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Modern Literature Overview On Fabrication of External Pipe Climbing Robot

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***Abstract*: This paper describes the problem identification, concept, design and prototype implementation of a wheeled pole climbing-robot. The goal of this work is to design pole climbing robot that uses clamping principle. In chemical industry, there are different types of chemicals or solution that will be harmful to human health or skin which may lead to health problems or irregularity in human working condition and so that the pipelines of the industry must be frequently inspected to avoid leakage or any other type of accidents. Humans have greater risks to do such operations, so this robot can be very useful in such types of inspection. Boilers do have the same conditions, as the temperature of the boilers is so high, periodical checking of the pipelines using this robot can be used for the purpose of a safer industry.**

***Keywords*: Pipe climbing, Remote controlled (transmitter and receiver), DC motor, Relay, Vertical/horizontal movement.**

1. Introduction

The pipelines are used to transfer oils and other types of fluids, so after periods of usage the pipes get corroded or may lead to leakage. Robotic inspection is quite better when compared with the human inspection. The design for this project is inspired by the human-climber's where their action relies on a broad strap around their waist. So the he must push his weight back to provide more torque around his waist to create higher force on his foot to withhold his position strongly. The principle of the construction is that the centre of mass has a fix distance to the pole, which has the effect that the normal force between the wheel and the pole is high enough to drive upwards. Robots which can climb poles are under development and are expected to be used in the inside/outside maintenance of the skyscrapers or high buildings, observations of disaster scenes from a height, pruning trees, and more. In late 90s of European countries many prototype machine has been developed for different types of applications like pipe inspection, inspection work during construction and cleaning the glass walls of huge buildings.

2. Objectives

- To reduce manual effort and accidents while inspection of the pipelines by the replacement of pipe climbing robot.
- To increase safety of workers in industries.

3. Literature Survey

Ram Sudhir et al., proposed this journal as it discusses about the design and development of a wheeled pole climbing-robot. These have been the most interesting area in the industry sector. There are several pipe climbing robots that are developed and also in research. Every robot has its own positives and negatives. This robot is also a pole and pipe climbing robot but it has different clamping principle. Pole and pipe climbing robot has number of applications in chemical industries. There are too many harmful chemicals are used which are harmful to human workers and they are used to inspect the pipes which leads high impact on human workers. In such cases this robot is used. This model has six wheels which are mounted in two rows and the six wheels have connected to 3 dc motor (each dc motor connected to couple of wheels). For the pole gripping, this model used a various diameter spring arrangement. For the backward and forward motion toggle switches are used. The frame has hinge joint for opening and closing the model.

Md. Hazrat Ali et al., proposed this journal as it discusses about the paper of development of a robot for boiler tube inspection. The main aim of this project is to prevent hazardous failures, which happened during in boiler tube analysis. Boiler tubes are too hot to handle. So, it is dangerous for human workers and also it is time consuming process. This robot is designed particularly for boiler tubes. It has duct fan and with the help of this fan thrust force is to be developed and also motion is given by a dc motor to climb in pipe. The ultrasonic sensor is provided in the robot to detect the defects. This ultrasonic sensor gives a reference signal and that signal is compared with the signal received from the damaged tubes.

Ruchita Vucha et al., proposed the journal work as it discusses about the design and fabrication of the Modular Pipe Climber inside ASTM D1785 - 15e1 standard pipes. There are three climbing track in the robot that tracks are independently mounted at 120° to each other track. In this project they used tracks instead of wheels which are highly gripped than wheels. These tracks are entered onto the pipe moved along with the inner wall of the pipe with the help of passive springs in vertical climbing and also while in a bends. The asymmetric design of the robot helps the tracks to take turns in bends. The spring stiffness and torque required for this robot is obtained with the help of quasi-static and static equilibrium during vertical climb.

