ISSN 2393-8471

International Journal of Recent Research in Civil and Mechanical Engineering (IJRRCME)
Vol. 2, Issue 2, pp: (81-84), Month: October 2015 – March 2016, Available at: www.paperpublications.org

Review of Design and Fabrication of in Pipe Inspection Robots

[1]Prof. Kuber K.H., [2]Praveen Kumar, [3]Ashish Patil, [4]Udayraj Yadav, [5]Jashita Nair

Department of Mechanical Engineering, S. B. Patil, College of Engineering, Indapur (Pune), India

Abstract: **Pipeline is a popular option for long distance transport of materials such as oil, gas, water and solid capsules etc. Almost in all industries pipelines are vital part of fluid transport. In cities and towns they are used to carry sewage water. Any defect in pipeline cause either losses or hazard to the surrounding area. So disciplined pipe inspection and maintenance are necessary steps to maintain pipelines. Using man power for inspection of pipelines may claim many lives or cause permanent injuries. In such cases, use of robot is beneficial for inspection. In this review paper, we have discussed different options to detect cracks, corrosion or third party damages in the pipelines.**

Keywords: **FSR (Force Sensitive Resistor), RFID device, detector module, Pressure Difference.**

1. INTRODUCTION

Long distance pipeline is a safe transportation option across remote areas. Pipelines give ease of transportation of fluid such as petroleum oil, natural gases and even solid capsules etc. Every town and cities need sewage pipelines for collection and treatment of water for reuse. Medium and large size pipelines are also used in most of the industries such as milk production, chemical plant, and power stations etc.

Due to weather conditions and third party damages, pipeline may face problems like cracks, corrosion, bends etc. These problems lead to leakage of fluid and causes contamination of atmosphere.

Bhopal gas disaster in 1984 was the world's worst industrial disaster due to leakage in gas pipeline. The death toll was around 4000. There are many more such terrible incidences around the world. Dalian pipeline disaster in China (2010) is another instance of a nasty disaster. It caused ecological damages and fatalities. Around 11 000 barrel oil was released into yellow sea. To avoid such circumstances we need to develop more advanced monitoring and inspection techniques to detect defects in pipeline transportation.

In-pipe leak detection means using the unit for detection inside the pipeline. This consists of moving and non-moving methods for detection. This methods rely mainly on the usage of special sensing devices in the detection of gas leaks. Depending on the type of sensors and equipment used for detection. The design can be suitably changed according to the diameter of the pipeline under study.Slight variation inside the pipe will be automatically adjusted by the robot. The design can be used in any kinds of pipelines, let it be plastic, metal or any other kind as there will be pressure difference in all kind of pressurised pipelines.

2. DESIGN

2.1 Pressure Difference Sensing Mechanism:

Principle:

Design: There are two main components of the system. They are as follows,

1. Mobile Robot

ISSN 2393-8471

International Journal of Recent Research in Civil and Mechanical Engineering (IJRRCME)
Vol. 2, Issue 2, pp: (81-84), Month: October 2015 – March 2016, Available at: www.paperpublications.org

2. Detector Unit

2.1.1 Mobile Robot:

The presented robot is for the in pipe inspection of the urban gas pipelines with the diameter of 250mm which is the most popular size in our country. A 2 wheel drive mobile robot was designed with an Omni-directional wheel at the front for easy turn ability. Chassis was made with Plywood and the motor for the movement of the robot was attached on to the downside of the robot. 1 inch thick wheels were attached to the motors. The mobile robot motor was selected by calculating the torque the robot has to carry.

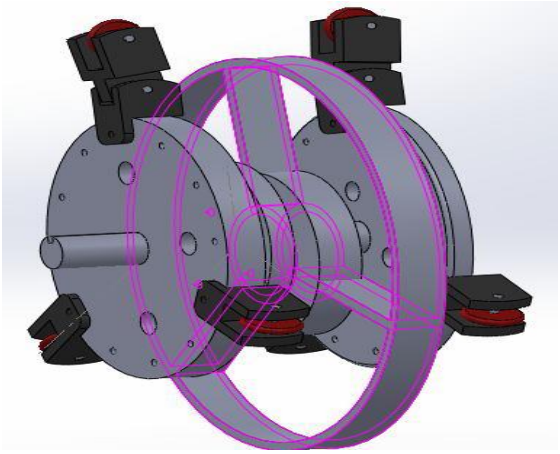
2.1.2 Detector Unit:

When designing the detector unit the main problem faced was obtaining a design which can detect leaks at any angle around the circumference of the pipe. 360 degree observability in a long pipeline, the module should also comply with the diametrical change in the pipeline due to damages, bends etc. The detection concept and the detector design are discussed in the forthcoming part.

Detection is based on identifying the existence of a localized pressure gradient ($\partial p/\partial r$, where r stands for the radial coordinate of the pipe). This pressure gradient appears always in pressurized pipes in the vicinity of leaks and is independent of the pipe size and/or pipe material. Moreover, the pressure gradient exists in different media inside pipes, which makes the detection method widely applicable (gas, oil, water pipes, etc.). This can be shown by considering a straight pressurised pipe. Due to the difference in pressures (Δp=phigh- plow) the gas leak through the opening. All size of leaks can be detected using the pressure difference, but we concentrate only on smaller diameter leaks, as larger diameter leaks can be found out by other means.

The proposed detection concept is based on the fact that any leakage in a pipeline changes the pressure and flow field of the working medium [4]. The main conclusion is that the region near the leak that is affected is small. However, this region is characterized by a rapid change in the static pressure, dropping from pHigh inside the pipeline, to plow the surrounding medium resting outside. The latter phenomenon is essentially a radial pressure gradient.

