DESIGN AND FABRICATION OF MECHANICAL BIPEDAL MOTION

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***Abstract*: In this project, we design and develop a mechanism for the bipedal robot. This bipedal robot is one of those kinds of bio-inspired robot that emulates the human movement. The goal of this project is to design the bipedal robot's mechanical structure and power. The key aspect of controlling the robot (did not tilt and slip) is centre of mass. For 6 degrees of freedom, the biped gait is achieved: one at each hip, one at each knee, one at each ankle. The cycle of walking should be performed via the connection system. Stepper Motor must power the whole system, which will be able to push two legs step by step phase one after another. The operation of motors relies on the system of mechanical self-balancing. Then the whole performance should be biped gait, which should look like a human walk.**

INTRODUCTION

Designing robotic walking controllers faces many challenges. While several re-searchers have managed to create practical robots, there is little agreement about how to operate them. A walking robot has yet to come close to matching human abilities. In the meantime, the robotic arms have been refined to a point where they can equal or even surpass human trajectory skills following tasks. To reach this point, walking robotics may need a new approach to legged robotics. Bio-inspired robotic locomotion is a very new sub-category in the robotics field. It's about designing real world engineering structures, focused on nature-related motions. A bipedal robot is one such form of bio-inspired robot that emulates the walking movement of humans. Recent years have seen a significant rise in the study of bipedal robots. The goal of this paper is to design the mechanical structure and control of a bipedal robot. While almost every human being knows what walking feels like, it's difficult to understand all the processes that make walking possible. This problem has been addressed by many researchers and some of their efforts have yielded impressive results. Two of today's top walking robots are the ASIMO and Qrio, created respectively by Honda and Sony. All of these humanoid robots use an algorithm for position control to shift and rotate various limbs and joints similar to those used in robotic arms. The biped structure consists of just two legs, which are attached to the hip joint and used for the robot / humanoid locomotion. The most influential problem with a biped walking system is complete robot stability. Various methods for stabilizing the robot both statically and dynamically were developed.

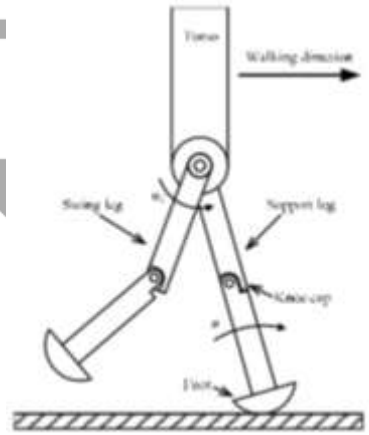

Fig1: bipedal mechanism

KLANN MECHANISM

The Klann linkage is a planar system designed to mimic the legged animal's gait and act as a support axle, a system for the legs. The attachment consists of the base, a handlebar, two grounded rockers and two couplers all connected by pivot joints. The proportions of each of the links within the mechanism are specified to optimize the foot linearity for half the crank rotation. The remainder of the crank rotation causes the foot to be raised to a set height before moving back to the starting point and completing the process.

Excluding any of their drawbacks, the Klann connection offers many of the advantages of more sophisticated walking vehicles. It can cross curbs, climb stairs or move to areas which are currently not wheeled accessible but do not need microprocessor control or multitude of actuator mechanisms.

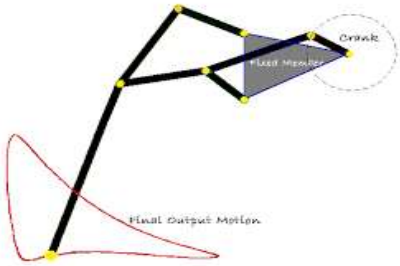

Fig 2: klann mechanism

MECHANICAL DESIGN OF BIPEDAL ROBOT

The mechanical design of a walking robot can be divided into 3 phases

1. Determining the mechanical restrictions
2. Specification and Fabrication of model

Determining the mechanical restrictions

When we design a bipedal robot there is a different design considerations can make the perfect robot design. Some of the factors that have to be considered as

1. Robot leg size selection.
2. Degrees Of Freedom (DOF).
3. Part design.

Robot leg size selection

The size of the robot leg can plays a major role for developing a prototype model. Based on the size of the leg we can estimate the centre of mass and balancing the bipedal mechanism. In this project the robot leg height is 300mm by using universal joint at the knee. The cost of the project can be determined on the material required for fabrication and the motor required.

