

## Fabrication of Kinematic Walker

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**Abstract** - In this paper current state of many walkers are compared and advantages of a legged systems against wheeled walker are described. In the subject of project work a six legged walker is selected biologically inspired by insects. The focus is mainly on locomotion on an uneven terrain using opposite gait of locomotion. The six legged walker is designed to navigate smoothly on an irregular terrain. The stabilization of legs are inspired by biomimetic stepping leg transferences with an active balance control so as to reduce the propagation of instability while performing rapid stepping actions for a fast walking gait. Walker has borrowed from nature with varying degrees of abstraction, from physical appearance to observed behaviors. This work describes the design and construction of a six legged walker normally called as "hexapod robot" to navigate on an uneven terrain.

**Key Words:** D C motor, Gears, shafts, sprocket, Nut and Bolt, Battery etc....

### 1. INTRODUCTION

The hexapod is an insect inspired robotic which has six legs that permit to transport flexibly on various terrains. The principle benefit of this form of walker is its balance. The character inspired the researchers and new progressive thoughts are available in thoughts but occasionally they are easy and effective, occasionally bulky and vital. One of the first taking walks machines turned into advanced in about 1870 by using Russian Mathematician Chebyshev. This walking system had four legs organized into pairs. Legged gadgets were used for at least a hundred years and are advanced to wheels in a few aspects:

Legged locomotion has to be robotically superior to wheel or to tracked locomotion over a variety of soil situations and truly superior for crossing obstacles. US army research reviews that approximately 1/2 the earth surface is inaccessible to wheeled tracked automobiles, while this terrain is ordinarily exploited by means of legged animals. Wheeled walker are the simplest and most inexpensive also tracked walker are superb for moving, but now not over almost all sorts of terrain. There are distinct sorts of legged taking walks robots. They're roughly divided into organizations in keeping with the range of legs they possess. Bipedes have two legs, quadrupeds four, hexapods six and octopods have eight legs. Bipedes' walker are dynamically strong, but statically volatile, such robots are more difficult to balance, and dynamic balance can only be completed

throughout walking. Hexapods are six legged walker, then again, have benefits of being statically solid. In the course of on foot they can pass three legs at a time, consequently leaving three different legs continually on the ground forming a triangle. Preceding paintings proved the feasibility of fabricating a crawling insect scale robot capable of forward locomotion on flat ground, and the results encouraged a couple of enhancements in design. The hexapod gives additional tiers of freedom for the robot's sensors and on board gadget. Some well-known reason robots were tested for this software at the primary however now day's unique prototypes developing unique features are being built and examined. The Titan VIII taking walks walker, a four legged robot developed as a popular reason taking walks walker at the Tokyo Institute of era, Japan. For some time now, researchers have been privy to the reservoir of insight available from a properly guided stud of current organic structures. The objective of this research is to broaden an efficient terrain negotiations and locomotion for hexapod. The team was able to understand the difficulties in maintaining the tolerances, quality and making use of available facilities, skill. Thus the group developed a "KINEMATIC WALKER"

### 1.1 LITERATURE REVIEW

- **D.Deepak, S.Pathmasharma [1]:** Studied "Design and Fabrication of Kinematic Robotic Walker with Left and Right Motion with Camera" in this paper authors concluded that in the earlier kinematic walker there is only front and back motion. Thus it cannot be moved or turned to left and right motion and also can't be rotated. Hence it is a big drawback that it is not able to do left and right movements. We planned and designed the structure such that it provides flexibility in operation. This innovation has made the walker more desirable and economical. This model helped us to know the periodic steps in completing a project work. Thus we have completed the project successfully.
- **Dr. B. Nagalingeswara Raju [2]:** studied "Design and Fabrication of Kinematic Walker" in this paper author suggest that the kinematic walker robot consists of 6 legs with 4 degrees of freedom on each leg to allow for better mobility and exceptional range of movement.

## 2. MANUFACTURING PROCESS

Manufacturing strategies are the steps thru which uncooked substances are converted into a very last product. The producing system begins with the introduction of the materials from which the design is made. These materials are then changed via manufacturing strategies to end up the specified component. Manufacturing approaches can include treating (including heat treating or coating), machining, or reshaping the fabric. The producing manner also includes checks and assessments for great warranty for the duration of or after the manufacturing, and making plans the production procedure prior to manufacturing.

