Turkish Journal of Computer and Mathematics Education Vol.12 No.13(2021), 2264-2269

Research Article

Investigation of Pipe Inspection Robot by using Commercial Package

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Article History: Received: 11 January 2021; Revised: 12 February 2021; Accepted: 27 March 2021; Published online: 4 June 2021

Abstract: There will be a great commercial and industrial advantage to the robot device competent of operating in lively pipelines. While a pipe is carrying fluid and pipe inspection is vital in order to recognize flaw owing to wear and corrosion. As Pipelines are usually obscured subversive, therefore they are getting in occurrence with soil and susceptible to deterioration. The wall thickness decreases efficiently due to oxidizing in wall of the steel pipe. The pipes and drains of many plants have recently become old and many robots have been built in the past to inspect these pipes. In several fields of manufacturing, inspection robots are used. The major application of the pipe inspection method is scrutinize the indoor of the channels and pipes, detecting and resolve troubles from the interior of channels or pipes.

Keywords: Industrial, pipe flaw, economical cost

1. Introduction

One of today's fastest rising engineering fields is robotics. Robots are intended to eliminate the individual from hazardous work. It is also function in unapproachable milieu. The utilization of robotics is more widespread now and is no longer employ solely by the weighty manufacturing industry. Pipe examination may be important to the improvement of safety and competence in industrial plants. Such precise tasks like testing repair, washing are costly, so utilization of robots materialize to be most desirable solutions. Pipelines, which are devices for the transport of fuels, gases and other liquids such as chemicals, have long been used in a variety of countries as major utilities. If the fault in the pipe is cause by natural calamity and rust then it's intricate to figure out the flaws and the position of the flaws. There is also a significant amount of damage. Therefore, scheduled inspections must be carried out. If we want to manually do this inspection, then it is vital to excavate up the pipes which are hidden under the soil for an extensive amount of efforts and time. If the robot can inspect the inside of the tubes, it will be possible to conduct simple and precise inspections at a low cost.

2. Academic Review

Pipes made of steel, ceramic, concrete, and plastic worn for gas as well as water shipping become old in many plants. Because of degradation and corrosion, these tubes become cracked. Pipe inspection is therefore significant for humanizing safety as well as productivity in industrial plants. It includes scrutiny; repair, cleaning which are costly, so one of the most desirable choices appears to be the application of the robots. Pipelines, which are devices for the transport of fuels and gases have long been used in a variety of countries as major utilities. Many robots were built in the past to inspect these pipes, nevertheless had a weighty power contribution and a signal cable. The desire to travel is definitely the hardest challenge to pact with. It offers a study of different pipe inspection strategies, taking into account the advantages and disadvantages of current systems.

It has a turning test, and a vinyl chloride pipe test has been tried, and another channel pipe assessment robot framework has been created. They assembled a channel pipe assessment robo that can be worked inside the line through remote radio correspondence and can likewise transfer continuous picture data from within the line. A 19 m cleaned fired line with a distance across of 25 cm and 30 cm was utilized. Utilizing recently tried robots, this trial examined transmission misfortune in fired lines and furthermore investigated transmission misfortune in soil and space. Also, the social condition between the measurement of a line and the potential radio transmission distance in a ceramic line was explained. A channel pipe assessment robot outfitted with a useful remote radio correspondence framework was made from those discoveries. The robot was assembled dependent on the 'Mogurinko250' channel pipe investigation robot.

