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Design and Fabrication of Drum Robot

Keshav Jha¹, Sai Phanindra Dinesh Kakarlamudi², Shravani Rallapati³, Vishwas Dussa⁴

U.G. Student, Department of Mechanical Engineering, JNTUH College of engineering, Hyderabad, Telangana,
India^{1,2,4}

U.G. Student, Department of Mechanical Engineering, Mahatma Gandhi Institute of Technology, Hyderabad,
Telangana, India³

ABSTRACT: - In the past, the human labor and the aid of domesticated animals, both gave the efforts to build the earliest societies. It is no secret that robots can be very helpful and beneficial to humans. Certain robots are able to help with household chores and things that you may not be able to accomplish alone. A robot is a mechanical or virtual artificial agent, usually an electro- mechanical machine that is guided by a computer program or electronic circuitry. The branch of technology that deals with the design, construction, *operation* and application of robots, as well as computer systems for their control, sensory feedback, and information processing is robotics.

There are many different kinds of robots available, each created for different tasks and behavior, and works on different platforms. Robots can be built for Industrial, Domestic or household, medical, service, military, entertainment, space, hobby and competition. Each of these robots can be classified as autonomous, controlled, semi-autonomous and virtual based on the way they are controlled.

Here, we have designed drum robot on AUTO CAD and fabricated the drum with iron and the remaining part of the robot i.e.; chassis, motor clamps etc with the help of aluminum in CNC machining shop and also in our college engineering workshop and machine tools Lab. After fabricating it, we have participated in robo wars competitions of SHAASTRA 2014 held at IIT madras, and were finalists. Apart from that we have participated in many other competitions and have won prizes.

KEYWORDS: Robot, AUTO CAD, CNC machining, Robo wars competitions

I. INTRODUCTION

Rob wars is a two or more custom-built machines use varied methods of destroying or disabling the other. As of today, in most cases these machines are remote-controlled vehicles rather than autonomous robots, although there are exceptions, particularly in the field of robot-sumo. There are different types of war robots. They are:

- 1.1. Ram Bots
- 1.2. Wedge Bots
- 1.3. Lifter Bots
- 1.4. Launcher Bots
- 1.5. Thwack Bots
- 1.6. Spinner Bots
- 1.7. Drum Bots
- 1.8. Hammer Bots
- 1.9. Crusher Bots

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1.1 Ram Bots: The ramming robot features a powerful drive, big wheels with high traction, a strong frame, and good shock resistance. With no active weapons, this robot batters its opponent with brute ramming and shoving force.

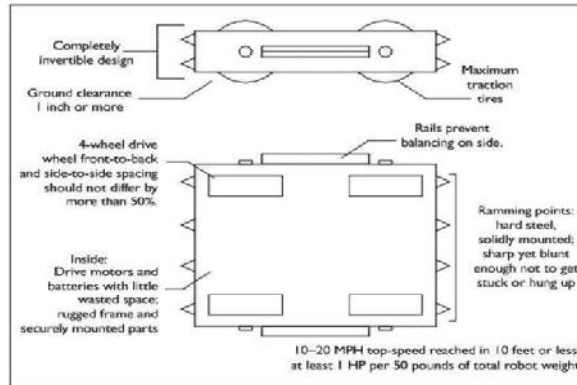


Figure 1 :- Ram Bot Design

1.2 Wedge Bots: The wedge weapon features a thin, wide, ground scraping scoop on the front, backed up by a strong frame and powerful drive system.

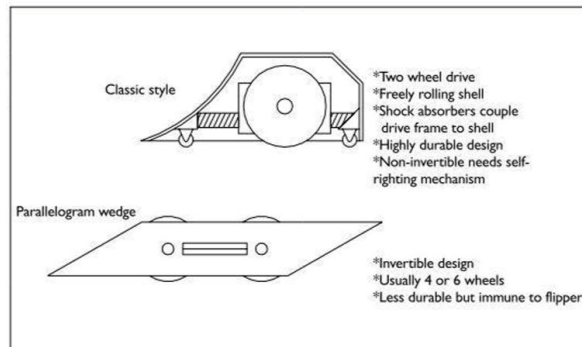


Figure 2 :- Wedge Design

1.3 Lifter Bots: A lifter bot features an actuated arm that's designed to hook under the opposing robot and lift it off the ground, flipping it over or carrying it about.