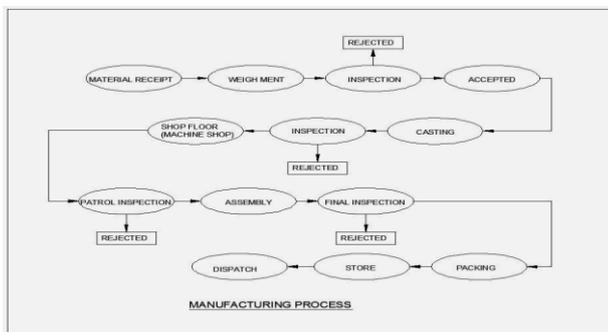


Fig -1 Manufacturing Process

### 2.1 Metal cutting:

Metal slicing or machining is the procedure of through putting off undesirable cloth from a block of metal within the form of chips.

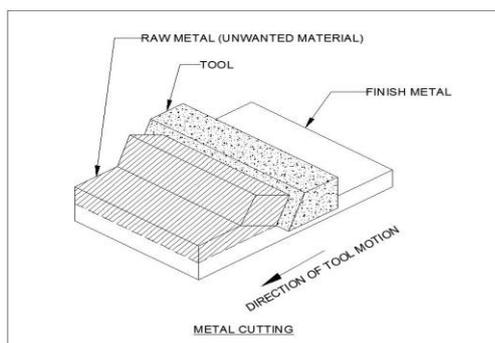


Fig -2 Metal cutting

Slicing strategies paintings by means of inflicting fracture of the material this is processed. Generally, the portion that is fractured away is in small sized portions, known as chips. Commonplace cutting tactics consist of sawing, shaping (or making plans), broaching, drilling, grinding, turning and milling. Despite the fact that the real machines, equipment and tactics for reducing look very distinctive from every different, the primary mechanism for causing the fracture

may be understood by using just a simple model called for orthogonal reducing.

### 2.2 SAWING

Cold saws are saws that employ a round noticed blade to reduce via numerous styles of metal, together with sheet metal. The call of the noticed has to do with the action that takes location during the reducing method, which manages to hold each the metallic and the blade from becoming too hot. A cold noticed is powered with electricity and is often a desk bound type of noticed machine in place of a transportable kind of saw.

The round noticed blades used with a cold noticed are frequently built of excessive pace metal. Metallic blades of this type are immune to wear even underneath day by day usage. The give up result is that its miles viable to finish some of reducing tasks before there are a want to replace the blade. Excessive speed steel blades are mainly useful while the saws are used for reducing through thicker sections of steel.

Along with the high pace metallic blades, a chilly noticed may also be equipped with a blade that is tipped with tungsten carbide. This form of blade construction also helps to resist wear and tear. One main difference is that tungsten tipped blades can be re-sharpened occasionally, extending the lifestyles of the blade. This form of blade is a good suit to be used with sheet metal and other metal components which are surprisingly skinny in design.

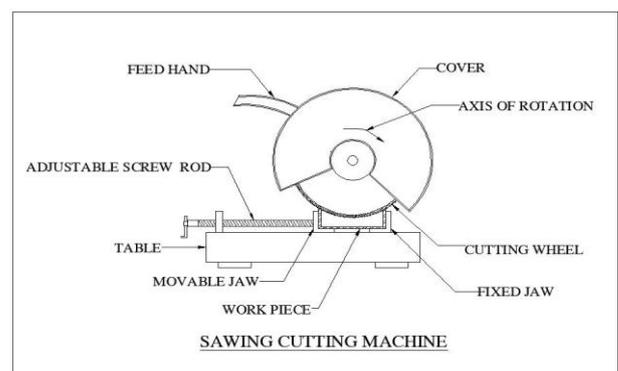


Fig -3: Sawing Cutting Machine

### 2.3 WELDING:

Welding is a method for becoming a member of similar metals. Welding joins metals by melting and fusing 1, the bottom metals being joined and 2, the filler steel applied. Welding employs pinpointed, localized heat input. Most welding involves ferrous-based totally metals along with metal and chrome steel. Weld joints are typically stronger than or as strong because the base metals were being joined.