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This robot is further simulated and analysed by ADAMS MSC which is prototype, that built based on the obtained values is experimented on, in complex pipe networks. To avoid the stresses during bends, they used differential and also that improves the efficiency of the robot. This paper discusses about design and fabrication of pipe climbing robot which is operated by wirelessly using Zigbee modules. This project uses a new technology called Zigbee which is used to control the robot with remote location. Zigbee technology is not like a Bluetooth or other wireless technology. It is completely different from that. Zigbee is a PAN technology based on the IEEE 802.15.4 standard. This Zigbee devices have mesh the network between the nodes to perform actions. This robot has a camera to capture images, during climbing the camera is fixed above the robot and it works wirelessly. The central element in the robot is the main part of it and it also acts as a back bone of this robot. It holds the wheels and all other links. This central element is a hollow portion and made up of cast iron. It uses a wheel leg mechanism for a movement. In this pantograph mechanism with a sliding base that permits the natural folding and unfolding of the leg. The legs are contract and expand along with radial directions.

Angelica Brusell et al., proposed a journal on the project of inspection application of Pneumatic wall-climbing Robot. This robot generally uses a negative pressure as its adhesion method with the help of suction cups or general, a PWCR utilizes negative pressure thrust based mechanisms. The main advantage of this robot is to climbing a non ferro-magnetic surface for example glass and composite materials. Because of the non ferro-magnetic technology it consumes less time and also safety to the workers. Their main advantage is to climb non-ferromagnetic surfaces, such as glass and other composite materials, in comparison magnetic adhesion method is not suitable climbing glass like materials. Non ferro-magnetic process offering the important advantage of protecting human workers from hazardous and unreachable environment.

Bijo Sebastin et al., proposed this journal as it represents the design, analysis and development of an external pipeline inspection robot. In this it has two arms to climbing the pipe. It has four wheels, two large hollow ones enclosing the complete base structure and two smaller ones at the end of each arm. During the climbing operation the system grabs the pipe outer surface tightly. So, with the help of the wheel in the arm it can move along with the pipe. The mathematical modelling of the robot is analysed by ADAMS-Matlab co-simulation. Arms are moving with the help of digital servo motors and the wheels consist of dc motor. Also this robot has a microcontroller and a wireless camera. This robot can be controlled by a remote through WiFi connection. This robot has shown the field trial of inspection with capable of inspecting the diameter about 200mm. The application potential of the system includes surface and exposed large diameter pipeline inspection in outdoor and industry.

B. Bharathi, B. Suchita Samuel proposed this journal as the aim of the project is to develop and design a bore well rescue robot. This robot can be controlled by human operator and this robot gives an insight view and necessary steps can be taken for the rescue process. This robot is fully operated by human commands with the help of PC. This robot can also do pick and place process for handling objects due to the arm design. The technology used in this project is Zignee. Also it has wireless camera. So we can see the proper image of the in-sightvog borewell. This robot has a high power LED which acts as a light source when light intensity inside the pipe is low. High power dc motor is used to sliding into the borewell pipe. This robot contains PIC 16F877A microcontroller for instructions.

N. R. Kolhalkar et al., proposed this journal is about the study of the wall climbing robots. Main purpose of these robots is to help the human worker in surface works related industries. Like cleaning, painting surface of a wall and inspection of pipes and high rise buildings etc. Due to the ability to relieve human beings from these hazardous works, more & more people are interested in developing various service climbing robots in recent years. There are various types of mechanism and adhesion systems are used in these type of robots. Example, locomotive mechanism, wheel-driven mechanism etc., and also nowadays various sensors and microcontroller are used in climbing robots for motion purpose. Wireless technology like WiFi, Bluetooth, Zigbee are also used in climbing robots. Collor cameras are also used for inspecting process. Depending upon these, positives huge market values available for this climbing robot.

Kshitij Kumar et al., proposed this paper work which represents the inspection robot for crack detection on the structures. This robot uses a suction cup and servo motor for adhesion and generates motion respectively. This robot can climb vertical and rough surface planes with the help of suction cups. It uses a vacuum pump for adhesion process to climb a plane. The main objective of this robot is to detect the crack on the wall and a plane surfaces. It uses digital image processing for visual inspection. Canny edge detection method is used to detect edges. For the power supply this robot uses a 11.1 V 3000 mAh battery used. Approximately it stands up to 30 min.

