Oil/Water/Gas Pipeline Crawling Robot

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Abstract— Pipeline Crawling Robot is playing an important and expanding role in Remote Testing and Inspection of 8.5 in. to 8 ft. diameter pipe. It provides the power, process and pulp industries an economical and time-saving approach to inspection of insulated, buried or inaccessible pipe. Three locomotive mechanisms commonly-employed Non-Destructive Testing (NDT) Sensors and techniques, as well as field deployments are discussed in this paper.

Key words: Water Pipeline Crawling Robot, Oil Pipeline Crawling Robot

I. INTRODUCTION

Industrial ductwork has been widely used in metallurgy, petroleum, chemical engineering, water supply and other special professions. The formidable work environment makes pipelines easy to be eroded or fatigued which can lead to leaking accident, so the periodic maintenance and overhaul are necessary for industrial pipelines. Absence of fresh air makes it impossible for humans to perform maintenance task.

As maintenance of these pipelines is nearly impossible from outside we need a machine that can crawl inside these long pipes. The crawling robot can be wirelessly steered into the long pipelines. The embedded cameras will use the complete inside picture of a long pipeline, which would help us, detect and fix the leakages or any other technical problems. The above Robot can also be used for cleaning of the pipelines.

II. BLOCK DIAGRAM

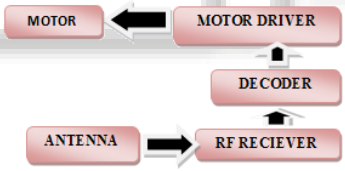

Fig. 1: Device

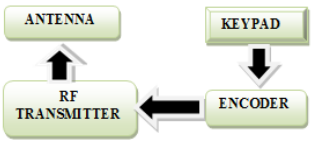

Fig. 2: Remote

III. DESCRIPTION

The constructed robot is designed in such a way that it can move in pipe very efficiently having a given range of diameter. The robot is RF controlled. The complete working of RFI based system can be divided in the following blocks for easier understanding:

IV. COMPONENT LIST

- HT12 E
- HT12D
- L293D
- DC MOTOR
- RF MODULES(434 MHz)

V. RF TRANSMITTER UNIT

This 4 bit data is essentially a RF transmitter that transmits encoded signals. It can be further classified into following parts:

A. Data 4 Bit through Switch:

This part is unique for every RF. It creates a 4-bit data that is used to identify when the data is read by RF reader.

B. Encoder:

This part converts the data into an encrypted data that can be transmitted over RF channels. The encoder used here is HT12E which can be used to encrypt 4 bit data. The encrypted data is a serial digital signal.

C. Transmitter:

This part takes the encrypted data from transmitter and transmits it in form of Radio Frequency. The transmitter used here is ASK 434 MHz RF-TX modules.

Fig. 3: Transmitter

D. Power Supply Block:

This consist a 12V power supply source and a power regulator (7805) to get 5v power supply. This 5v supply drives the transmitter and the encoder.

Fig. 4: IC (7805) and 12v Battery

VI. RF DATA RECEIVER

This reader is basically a RF receiver that receives encoded signals decodes them and. It can be further classified into following parts:

A. Receiver:

It receives the encrypted data in form of RF waves and converts it into electronic signals. The receiver used here is ASK 434 MHz RF-Rx modules.

Fig. 5: Receiver

B. Decoder:

This part decrypts the data to yield the 4-bit data. This data is fed into the circuit. HT12D has been used here which is compatible with HT12E module. The output is the 4 bit data format.

Fig. 6: Decoder IC (HT12D)

VII. COMPONENTS DETAILS

A. RF Module:

Radio Frequency Module is an integral part of boarder security system together with a control module or unit and an antenna it is used for wireless identification. Main tasks of the RF module are to send an energizing signal via the antenna. The RF module delivers a digital data stream and a clock signal for further processing to its control unit or module. Furthermore a field strength dependent digital output is available for synchronization purposes. The RFM is tuned to resonance with the antenna by adjusting the inductance of the tuning coil at the RFM's output stage.

B. RF Module can be categorized into two parts:

- Transmitter
- Receiver

VIII. TRANSMITTER

This wireless data is the easiest to use, lowest cost RF link we have ever seen! Use these components to transmit position data, temperature data, and even current program register values wirelessly to the receiver. These modules have up to 500 ft range in open space. The transmitter operates from 2-12V. The higher the Voltage, the greater the range - see range test data in the documents section. We have used these modules extensively and have been very impressed with their ease of use and direct interface to an MCU. The theory of operation is very simple. This is an ASK transmitter module with an output of up to 8mW depending on power supply voltage. The transmitter is based on SAW resonator and accepts digital inputs, can operate from 2 to 12 Volts-DC, and makes building RF enabled products very easy.