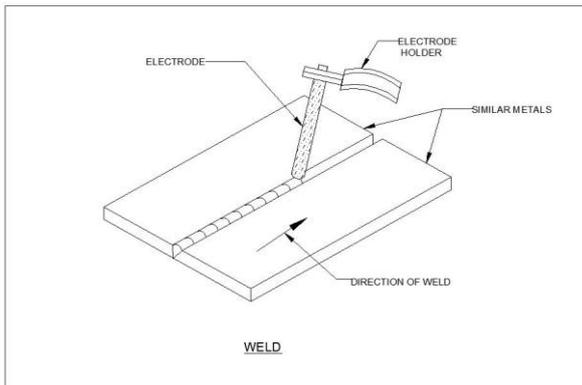


Fig -4: Welding

Welding is used for making permanent joints. It's far used in the manufacture of automobile our bodies, plane frames, railway wagons, system frames, structural works, tanks, furnishings, boilers, enormous restore artwork and deliver constructing.

#### 2.4 DRILLING:

Drilling is a reducing method that uses a drill bit to cut or expand a hollow of round pass-phase in solid substances. The drill bit is a rotary slicing tool, frequently multipoint. The bit is pressed towards the work piece and circled at rates from masses to lots of revolutions consistent with minute. These forces the reducing area in opposition to the paintings piece, cutting off chips (swarf) from the hollow as its miles drilled.

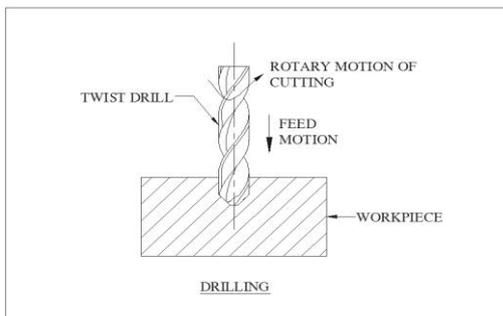


Fig -5: Drilling

#### 2.5 ASSEMBLY:

An assembly line is a producing procedure (maximum of the time referred to as a innovative meeting) in which components (normally interchangeable elements) are added as the semi-completed meeting moves from paintings station to work station wherein the components are added in series till the very last meeting is produced. by mechanically transferring the elements to the meeting work and moving the semi-completed meeting from work station to work station, a completed product may be assembled a good deal faster and with an awful lot much less labor than by way of having workers bring parts to a desk bound piece for meeting.

### 3. COMPONENTS AND DESCRIPTION

The main components are used in this project are

- Dc motor,
- Battery,
- Spur gear,
- Bearing.

#### 3.1 DC MOTOR

An electric powered motor is a gadget which converts electric energy to mechanical energy. Its motion is primarily based at the principle that after a present day-sporting conductor is located in a magnetic subject, it reports a magnetic force whose route is given via Fleming's left hand rule. While a motor is in operation, it develops torque. This torque can produce mechanical rotation. DC motors also are like generators labeled into shunt wound or collection wound or compound wound cars.

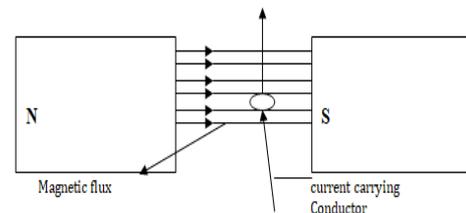


Fig -6: Principal of DC motor

#### 3.2 BATTERY

In isolated structures away from the grid, batteries are used for storage of more solar power transformed into electric powered energy. The best exceptions are isolated sunshine load along with irrigation pumps or consuming water components for storage. In reality for small units with output less than one kilowatt. Batteries seem like the only technically and economically available storage way. For the reason that each the picture-voltaic system and batteries are high in capital costs. In which high values of load present day are important, the lead-acid mobile is the kind most usually used. The electrolyte is a dilute answer of sulfuric acid (H<sub>2</sub>SO<sub>4</sub>). In the software of battery electricity to begin the engine in an automobile cell, as an instance, the burden current to the starter motor is usually 200 to 400A. One cellular has a nominal output of two.1V, but lead-acid cells are often utilized in a series aggregate of three for a 6-V battery and six for a 12-V battery.

#### 3.3 SPUR GEAR

The spur gears, which can be designed to transmit motion and strength among parallel shafts, are the lowest in cost gears inside the energy transmission industry.

