JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

STUDY OF IN-PIPE INSPECTION ROBOT

Prof. R.M. Kawale[1], Divya Londhe[2], Priti Gawade[3],Rutuja Shelke[4],Hrishikesh Patil[5]
Department of Information Technology
PDEA's College of Engineering (Manjari B.K.)
Pune, India, 412307

1. ABSTRACT

This Project proposes is to design a pipeline inspection robot that can detect various pipe cracks internally by using camera at very low cost. The economic value of pipelines which are used in industry for various purposes is very large. Pipeline inspection has become an important issue as replacement of defected pipeline is more costly as well as more complicated. Here the unique 4W chassis design and camera is selected for pipeline inspection robot. The hardware part consists of bot chassis, NodeMCU board, CMOS-Camera with SD card slot, DC geared motors and motor drivers, LED's etc.

2. INTRODUCTION

The internet of things or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.
An IoT ecosystem consists of web-enabled smart devices that use embedded systems, such as processors, sensors and communication hardware, to collect, send and act on data they acquire from their environments. IoT devices share the sensor data they collect by connecting to an IoT gateway or other edge device where data is either sent to the cloud to be analyzed or analyzed locally. Sometimes, these devices communicate with other related devices and act on the information they get from one another. The devices do most of the work without human intervention, although people can interact with the devices -- for instance, to set them up, give them instructions or access the data.

Robot is a machine which is capable of carrying out a complex series of actions automatically. A robot can be guided by an external control device, or the control may be embedded within. Robots may be constructed to evoke human form, but most robots are task-performing machines, designed with an emphasis on stark functionality, rather than expressive aesthetics.
robot, any automatically operated machine that replaces human effort, though it may not resemble human beings in appearance or perform functions in a humanlike manner. By extension, robotics is the engineering discipline dealing with the design, construction, and operation of robots. Robots eliminate dangerous jobs for humans because they are capable of working in hazardous environments. They can handle lifting heavy loads, toxic substances and repetitive tasks. This has helped companies to prevent many accidents, also saving time and money.

The integration of IoT and robotics has reduced human tasks' complexities and has enabled humans to perform their daily life activities with ease. Hence, the merger of these technologies has created the Internet of Robotics Things (IORT) to represent intelligent devices that can monitor events, gather data through sensors and determine the best action accordingly.

Zigbee is a standards-based wireless technology developed to enable low-cost, low-power wireless machine-to-machine (M2M) and internet of things (IoT) networks. Zigbee is for low-data rate, low-power applications and is an open standard. This, theoretically, enables the mixing of implementations from different manufacturers, but in practice, Zigbee products have been extended and customized by vendors and, thus, plagued by interoperability issues. In contrast to Wi-Fi networks used to connect endpoints to high-speed networks, Zigbee supports much lower data rates and uses a mesh networking protocol to avoid hub devices and create a self-healing architecture. Zigbee is used by a variety of cable and telecommunication companies in their set-top boxes, satellite transceivers and home gateways to provide home monitoring and energy management products to their customers.

Chemical industry pipelines carry various chemicals hence there may be chances of problems like

corrosion, cracking, metal losses and leakages. These problems are inevitable. The blockage inside the pipe can reduce the efficiency of the chemical flow. The conventional method is very difficult, tiring and expensive. These problems are not only seen in industry but also in houses and power plants. To overcome this, the pipelines can be inspected and cleaned with the help of "PIPE INSPECTION AND CLEANING ROBOT."

3. LITEATURE REVIEW

Authors of paper [1] designed a pipeline inspection robot with belt driven ridged cone shaped skate model and implemented. In this paper author developed a pipeline inspection robot with a linkage mechanical clutch, which consists a novel belt driven ridged cone shaped skate model that can be used to conquest irregular environmental barriers. The mechanical clutch is a 3-bar linkage mechanism. The robot was designed to be conformal to the environment: each chain being in touch with the walls of pipeline or tunnel. Thus, the robot can be operated in various configurations and sizes of pipeline, and can utilize the belt driven corrugate-ridged cone shaped skate model to advance in irregular barriers of pipeline. The prototype of the robot system has been developed, and experiments were carried out to verify the validity of design.

