# Pipe Inspection Robot

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***Abstract-*** *A pipe inspection robot is device that is inserted into pipes to check for obstruction or damage. These robot are traditionally manufactured offshour, are extreamly expansive , and are often not adequately supported in the event or malfunction. This had resulted in accosiated enviromental services limited a newzealand utilize of this equipment, facing significant period of down time as they wait for their robot to be the repaired recently , they were information that several robots were no longer supported.*

*This project was conceived to redesign the electronics control system one of these PIR utilizing the existing mechanical platform requirement for the robot were that it must operate reliably in confined dark and wet enviroments and provide a human wears with a digital video feed of the internal status of the pipes. There robot should as much as possible incorporate off the shaft component ,cheap and potentially onsite repair. This project detail the redesign and contruction of such robot. It employees there electronic boards integrated with mechanical components and provides video feed back wia custom graphical interface although at the prototype state the electronic has been successful with cost of less than a length of the original robot purchase prize.*

***Keywords***- robot, Pipe defects, Electronics control systems, Digital video..

## I. INTRODUCTION

Pipeline systems deteriorate progressively over time. Corrosion accelerates progressively and long term deterioration increases the probability of failure (fatigue cracking). Limiting regular inspecting activities to the "scrap" part of the pipelines only, results ultimately into a pipeline system with questionable integrity. The confidence level in integrity will drop below acceptance levels. Inspection of presently uninspected sections of the pipeline system becomes a must. This project provides information on the "robotic inspection technology".

Pipelines are proven to be the safest way to transport and distribute Gases and Liquids. Regular inspection is required to maintain that reputation. The larger part of the pipelines system is accessible by In-Line Inspection Tools but this access is limited to the section in between the launching and receiving traps only. Unfortunately, corrosion does not have this limitation. The industry looks for means of inspecting these in-accessible pressure holding piping systems, preferably, without interrupting the operations. It is a fact that sufficiently reliable and accurate inspection results can only be obtained by direct pipe wall contact/access. If that is not feasible from the outside, we have to go inside. Since modifying pipeline systems for In-Line Inspection is mainly not practical, PIPE INSPECTION ROBOT pursues development of ROBOTIC inspection services for presently in-accessible pipeline systems.

Robotics is one of the fastest growing engineering fields of today. Robots are designed to remove the human factor from labor intensive or dangerous work and also to act in inaccessible environment. The use of robots is more common today than ever before and it is no longer exclusively used by the heavy production industries. The inspection of pipes may be relevant for improving security and efficiency in industrial plants. These specific operations as inspection, maintenance, cleaning etc. are expensive, thus the application of the robots appears to be one of the most attractive solutions. Pipelines which are tools for transporting oils, gases and other fluids such as chemicals, have been employed as major utilities in a number of countries for long time. Recently, many troubles occur in pipelines, and most of them are caused by aging, corrosion, cracks, and mechanical damages From the third parties. So, continuous activities for inspection, maintenance and repair are strongly demanded. The robots with a flexible (adaptable) structure may boast adaptability to the environment, especially to the pipe diameter, with enhanced dexterity, maneuverability, capability to operate under hostile conditions. The wheeled robots are the simplest, most energy efficient, and have the best potential for long range. Loading the wheels with springs, robots also offer some advantages in maneuverability with the ability to adapt to in-pipe unevenness, move vertically in pipes, and stay stable without slipping in pipes. These types of robots also have the advantage of easier miniaturization. The key problem in their design and implementation consists in combining the capacity of self-moving with that of self- sustaining and the property of low weight and dimension. A very important design objective is represented

by the adaptability of the in-pipe robots to the inner diameters of the pipes.

## II. LITERATURE REVIEW

***A)***. Amr Bekhit

The robot capable of operating in active pipelines would be of great commercial and industrial benefit. This paper describes the requirements for such a robot and considers the benefits and limitations of existing systems. A new design for an inchworm robot is presented based on the Gough-Stewart parallel platform. The control system made relatively simple due to use of inchworm locomotion, while the use of the Gough-Stewart platform allows the robot to benefit from the accuracy, rigidity and speed of parallel robots and provides a flexible base. The design aims to provide minimal resistance to fluid flow by providing a low front area. An analysis of the robot's degrees of freedom, a derivation of the robot's inverse kinematics equations, and a static force analysis are presented along with a description of the robot's proposed locomotion algorithm.

