Design and Development of Six Wheeled Robot for Pipe Inspection

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Abstract- Pipelines or bulk transport lines are the applications concerned within the oil and gas business. The pipeline concerned in such industries comes from the development of technology and materials. Therefore, inspections and maintenance ought to be done frequently to confirm that the pipe is often employed in the simplest operating condition. Pipe testing ought to be done before and when repaired. However it's troublesome to examine currently, a spread of the latest technologies is employed for the needs of special testing for Non-Destructive Testing. As a result, the focus of this article is on the creation of a pipeline check mechanism.. Some applications that permits the look of the mechanism to permit the machine to maneuver around the pipe.

Keywords- In-Pipe scrutiny, Chuck Jaw Mechanism, Pipeline Exploration mechanism, Laws of AI, etc.

1. Introduction

The robot is adaptable in various companies and other fields. Robots are made for purpose to reduce human efforts. It can work in that area where human cannot. Using robots as an assist has become common practice now and is not limited to more productive companies [1]. Using robotic technology has a lot of advantages, including lower ongoing costs, time savings, and increased worker safety. The usage of robots provides a variety of job opportunities, particularly in the sector of production, such as staining and painting. In fact, robots are built to reduce human interaction in a subservient and dangerous world [2-3]. Robots are sometimes used to identify inactive labour regions where humans are unable to reach.

Robots are sometimes used to identify inactive work locations that are inaccessible to humans. It is advisable to utilize a robot for pipeline testing in order to examine the rust level, detect useable portions, mud samples, and the scale pattern in the internal part [4-5-6-7].Pipe wear, cracks, mechanical damage, and corrosion can lead to many problems. Mobile robots for testing and storage are the future of the industrial market. The ability to reach areas beyond human limitations due to size limitations, temperature, and safety precautions are among the significant benefits of mobile robots [8-9].

The new technology allows a test robot(BIKE) to perform its functions. It is also used in some cases to find inaccessible workplaces that are difficult to inspect by people.Robots are required for inspection of such pipelines, in particular to assess pipe corrosion levels, , collect sludge and scale samples, particularly on the inner surface of pipes [9-12]

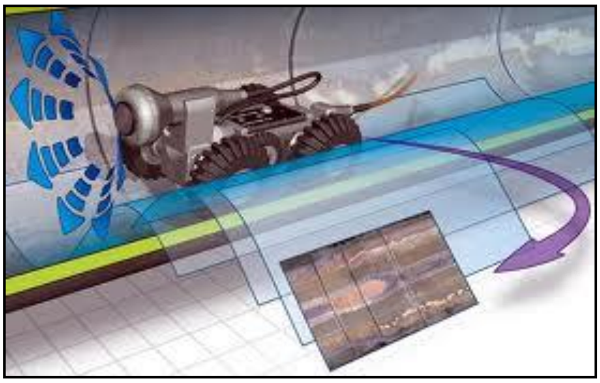

Fig1. Pipe inspection robot

Background of PIR

It's advisable to employ a mechanism specifically for pipeline testing functions, such as seeing the rust level, detecting useable components, mud samples, and also the structure of the size within the interior, etc. The mobile mechanism is often controlled as Autonomous, Semi-Autonomous, or is often Manually controlled with a particular controller. This leads to a bearing system that differs from all alternative operational systems [6]. Pipeline testing is a straightforward way to improve the protection and potency of commercial plants. Specialized duties such as testing, repairing, and cleaning are pricey, thus robots appear to be one of the most cost-effective solutions. Drinkable water, liquid waste, petroleum, and gas are all transported via pipes [7].

Mobile robot for testing can be one of the solution to withstand long run in economic market. The BIKE inspection system with modern technology that acts like a checking mechanism [8 - 12].The BIKE mechanism may be a mechanism with a magnetic wheel that works well for exploring station locations and for a variety of functions within the oil and gas business, like artificial satellites or pipelines. As there are many issues that arise within the pipe in businesses, homes, and electrical companies, such as corrosion, cracking, dent marks, metal losses, and so on. As a consequence, development of the "PIPE scrutiny ROBOT" to inspect the pipe can be one solution.