Authors of paper [2] implemented semi-Automatic Pipeline Inspection Robot System. Here, author introduced a new semi-automotive pipeline inspection robot system for cleaning and inspection of the in- house pipeline which is small in size. It consists of a camera, a steering mechanism, and sensors to locate the robot inside the pipeline. The robot system is carried by an extension cable, which is in advance being penetrated into the pipeline by a compressed air. A lab prototype pipeline was developed to test the feasibility of the developed pipeline inspection robot system and the feasibility of this semi-automatic pipeline inspection method was proven successfully through experimentation. This semi-automotive pipeline inspection robot system enables user to inspect the state of corrosion and water leakage inside the pipeline. Thus, it can be used as a decision making tool whether it is necessary to replace the pipeline with a new one or not.

Authors of paper [4] implemented A Flat Pipeline Inspection Robot with Two Wheel Chains. In this paper a new pipeline inspection robot that has multiple sensors for inspection of 80-100mm pipelines. The robot device consists of two wheel chains which has a flat shape. The steering and moving motion can be generated by using just one robot module without having any singular motion. As another advantage, the flat shape of this robot allows mounting additional sensors on the both sides of the robot. The kinematics and three control modes are described i.e. driving mode, detecting mode and searching mode. Compared to popularly employed pipeline robots using three wheel chains, the new design allows simple robot control and easy user interface, especially at T-branch.

4. METHODOLOGY

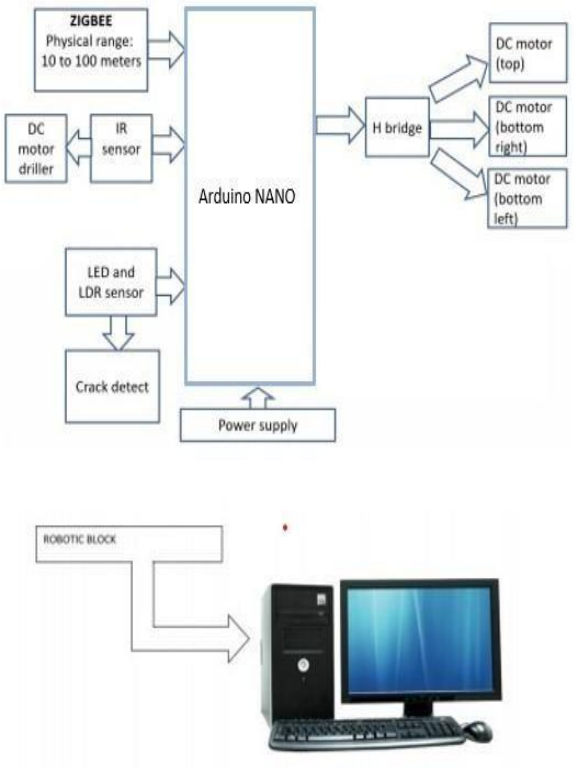

Fig-1: Block diagram of the proposed system

The robot is designed in such a way that it can detect the exact location where the leakage has occurred in the pipe [6]. The crack detection is done with the help of LDR sensor. IR sensor is used to detect the obstacles and a driller is used to remove them. The codes required to detect cracks and obstacle were written and dumped on an Arduino Nano.

The controlling system consisting of microcontroller, motor driver, different sensors and wireless camera was mounted on the model and synchronized with the mechanical part. Wireless transfer of information of the conditions inside the pipe is done with the help of ZigBee module connected to both the robot and laptop. A PVC pipe of six inches diameter was used for testing the pipeline inspection robot.