***B)***.E Navin Prasad

Designed a robot for inspection of pipes in industrial plants. The inspection of pipes may be related for improving security and efficiency in industrial plants. The operations like inspection, maintenance, cleaning etc. are expensive, thus the application of the robots appears to be one of the most attractive solutions. Pipelines which are tools for transporting oils, gases and other fluids such as chemicals, have be should have high magnetic susceptibility and should be good conductor of electricity. The materials are copper, etc. But aluminium is selected as the materials for the linkages and central body because of its much-desired properties employed as major utilities in a number of countries for long time. Aluminium is light in weight and strength; it can be used in many applications. Aluminium alloys with a wide range of properties are used in engineering structures. The strength and durability of aluminium alloys vary widely because of the components of the specific alloy as well as heat treatments and manufacturing processes.

## III. WORKING OPERATION

As Pipe Inspection Robot is designed mainly for circular bore pipes, it have ability to move inside any bore diameter pipes ranging from 8 inch to 10 inch(203mm to 254mm ). Suitable mechanisms are provided so that it gains ability to move inside the bends and tapered pipes. The PIR have ability to see inside the dark pipes where no human eyes can see. This made possible by mounting the surveillance camera and LEDs on head of the PIACR. The output is send to outside screen where the digital hi-quality image can be received.

The perfect fitness between the pipe and robot is first conformed after inserting the robot in the pipe. Then the supply of DC 12Vdc current from is on for working of robot and the camera is also started. With the help robot control having three buttons, working of robot can be easily control the motions which is forward and reverse by one button and by other two buttons the motion which is swiveling and tilting of the camera head fitted in front of the robot can be control so that we can see the pictures and videos inside the pipe.

Working of PIR is starts from its insertion in pipe. The front three arms is compressed by hand and then inserted in the pipe and then back three arms is inserted by pushing the PIR. The motors driven are the first six arms mentioned here, they pull whole setup. PIR is about 175 cm in length and to move it freely inside the bend pipes, a 2 degree of freedom joining is provided at the middle so that it can turn easily. As switch is on and current is flowing through wires, wheels starts moving and forces PIR to propel forward. Using the friction between wheels and pipe, the motion of wheels become possible. PIR could have more than three arms for better judgment and perfection but it would increase the weight and cost of manufacturing and hence we need to do tradeoff between money involvement and perfection. PIR wheel motion is provided with 10 rpm, 12 V DC motors hence its speed can be maintained between -10 to 10 rpm. The power provided to motors is from single 12V dc adapter hence load on each motor will be minimum that expected.

As we mentioned earlier that PIR will be able to move inside any diameter ranging between 203mm to 254mm, we had to provide auto adjusting mechanism that can expand and contact as PIR moves inside the pipe. Spring of suitable stiffness is mounted on base rod, as seen in figure, so that as arms gets contracted due to load of compression against pipe, spring get compressed and tend to expand outward trying to push arms back to their normal position but as pipe restrict them, they cannot move. We took good care of stiffness of spring such that it can move against the pipe and do not put too high pressure of tires which can jam it and restrict the motion. Even if the pipe interior is smooth, using pressure between compressed tire and pipe, PIR can move easily. This is another application of spring.

The main idea behind providing small shock-ups is not meant to absorb shocks but to make good individual expansion of arms in case of bends and turns.

When a vehicle turns, two vehicles cannot have same angular velocity. Hence the outer arm must expand and shorter arm must compress. But as if we have used simple links then this wouldn't be possible. The mini suspension arms (previously mentioned shock-ups) provide individual expansion provision to arms and hence all arms are sticked to the pipe while turning. If we were not used the mini suspension arms then one of the which might not be able to make constant contact with pipe interior and whole setup would be unstable, might collapse under gravity.

