Implementation of Quadped Walking robot using Theo Jansen mechanism

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***Abstract*— this paper presents Theo Jansen model which is going to be much popular and efficient mechanism in Robotics Era. This mechanism is based upon the leg mechanism. Most of the researchers showing their attention towards this model to make more practical and efficient. This model have more energy efficiency. Theo Jansen mechanism can actually seems like a walking robot. In this paper simulation of mechanism through solid works and implementation in real life with image processing and working of esp32 cam and esp8266 and live transmission through host and MATLAB.**

***Keywords*—** robotic arm,solidworks, webcam, Arduino UNO

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I. INTRODUCTION

In the Era of Wheeled vehicles in automobile world Theo Jansen model is the upcoming technology in walking mechanism. This mechanism is designed by a Theo Jansen a kinetic sculptor. As we know wheeled mechanism will take more friction to get a moment and unable to move through discrete shape and uneven roads. By using this Jansen model we can make robot more stable and accurate. This model is having multiple legs in this project, we worked on quad legged mechanism. We can use solid works for designing and 3D simulation of Jansen model. Solid works is a software which is used for making 3D models and analysis of strengths in links of a robot.

Now-a-days security is major concern for every person in their personal life and we can use this model for surveillance and in defence operations. To keep things under our observation with live video streaming and stored footage. Cameras are also upgraded to wireless and available in bluetooth, Wi-Fi. This cameras capture images and detect the objects and sends the data to the operator.

In first Theo Jansen model, Jansen used a central crank shaft for connecting all legs. In this project we have connected individual dc motor to connect each leg and it represent the combination of Theo Jansen model of four legged and image recognition robot, we control this bot using mobile application or MATLAB.

Theo Jansen Mechanism

This mechanism works on one rational force acting at one or more parts of links.

There are total 11 points or more in single leg, based up on the beam strengths. The links are placed in an order and with a calculated dimensions. So that when a rational force applied on the joint as shown in figure below the moment will be seems like a moment of an animal leg. The relative motion plays key role in this mechanism. In this four legged mechanism, the body of robot placed on four legs.

The weight of robot totally exerts on legs. So while walking the weight should be balanced. Then we can say when one leg is lifted, other three legs are relatively rest with other or placed on ground. But all four legs are in motion entire time of working.

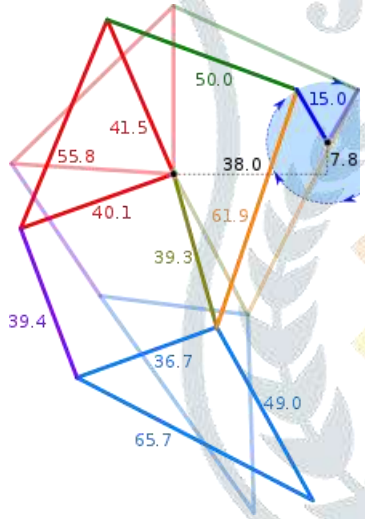
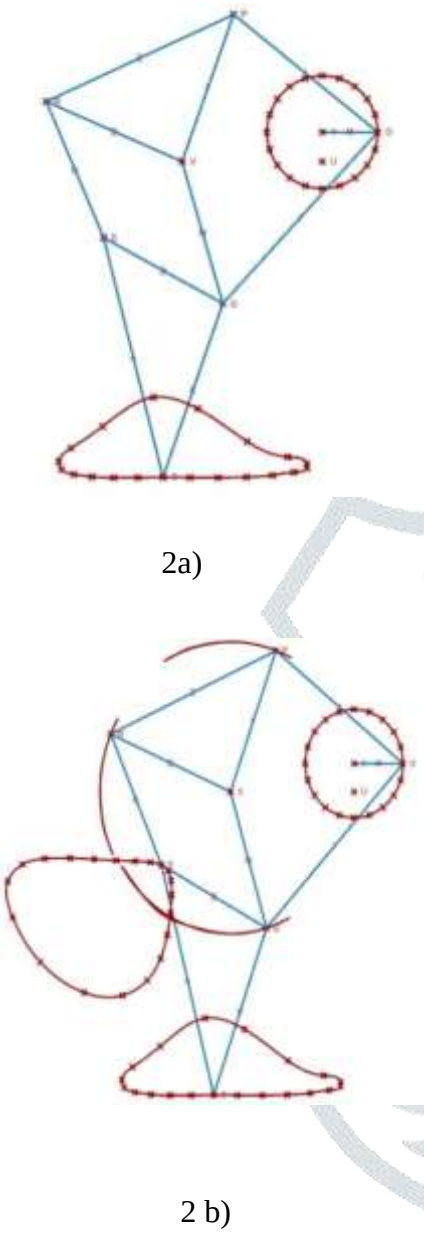