Degrees Of Freedom (DOF)

Basically the human leg has 6 degrees of freedom: 3 at hip, 1 at ankle, 2 at knee. We can make the project by using 6 degrees of freedom the cost will be increased and the running the mechanism is become complex. So in our project we implement 3 degrees of freedom: 1 at hip, 1 at ankle, 1 at knee.

Part design

For designing and modelling of a bipedal robot the solid works software is used. We can make the part design by using appropriate dimensions.

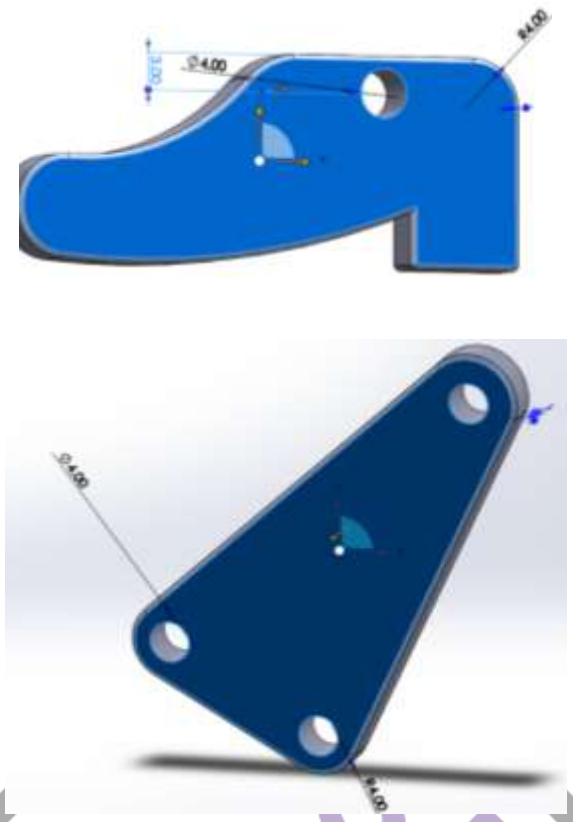

Fig3: Part modelling in solid works

SPECIFICATIONS AND FABRICATION OF BIPEDAL ROBOT

Degrees of freedom-3-DOF/leg.
Total 3 DOF (hip, knee, ankle)
Dimensions of the robot leg:
Ankle height = 100 mm
Height from ankle to knee = 500 mm.
Height from knee to hip = 350 mm.
Total height of the leg = 850 mm.
Total height of the leg with universal joint = 920 mm.

Fig4: Design of the leg

WORKING PRINCIPLE

The working principle of a bipedal robot should depends on the different types of mechanisms. In this project we use the klann mechanism for easy moving of the legs. In our project we can made the linkages with the help of the wood pieces. Two pieces are taken, the bottom part should connected to the leg and upper part connected to the triangular shape wooden piece. This triangular shape wooden piece can make the triangular movement of the leg. At the above part of the triangular wooden piece is connected to the circular wheel which is also made by the wooden piece. Then the rotation of the wheel can make the gait. A wheel can rotate in any direction the movement of leg should resembles the human walking.

Fig5: working of the Leg by using mechanism

RESULT

We can make the simple prototype models in both solidworks and hardware. The entire mechanism can be done at one point. If we can rotate the wheel arranged at back of the leg then the bipedal motion of the leg can be observed.

3D MODEL DESIGN IN SOLID WORKS

Fig6: Model design in solid works

PROTOTYPE MODEL

Fig7: Prototype Model

CONCLUSION:

In this paper we have show the concept of bipedal robot movement through klann mechanism. Robotics has a capability to make life easier and decrease the burden to the people. But there is lot of risk to implement the robotic works. This particular bipedal robot can be enhanced with simple modified gait. We can improve the bipedal robot with some actuators and sensors, these can be used in inclined surfaces and roughly areas. The main important thing is that the bipedal robot require more balance and control. The bipedal gait can make it easy to travel both indoors and outdoors. By using this bipedal leg mechanism, Artificial legs can also be placed to people, who lost their legs in accidents.

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