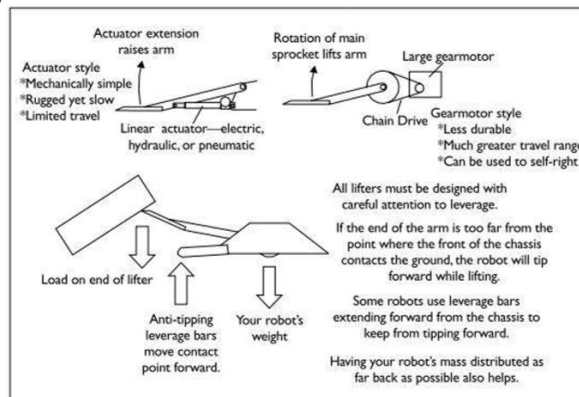


Figure 3: Lifter Design

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1.4 Launchers: The launcher features an actuated arm that's powered by extremely high-flow-rate pneumatics, capable of launching the unlucky opposing robot high into the air.

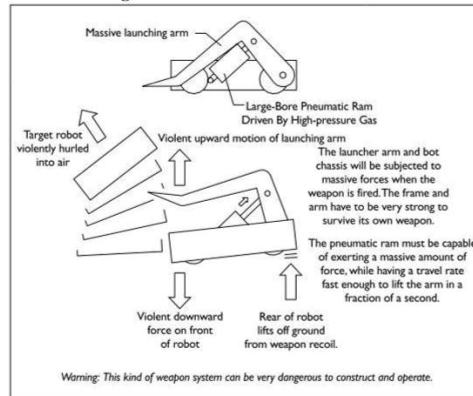


Figure 4 : Launcher Design

1.5 Thwack Bots: Thwack bots feature a powerful, two-wheeled base, with a long-tail boom having an axe, pick, or hammer head on the end. They are capable of spinning in place at high speed.

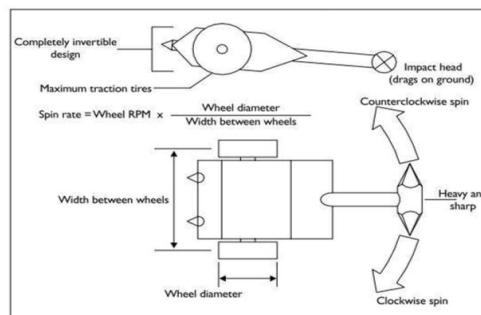


Figure 5 : Thwack Bot Design

1.6 Spinner Bots: These bots feature a heavy spinning bar or disk, possible with hammer heads, chisels, maces, or other protrusion pieces attached.

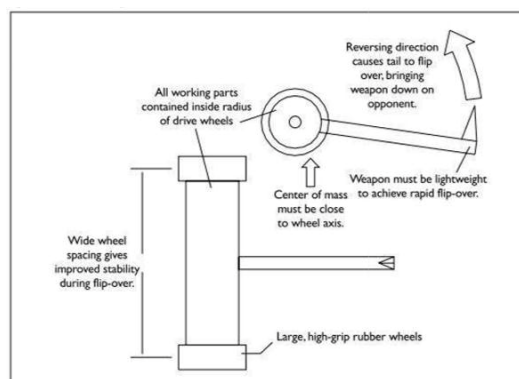


Figure 6 : Spinner Design

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1.7 Drum Bots: Drum bots feature a wide drum with protruding, spinning teeth or blades that are mounted on a horizontal axis across the front of the robot. Like the vertical spinner, the front of the drum spins upward to lift the opponent on contact.

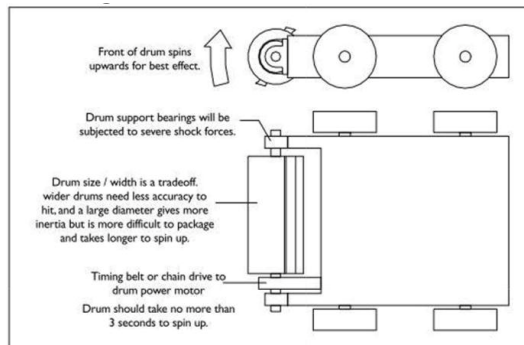


Figure 7 : Drum Design

1.8 Hammer Bots: Hammer bots feature hammers, axes, picks, or mace weapons on powered overhead arms, and are designed to inflict repeated blows on an opponent's top armor or exposed wheels.