Wheeled robots are the best, most energy-efficient, and have the most potential for extended variations. By adding springs to the wheels, robots can adjust to in-pipe unevenness, travel vertically in pipes, and stay stable..These robots also have the benefit of being easier to downsize. Such robots can also be shrunk more easily. The main advantage of their design and implementation is that they combine self-regulation with self-sufficiency as well as minimal weight and size. Robotic applications for pipeline maintenance are currently regarded as one of the most appealing options available. Figure 1.1 depicts the pipe inspection system

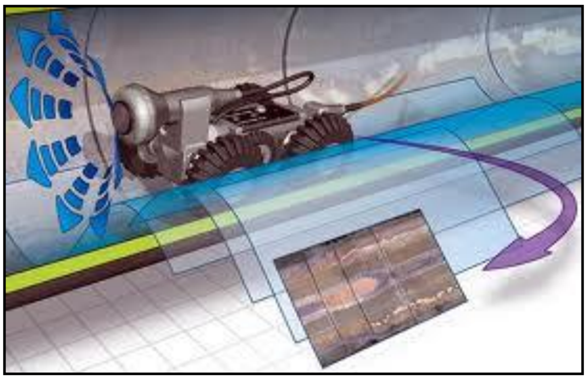

Fig1.1:- Pipe inspection robot

2. Literature survey

Jong -Hoon Kim et.al have developed an automatic drive robot, called FAMPER for testing 150mm pipes. The robot is made up of four wall-mounted caterpillars that are powered by two DC motors. Each caterpillar's pace is regulated independently, allowing for direct control of 45-degree elbows, 90-degree elbows, T-branches, and Y-branches. The novelty of the innovation is that it demonstrates the ability to employ the fourth worm configuration on a variety of complex pipe networks. With various piping structures, the robotic system is constructed and tested successfully [1].

The robot, according to tul Gargade1et.al, featured a front-leg system, a hind-leg system, and a body. To function inside a pipe of varied widths, the front and rear leg systems have been created for utilizing every corner of work area. To work with pipes of 125 mm to 200mm, the springs are linked to each leg and body of the robot.[2]

Palwinder Kaur1et.al have developed a new method of performing rescue operations without the need for human participation, as well as inspecting pipes for leaks. This idea makes use of a wheelbarrow to access inside the pipe. The legs are round and 120 degrees apart. The robot's legs are normally approximately the size of a pipe.This architectural concept allows the pipe width and force applied to the wall well [3].

In a pipeline trials, Nur fiqah Binti et.al have configured the robots for various applications. The goals was to examine various robotic configuration in pipeline testing, diagnose difficulties, and promote flexibility in the usage of used robots. Improvements in a number of robotic models, such as the Parallelogram Wheel Leg, were noted at the conclusion of this review paper[4].

The robot was built by Ankit Nayak and S. K. Pradhan to reduce human intervention in a tough and dangerous work environment . A pipe testing is included in this category because it contains harmful chemicals and liquids. They used a screw driver for pressing the test robot within the wheeled pipe against the wall. It can run on horizontal pipes that are straight and can easily pass through the elbow. The rotor, stator, and control unit are the three components of this model. Three wheels make up the Rotor module[5]

Problem Statement

Several industries have recently used pipelines of varying diameters for a variety of applications, including chemical transportation, hazardous emissions, and water. As a result, there is a possibility of corrosion, cracks, decay, metal loss, and outflow. These problems are unavoidable. Water flow efficiency might be reduced by blockages within the pipe. The traditional method is time-consuming, difficult, and expensive. These challenges can be seen not only in trade, but also in housing and industry. To combat this, the pipeline need to be examined. From the literature survey, it has been pointed out that many issues occur within the pipe in businesses, homes, power plants, and other locations, such as corrosion, cracking, dent marks, metal losses, and so on, we proposed the "PIPE INSPECTION ROBOT" to inspect the pipe.

4. Working Principle of PIR

Inspection Robot is primarily designed for circular drilled pipes, with the ability to travel within any bore diameter pipe from 6 to 7 inches (203mm to 254mm). PIR implementation begins with its placement in the pipeline. Appropriate ways for gaining the capacity to travel within curved path and taped pipes are presented. The PIR can see inside dark circles that the human eye cannot. A camera is installed to capture image on PIR. sThe output is delivered to an external screen, which displays a high-quality image.