In a spotless vinyl chloride pipe with a distance across of 25cm, this investigation utilized a resting robot with a turning test. In free turn, and when the test contacted absconds with statures and widths of 5 mm, 3 mm and 1 mm, the voltage shift was estimated. For this situation, the 5mm, 3mm and 1mm deformities in the vinyl line could be dictated by a test. At the point when the deformity was influenced by a test, the voltage showed an enormous decline[6]

The adaptability to the inner diameters of the pipes is a very significant design objective of robotic systems. So, for inspecting pipelines, a new concept is suggested. The key benefit is that the basic mechanism may be used in the event of a variation in pipe diameter. We have built a robot for pipe inspection that can be used on 140-180mm pipelines. The kinematics of this robot's mechanism and actuator sizing have been investigated. To test the feasibility of this robot for in-house pipeline inspection, a real prototype was created. The problem is solved in the proposed mechanism by a spring actuation and the mechanism's versatility is increased. The robot's propulsion was successfully carried out using only three motors, a drastic simplification of existing efforts. A four bar mechanism is the mechanism used.

Three revolute joints and one prismatic joint are composed. [2]An in pipe scrutiny machine has been intended to pact with several kinds of pipes of different diameters (140 mm-200 mm), such as plastic pipes or metallic pipes that are just 750 mm apart horizontally or vertically. The body, foreleg system, rear leg system and springs are part of the pipe inspection robot. Three legs of each leg system are arranged to travel within different pipe diameters at an angle of 120 degrees to each other. It can travel freely inside pipes of various diameters with the use of spring. A CCD camera is mounted to conduct visual pipe inspection on the front part of the foreleg system. [3]

3. Construction of Machines

The materials used are light and rigid for this unit. For different parts of the robot, various materials may be used. The resources used should be lightweight and solid for the optimal use of electricity. Wood is wearable, if used for this unit even it is light. Metals, Since most of plastics may not be as solid as metals, metals are the best materials for such robots. The material should be ductile, less fragile, malleable, and highly sensitive to magnetism. Aluminum is the material chosen for the links and the standard rod between the metals, which is made hollow for weight reduction. However, other materials are chosen for the motor. The engine materials selected should be highly susceptible to magnetism and conduct electricity well. The products include copper and so on. But aluminum is chosen as the materials for the linkages and central body due to its much-needed properties. Aluminum is lightweight and robust; in a variety of applications, it can be used.

A. Main Component

A body, front leg framework, back leg framework and springs front leg framework and back leg framework comprising of an in-pipe assessment robot are symmetric. A DC engine is made out of each leg instrument. The DC engine is the essential engine that is utilized to control the robot. Three legs of every leg framework are orchestrated to go inside various line measurements at a point of 120 degrees to one another, given below. A CCD camera is introduced on forward portion of the front leg framework and remote control framework is mounted on a robot body. For review, robot is placed into pipe. At the point when electric stockpile begins, robot covers distance equivalent to edge of robot haggle it get stop. The ultrasonic sensor identifies the breaks and harms in the line and it gives remote information to PC. In this manner it get size and area of break from beginning stage in plain view screen of PC. During break location measure, CCD camera does visual review of line and it gives a picture of robot way in each break identification period. The vital piece of the manufacture of the line assessment robot incorporates penetrating and shearing tasks. The boring is accomplished for making openings for addition of the bolts. The linkages are associated with each other utilizing bolts. In a solitary 4 bar linkage every one of the four connections are connected by a bolt. Three linkages are joined to the focal body at 120 degrees utilizing bolted. Consequently, penetrating activity is needed for working with openings for the addition of these bolts. The bolt width utilized here is 5mm Thus, The punctured opening should be 5 mm or more prominent. In any case, for the infusion of pencil batteries, the penetrated opening for the focal body at its center will be 15 mm. From an aluminum board, the genuine linkages are cut. The aluminum sheet is around 3 mm thick.The single aluminum is cut into rectangular sheets with the length and width required. Utilizing a shearing machine, this is done. Welding frequently must be performed to interface a bolt to the joints that convey the ties. The binding instrument utilized was the brazing strategy.

B. Component of PI Robot:

1) Central Frame: The focal body is the robot's construction. It upholds any remaining segments and at the center of the body conveys batteries. At 120 degrees, the joints are brazed on the focal system. The focal body is punctured and its finishes strung. For introducing pencil batteries inside and shutting with remotely strung covers. Toward one side of the casing, the remote camera is fixed.

