

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

DESIGN AND FABRICATION OF METAL DETECTING MECHANICAL SPIDER USING KLANN MECHANISM

Prof. Atish.B.Mane¹, Atharva Barje², Shubham Kurale², Vilas Oulkar² & Mahesh Waghmare²

¹Assitant Professor, Department of Mechanical Engineering, Bharati Vidyapeeth's College of Engineering, Lavale, Pirangut, Pune

²Student, Department of Mechanical Engineering, Bharati Vidyapeeth's College of Engineering, Lavale, Pirangut, Pune

ABSTRACT

As we know wheels were discovered in year 3500 B.C. in Mesopotamia. The wheels are the main components of the transportation vehicle. Without wheels the vehicle cannot move from its stationary state. But this wheel is having few drawbacks. We know wheels can catch grip on normal roads easily. But these wheels slip on wet areas, snowy region, in muddy region and also on high elevation. So to allow vehicles to move on such areas the wheels can be replaced by the insect walking gait pattern. The best effective leg mechanisms are Joe Klann's Mechanism and Theo Jansen's Mechanism. By using Joe Klann Mechanism the wheel gets look of spider leg. The purpose of our paper is to make the wheeled vehicle to move in muddy regions, high elevation, etc by reinstating the wheels with insect gait (with insect leg). This is useful in dangerous material handlings, detecting and clearing the explosive minefields without making any harm to human troops.

Keywords: *Wheels, Joe Klann Mechanism, Theo Jansen Mechanism, Explosive Minefields, Human Troop.*

I. INTRODUCTION

Walking mechanisms are built up in such a way that they move same as the insects move. There are number of walking legged mechanisms. These mechanisms are further classified according to number of legs they include. They are classified into two, four, eight legs. As spider has eight legs so it is balanced. So using eight legs for making model is best suited.

1.1 Why Joe Klann Mechanism

There are two mechanisms namely Klann mechanism and Theo Jansen mechanism that replaces wheel. The biggest advantage of Klann mechanism robots is that it can travel into areas that are not possible for wheeled robots. By xeroxing the structure of legged animals, these robots can walk in muddy regions etc.

1.2 Advantages of Klann Mechanism

- The number of links is less in Klann mechanism as compared with Jansen mechanism.
- Weight of Klann mechanism is less as compared with Jansen mechanism.
- Klann mechanism is less complicated than Jansen mechanism.
- To allow the robot to walk in muddy, snowy or slippery surfaces.
- To give access to the places which are dangerous.

II. LITERATURE SURVEY

“Norton 2004^[1]”, For legged robots, 2 DOF is minimum required to move a leg forward by lifting and swinging. It shows leg mechanism which is similar to spider leg. We chosen 6 bar mechanism because of its superior force transmission angle and bigger oscillating angle in comparison with other types such as the four bar mechanism.

“Swadhin Patnaik^[2]”, conducted research on four legged walking machines. After researching on mining industries I came across some data. About fifty percent of cost is spent on roads. Haul roads cause severe wear and tear of tyres of vehicles used in transportation which then needs frequent replacement of tyres. In haul roads the weight is

not distributed evenly which cause high stress problems. After researching I found that the legs worked good on terrain instead of wheels. After researching this mechanism I founded that it copy the motion of insects.

“Al Salameh Shamsudin ^[3]“,made research on movement of walking machines. He showed the overview of robot , configuration , number of DOF, analyzed the movement of leg. Biological inspired gaits of the walking robots were discussed.

“ Richard Edgeworth ^[4]“, In 1770 he tried to construct a wooden horse. That horse constituted eight legs. It was constructed to jump over high walls. However 40 years of experimentation was unsuccessful in constructing such a mechanism.

“Frank and McGhee^[5]“, made the first computer controlled walking machine. Most recently a Mechatronics Research Group from the University of Southern Queensland created pneumatically powered walking robot.

III. METHODOLOGY

As we know the major demerit of wheel that is it gives poor performance on rocky and muddy areas. To avoid such case and keep the movement robots with legs by using Joe Klann Mechanism are proved to be best. These robots can travel into areas where the wheeled vehicle cannot. The legged robot is useful in explosive materials handling, detecting the bombs without harming any troop, etc. It can be used in security firms. Purpose of our project is to help the army to detect the bomb or minefields without putting lives of troops in risk.

i. Joe Klann Mechanism

The Klann Mechanism is a Planer mechanism which is developed to simulate the walking manner of legged insect and also function as a wheel by restoring the wheel. The linkage constitute of crank, rocker arm, leg, frame all connected with pivot joints. The proportions of each of the linkages in the mechanism are optimized in such a way that the linearity of foot for one half rotation of crank. The other half rotation of crank allows the foot to be raised to determined height before arriving to its original position. The Joe Klann Mechanism provides many advantages of advanced walking robots. The robot with Klann Linkage can step over stairs, move into areas which are not safe for human lives.

