SEWAGE PIPE CRAWLING ROBOT

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Abstract

The name of our project is piping the pipe inspecting and cleaning robot (PIAC); in a nutshell it is a robot that will be used to clean the interior of the pipes using a brushing mechanism. One of the critical areas of the oil and gas industry is the transport of oil and other fluids through a network of pipes. Over time these pipes have accumulated amount of slug and other deposits; this leads to decrease in pipeline carrying capacity, reduced reliability, loss of power due to higher pumping pressure required and irregular flow. In the light of the problems mentioned above we have decided to attempt to solve this problem using our project. This will not only clean the interior of the pipe but also be able to send live video feedback to the personnel on the ground depicting the kind of residues found in the pipes. The robot can also be added with additional sensors to relay any other critical information. The pipeline cleaning robot is one of the most important systems developed for a proper maintenance of underground pipes. Due to large development and increase in usage of fuel, oil, gas and the pipes used for such process need to be maintained properly. There are many ways to do that so but biggest problem arises with such maintenance machine are heavy cost and durability to work in and out of the pipes. Pipelines are very significant tool as they are used in many different industries for various applications such as transportation of gas, water, fuel, oils, etc. Over time, they are prone to aging, corrosion, cracks, mechanical damage etc and ignorance of these problems leads to accidents which incurs huge losses in terms of both economy and lives. This highlights the inevitable need to inspect pipes at a regular interval for the purpose of security and improved efficiency in industrial plants. Now there is many ways of inspecting pipes such as X-rays, magnetic particle inspection method etc, but these methods do not give a full proper internal inspection of pipes. This pipe inspection robot aims at detecting the exact location of leakage and clearing the blockages and thus

removing human factor from labour intensive and dangerous work, thereby reducing the number of accidents that happen due to the lack of regular inspection

Introduction

Pipeline cleaning robot is used to clean the interior of the pipes using a brushing mechanism. One of the critical areas of the oil and gas industry is the transport of oil and other fluids through a network of pipes. Over time these pipes have accumulated amount of slug and other deposits, this leads to decrease in pipeline carrying capacity, reduced reliability, loss of power due to higher pumping pressure required and irregular flow. In the light of the problems mentioned above we have decided to attempt to solve this problem using our project. This will not only clean the interior of the pipe but also be able to send live video feedback to the personnel on the ground depicting the kind of residues found in the pipes. The robot can also be added with additional sensors to relay any other critical information. A pipe inspection robot is device that is inserted into pipes to check for obstruction or damage. These robots are traditionally manufactured offshore, are extremely expensive, and are often not adequately supported in the event or malfunction. This had resulted in associated environmental services limited. Inspection robots are used in many fields of industry. One application is monitoring the inside of the pipes and channels, recognizing and solving problems through the interior of pipes or channels. Automated inspection of the inner surface of a pipe can be achieved by a mobile robot.

Literature Review

Prof.Sowmya Met. al. [1]: This research paper explores robots can be effectively used as tools to carry out work in labor intensive, hazardous and unreachable work environments. Pipeline systems are one such environment. Robots can be successfully implemented in pipe line inspections for better detection of defects. The project aimed to create an in-pipe robot with adaptable structure, autonomy and achieve vertical motion. The following conclusions can be drawn from the project. Our robot is able to inspect in practical situations. It has ability to travel in vertical as well as horizontal directions and turn in elbows. It is employed with dual locomotion system to achieve this goal. It helps to show the actual image inside the pipe. It able to easy to find defect, flaws, material decay, corrosion and crack. Robot have a good work accuracy and very fast in process than human being

Deepak Sonawane et. al.[2]: This research project is focused on the development of an innovative flexible autonomous inline pipe inspection robot is designed and fabricated. The design is prepared in Solid Works to simulate the model. Our robot is able to inspect in practical situations. It has ability to travel in vertical as well as horizontal directions and turn in elbows. It is employed with dual locomotion system to achieve this goal. It helps to show the actual image inside the pipe. It able to easy to find defect, flaws, material decay, corrosion and crack. Robot have a good work accuracy and very fast in process than human being.

Prakash Kalpesh Nakum et. al.[3]: The study introduces the parameters considered are uniform flow rate of water, depth of the channel is 1feetand height of the channel is 3feet, rate of disposal of waste is in uniform manner, lifter speed and motor speed is constant.The cost of the machine is economic and it requires only12-24 volts of current.These cleaners are the cheapest way to fix drainage problems. Easy to operate and control as no special skill is required.Reduction of a labor-oriented method of cleaning, thus Upgrading dignity of labor. Lightweight and easily portable. A large amount of garbage will collect which can be remanufactured.