There is a local drop in the pressure around the leakage region. A suction pressure will be developed due to the pressure drop between the high pressure inner side and atmospheric pressure outside. Numerical studies showed that the radial pressure gradient close to the leak is large in the magnitude and drops quickly as the distance increases. Identifying leaks based on radial pressure gradient will be reliable and effective.

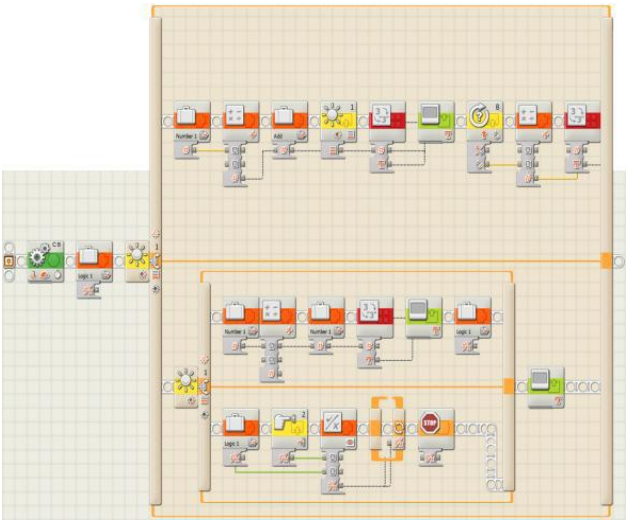


2.2 Mindstorm Robot Principle:

Design: NXT-G

NXT-G v2.0 is a user friendly graphical interface programming environment that is comes with the NXT kit. With a good assembly of blocks and data wires to sum up complexity, NXT-G is capable of being applied in a real world programming challenge. Similar "sequence beams" are in reality matching threads, therefore this software is pretty fine for running a good number of similar sense/respond loops (For instance: wait 30 seconds, play a "beep" sound at high volume if battery

level is good, iterate), or merging independent management using the Bluetooth or any other "remote control". The programming language permits virtual tools for all LEGO labelled and a good number of 3rd party sensors/components. The Version 2.0 (which is the version being used for this project) has new tutorial problems, a remote control, custom images and sound making, and latest Lego colour sensor support. The graphical program was built by making the robot wait for one second before starting to move. Then the light sensor was applied to detect the range of colour that indicates a hole. If the colour is black which indicate the presence of a hole, it executes the first layer of the program as shown in figure 8 below. If otherwise, it moves to the next layer, where it also tests to see if the colour present is white. If a white colour is detected, then it follows the program on the upper layer of the second phase of the program and if otherwise, the last layer will be run on the robot. However, in each of these layers, a set of blocks are used to program the activity of the robot and the wires are used to connect one related block to the other. The first layer, after detecting the hole increases its counter by 1 and this information is converted into the text format and stored in the NXT memory. The text is then displayed on the NXT display and the robot continues its journey. The distance travelled on detection is calculated and displayed. A similar thing is repeated on the upper layer of the second layer. It also increases its counter by one, converts it into text and display the number of cracks detected modelled with the white coloured tape, and then moves on. The distance travelled is also calculated and displayed. The lower layer of the program detects no other colour that means no crack has been detected and therefore displays “no crack” on the NXT display screen. The software building block is as shown below:



3. CONCLUSION

The design of the robot, virtual analysis of the design concept, development of electronics compartments were done. When considering areas where human can’t reach to detect the leaks in pipelines, this mobile robot can be used. The design can be taken as the basic concept for improvements in the in-pipe leak detection Using pressure gradient technology. The study conducted above can be used for detecting leaks in oil pipelines also, by some basic changes in the design.

REFERENCES

[1] Midin Francis K.A, V. Manoj Kumar,’’ Design and Fabrication of an In-Pipe Leak Detection Robot’’, ISBN: 978-93-82702-78-8, 2015

[2] Dr. Zhiyuan Chen, Maryam Temitayo, Prof. Dino Isa,’’ Pipe Flaws Detection by Using the Mindstorm Robot’’, IJERA, Vol. 2, Issue 6, 2012, pp.569-574

[3] http://science.howstuffworks.com/gimbal1.htm

[4] https://www.google.co.in/search?safe=strict&hl=en&site=imghp&tbm=isch&source=hp&biw=1024&bih=615&q=Detector+module+for+in+pipe+inspection+robot&oq=Detector+module+for+in+pipe+inspection+robot&gs_l=img.

3...4103.20517.0.20701.46.17.0.29.1.0.170.1781.0j14.14.0....0...1ac.1.64.img..32.14.1639.cj4WG1Uytek#safe=strict&hl=en&tbm=isch&q=Detector+module+for+in+pipe+inspection+robot+with+gimbal+mechanism&imgrc=ETUgeZpgOViTdM 3A

[5] https://www.google.co.in/search?safe=strict&hl=en&site=imghp&tbm=isch&source=hp&biw=1024&bih=615&q=Detector+module+for+in+pipe+inspection+robot&oq=Detector+module+for+in+pipe+inspection+robot&gs_l=img.3...4103.20517.0.20701.46.17.0.29.1.0.170.1781.0j14.14.0....0...1ac.1.64.img..32.14.1639.cj4WG1Uytek#safe=strict&hl=en&tbm=isch&q=Detector+module+for+in+pipe+inspection+robot+with+gimbal+mechanism&imgrc=mD4QEcGXN3t_wM 3A

[6] Jong-Hoon Kim,"Sensor Based Autonomous Pipeline Monitoring Robotic system",B.E., Seoul National University of Science and Technology, Seoul, Korea 2005 M.S., Louisiana State University, Baton Rouge, USA 2008 December, 2011.