2) Compression Spring: A versatile material utilized for putting away mechanical energy is a spring. The spring is made of built up steel utilized here. The pressure spring is utilized principally to apply pressure. As follows:

With the guide of an extendable spring, the power that the scaled down robot system practices on the line dividers is made. On account of line measurements, the helical spring orchestrated on the focal pivot guarantees the framework is repositioned.

3) Translational Element: In the event of pipe diameter variance, the translational portion is the movable component of the robot that slides along the central body for repositioning. At the center for translating along the central body, this element is drilled. This will limit the relations to those extreme angles above which it can not be translated. 15 degrees and 60 degrees are found to be the extreme angles. At 120 degrees, the joints are brazed on the translational portion for the links to be fixed onto it.

4) Links: In a machine that moves comparative with another safe body, each safe body is alluded to as the Kinematic association or part. A safe body that, while communicating power, doesn't go through misshaping. The principle part of the robot that interprets movement is ties. To frame a linkage, ties are associated. A 4 bar instrument that has 3 revolute sets and 1 single kaleidoscopic pair as shown is the component required here. The receptor, switch, and 9v battery for the camera are kept by Connections. It additionally helps the actuator.

5) Actuators: Actuators are the drive for the robot since the aluminum material chose for research is relatively lower in weight. Thus, to move inside the tubing, the engine ought to have 2 kg of force. To get the robot moving, it utilized 3 engines with 1 kg of force. The engine supply is 6V, which is from the focal body. The three motors are in activity. They are helped at 120 degrees and on the ties by a tag.

6) Batteries: Batteries incorporate an engine supply and remote camera supply. The motor and radio recurrence are provided with 6 V from the focal body and the remote camera is provided with a 9 V battery. What's more, 3V transmitter batteries, which have two flip switches. One is for forward and turn around force of the motor and the other for gleaming Led lights.

7) Wireless Camera- Remote correspondence is the transmission of information without the utilization of electrical conveyors or 'wires' over a distance. The distances concerned might be short

or long. Remote cameras don't have a channel. There are channels for the collector to tune in and afterward you get the picture. The remote camera picture is sent by the beneficiary's transmitter that gathers this sign and yields it by means of a TV tuner card to your TV or PC. Toward one side of the edge, the camera is fixed and the robot is worked for investigation inside a line that can be controlled on a work area. The camera sends the sign to the recipient that gets the sign and is associated with the showcase to see the inside signal.

4. Configuration of Components-

1) Helical Spring- For Helical Spring configuration**,** Outside diameter consider as – 24 mm, Inward diameter consider as 20 mm; with respect to this Pitch taken as 5 mm and Length as 60 mm. Stainless steel material is taken into consideration.

2) Translational Element- For the translational element, aluminum material is used with External diameter consider as 25 mm; Internal diameter consider as 20 mm; length of the element – 40 mm.

3) Central Element- While choosing Central element, aluminum material is used with External diameter consider as 20 mm; Internal diameter consider as 15 mm; length of the element is 220 mm.

4) Distance between the Extreme Drilled Holes- for this purpose also aluminum material is used 1st link – 24 mm; 2^{nd} link – 56 mm; 3^{rd} link 84mm has been rectified. It is having a thickness of 3 mm; fillet 5 mm; width as 10 mm; Drilled holes as 6 mm.

A. Wireless Communication

1) Radio Frequency- Radio recurrence (RF) radiation is a subset of electromagnetic radiation with a recurrence of 3 KHz to 300 GHz and a frequency of 100 km to 1 mm. The radio range contains this electromagnetic radiation range which alludes to the recurrence of exchanging flow electrical signs used to produce and track radio waves.

2) Antenna- A transducer allotted to communicate or get electromagnetic waves is a recieving wire (or ethereal). Receiving wires, at the end of the day, make an interpretation of electromagnetic waves into electric flows and the other way around.