A. Features:

- 434 MHz Transmitter Operation
- 500 Ft. Range - Dependent on Transmitter Power Supply
- 2400 or 4800bps transfer rate
- Low cost
- Extremely small and light weight

IX. RECEIVER

This receiver type is good for data rates up to 4800bps and will only work with the 434MHz transmitter. Multiple 434MHz receivers can listen to one 434MHz transmitter. This wireless data is the easiest to use, lowest cost RF link we have ever seen! Use these components to transmit position data, temperature data, even current program register values wirelessly to the receiver. These modules have up to 500 ft range in open space. The receiver is operated at 5V. We have used these modules extensively and have been very impressed with their ease of use and direct interface to an MCU. The theory of operation is very simple.

A. Features:

- 434 MHz Operation
- 4800 bps transfer rate
- Low cost
- Extremely small and light weight

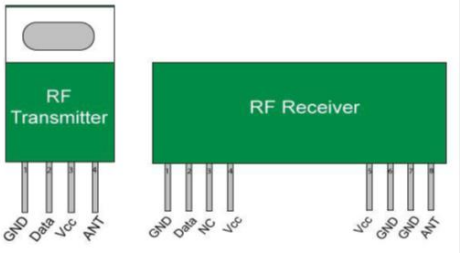

Fig. 7: RF Transmitter and RF Receiver

X. MICROSWITCH

A micro switch, also known as snap-action switch, is a generic term used to refer to an electric switch that is actuated by very little physical force, through the use of a tipping-point mechanism. They are very common due to their low cost and durability, greater than 1 million cycles and up to 10 million cycles for heavy duty models. This durability is a natural consequence of the design. Internally a stiff metal strip must be bent to activate the switch. This produces a very distinctive clicking sound and a very crisp feel. When pressure is removed the metal strip springs back to its original state. Common applications of micro switches include the door interlock on a microwave oven, levelling and safety switches in elevators, vending machines, and to detect paper jams or other faults in photocopiers. Micro switches are commonly used in tamper switches on gate valves on fire sprinkler systems and other water pipe systems, where it is necessary to know if a valve has been opened or shut.

The defining feature of micro switches is that a relatively small movement at the actuator button produces a relative large movement at the electrical contacts, which occurs at high speed (regardless of the speed of actuation). Most successful designs also exhibit hysteresis, meaning that a small reversal of the actuator is insufficient to reverse the contacts; there must be a significant movement in the opposite direction. Both of these characteristics help to achieve a clean and reliable interruption to the switched circuit.

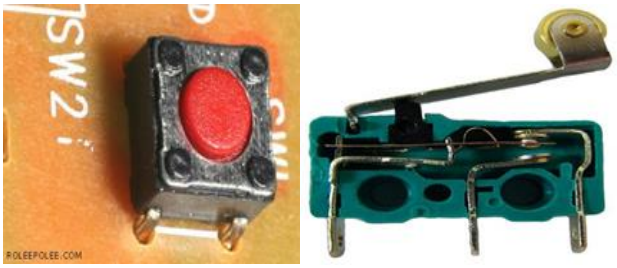

Fig. 8: Microswitches

The first micro switch was invented by Peter McGall in 1932 in Freeport, Illinois. McGall was an employee of the Burgess Battery Company at the time. In 1937 he started the company MICRO SWITCH, which still exists as of 2009. The company and the Micro Switch trademark have been owned by Honeywell Sensing and Control since 1950.The trademark has become a widely used description for snap-action switches. Companies other than Honeywell now manufacture miniature snap-action switches.

Micro switches are applied in appliances, machinery, industrial controls, vehicles, and many other places for control of electrical circuits. Micro switches are usually rated to carry current in control circuits only, although some switches can be directly used to control small motors, solenoids, lamps, or other devices. Micro switches may be directly operated by a mechanism, or may be packaged as part of a pressure, flow, or temperature switch, operated by a sensing mechanism such as a Bourdon tube. A motor driven cam and one or more micro switches form a timer mechanism. The snap-switch mechanism can be enclosed in a metal housing including actuating levers, plungers or rollers, forming a limit switch useful for control of machine tools or electrically-driven machinery.