Dr. Rajesh Kannaet. al.[4]: This study focuses on a The real prototype had been fabricated and tested for the robot functionally. The spring mechanism designed has improved the mobility of the robot in pipeline. The control system consists of two sections, one on the robot to control the movement and to overcome the obstacles on the path and also to identify the joints on the pipe lines. The second section of the control system is on the digital machine to run the image processing module and artificial neural network module which assist the robot for cleaning purpose. These control systems has communicated through one transmitter and another receiver.The robot performance of the robot had been improved investigating the angular positions of the links, by compressing the image using SPIHT and by conducting sensitivity analysis for identifying the ANN parameters. The experimentation had been conducted for various combinations of pipes with different types of joints and sediments. The obtained results were found satisfactory and the developed intelligent robot can be used for the real time pipe inspection and cleaning.

Chandan. R.et.al.[5]: In this paper inside pipe modular robotic system is proposed. An important design goal of this robotic system is the adaptability to the inner diameters of

the pipes. The given prototype permits the usage of Smartphone camera for visualization of the in-pipe inspection. This prototype is wirelessly controlled by a Smartphone using Bluetooth. Connectivity . The major advantage is that it can be used in case of pipe diameter variation with the simple mechanism. A pipe inspection robot was developed that can be applied to 8inch - 15-inch pipeline. A real prototype was developed to test the feasibility of this robot for inspection of in-house pipelines. The types of inspection tasks are very different. A modular design was considered to easily adapt 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 the installation of a declogging system at the front of the robot. The robot is designed to be able to traverse horizontal 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.

Poojitha Das et. al. [6]: This paper presents a a method that combines robotics and Internet of Things (IoT) technology to detect water leaks in pipelines. The system involves using small autonomous robots equipped with sensors to monitor sewage pipes for leaks. These robots are designed to move in pipes and detect pressure or flow changes that could indicate a leak. The robots are also equipped with wireless communication capabilities that allow them to send data to a central server or cloud-based platform.

Devashis Debnath et. al.[7]: This paper presents that the robotic system is adaptive to the changes in the inner diameters of the pipes. The design of the robot permits the usage of a mini-cam for visualization of the inpipe inspection or other devices needed for failure detection that appear in the inner part of pipes. One of the advantages is that it can be used in pipes with diameter variation. The developed pipe inspection robot can be applied to 100 mm to 250 mm pipeline. It can easily move through the bends and t-sections as well.

Problem Statement

Recently, many industries use different diameter pipes for different applications, like to carry chemicals, high pressure steam gases and water. Hence there may be chances of problems like corrosion, cracking, dents, metal losses and leakages. These problems are inevitable. The blockage inside the pipe can reduce the efficiency of the water 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.

Objectives

- To construct a machine that is easy to use and movements of parts occur smoothly.
- To build a device that is durable as it should be free from rust.
- To build a machine that is safe in all aspects as it does not harm the interior of the drainage system.
- To make our project user friendly and eco-friendly.
- Handling the machine should be easy.

Methodology

1. Robot Design and Construction: The first step is to design and construct the pipeline cleaning robot. This involves selecting the appropriate size, shape, and materials to ensure compatibility with the pipeline being cleaned. The robot should be equipped with necessary cleaning tools, sensors, and cameras to perform its tasks effectively.

2. Navigation and Propulsion: Pipeline cleaning robots need to navigate through the pipeline system autonomously or under remote control. They are equipped with propulsion mechanisms such as wheels, tracks, or even crawling mechanisms to move through the pipeline. Navigation systems may utilize sensors, cameras, or mapping technologies to help the robot navigate and identify its location within the pipeline.

3. Cleaning Mechanism: Pipeline cleaning robots use various cleaning mechanisms depending on the type of deposits or contaminants they are designed to remove. Some common cleaning mechanisms include brushes, scrapers, water jets, vacuum suction, or high-pressure air systems. These mechanisms are designed to effectively dislodge and remove debris, sediment, scale, or other contaminants from the pipeline walls.

4. Sensing and Inspection: Pipeline cleaning robots often incorporate sensors and cameras to monitor and inspect the pipeline's condition. These sensors may include proximity sensors, pressure sensors, or corrosion sensors to detect abnormalities or damage in the pipeline. Cameras and imaging systems provide visual inspection capabilities, allowing

the robot to identify cracks, leaks, or other structural issues.

