Simulation and Development of Pipe Inspection Robot

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***Abstract*- Now a day facing many problems related to repairing, inspection and maintenance of interior pipelines. To avoid this risk and reduce the time of inspection, repairing, maintenance of interior pipes. One of the most important requirements in repairing and maintaining of pipelines is the ability to monitor and evaluate the pipes interior. This work deals with the modelling, simulation and prototyping of an apparatus to piping systems for inspection, cleaning and examination of the interior piping systems. The mechanism involves a central rod upon which a translational element is fitted which in turn is connected to three frames of links, joints and wheels. DC motors are attached to the wheels to achieve the drive required. The mechanism allows for small accommodation in pipe diameters. An electronic and controlling circuit consisting of relay switches is used to control the entire circuit of DC motors, camera and translational element. The camera is mounted on the top of the assembly of robot. The robot may allow for detection of cracks, buckle, corrosions, fitting and many others.**

***Keywords*: Motors, Control relays, switches, inspection, repairing, maintenance.**

1. INTRODUCTION

Robotics is one of the rapid developing engineering fields of today. Robots are to discard the human factor from labour intensive or dangerous position and also to act in inaccessible environment. The use of robots is more common today than ever before and it is no longer completely used by the heavy production industries. The examination of pipes may be relevant for upgrading security and efficiency in industrial plants. These peculiar operations as inspection, maintenance, cleaning etc. are expensive, thus the application of the robots aspect to be one of the most prepossessing solutions. Pipelines which are tools for transporting oils, gases and other fluids such as chemicals, have been employed as major effectiveness in a number of countries for long time. A lot of difficulties caused by piping networks aging, corrosion, cracks, and mechanical damages are possible. The main focus of the project is to create a robot for pipe inspection and cleaning, as the name suggest the robot will be construct to remove the residues that are built up inside the pipe. This is done through a brushing mechanism. Not only will this robot also be able to relay live video observation from the ground to the controller. This design consists of battery, DC Motor, USB Camera. Battery is used to contribute the power supply to the Robot. DC motor followers electrical energy to the mechanical energy. By that effort shaft rotates. Brushes are applicable to shaft, so that Robot hygienic the pipe. USB Camera is linked to the robot, it gives the regular live streaming of the pipe. User can guide the live video on PC. Pipe evaluation robot is shown in Figure 1.

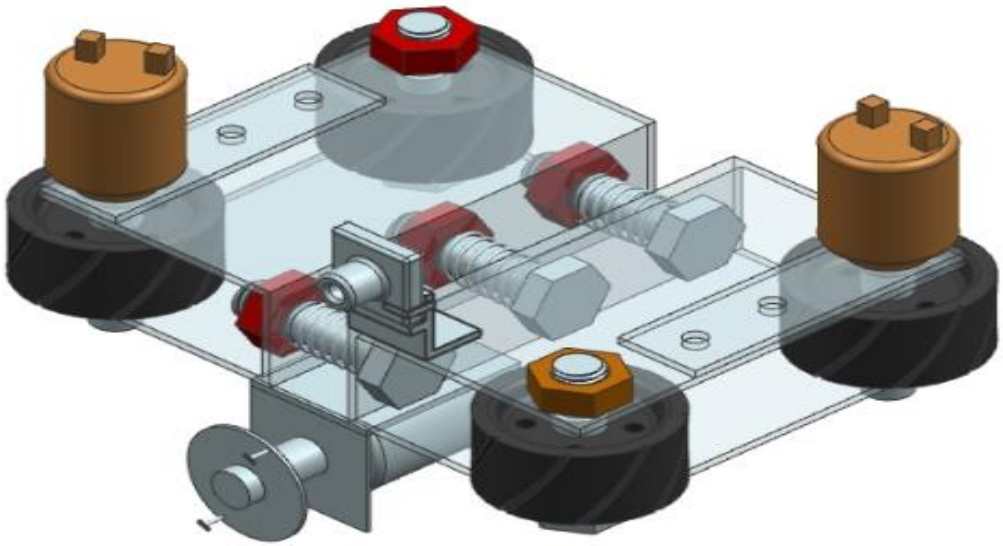

Fig. 1.1 pipe inspection robot

2. OBJECTIVE

- This plan is made to investigate the underground horizontal gas pipe line. This plan is very useful for evaluation team to examine the leakage, blockage, or any other destruction.
- This design reduces labour cost and accidental cases. Examine the damage portion and easily we recover from it by conclusion applicable area.
- To reduces human efforts, wastage of money material handling cost. Easy to engage and detect the cracks and defect