First up all the robot is inserted in pipe with precise fit.. Then, for the continuous functioning of the robot and the camera, DC supply is provided. The robot's function can simply manage the forward and backward movement with one button. With the help of another two buttons, the camera can be rotate and images are captured within the pipe.

The front three arms are shoved into a pipe by hand, and the back three arms are placed by pushing the PIR. The entire setup was pulled by wheel drive engines. The PIR is about 175 cm long and to move it freely within the curved pipes. With the turning on of switch, wheel will move. The sketch below depicts the working of PIR.

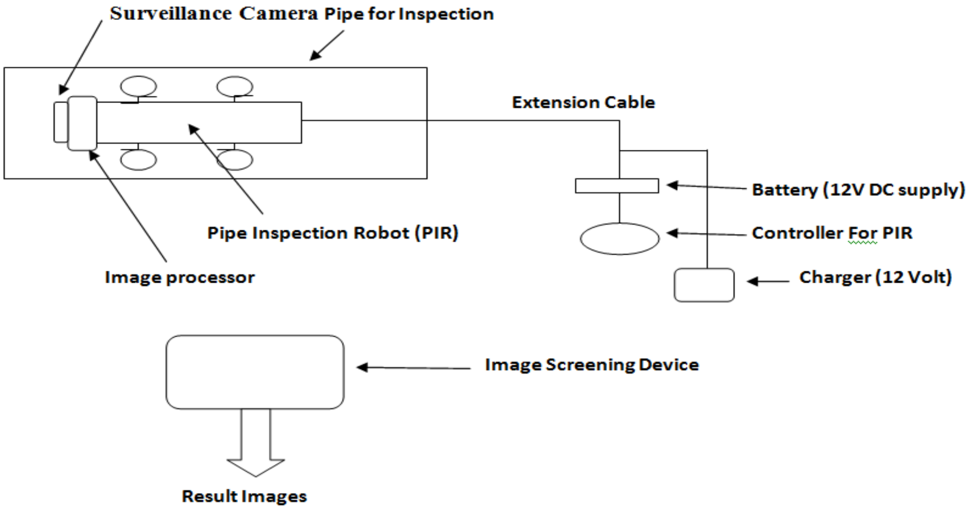

Fig 3. Block diagram showing working principal of pipe inspection robot

5. Components Specification

- **Battery operated Motor**

Single/twin shaft, 60 RPM Battery-operated plastic gear motor Motors deliver smart force and rate at low voltages. A small wheel with similar wheels gives your app or automaton a unique look. It's perfect for in-circuit implantation because holes are drilled into the body with a

lightweight.

Fig 4 :- Bo Motor

- **Camera**

Fig 5: Camera head.

• 1/4 SONY CCD; 520TVL solution; 0.01LUX; automatic black / white color / change color

• Zoom: 10 times (1X optical, 1X electronic)

• Size: width: 40mm, height: 70 mm;

- **Distance Meter**

Fig 6**: Distance Meter**

Enhanced digital counter, with 5 counters. These are in the main design for affordable hand-woven machines. Our Digital Counters are put in to reset the left/right lever & each extension aspect shaft drive.. Some details are as follows:

• Total size (mm): L-166, W-66, H-70

• Entrance holes: 4 hole, 5mm X-98.5 mm, Y-16.5 mm.

6. Design process

The machine concerned here could be a four-bar machine consisting of 3 rotating members and one prismatic member as shown.

In this study, the kind of caterpillar is chosen because of the tubing within the pipe. The energy employed by this sort of automaton within the inner walls of the pipe is generated with the assistance of a growing spring. A volute spring mounted on a central axis guarantees a reconstruction of the automaton, forward there's a distinction in pipe diameter. 3 DC motors are accustomed steer the rear wheels.

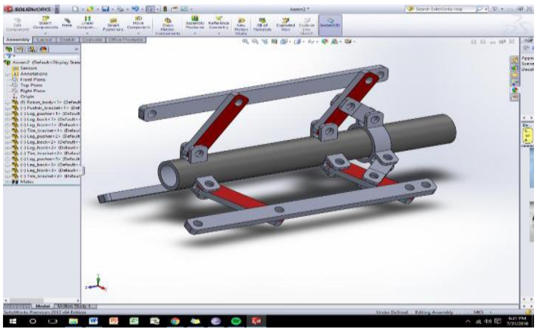

Fig.8.Conceptual design (Initial phase)

The diagram shows the primary part of the computer-assisted Solid Works software package project. The planning does not reproduce the entire concept, but it does include a few options for displaying the automaton's body. For example, behind the automation spring loading should be installed, and a bracket to hold the engine and attach the wheel is necessary.

