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Numerical Analysis of Pipe Cleaning Machine

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Abstract*: Now a day inspection and cleaning of inner side of pipes quiet difficult Because pipelines are frequently hidden underground they are contact with the soil subjected to corrosion where pipes made up steel are effectively oxidizing and get corroded. Although its less common corrosion also occurs on the inward surface of the pipe and lower the strength of the pipe. If crack goes undiscovered and becomes sunder therefore by the pipe cleaning machine the surveillance of innermost of the pipe cleaning can be done by using surveillance camera and cutting cleaning mechanism robot can move inner horizontal and vertical pipe has been design and fabrication. The robot consists of a motor for propulsive and camera for investigation and by which lie streaming of cutting action can be seen on android and IOS software.*

Keywords*: Pipe Inspection; pipe cleaning; robot; PIR, Audit, Miniature.*

I- INTRODUCTION

The robotics is a fastest growing field in engineering and Now a they are used in wide range in many field to easier the work. Generally robots are used in many industries. Due to this application they are varies in sizes and work easily at any condition and atmosphere where manually operations are impossible. Due to this applications of robot in oil and gas industries and pipelines caries fluids cracks and corrosion are occur and leakage of fluids explode will happens and because these pipes are hidden underground they are difficult to inspect and cleaning. For that Hoon Jong Kim & Gokarna sharma proposed a "Pipe Inspection autonomous mobile exploration robot" for 150mm pipeline and which can control independently called FARMER ' A Fully Autonomous Mobile Robot for Pipeline Exploration'[1]. Also Mihita Horodinca and Loan Doroftei proposed a miniature of inspection Robot, with a stator rotor and universal joint used for mobility of robot[5] , Zhelong wing and Hong Gu prosed a Brush pipeline robot used to clean a pipeline with stubby bristles between a diameter of 9 to 15 called 'A Bristle-Based Pipeline Robot.[3]. Hyouk Ryeol Choi and se-Gon Roh proposed a miniature of in pipe inspection MRINSPECT series robot for used in practical application.[4]

II- OBJECTIVE

- To make an flexible robotic design so as to regulate according to the pipeline parameters.
- To add gripper to robot which can contract and enlarge according to the pipeline parameters?
- To regulation the whole system with remote.
- The cleaning and surveillance of interior of pipe by mechanism.

III- WORKING PRINCIPLE

Working principle used in this robot is Inversion of Four bar chain mechanism or GROSEFF Law.

A. Condition for four bar Kinematic chain or GROSEFF Law

"It states that the sum of the shortest and longest link in the kinematic chain must be less than the sum of other two remaining links."

B. Inversion of Mechanism

A mechanism is a kinematic chain with one link fixed. The fixed is called as frame. Distinctive mechanisms are obtained by fixing distinctive link in a kinematic chain. The process of choosing different link in a kinematic chain for the frame is known as invasion.

Inversion of Four bar chain Mechanism

Various types of inversions are;

a) Coupled wheels of Locomotive(Double crank Mechanism)

b) Pentograph (Double Lever Mechanism)

For inserting robot in the pipe we have to pull the translation element backward there by compressing the spring as shown in fig A. due to the arrangement of links according to four bar mechanism the outer most link move inward. After introducing robot in pipe we have to leave the translation element, then spring expand and due to the fore of spring and arrangement of link again the outmost link move outward and robot get hold in the pipe.

KINEMATICS OF MECHANISM

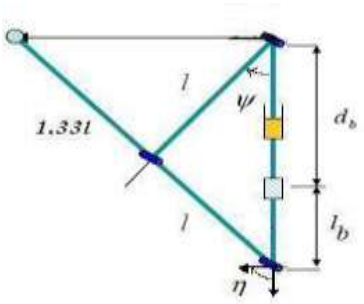
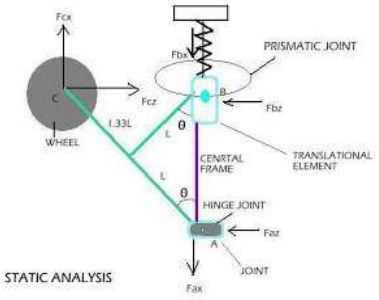


Fig :- Kinematics of Mechanism

This is a four-bar mechanism consisting of three revolute joins and one shimmering as depicted. Thus, the passage of all revolute joints can be specify in terms of the movement d_b.

A Static analysis



Fig; Static analysis

$\delta W = Fcz\delta z - Fbx\delta x = 0$where F_{bx} is a spring force.