3. DESIGN PARAMETERS.

1. Wheels:

The wheels of the robot should be selected such that they should be efficient of gripping without slipping in the vertical and horizontal direction by utilise the appropriate traction force. These factors are examined by the co-efficient of friction between the wheel and the pipe. Rubber wheels are excellent choice for this environment as they meet the above demands.as Shown in fig 3.1

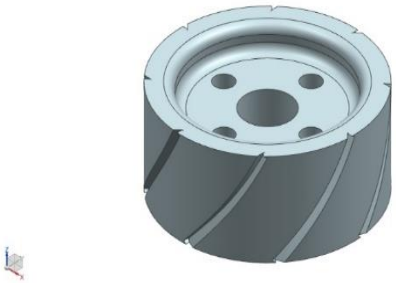

Fig. 3.1 Wheel

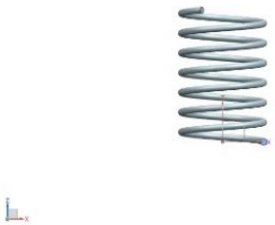

Fig. 3.2 compression spring

2. Compression spring:

A spring is an elastic substance used to store mechanical Energy. Spring used here is built out of hardened steel. Compression spring is essentially used to exert tension. The function of spring is as follows. The force that the robot mechanism movement on the pipe walls is develop with the help of stretchable spring. The helical spring disposed on the central axis assures the repositioning of the structure, in the case of the pipe diameters fluctuation. Shown in fig 3.2

3. Body frame:

This design of pipe inspection robot structure of frames considered as 10 inches length,5 inches breadth and suitable height is considered as per required pipe diameter as shown in fig.3.3

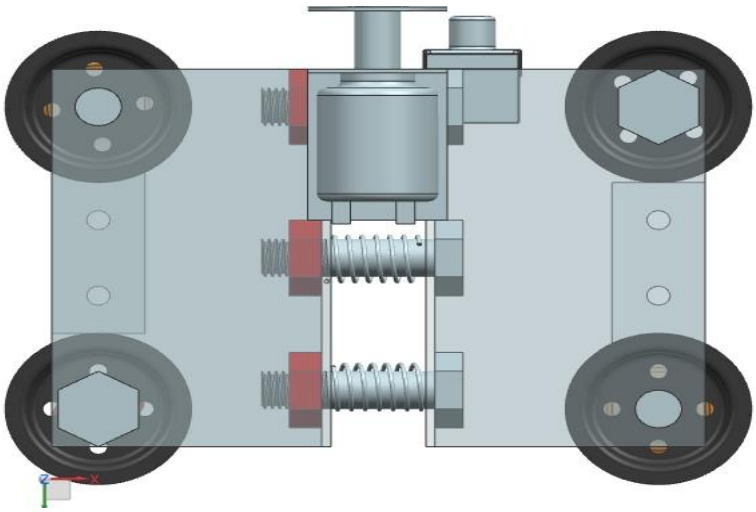

Fig. 3.3 Frame

4. Bolts and nuts:

Bolts and nuts are mainly used to join the similar and dissimilar materials. Shown in fig 3.4

Fig. 3.4 Bolts and Nuts

3. COMPONENTS OF PIPE INSPECTION ROBOT

1. Channel Relay Circuit:

Control relay is a sequence of Transmitter and Receiver which involve Relays and Speed Control through two-way switches is shown in Fig. 4.1 This makes the system very easy to operate and integrate with actual systems. The control switches works the similar relay on the receiver board.