5. Data Collection and Analysis: The robot collects data during the cleaning and inspection process. This data includes information on cleaning progress, pipeline conditions, and any detected anomalies. The collected data can be analyzed in real-time or later to assess the pipeline's integrity, identify maintenance needs, or generate reports for further action.

6. Communication and Control: Pipeline cleaning robots may require communication capabilities to receive commands, transmit data, or provide status updates. This can be achieved through wired connections or wireless communication protocols. Remote control systems or autonomous algorithms enable operators to control the robot's movements and cleaning processes.

7. Maintenance and Upkeep: Regular maintenance and upkeep are necessary to ensure the pipeline cleaning robot's optimal performance. This includes cleaning and maintenance of the robot itself, such as cleaning the brushes, replacing worn-out parts, or calibrating sensors. The robot's cleaning tools or attachments may need to be replaced or adjusted depending on the pipeline's specific requirements.

The Proposed System Consists

1. The robot has 4 wheels and 1 cleaning brush. The cleaning brush is significantly large because it snugly fits into the pipe diameter and also can comprehensively clean the top and the bottom.
2. Mobility system: The mobility system consists of the motors that control the motion of the robot with the pipe. There are 2 motors that are connected to 4 wheels 2 in the front and 2 at the back.
3. Cleaning system: the cleaning system consist of the powerful cleaning motor that is connected to the front of the robot.
4. Wireless control: Wireless control system is responsible for the wireless communication between the robot.

5. Video feedback: This sub system connects the camera to the rest of the robot.

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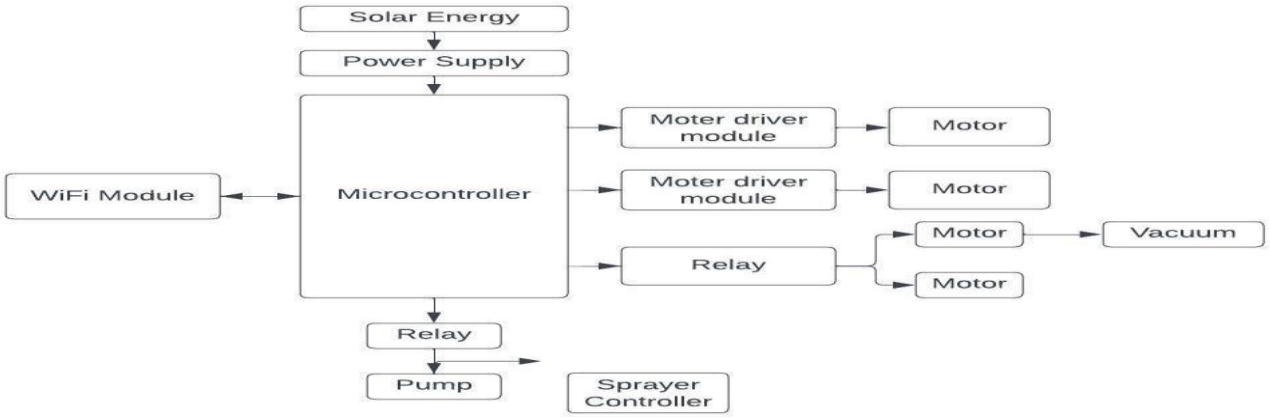

Fig.1: Block Diagram of Pipe Inspecting and cleaning Robot

Expected Outcome

1. Resource Conservation: By deploying precise seed planting and fertilizer application, the project is expected to significantly reduce resource wastage. This includes a more efficient use of seeds, fertilizers, and water, leading to cost savings for farmers and a more environmentally sustainable approach to agriculture.

2. Improved pipeline efficiency: By removing deposits, sediments, and contaminants, pipeline cleaning robots can restore the desired flow capacity, optimizing the overall efficiency of the pipeline system.
3. Extended pipeline lifespan: Regular cleaning and maintenance with pipeline cleaning robots can help prevent corrosion, reduce the risk of leaks, and minimize structural damage, potentially extending the lifespan of the pipeline.
4. Enhanced operational safety: Pipeline cleaning robots eliminate or reduce the need for manual cleaning methods, minimizing risks associated with human entry into confined spaces or hazardous environments.
5. Real-time inspection and monitoring: Many pipeline cleaning robots are equipped with sensors and cameras that enable real-time inspection and monitoring of the pipeline's condition. Early detection of issues such as cracks, leaks, or corrosion allows for timely repairs and maintenance.
6. Cost efficiency: While the initial investment in pipeline cleaning robots can be significant, they can offer cost savings in the long run by reducing manual cleaning operations, minimizing downtime, and preventing costly damages.

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