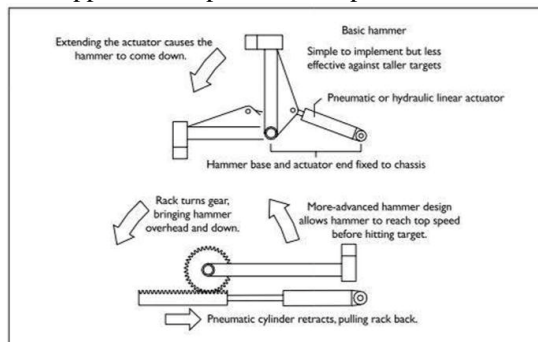


Figure 8 : Hammer Design

1.9 Crusher Bots: Crushers feature a large, heavily reinforced claw, usually hydraulically powered and capable of closing with several tons of force to crush or pierce the opposing robot.

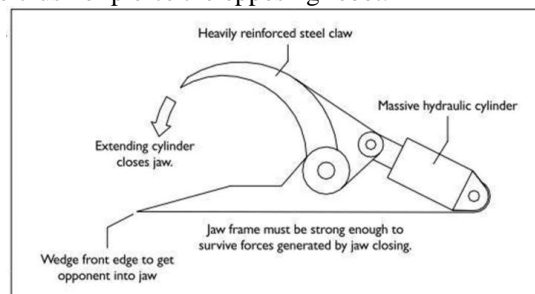


Figure 9 : Crusher Design

II. MATERIALS AND METHODS

Different materials like aluminium, iron and alloys of both etc can be used for chassis fabrication of any war robot. Wheels can be of nylon, plastic or rubber. Bot, nuts and screws of different sizes and shapes can be used for mounting of different parts. Tool box is compulsory for each and every robot for assembling different parts of the robot. Tool box mainly consists off hammer, spanners of different sizes etc.

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Different machining methods are applied during fabrication of any robot. These include drilling, welding, CNC machining, filing etc.

III. PARTS INVOLVED

3.1) Batteries

It is a collection of one or more electrochemical cells in which stored chemical energy is converted into electrical energy. The principles of operation haven't changed much since the time of Volta. Each cell consists of two half cells connected in series through an electrolytic solution. One half cell houses the **Anode** to which the positive ions migrate from the **Electrolyte** and the other houses the **Cathode** to which the negative ones drift.

Batteries are classified into primary and secondary forms.

- Primary batteries irreversibly transform chemical energy to electrical energy. When the supply of reactants is exhausted, energy cannot be readily restored to the battery. Alkaline batteries, Mercury batteries, Silver-Oxide batteries, and Zinc carbon batteries are examples of primary batteries
- Secondary batteries can be recharged; that is, they can have their chemical reactions reversed by supplying electrical energy to the cell, approximately restoring their original composition. Lead-Acid batteries and Lithium batteries fall into the secondary battery's category.

3.2) Motor

- Self start motor
An electric motor forms the basis of the starter motor. When the starter switch is turned on, the starter relay turns on the electric motor. This motor drives the starter gear ring via the pinion gear. The rotating movement of the starter motor is created through the interaction of two magnetic fields. Starter motors come with permanent magnets or with electromagnets. Each of these configurations has its own specific characteristics. The energy required by the starter motor is provided by the battery. The starter motor requires a lot of start-up power. The battery must therefore have sufficient capacity and any losses must be kept to a minimum. As the starter motor begins to turn faster, start-up power is reduced. This is caused by the inverse voltage generated. This motor is used for running of the drum.
- Wiper motor
Wiper motors are designed for two speed operation. The motor consists of three brushes namely; common, low speed and high Speed. Two of the brushes will be supplied for different mode of operation. These can be used for locomotion of wheels.
- Power window motor:
These are the motors usually used for automobile vehicles. For locomotion of war robot, these motors can be used.

3.3) Wires

A wire is a single, usually cylindrical, flexible strand or rod of metal. Wires are used to bear mechanical loads or electricity and telecommunications signals. Wire is commonly formed by drawing the metal through a hole in a die or draw plate. Wires of different companies like finolex, polycab, havells etc of different thickness like 2 square mm, 3 square mm, 16square mm can be used.