Fig. 4.1 Channel Control Relay

Fig. 4.2 Power supply board

***2. Power Supply Board*:**

The power supply board as shown in Fig. Is used to control and regulate the voltage. A potentiometer present on the board can be used to change the resistance, thereby changing voltage. This results in control of the speed of the motor.as Shown in fig.4.2

3. *DC Motors:*

A DC motor converts electrical energy to produce energy, generally through the interaction of magnetic fields and current-carrying conductors. The reverse process, generating electrical energy from mechanical energy, is proficient by an alternator, generator or dynamo. Many category of electric motors can be run as generators, and vice versa. DC motor works on the basis, when a current transfers conductor is located in a magnetic field, it practice a torque and has a tendency to move. If the control of current in the wire is reversed, the direction of rotation also reverses. When magnetic field and electric field cooperate, they produce a mechanical force, and based on that the working principle of dc motor established. DC motors are used to conclude the drive on wheels and rotation of rods.as Shown in fig. 4.3

Fig. 4.3 DC Motor

Fig. 4.4 USB camera

4. USB Camera:

A USB camera is a video camera that feeds its image in real time to a computer or computer network. USB camera is usually connected by a USB cable, FireWire cable, or similar cable. Their most attractive use is the establishment of video links, permitting computers to act as videophones or videoconference stations. The natural use as a video camera for the World Wide Web gave the USB camera its name. An alternative popular use consists of security surveillance, computer vision, video broadcasting, and for recording social videos. USB cameras are established for their low manufacturing cost and flexibility, making them the lowest cost form of videotelephony. They have also become a source of security and privacy issues, as some built-in USB cameras can be remotely activated via spyware. As shown in fig. 4.4

***5. Batteries*:** Batteries provide supply for a motor and camera. Motor and radio frequency gets 6v supply from the central body and camera gets supply from a 9v battery. And 3v batteries for transmitter which has two toggle switches. One is for motor forward and reverse control and the other one is for glowing LED's.as shown in fig. 4.5

Fig. 4.5 Batteries

***6. LED Bulb*:** A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices, and are progressively used for lighting. Early LEDs emitted low-intensity red light, but current versions are ultraviolet and infrared wavelengths, with very high brightness.as shown fig 6.

Fig. 4.6 LED

4. FABRICATION AND WORKING:

Fabrication:

The invention of design involves production of the parts designed by using NXCAD designed software. The suitable dimensions of designed parts taken as per required diameter of the pipe. it also the alternative of appropriate electronic circuitry which can be completely used to manage and control the robot motion. The various techniques used in fabrication of the components are Cutting, Drilling.

Circuit integration and assembly:

At the end of design, the electronic circuitry is integrate onto the robot. The DC motors are attached to the wheels, the approach relay is combined with all the DC motors. Suitable wiring is done and a 12 V battery is connected to all electronic components. The fully assembled robot is shown in fig: 4.1

Working:

The complete design of the robot leads to the next development of the project Working. Here the robot is monitor for its performance of the desired functions. Drive to the wheels is obtained through DC motors. These motors are attached through relay switches which control the start/stop work and rotational direction of the motors. The robot functions through the electronic circuit - mechanism interface. One relay switch, worked manually, is used to manage the development of the pipe evaluation robot. The

camera fixed at the one side of the robot is switched on manually and the other side of the robot brushing mechanism is located on the robot. This brushing mechanism is necessary role to clean the interior pipes. RF receiver is set up with connections made to a TV monitor. The DC motors to the wheels are connected through the channel relay circuit. This makes the wheels rotate at a set rpm. Once fixed abundantly inside the pipe, the manual relay switch is influenced and controlling the robot so as to accommodate to the pipe diameter. The development is continued till suitable gripping is achieved. The gripping establish motion in horizontal or vertical direction. The channel relay circuit is controlled through the remote for forward motion and back ward motion of robot. Camera plate is monitored through another relay on the circuit board. This is activated to initiate rotation of camera. As the robot proceeding inside the pipe, signals are transfer to the receiver providing outlook of the inside surface of pipes.