3) Transmitter- The camera sees a picture, sends it to the transmitter, and conveys the message to the air through the transmitter. The recipient gets the sign and communicates it to an optical video recorder/TV/Monitor.

4) Receiver- The collector assembles this sign after the remote camera and transmitters have given the remote video sign and courses it to the screen, TV, VCR or elective account.

B. Machining Process

One of the most relevant methods of material removal is traditional machining. Turning, drilling and milling are known as the three main machining methods.

1) Radial Arm Drill Machine- Openings as wide as four inches (101.6 mm) in breadth can be bored by the biggest spiral arm drill presses. Yet, just openings of 5 mm and 6 mm were required for this undertaking. For the vital estimations, the boring was performed on the aluminum sheets and afterward the completed part was recorded and turned around utilizing a bigger bore for a decent completion.

2) Boring Operation- For more modest tasks, the exhausting cycle might be done on a machine, however an extraordinary exhausting plant (work piece turn around an upward hub) or an even exhausting machine (revolution around the level pivot) are utilized for bigger yield parts. By turning the head, a tightened opening can likewise be made.

3) Gas Welding- Oxyfuel welding, otherwise called oxyacetylene welding, is the most well-known strategy for gas welding. Just as fix work, it is still regularly utilized for welding lines and cylinders. Oxy fuel gear is adaptable and loans itself not exclusively to certain kinds of iron or steel welding, yet additionally to brazing, braze-welding, metal warming (for twisting and framing), just as oxyfuel cutting.. The gear is generally cheap and speedy, ordinarily utilizing acetylene burning in oxygen to accomplish a temperature of around 3100 °C for the welding fire.

4) Brazing- By the utilization of warmth and a filler metal, brazing is the joining of metals whose softening temperature is over 840 ° F (450 ° C) however underneath the liquefying point of the joining metals. Brazing isn't eliminating the foundation metals. Subsequently, brazing temperatures are ordinarily more modest than the base metal liquefying focuses.

5) Surface Finishing- Polishing and buffing are finishing techniques using an abrasive and a work wheel to smooth the surface of a work piece. Although buffing is less rough, polishing is a more vigorous operation, leading to a cleaner, lighter finish. Surface Grinding Process is used on flat surfaces to achieve a smooth finish.

C, Design Requirement

A variety of basic design criteria that must be taken into consideration when the robot is built are:

- Continuous diameter change modification in pipe steering potential to move in pipes by elbows and roots
- Sufficient traction force support in order to withstand its weight
- Capability to lift within pipes vertically
- Acknowledgement of the orientation and direction of motion
- Capability of tolerating the presence of slip and grit when in motion
- Robust architecture that makes for more growth and modifications.

5. Design calculations of PI robot Mechanism –

A four bar framework comprising of three revolute joints comprising of three revolute joins and one kaleidoscopic as portrayed is the instrument required here. In this manner, as far as relocation, the movement of all revolute joints can be characterized as shown in figure1.