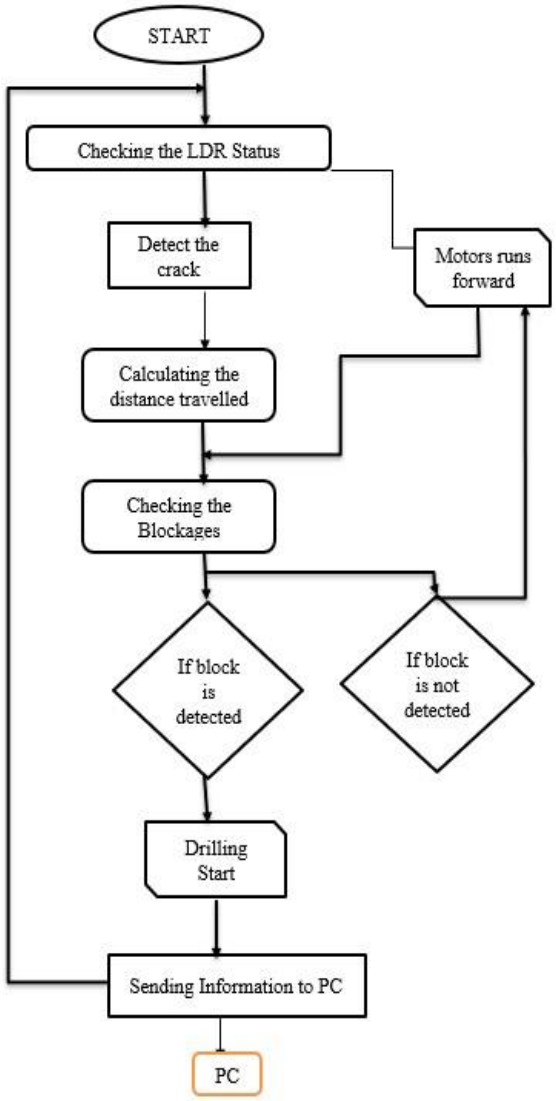

Fig-2: Flowchart of the proposed system

Once the robot is placed inside the pipe, led which is attached to the robot glows throughout and the pipe and LDR would monitor the values [6]. Where ever the variation is seen that particular place will be identified as crack detected and we would be calculating distance. As the robot moves forward it also checks for blockage, if blockage is present then drilling operation would start, information of the conditions inside the pipe is communicated wirelessly with the help of ZigBee module connected to both the robot and laptop.

5. CONCLUSION

A low cost, portable Pipeline inspection robot design has been proposed. In this system we only used one camera in the front module of robot and crack detection done by using MATLAB. Further we will implement one more camera in order to provide better visual information to the user. Another further work is the retrieval function. Sometimes, the robot gets stuck inside the pipeline for various reasons. In these cases, the robot needs to be taken out of the pipeline by using some retrieval function.

6. REFERENCE

[1] Fa-Shian Chang, Lih-Tyng Hwang, Chih-Feng Liu, Wei-Sheng Wang, Jeng-Nan Lee, Shun-Min Wang, Kai-Yi Cho, “Design of a pipeline inspection robot with belt driven ridged cone shaped skate model”, 2015 IEEE Conference on Robotics and Biomimetics, pp. 787 – 792, December 2015.

[2] Jae Yeon Choi, Hoon Lim, and Byung-Ju Yi, “Semi-Automatic Pipeline Inspection Robot Systems”, SICE-ICASE 2006. International Joint Conference, pp. 2266-2269, Oct. 2006.

[3] Young-Sik Kwon, Jong Tae Suh, Byung-Ju Yi, "A linkage type mechanical clutch synthesis for pipeline inspection robot", Automation Science and Engineering (CASE) 2012 IEEE International Conference on, pp. 618-623, 2012, ISSN 2161-8089.

[4] Young-Sik Kwon, Bae Lee, In-CheolWhang, Whee-kuk Kim, Byung-Ju Yi, "A Flat Pipeline Inspection Robot with Two Wheel Chains", 2011 IEEE International Conference on Robotics and Automation, pp. 5141-5146, May 2011.

[5] Young-Sik Kwon, Byung-Ju Yi, "Design and Motion Planning of a Two-Module Collaborative Indoor Pipeline Inspection Robot", IEEE Transactions on Robotics, vol. 28, no. 3, pp. 681-696, June 2012.

[6] https://www.irjet.net/archives/V7/i8/IRJET-V7I810.pdf