XI. MOTOR DRIVER

Here we used L293D to drive the motors .whatever signals it receives from the on the basis of that it will drive the motors.

XII. DC MOTOR

A direct current (DC) motor is a fairly simple electric motor that uses electricity and a magnetic field to produce torque, which turns the motor. At its most simple, a DC motor requires two magnets of opposite polarity and an electric coil, which acts as an electromagnet. The repellent and attractive electromagnetic forces of the magnets provide the torque that causes the DC motor to turn.

XIII. WORKING

The input is 230V AC which is step down using the transformer (12-0-12) .The 12V ac input is fed to the bridge diode to gives 12V pulsating DC. This DC voltage is filtered through the capacitor to remove the ripples. The filtered DC is fed to 7805 regulator to fetch +5v regulated output. This regulated voltage is given to all the components to function properly.

The data here is basically a binary sequence. Here we use a 4-bit system. The 4 bits data are controlled by the four switches. The transmitter section will consist of the switches (enables binary sequence) and HT12E encoder that encodes the parallel data to serial data. Now this serial data is transmitted over 434Mhz carrier channel using ASK modulation through a short dipole antenna.

The receiver section consist RF receiver which receives the serial data on same carrier frequency and HT12D decodes the serial to the parallel data (as initially was on the transmitter). This 4 bit data received will drive the motor driver and the driver in turn will drive the motors of the oil pipeline crawling to perform the operations

XIV. TESTING

- Connect the black terminal of the Digital Multimeter to the ground of the supply source and turn the knob to 20V DC voltage.
- Check the continuity and short circuit of the PCB's.
- Before placing the IC test the power supply first
- Check the voltages at pin o (output) of all the three 7805 and it should be +5 volts.
- Check the voltage at pin 1 and pin 8 of L293D IC it should be +5 volts.
- Check the voltage at pin 9 and pin 16 of L293D IC it should be +12 volts.
- Check the direction of RF module, the ant point should be towards antenna.

XV. TESTING TRANSMITTER SECTION

- Encoder Pin 18 is (Vcc) , and Pin 9 and pin14 is Ground, Pin 1 & 3 of RF is Vcc & ground
- Check the pin number 10,11,12,13 default voltage +5V without pressing the buttons
- Check the pin number 10,11,12,13 default voltage 0V pressing the buttons.
- Check the pin 17 in case 2 default voltage V1
- Check the pin 17 in case 3 default voltage V2, V1<V2

XVI. TESTING RECEIVER SECTION

Test it putting the transmitter on.

- Decoder Pin 18 is (Vcc), Pin 9 Ground, Pin 1 &3 of RF Vcc & ground.
- Check the pin number 10,11,12,13 default voltage +5V without pressing the buttons.
- Check the pin number 10,11,12,13 default voltage 0V pressing the buttons.
- Check the pin 14 in case 2 default voltage V1.
- Check the pin 14 in case 3 default voltage V2, V1<V2.

XVII. FUTURE SCOPE

As we are observed that in industry, home, power plant etc. There are several problems occurs inside the pipe like Corrosion , Cracking , Dent Mark , Metal Losses etc. so , we are inspecting the pipe with the help of "PIPE INSPECTION ROBOT". In future we can install a mechanical arm, air blower, vacuum, an embedded software can be installed which can help for coordination between all the component and work according to command given by the operator

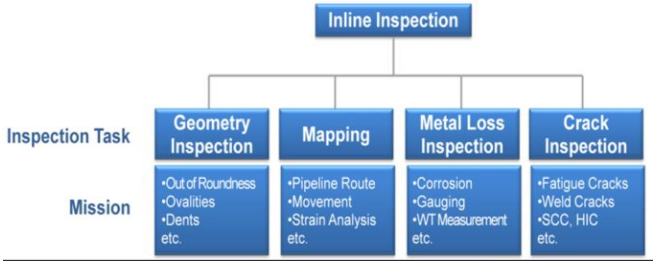

Fig. 9: Flow chart showing scope of pipe inspection

XVIII. CONCLUSION

Pipeline crawling robot is though still in early development stages, have proved invaluable to inspection of plant

equipment and piping at nuclear, fossil and hydroelectric power stations. PCIRs offer more comprehensive inspection, improved safety and plant reliability, and help solve maintenance and operation problems economically. The goal of this project was to developed a pipeline crawling robot by using motor driver. We can also understand how the command passes through various modules & how the robotic body will be work as per our command. We can increase the system performances by give them training & we are trying to implement more advanced mechanism

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