3.4) Tool kit

- Wrench : A wrench (also called a spanner) is a tool used to provide grip and mechanical advantage in applying torque to turn objects—usually rotary fasteners, such as nuts and bolts or keep them from turning.
- Screw drivers: A screwdriver is a tool, manual or powered, for turning (driving or removing) screws. A typical simple screwdriver has a handle and a shaft, and a tip that the user inserts into the screw head to turn it. The shaft is usually made of tough steel to resist bending or twisting. The tip may be hardened to resist wear, treated with a dark tip coating for improved visual contrast between tip and screw—or ridged or

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treated for additional 'grip'. Handle are typically wood, metal, or plastic and usually hexagonal, square, or oval in cross-section to improve grip and prevent the tool from rolling when set down.

- Hammer: It is mainly used for hammering the chassis to make it flat or to tighten the screws.

3.5) Wheels

A wheel is a circular component that is intended to rotate on an axle bearing. The wheel is one of the main components of the wheel and axle. Wheels of different materials like plastic, nylon and of different sizes can be used.

3.6) Switch Box

Most business networks today use switches to connect computers, printers and servers within a building or campus. A switch serves as a controller, enabling networked devices to talk to each other efficiently. In war robots, switch box with switches is used for moving the robot in different directions like right, left, full rotation etc.

3.7) Chassis

A chassis is the physical frame or structure of an automobile, an airplane, a desktop computer, or other multi-component device. For war robot, chassis can be made of different materials like Iron, aluminium of different thickness.

IV. FABRICATION

Drum:

We have fabricated drum by using iron. We initially designed the shape of the drum and with the help of CNC machine we were able to fabricate the drum. The weight of the drum alone is 8 Kg. We have put two blades on the top portion of the drum on opposite sides to attack the opponent's robot in the competitions. These blades were assembled to the drum with the help of screws. A solid rod was made to pass through the centre of the drum and was held tight with the help of bearings on either side so as to hinder its rotatory motion. A gear of 26 teeth was mounted on one side of the drum with which the drum rotates when chain passes over this gear in connection to that of motor gear and connected to a battery.

Chassis and other parts:

Considering the weight, strength, stiffness, payload capacity, and easy to shape, we chose aluminum for the chassis formation. 6061-T6 aluminum is the most common structural aluminum alloy, used in several applications such as bicycle frames, structures, naval and truck components. It has medium strength and it can also be welded. The thickness of aluminum plate chassis of 5mm was taken. The plate was kept for CNC machining process. The dimension of chassis and the dimension for drilling were feed to the CNC process through G code. We used two clamps with holes in each one as to pass the shaft of drum. Furthermore two clamps were used to hold the motor parallel to the drum. Threading was done to fit the screws in it hold the clamp. Gear was fabricated and attached with the help of lock on the shaft of motor. Chain with suitable size and length was used to drive the gear and drum. A small aluminum clamp was welded at the back corners to hold the wheel of the robot. A shaft was fabricated by CNC lathe machine to connect the motor and the wheel. A parallel key was used in the shaft for the desired rotation of shaft with the rotation of motor. Screws were used to fix the shaft and the wheel.

V. SPECIFICATIONS OF OUR DRUM ROBOT

Length of robot: - 28 cm

Maximum width of robot: - 30 cm

Weight of robot: - 15 kg

Speed of motor: - 3500 RPM

VI. ASSEMBLY

The drum robot mainly comprises of chassis, a drum, wheels, motors for locomotion, switch box (remote), bike chain, bearings, solid rod which acts as shaft for drum and gears. The main assembly of the drum robot starts from the chassis. The aluminum made chassis, which is about 5mm in thick, is made to have side supports which are screwd to the chassis with the help of Allen key set. These side supports have holes to hold the shaft of the drum given. This

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drum is a cylindrical one, which has two projections (blades) on either side of it so that it can hit the opponent's robot effectively. The shaft of the drum is mounted between two side supports using bearings on the both sides.

The drum mounted is driven by a self start motor whose speed is 3500 rotations per minute. This self start motor is mounted using aluminum clamping of thickness 12mm. The type of transmission used between self start motor and drum is through chain drive mechanism. The gears attached to self start motor and drum have tooth in the ratio of 1:2. We have also used bat grips for wheels to avoid friction.

The movement of the robot is taken care by two power window motors, which are mounted to wheels. These motors are clamped with aluminum clamps on either side. The wheels used have a shaft which is attached to them using a key. These locomotion motors and self start motor terminals are connected to battery and a switch box (remote) using wires. The finolex company wires of 2.2square mm are soldered to the terminals of motors with the help of soldering gun, wire and soldering flux.