Ahireakash et al., proposed this paper that presents the study of pipe inspection and cleaning robots. The main body of this robot is central frame which holds batteries and all other components. The supporting joints are brazed at 120° each other. Translational Element is the movable part in the robot which slides along the central body for repositioning in case of pipe diameter variation. This element is drilled at the centre for the translating along the central body. This will restrict the links to some extreme angles beyond which it could not be translated. The extreme angles are found to be 15 degrees and 60 degrees. The joints are brazed on the translational element at 120 degrees for the links to be fixed onto it. Hardened steel compression spring is used for a robot extension. dsPIC130F4011 microcontroller is used for driven the DC motor with the help of c programming language.

Muhammad Nor Hakim Bin., proposed this journal discusses about the project of design and development of crawling robots for internal pipe inspection. In this robot they used wheeled type one with pantograph mechanism of kinematics with a sliding base of folding and unfolding robot legs. The mechanism of this robot is based on the design of MRINSPECT III and the driving mechanism of MRINSPECT IV. This robot is adoptable for

using in 6 to 10 inches diameter pipes. The design of the robot is made by using AutoCAD and for simulation using ADAMS. The tilted wheels are placed in the rotor of the DC motor. The maximum and minimum height of this robot is 10 and 6 inches respectively. The locomotion of the robot must be in wheeled-type design in which the slider crank is placed 120° from each other.

Noor Juraizah Binti, Mohd Jinal., Proposed this journal as the aim of this project is to design and development of a rope climbing robot. This robot used a Peripheral Interface Connection (PIC) software. PicBASIC Pro-compiler and MicroCode studio from Microchip has been used to design a programming and compile the program. The PlC 18F4550 has been used as a microcontroller of the robot. This robot has a gripper in top and bottom of the body, which alternates the position while moving upwards. Type HITEC HD7 150 M DC Servo Motor from Cytron Technologies Sdn. Bhd has been choose as a gear to move each pair of robot arms. The main function of the robot is integrated with the PIC.

Abdullah Al Deghreer et al., proposed this journal as it discusses about the project of pipe inspecting and cleaning robot. This robot is used to clean the interior of the pipeline using brushing mechanism. Mainly we can use this robot in oil and gas industries which where the place slug is formed. This pipe can remove the dust in pipe was about 4 grams in surface area of about 0.398 square meters. It has used metal bristles for cleaning purpose and also it has 7 megapixels inbuilt camera for recording video up to 480p. It has arduino board for controlling dc motor.

Mansi S. Chabukswar et al., proposed this paper that discusses about the design and development of robot with permanent magnetic tracks to facilitate cleaning inspection issues of pressure vessel. This robot uses permanent magnetic adhesion mechanism for inspecting pipes and duct system. Conceptual design of proposed system considering all working parameters is done by suitable CAD modeler (CATIA). This system uses many hardware systems. It includes temperature sensor, infrared sensor, gas sensor, 12v dc motor. This robot has Arduino UNO board for control of the main movement.

Ankit Nayak et al., proposed this journal as it represents a model of a screw drive type wall press adoptable wheeled In-pipe inspection robot. This robot can move horizontal, vertical and even elbow of the pipe line. The main three modules of this robot is rotor, stator and control unit. Three wheels are attached to the rotor for moving the robot with a helix angle of 15°. A rotor is moving inside the pipe in longitudinal direction, follow the helical path of the wheel. This robot has a tilted wheels and supporting springs of each unit. In the screw drive mechanism, it used single actuator with one degree of freedom. This robot is used to inspecting the range of pipe diameter between 127mm to 152mm.

4. Conclusion

Here the pipe climbing robot that can move in upward and downward direction, also it can remain stationary with its own weight. Future scope is high with better development of the robot by providing obstacle detection, camera with infrared vision and path finding. It can be applied in nuclear reactors, boilers, chemical plants etc., for inspection of pipes.

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