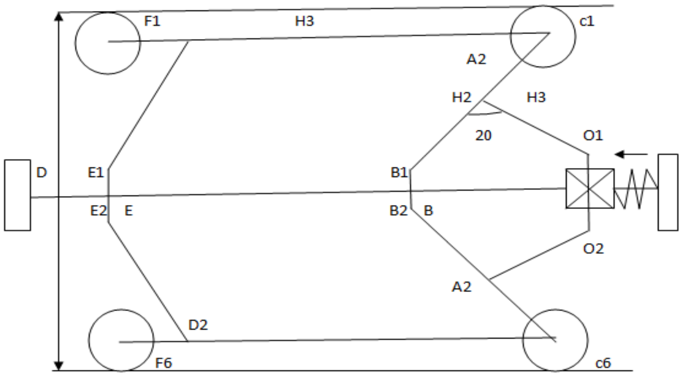

Fig 9: Mechanism of PIR

- H = (2r) + second +(2h 2cosθ)
- Where,
- h1 = 30 MM
- h2 = 85 MM
- h3 = 105MM
- Where h1 = OA

h2 = BC = D
h3 = CF

- H = (2×36)+(2×28)+(2×85×cos45)
- H = 248.20 MM
- Where D - Diameter of the pipe in MM

d - Distance between EE' in MM

- h1, h2, and h3 are the length of the links in MM.
- r = Wheel radius
- H=Height of automaton outside the pipe.
- For uniform Diameter,
- Assume D = (2r)+(2d)+(2h2cosθ)
- D = (2×36)+(2×28)+(2×85×cos50)
- D = 237.27MM

7. Result

Since the Pipe Inspection Robot was primarily designed for usually coated hours. It was flexibility to travel between any diameters from eight to 205 metric linear units (4 inches). Applicable way was provided to achieve the flexibility to maneuver inside bends and taped pipes. PIR has the flexibility to vision dark circles wherever the human eye cannot see. Supplementary camera are attached to the PIR head where a high-quality image can be seen..

Once the automaton is inserted into the pipe, the continuous functioning of the automaton and camera with supply of 12V DC. The automaton's performance will be managed with the help of three-button automaton management, which will simply manage forward and reverse with one button. The rotation and tilting of head of camera head was operated by two buttons.

The implementation of the PIR begins with its installation within the pipeline. The 3 front arms were ironed manually into a tube and also the 3 hind arms, ironed against the PIR. The primary six-wheel-drive engines pulled out an entire set. The PIR is 175 cm. long and it freely moved inside the pipes. A 2d degree free connection is provided within the center so that it will rotate simply because the button opens and also the wave flows between the wires, the wheels begin to maneuver and force the PIR to maneuver forward

PIR is capable of moving from 203 and 254 mm in width. To propel the arms in the usual fashion, the spring is compressed and stretched as per requirement. We've had to keep a firm grip on the spring force in order for it to close tightly

When delivering a small amount of shock, the key goal is to have every arm extended during turning and bending. The outside arm should be large, and the short arm should be ironed.

8. Conclusion

I. Robots play a very important role in maintaining and repairing a network of pipes. a number of them square measure designed to discover sure fixed-pipe pipeline functions, whereas others could also be associated with the operation of a varied pipeline structure.
II. A standard robotic system pipeline was developed. a very important style goal of those robotic systems is the flexibility of the interior diameter of the pipes. The provided example permits the employment of a little camera to envision internal testing of the pipe or alternative instrumentality necessary to discover failures within the inner part of the pipe (laser measuring systems, sensors, etc.).
III. The main advantage is that it is often used if there's a distinction in pipe diameter with an easy machine. Tubing was created that will be utilized in a 203mm-254mm pipe. the particular example is intended to check the power of robots to check indoor water pipes.
IV. The types of check tasks square measure differently. the standard style was taken into account to be simply custom-made to new areas with the least changes.
V. The presence of barriers in the pipeline may be a sensitive issue, the matter was resolved by spring effort and inflated mechanical flexibility. The golem was intended to cross horizontal and vertical pipes.

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