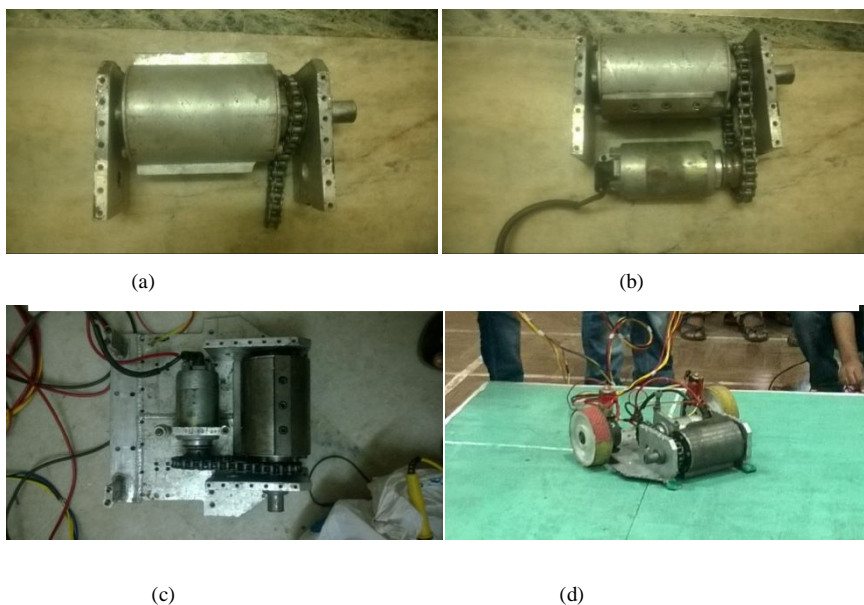


Figure 15 :- (a) Drum (b) Drum with Motor (c) set up of drum and motor on chassis (d) Complete set of drum bot
Figure 15 shows the assembly of the drum bot. In figure (a) the drum the chain and the clamp is assembled whereas in figure (b) the motor is also added. In figure (c) the set up of the drum, clamps, chain and motor is done. In figure (d) the complete setup of drum bot is assembled

VII. TESTING

The positive and negative terminal of either locomotion motors is not known to us. So initially, terminals of the motors are connected to the positive and negative terminals of the battery with the help of wires and is operated with switch box. If both the wheels are rotating in same direction then no need to change the connections or else connections need to be changes.

Similarly, for the self start motor which is driving the drum, initially terminals of the motor are connected to the battery with the help of 16 square mm finolex wires. If the drum rotates in clockwise direction (seeing from the back of robot), then the connections are correct. If it is rotating in anti-clock wise direction, then change the combination of the wiring. Because if the drum rotates in clock wise direction , the opponents robot get damaged very easily.

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Also test the battery voltage with voltmeter. The voltage should be 12v. if it is less than 12v then power will not be sufficient for the locomotion motors to run. We can also increase the power of the motors by connecting the batteries of 12v in series so that total voltage becomes 24v. The same procedure is adopted for drum motor also. The wires are taped with the help of electric tape. The robot is made to move front and back and in different directions with the help of switch box. If any screws got loosened, tight them with the help of Allen keys.

VIII. CONCLUSION

Robo wars competition is the most prestigious event in all the technical fests of IITS, NITS, BITS etc through out India. Every technical fest gives a problem statement which describes about the specifications of the robot, type of mechanisms to be used, rules and regulations of the event. Participating in these events rather than just attending them gives all the participants an opportunity to think out of box; design their own robot; fabricate it using different mechanisms, materials etc which in total builds their technical skills, team work skills and also provides the students to get placed in any of the manufacturing industries.

We have designed, fabricated , assembled and tested it and finally participated for the first time in January 2014, in SHAASTRA 2014 at IIT madras and were successfully qualified for the finals and stood 4th out of 48 teams which have participated in the event. This has build our confidence levels and made us use different mechanisms like flipper , wedge etc for our robot. Unfortunately we could not win that competition because our locomotion motors were not good. For this we need to use bane motors or planetary gear motors for locomotion which should be imported from countries like GERMANY and USA. As we do not have enough money we were not able to buy those motors. Apart from all this, we have even taught our juniors and helped them during the fabrication of their robot for participating in competitions.

XI. ACKNOWLEDGEMENT

The satisfaction that accompanies the completion of any task would be incomplete without naming the people who made it possible whose constant guidance and encouragement made the work perfect.

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