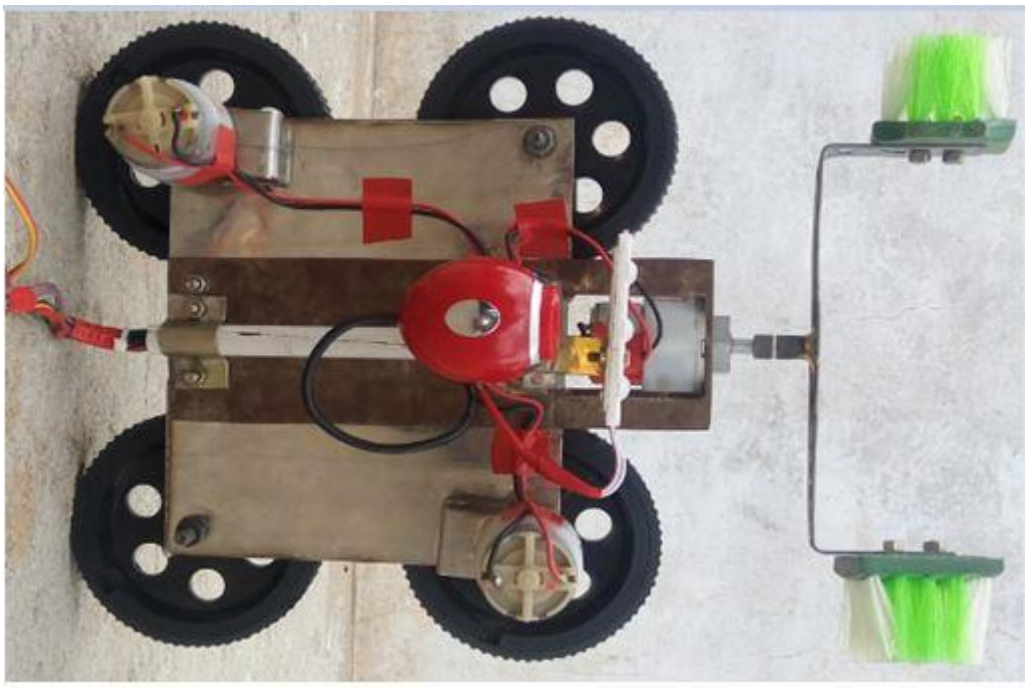

Fig: 4.1 Pipe inspection robot

5. RESULTS:

Pipeline systems resulting in a number of defects are as fallows. Evaluation of defects is an important problem in chemical plants, sewage pipes and oil and gas refinery industries. This conceptual design aimed to create an autonomous robot for inspection, repairing and maintenance capable of vertical and horizontal motion suitable to the interior piping systems. The following results were obtained from the completion of the project.

Fig. interior pipe defects

The robot was capable of adapting to pipe diameters in the range of 10 inches. The robot was tested for motion in a 10 inches pipe. It was found to move well in both horizontal and vertical direction. The camera transmitted the video feed through the RF transmitter onto a PC screen.

CONCLUSION AND FUTURE SCOPE:

Conclusion:

Robots can be precisely used as tools to carry out performance in labour intensive, hazardous and unreachable work environments. A very necessary conceptual design intension of the robotic systems is the adaptability to the inner diameters of the pipes. So, we had recommended a new concept design in inspecting, repairing and maintenance pipelines. A real prototype was developed to test the feasibility of this robot for inspection, repairing and maintenance of interior pipelines. Concept and design could regulate all

the problems. The types of evaluation tasks are very different. The robot is designed to be able to traverse horizontal and vertical pipes. Robots can be successfully implemented in pipe line inspections for better detection of defects.

***Future scope*:**

The project is limited in several ways and can be worked upon to develop its features and applications. A few of the developments that can be achieved are mentioned below.

- Use of tilted and guide wheels for traversing curves and bends in pipes.
- Use of lighter material for the links to reduce the weight.
- Infrared/Ultrasonic inspection for better detection of defects.
- Implementation of long range sensors.
- Implementation as a bore well rescue robot. Alternate design without links to facilitate better motion.

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