This is because only F_{cz} and F_{bx} manipulation work. The comparable coordinates of these forces analogous to the coordinate located at the A hook are expressed as

$$\delta W = Fcz\delta z - Fbx\delta x = 0$$

$$\delta W = Fcz\delta(2.33lsin\theta) - Fbx\delta(-2.33lcos\theta)$$

$$=> Fcz * 2.33lcos\theta\delta\theta - Fbx * 2.33lsin\theta\delta\theta = 0$$

Rearranging gives

$$Fbx = Fcz * cos\theta/sin\theta$$

Thus, the spring force at the shimmering joint B is related to the regular force F_{cz} by

$$Fbx = Fcz * tan\theta$$

And total weight W of robot is the sum of the six suction forces strive on the belt. Thus, each suction force F_{cx} is one six of the whole weight of the robot structure. Thus, dimensions o f the actuator boxed-in within the wheel is compured by F_{cx}*R=WR/6

Where R is that the radius of wheel. From the top of static analysis .it's additionally known that the massive weight of mechanism doesn't influence the folding motion of the linkage .The spring stiffness is found to be 0.9N/mm and also the spring force to be 4.5 . so we tends to came the conclusion that the mechanism ought to have atleast 3kg torque . So,we used 3 actuators with 1.5kg torque(total 4.5kg torque).It's safe to use an actuator with additional torque than the desired torque.

b) Basic construction Design

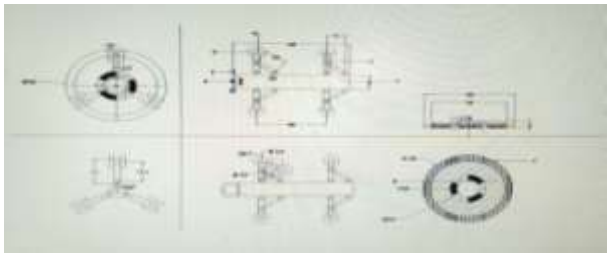


Fig:- Basic construction Design

METHODOLOGY

The principle of this project is to audit various pipes and provide its actual picture to operator. Robot works on the chuck jaw mechanism. Robot is draft in such a way that lower human efforts while audit the industrial pipes. Various steps carried out to lower weight of robot. Hence audit of pipes is done by robot to get vital data.

CONSTRUCTION

This robot comprise of following parts

- Central Body Parts
- Interpretation Element
- Connections
- Motors
- Wheel
- circuit
- battery
- spring

Central body is the casing of robot. On this edge joints are brazed at 120 degree, spring and interpretation is mounted on it combined with principle frame of focal body toward one side of spring by packing the spring . The connections are appended the joints on focal components and interpretation with the assistance of nut and fasteners engine is mounted on the furthest connection through an opening penetrated on it.

Central Body Element

Inner dia - 12mm

Outer dia - 15 mm

Length of body- 625mm

Material – mild steel

Fig :- central Body Element

a) Translation Element

Inner dia- 17mm

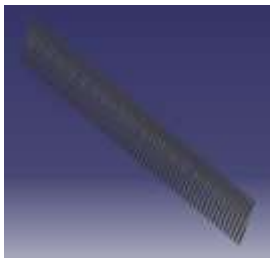
Outer dia- 20mm

Length of Body- 70mm

Material- Mild Steel

Fig :- Translation Element

b) Spring



Spring dia -2mm
Free

Length-
300mmCompressive
Length-240mm

Fig :- Spring

C.

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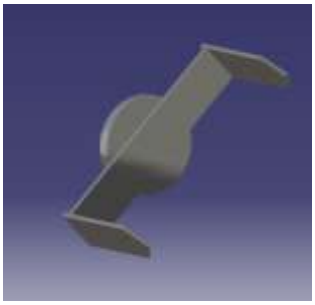
c) Link

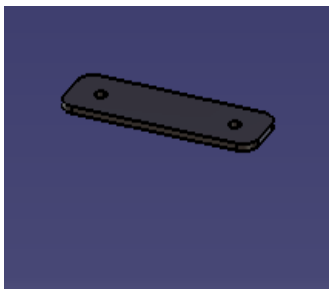


Length-63mm
Width-20mm

Thickness-2mm

Material -Aluminium

d) Cutter



Material Used
For Cutter is
High Speed

f) DC motor

50 rpm 12 volt dc

along with gear box for enhanching torque

Fig :- DC Motor

g) Wheel

Diameter-70mm

Thickness-4 mm

Fig :- Wheel

h) Actual Design of Construction

Fig :- Actual Design Of Construction.

ADVANTAGES

- It will alter itself per specific vary of pipe diameter
- Robot is simplest ,most energy economical and have the simplest potential for long vary
- This will move on pipeline with sensing element
- It may also sight tiny defects and flaws by scanning the surface of pipes.
- Simple in style and construction
- Low maintenance.
- Rechargeable batteries.
- Special varieties of accessories are often mounted on that.

FUTURE SCOPE

- To design the robot with track and wheel.
- To resolve type of flow and fluid employing sensors.
- To improve buckle by mounting autonomous roboti arm.
- To audit and improve flaws in a nuclear reactors pipeline.

CONCLUSION

Pipe cleaning robot is working on the mechanism of four bar mechanism which is to audit the pipe of four bar mechanism which is t audit the pipes of 9 inches to 12 inches horizontal and vertical pipes with maximum crawl of 2 km/hr and for cleaning the cutter sizes can varies as per requirement with Wi-Fi connectivity video monitoring of interior of pipes for inspection and cutting can be seen IOS and android software , also brushing action also allow on cutter mechanism for corrosion and oxide flames inside of pipes due to this inspection and cleaning of pipes done together

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