Fig. 1 shows Theo Jansen Leg Mechanism

The four legs should be calibrated if we are using different power sources for different leg mechanism. If we are using a single source for working of mechanism we need to use gears operation.



2a)

2 b)

Fig. 2 a and 2b shows Movement of Links of One Leg

The blue coloured line are links and the red coloured shapes are path movement of joints when a rotational force applied on fixed or grounded link. All links are movable except two. These paths can be changed according to lengths of links. At any case the middle links are parallel and equal lengths.

There are no fixed length for linkages. The ratios of linkages are experimental values. According to design there are two fixed joints to get relative motion of walking.

The whole stresses on the linkages distributed equally.

Simulation

We have used solid works for designing this model. Instead of solid works there are many other software like Auto Cad, ZW-CAD and more. Solid works have advantage than ZW-CAD where solid works can show analysis of strengths and many other features.

Before starting with 3D model we tried do with 2D design at beginning which is more easy and understandable.

Modelling

For modelling we need construct solid objects instead of 2D shape. The process is same we just need to construct solid blocks which will be visible as real object.

The figure below shows the complete 3D model of The Jansen.

We did modelling before construction in real because we will have some idea of lengths and angles of linkages.

By doing this part we were are more accurate at construction in real part.

Equipment Required

- Thin metallic or Acrylic sheet
- DC Motor
- ESP8266 Wi-fi module and ESP32-CAM
- Jumper wires
- custom mobile application
- Motor driver L293D

Construction

- First we need to cut the Acrylic sheet into required sizes as per dimensions. We can use the same dimensions which we used for making design of the model in solid works
- The sheets are to be connected by a rotational joints.
- Four DC motors are should connected either side if body, which can easily configured. Then construction will be less complex.
- DC motors are connected to motor driver L293D.

- The Motor Driver should be connected to Wi-Fi module 8266, which should be programmed as per project
- We need to connect to the same LAN in ESP8266 and in our mobile using hotspot.

Controlling

We can control this bot using a mobile application. This application use LAN to connect to esp8266 module. There are in-built buttons in application we just need to configure and run our bot.

- While the bot is moving, when one of the leg is lifted the centre of gravity of whole body will be shifted. We just need to use some excess weight to place on body to maintain the balance.
- The joints of the robot in legs will have friction we need to some lubricants or smoother object while making bot.

Practical Procedure

We need a CAM for taking images are send live video transmission. We can use any CAM module like ESP32 .In case if we don't want to spend money, we can use our own mobile cam as web cam. The ESP32 will be provided by IP address we just need to type it any browser which is connected to same LAN. Then a page will be opened of multiple options we can access there itself for image detected and live transmission. For mobile application the process is same except that we need to give permission to access. We use the same IP address in MATLAB and run image processing.

The ESP32 is programmed by Arduino IDE. We have to install libraries of ESP32 cam in Arduino IDE.

Integration of Theo Jansen and ESP32

After doing the above process we need attach the ESP32 on Theo Jansen model without any interference. We designed this robot based upon combining to different models.

We can control the Theo Jansen bot through BLYNK app and custom apk and Images which are were taken by Wi-Fi module can be processed in MATLAB without any wired connection.

Conclusion

Here in this paper we presented the 3D design modelling in solid works and how to implement it in real life. We used a Wi-Fi cam esp32 to transmit the data from module to a device using IP address, this data is processed by MATLAB and we can see a more clarity image in our desktop or mobiles.

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