The robot is run inside pipe by forward and reverse motion of the wheel which has the speed of 10 rpm. This constant slow speed is to insure better inspection because of the high speed there may be possibility to miss the any defect. The camera is tilted by another button provided camera head motion on the remote control. The swiveling of camera can be achieved for 180 degree in addition two 180 degrees for tilting and thus in combination the envelope of 180 degree can be easily seen through the camera. The output image from camera is send to Computer screen which may be laptop, monitor, TV or any such device which gives the visual picture. The camera sends this picture to the output screen with help of extension cable.

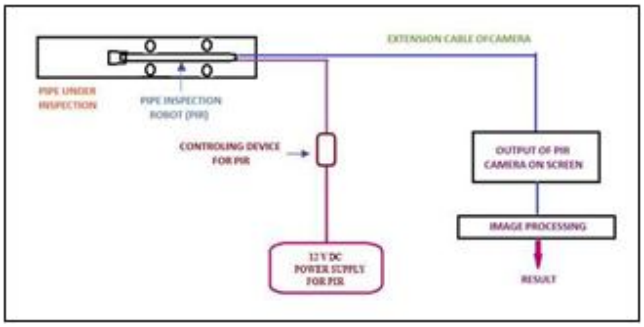


**Fig 1.1:- Block diagram showing working principal of pipe inspection robot**

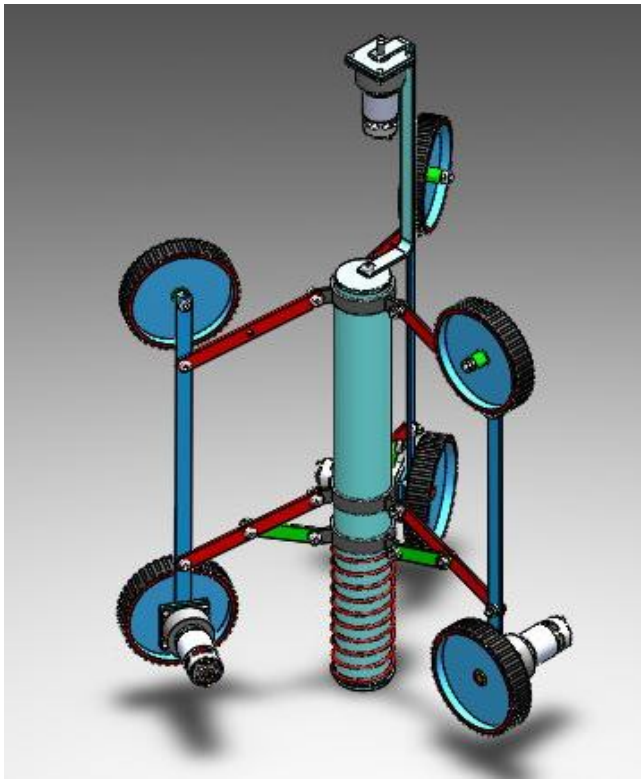

**Fig.1.2: Pipe Inspection Robot**

## VI. CONCLUSION

Robots play an important role in inside pipe-network maintenance and their repairing. Some of them were designed to realize specific tasks for pipes with constant diameters, and other may adapt the structure function of the variation of the inspected pipe.

In this project inside pipe modular robotic system are proposed. An important design goal of these robotic systems is the adaptability to the inner diameters of the pipes. The given prototype permits the usage of a mini-cam for visualization of the in-pipe inspection or other devices needed for failure detection that appear in the inner part of pipes (measuring systems with laser, sensors etc).

The major advantage is that it could be used in case of pipe diameter variation with the simple mechanism. We developed a pipe inspection robot that can be applied to 203mm- 254mmpipeline. A real prototype was developed to test the feasibility of this robot for inspectionof in-house pipelines.

The types of inspection tasks are very different. A modular design was considered for easily adapted to new environments with small changes. Presence of obstacles within the pipelines is a difficult issue. In the proposed

mechanism the problem is solved by a spring actuation and increasing the flexibility of the mechanism. The robot is designed to be able to traverse horizontal and vertical pipes. Several types of modules for pipe inspection mini robot have been presented. Many of the design goals of the Pipe inspection robot have been completely fulfilled.

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