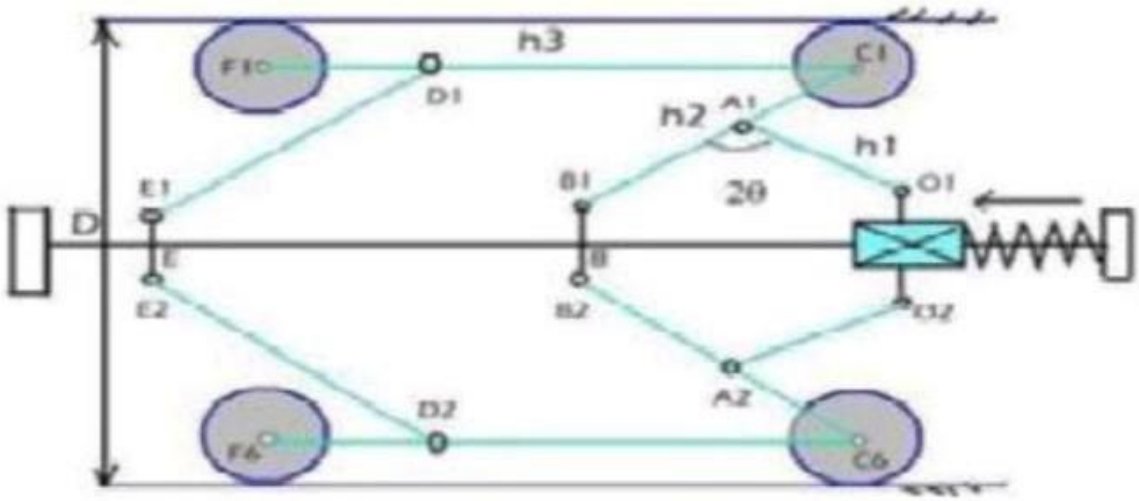

Fig.1 Line Representation of the Inspection Robot Mechanism.

Diameter of the pipe in mm (D) = 2r + 2d + 2h2 cosθ

Here the length of the links in mm represented by h1,h2,h3 consider as 24 mm, 56 mm and 84mm respectively.

Where, Detachment between EE is d and radius of the wheel is r. θ = 45° for unchanging Dia. Now, D = 2×20 + 2×22.5 + 2×56×cos45°=163.19 mm

Fcx= Reaction force; Fcz= Traction force; Fbz= Spring force

Fwt= 2× μ × Ftraction

$F_{traction}$= 30/2×0.8 = 18.75 N where μ = 0.8

Mass of total assembly = 3 kg

Speed of motor = N = 60 rpm

Angular velocity = ω = 2πN/ 60 = 6.28 rad/sec

Radius of wheel = r = 20 mm

Linear velocity = v = rω = 0.020 × 6.28 = 0.1256m/sec

Power of motor = 30×0.13=3.768 watt

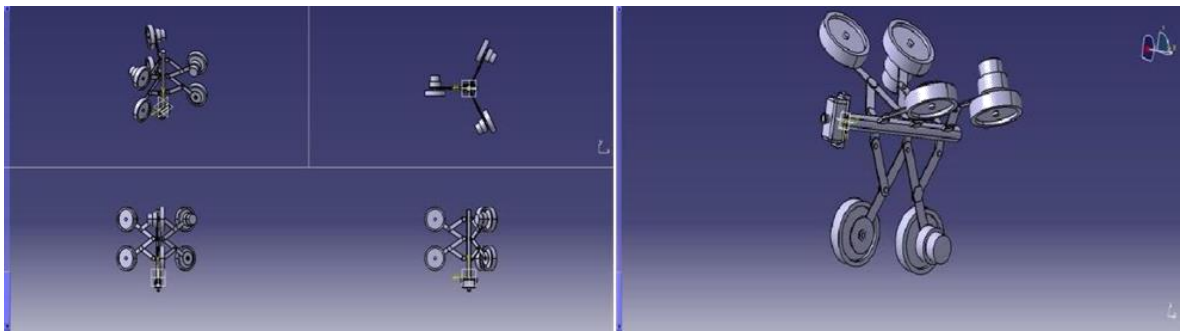

Fig.2 Three-Dimensional representation of Pipe Inspection Robot

6. Conclusion

The overall motto is to reduce the human efforts, time and risk involve in it to considerable level by using wireless camera, transmitter and receiver. The versatility to the internal widths of the lines is a huge plan objective of mechanical frameworks. The new concept proposed for the inspection of pipelines is then suggested. The key benefit is that the basic mechanism will be used in the event of a variation in pipe diameter. The built robot for pipe inspection can be used for 140-180 mm pipelines. The issue is defeated in the proposed component by a spring activation and the system's steadiness is improved. The robot's propulsion was successfully carried out using only three engines, a drastic simplification of current efforts. The robot is built so that horizontal and

vertical pipes can be traversed. It is possible to research the strength and scale of the robot part to operate over long distances in the future to improve.

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