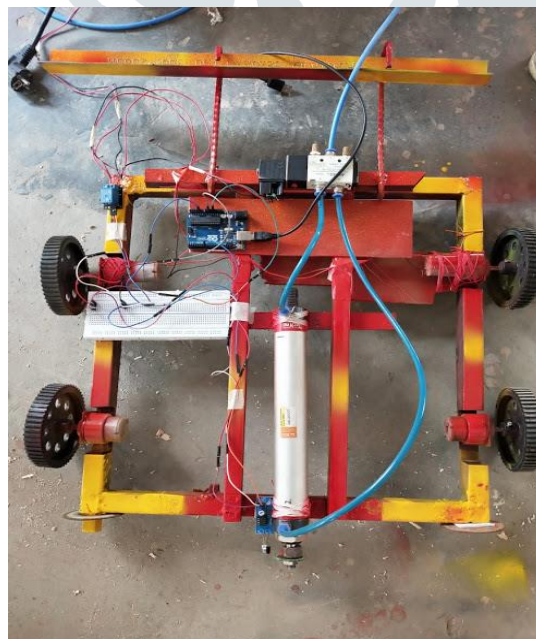
7. CONCLUSION

The vehicle design is new and innovative. After going through different analysis such as static, stress and strain we have drawn these conclusions:

- Maximum deflections are obtained within limits.
- Vehicle is rigid and safe.
- Vehicle can be easily dragged and move on rough terrains.
- Robot can be dismantled and assembled again with new technologies.
- Inspection and maintenance become easy with latest mechatronic system.

8. SCOPE FOR FUTRE

- New technologies can be applied to remove wires and adapting WIFI technology.
- Batteries that can be charged with solar power can also be used to reduce consumption power.
- Latest radar sensors can be used to effectively detect the hidden weapons/obstacles so as to activate the Armor immediately so as to minimize the loss to robot.

7.0. REFERENCE

1. T. Rahman, W. Sample, and R. Seliktar, "Design and Testing of Robot," presented at The Eighth International Confrence on Rehabilitation Robotics, Kaist, Daejeon, Korea, 2003
2. M. Goldfarb, E. J. Barth, M. A. Gogola, J. A. Wehrmeyer, "Design and energetic characterization of a liquid-propellant-powered actuator for self-powered robots", *IEEE/ASME Trans. Mechatronics*, vol. 8, no. 2, pp. 254-262, Jun. 2003
3. T. Noritsugu, "Development of PWM mode electro-pneumatic servomechanism. Part I: Speed control of a pneumatic cylinder", *J. Fluid Control*, vol. 17, no. 1, pp. 65-80, 1986.
4. A. K. Paul, J. K. Mishra, M. G. Radke, "Reduced order sliding mode control for pneumatic actuator", *IEEE Trans. Control Syst. Technol.*, vol. 2, no. 3, pp. 271-276, Sep. 1994
5. W. H. Tam, I. A. Ballinger, J. Kuo, W. D. Lay, S. F. McCleskey, P. Morales, Z. R. Taylor, S. J. Epstein, "Design and manufacture of a composite overwrapped xenon conical pressure vessel", *Proc. AIAA/ASME/SAE/ASEE Joint Propulsion Conf.*, 1996
6. C. Laschi, B. Mazzolai, M. Cianchetti, "Soft robotics: Technologies and systems pushing the boundaries of robot abilities", *Sci. Robot.*, vol. 1, no. 1, 2016.
7. J. W. Booth et al., "OmniSkins: Robotic skins that turn inanimate objects into multifunctional robots", *Sci. Robot.*, vol. 3, no. 22, Sep. 2018
8. A. Sprwitz, A. Tuleu, M. Vespignani, M. Ajallooeian, E. Badri, A. J. Ijspeert, "Towards dynamic trot gait locomotion: Design control and experiments with Cheetah-cub a compliant quadruped robot", *Int. J. Robot. Res.*, vol. 32, no. 8, pp. 932-950, 2013
9. J. W. Booth, J. C. Case, E. L. White, D. S. Shah, R. Kramer-Bottiglio, "An addressable pneumatic regulator for distributed control of soft robots", *Proc. IEEE Int. Conf. Soft Robot.*, pp. 25-30, Apr. 2018
10. H.-J. Yeo, "Design and Implementation of Task-Level Robot Language for Intelligent Robot System using Multi-Sensor Integration", *Trans. KIEE*, vol. 45, no. 6, pp. 899-909, 1996
11. R. A. Volz, "Report of the Robot Programming Language Working Group: NATO Workshop on Robot Programming Languages", *IEEE J. Robotics and Automation*, vol. 4, no. 1, pp. 86-90, February 1988.