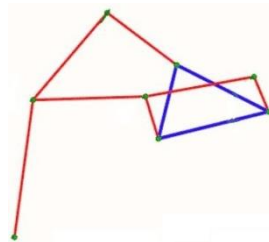


Fig.1 Klann Leg Mechanism

IV. COMPONENTS

- Spur Gear * 6
- Leg * 8
- Motor * 1
- Links * 48
- Base Plate * 1
- Top Plate * 1
- Support Plate * 2
- Shaft * 6

V. SPECIFICATIONS

Serial Number	Component	Length (mm)	Width (mm)	Thickness (mm)	Material Used
1	Base Plate	280	205	8	Acrylic
2	Top Plate	170	42	8	Acrylic
3	Support Plate	120	70	8	Acrylic
4	Spur Gear 1	Diameter = 60	Pitch = 3	8	Plastic
5	Spur Gear 2	Diameter = 30	Pitch = 3	8	Plastic
6	Leg	164	15	4	Acrylic
7	Connecting Arm	112	15	4	Acrylic
8	Support Arm	55	20	8	Acrylic
9	Rocker Arm 1	45	15	4	Acrylic
10	Rocker Arm 2	35	15	4	Acrylic
11	Crank	36	15	4	Acrylic

VI. DEGREE OF FREEDOM (DOF)

When the mechanism is analyzed, at that time the most important part is to calculate the mobility (degrees of freedom) of the mechanism. Degrees of freedom is the number of parameters that define its configuration. Degrees of freedom number can be calculated directly from total number of links and number of joints.

General equation to calculate number of degrees of freedom of a mechanism is given by,

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

Where, n = Degrees of freedom

i = No. of links

j = No. of joints.

The above equation is called as Kutzbach criterion.

Now in single leg assembly of Klann mechanism,

Number of links (i) = 6

Number of Joints (j) = 7

Therefore,

By using above equation, we get,

$$\begin{aligned} n &= 3(i - 1) - 2j \\ &= 3(6 - 1) - 2(7) \\ &= 3(5) - 14 \end{aligned}$$

Therefore, $n = 1$

Therefore Degrees of Freedom for single leg assembly of Klann mechanism is 1

VII. SOLIDWORKS MODEL

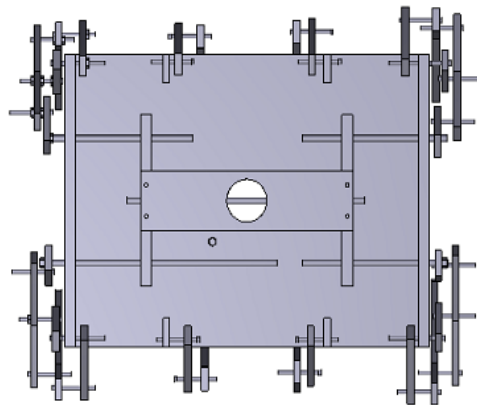


Fig.2 Top View of 8 Legged Spider Robot

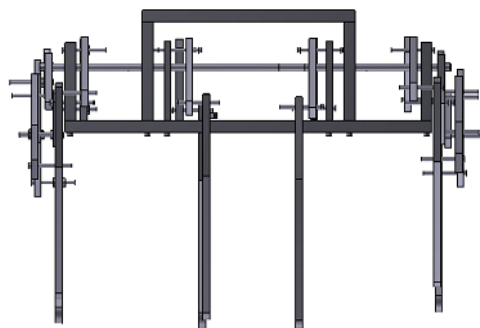


Fig.3 Front View of 8 Legged Spider Robot

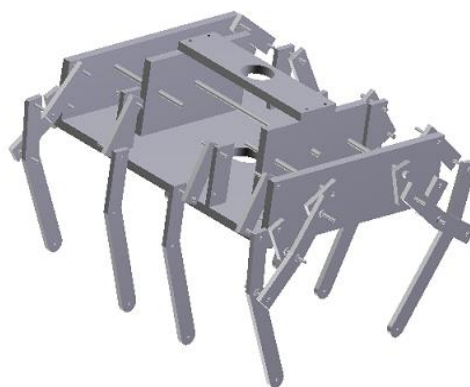


Fig.4 3D View of 8 legged Spider Robot

VIII. ADVANTAGES OF SPIDER ROBOT

i. Contact with the ground at discrete points:

The rims of wheels have continuous contact with the ground over which they travel. Walking machines place their feet and once placed, frictional forces prevent further movement of foot. Suspension is entirely eliminated in walking machines.

ii. Elimination of Roads:

Walking machines do not require roads or other prepared surfaces to walk on . It can travel into any areas.

iii. Minimal contact area with ground:

Consider a example, in an area of land where land mines have been placed in random order. In case of wheeled vehicle there are more chances of land mines getting triggered. But in case of walking machines it touch a very small area of the land over which it travels. So there will be reduced risk of triggering mines.

iv. Increased Traction:

Wheeled vehicles are subjected to slip condition, especially when applying high tractive effort on slippery or wet surface. A suitable walking machine with sharp leg foot increase ground pressure and hence penetration could apply more tractive effort than a wheeled vehicle.

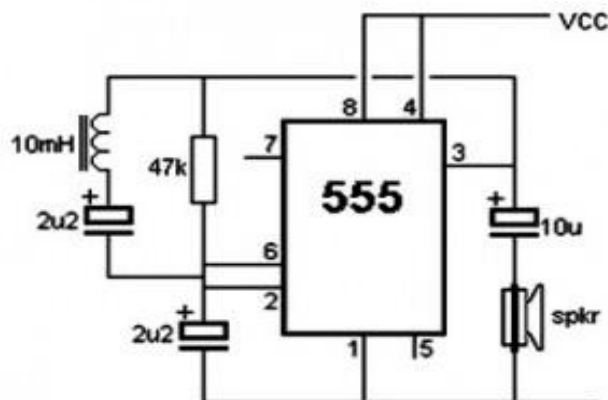
IX. APPLICATION

There are many applications of this project but the best application that we thought is using metal detector circuit. As an application we have used metal detector circuit so as to detect metal. Our aim of using this metal detector circuit with this model is that with help of this combination of walking spider and metal detector circuit it can be used to detect mines or bombs without harming army troops.

The following are the details of the metal detector circuit that we have used in our project.

Copper coil acts as inductance. The coil is fed into IC 555. The capacitor and copper coil induces a frequency for the output signal from IC 555. In case of any metal contacts with the copper coil, its frequency changes, thus changing the output signal frequency of IC 555. This could be noticed with small amount of change in the humming sound from buzzer.

Circuit Diagram of Metal Detector circuit



X. FUTURE SCOPE

The Klann mechanism can be made more flexible by making different modifications in geometry or dimensions of klann linkage. The metal detector can be used to improve the effectiveness of this spider robot in military applications. It can be used in detecting and clearing minefields without putting army troops lives in danger.

XI. CONCLUSION

By studying Klann mechanism, we implemented the Klann mechanism in our project by replacing the wheels of wheeled vehicles to Klann linkage. Legged robots can be used in hazardous places such as the inside of nuclear reactor, can be used in detecting and clearing minefields. The good point of Klann mechanism is that its construction is less complicated and it can be used in great applications without harming anyone.

REFERENCES

1. Miss Suman Sharma, “Mechanical Spider by victimization Klann Mechanism” *International Journal of Mechanical Engineering*, volume 5 , issue 3 , 2017.
2. K. Chinna Maddahia, S.P.Vasanth Nagesh, R. Murali, N. Ajay Paul, P. Shiva Kumar, “ Four legged walking robot using 8 bar mechanism”, *International Journal of Engineering Research*, volume 4, issue 2, 2016.
3. Senthil Kumar . M, Jayantheeswar . V, Dinesh . T, Sri Suryaa. M , Paul Sushil Dev. R, “ Design of Bomb Disposing Bot”, *International Journal of Engineering Research & Technology*, volume 2, issue 10, 2013.
4. Mano Raja Paul M, Arjun Nair, Arun Kumar G, Akshay G Nath, “ Klann Mechanism Held Telerobot With Security Systems”, *International Journal of Recent Trends in Engineering and Research*, special issue, 2017.
5. U. Vantia, V. Premalatha, M. NithinKumar, S. Vijayaganapathy, “Mechanical Spider using Klann Mechanism”, *Scholars Journal of Engineering and Technology*, 2015.
6. Shashwat Mishra, “ Design and Fabrication of Mechanical Spider “, *International Journal of Science and Research*, volume 6, issue 11, 2017.