**Inner Spur Equipment:** The inner gears are spur gears grew to become "inner out." In other words, the enamel is

cut into the interior diameter at the same time as the out of doors diameter is saved smooth. This layout permits for the riding pinion to rotate inner to the equipment, which, in turn, allows for easy operation. Intended for mild obligation packages, these gears are available simplest in brass. When selecting mating spur equipment, usually take into account that the difference inside the number of teeth between the internal gear and pinion ought to now not be less than 15 or 12.

**External Spur Equipment:** perhaps the most usually used and simplest gear gadget; external spur gears are cylindrical gears with directly teeth parallel to the axis. They're used to transmit rotary motion between parallel shafts and the shafts rotate in opposite directions. They have a tendency to be noisy at excessive velocity as the 2 tools surfaces come into contact straight away. Internal spur gears: The internal spur equipment works similarly to the external spur gears besides that the pinion is within the spur gear. They may be used to transmit rotary motion among parallel shafts however the shafts rotate inside the identical path with this association.

### 3.4 BEARINGS

A bearing is a system detail that constrains relative movement and decreases friction among shifting components to simplest the favored movement. The layout of the bearing may also, as an example, provide without spending a dime linear movement of the transferring part or free of charge rotation; or, it can prevent a motion by way of controlling the vectors of normal forces that undergo on the moving parts. Many bearings also facilitate the favored movement as much as possible, including by minimizing friction. Bearings are categorized widely in keeping with the form of operation, the motions allowed, or to the directions of the masses (forces) implemented to the elements.

The term "bearing" is derived from the verb "to endure"; a bearing being a gadget detail that allows one element to endure (i.e., to support) every other. The handiest bearings are bearing surfaces, reduce or shaped right into a component, with various tiers of control over the shape, size, roughness and area of the floor. Different bearings are separate gadgets installed into a machine or machine part. The most state-of-the-art bearings for the most worrying packages are very specific devices; their manufacture requires some of the very best standards of current generation.

## 4. WORKING PRINCIPLE

The primary operating principle of the six legged robotic is that the rotational movement of the motor is transformed into the (legged) on foot movement of the robotic. There may be a motor connected by the chain power to the spur tools arrangement of the device. The spur equipment shaft is hooked up to the legs of the strolling

robot, in order that the robot can convert the rotational motion into the linear motion of the legs. The legs are interconnected with every other so that there exists the linear movement of the legs and the legged motion. The DC motor can run thru the battery power deliver.

### 4.1 CALCULATION OF DEGREES OF FREEDOM

In general, number of degrees of freedom of a mechanism is given by,

$$(n = 3(l - 1) - 2j)$$

Where

n - Degree of freedom

l - Number of links

J- Number of binary joints

We have,  $l = 6$

$$j = 7$$

Hence,

$$\text{Degree of freedom } n = 3(6-1) - 2 \times 7$$

$$n = 15 - 14$$

$$n = 1$$

### 4.2 CALCULATION OF GEARS

$$\begin{aligned} \text{Pitch Diameter, } d_1 &= m \times Z_1 \\ &= 1 \times 14 = 14 \text{ mm} \\ &= 15 \text{ (is the standard dia} \\ &\text{from the data hand book)} \end{aligned}$$

$$\begin{aligned} \text{Diametric Pitch, } DP &= Z_1/d_1 \\ &= 14/15 = 0.93 \text{ mm} \end{aligned}$$

$$\begin{aligned} \text{Outside Diameter, } D_o &= (Z_1+2)/D_p \\ &= (14+2)/0.93 = 17.2 \text{ mm.} \\ &= 18 \text{ mm} \end{aligned}$$

$$\begin{aligned} \text{Addendum, } a &= 1/D_p \\ &= 1/0.93 = 1.075 \text{ mm.} \end{aligned}$$

$$\begin{aligned} \text{Dedendum, } d &= 1.157/D_p \\ &= 1.157/0.93 = 1.24 \text{ mm.} \end{aligned}$$



**Fig 7:** components for fabrication



**Fig -8:** Kinematic Walker kit

## 5. ADVANTAGES OF KINEMATIC WALKER

The benefits of walking over rolling on rough terrain are summed up in the following:

- 1) Higher energy efficiency, better fuel economy
- 2) Increased speed
- 3) Greater mobility
- 4) improved isolation from terrain inconsistencies

## 6. CONCLUSION

The project work, fabrication of six legged kinematic walker is successfully designed and a prototype model is made. The aim to move the model on an uneven terrain using opposite gait of locomotion is met. The six legged walker is designed to navigate smoothly on an irregular terrain.

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