

Experimental Design of Prototype Internal Pipeline Defects Detector (IPDD)

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Abstract

This experimental investigation pertains to design the prototype model of internal pipeline defects detector. The structural and working conditions of an underground pipeline need to be checked and rectify. The experimental design is to ensure the safety and long running of these underground pipelines. The most important issue faced in defect detection is the space constraint for accessibility. The prime focus is to overcome this constraint by designing and fabricating a robot. This robot will inspect the pipeline by navigating internally while being accessed wirelessly by a system. To achieve this navigation through the internal network pipeline, a prototype needs to be designed and fabricated.

Keywords: *Robotic Inspection, Fixture, Internal Pipeline Surfaces, Wireless Robots*

INTRODUCTION

To reduce the burden on human beings, inspection robots are used. The work which used to be carried out manually is now carried out robotically to help ease workload and reduce the injuries. They are used in

various industry fields. One such field is the pipeline field. The inspection robots will navigate through the pipeline and its channels to see if there are any problems in the pipeline interiorly and solve them if need be.

The main reason to choose underground pipeline is because they are buried underground, so in order to inspect them manually we would have to dig the ground, remove the pipeline then inspect it. This would mean that we would require heavy machinery and workforce. In order to overcome this, mobile robots can be used.

There are a lot of issues that are associated with underground pipelines. Corrosion is main the issue as the pipelines are underground that means they are surrounded by soil on all sides. This leads to reduction in wall thickness as most of the pipes are made up of steel and when the wall of pipeline comes in contact with the soil oxidization takes place. This happens on the outer surface of the pipeline wall. Corrosion also has its effects internally where it affects the pipeline strength. The other defects that are caused to the pipeline are cracks in the pipeline, sometimes cavities are to be seen and scaling takes places. Pitting and bending are other defects that occur in the pipeline which affect the pipelines geometrically. The need to rectify these problems is necessary as pipe leakages can occur if a crack goes unnoticed in the detection and if it deteriorates it can even lead to failure.

We intend to design and fabricate an Internal Pipeline Defects Detector (IPDD) which would have the ability to move in all the sections of pipeline that is horizontally and vertically. This would help detect the wear occurred in the pipeline while the fluids are being transported through it. The device would consist of a motor for the mobility, a wifi camera for visual inspection and to power the wireless system a battery pack also.

METHODOLOGY:-

The main of this experimental design is to make a prototype model for internal pipeline defects detector. The design is done in such way that our model is flexible as it has to manoeuvre into pipes of varied sizes. These sizes vary from 4.5 inches to 8 inches. The same can be represented in figures below.

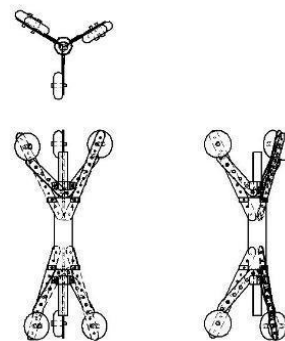


Figure: a

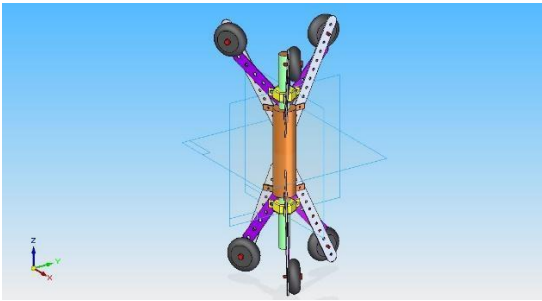


Figure: b

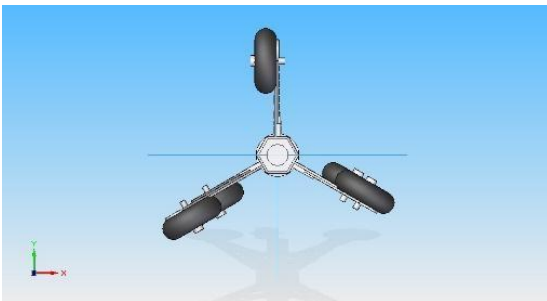


Figure: c

Fig a, b and c represents the complete structure of the internal pipeline defects detector model.

Once the design is done, we move onto fabrication. For fabrication to be started the components need to be gathered, once we have got them we can do the fabrication of each part with the dimensions deciphered from the designs. Simultaneously we can carry out the sub-assembly of the parts to avoid glitches in the fabrication. Once we are completed with fabrication we can move onto to the assembly of all the parts.

The assembly once done, we move onto the last step that is testing. The main testing here is of the assembled parts functioning properly. As electronic parts also play an important part here, we have to check the reception of the wifi camera too. Since it also works in night, we have to check the functionality of the wifi camera in the night vision mode also. Once we are done with all this, we are ready for inspection.

The components that will be used in our model are a wifi camera, Arduino nano, H bridge module LM298, Bluetooth module HC 06, 18650 Li-ion Battery, Battery Holder, Bread Board, Node MCU - ESP8266 12E, BO Motor, Wheel, Aluminium Pipe, Aluminium Strip. The wifi camera is used to send us images when our inspection robot is inside the pipe. The Arduino nano is the microcontroller that will be used. The H bridge module LM298 is the motor controller. The Li-ion battery is used to power the robot remotely. The node MCU – ESP8266 12E is used as an open source. The BO motor is used to run the wheels.

The working principle of the robot is quite easy, firstly we have to adjust the size of our robot according to the pipe size. Since our

robot size can vary from 4.5-8 inches, we can adjust the size and place it in the pipe. We even switch on our wifi enabled camera. Once we are done with it, we let our controllers do the talking. Since it's a wireless robot, its movement is controlled with the help of a mobile phone. The forward, backward, left and right movement is controlled using the mobile phone. The programs helps us to enable the movement of the robot.

The camera is wifi enabled so it projects itself on the mobile. With the help of the camera it becomes easier for us to spot any corrosion, scaling, cavities, pittings, bends, etc. The camera lens projects about 180° in the frame so we have clear view. Since it's a night vision camera and as we go inside the pipe it is going to be dark, the night vision helps us to get a good quality pictures from within.

CONCLUSION

Since we discussed about manual inspection and its issues or disadvantages, we chalked out a solution in the form of internal pipeline defects detector (IPDD). So our main objective was to design and fabricate an inspection robot which will travel inside the pipeline wirelessly and with the help of

the wifi enabled camera project images externally from the pipelines internally.

Our inspection robot was able to navigate through the pipelines internally irrespective of the pipeline configuration. And could help us detect the defects present in the pipeline internally. Defects such as corrosion, scaling, cavities, pittings, bends, etc could be captured by our wifi enabled camera. These captured images there by helped in deciding the further due course of action to be taken. Thereby helping solve the issues related to pipelines internally.

We can proudly say that our robot has the ability to be used in practical application compared to the general purpose robot which cannot be used in internal pipelines but a lot of improvement needs to be done to achieve this and it is under development.

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