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EXTERNAL CRAWLING ROBOT FOR FAULT DETECTION IN PIPE

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Abstract:-

The target of the undertaking is to plan a conservative and consistent outer line creeping gadget that helps the assessment of the line in ventures to identify the spillage of gas in the line. The robot is constrained by the remote for its development. The interesting element of the plan of the line crawler is that it can slither in the two ways and stops its creeping when an issue is recognized. The gadget comprise of two rings that are connected to one another along the longitudinal pivot of the line. In the middle of the two rings the agreeable system is put. The consistent system comprise of the tension sensor which detects the air spillage from the line. The agreeable instrument changes the data about spillage in the line to the microcontroller. The microcontroller shows the shortcoming data in the LCD show and alongside the distance where precisely the issue is found from the beginning stage of the robot. One more benefit of the plan is that the robot stops itself toward the finish of the line by the surface sensor and abstain from tumbling down. The PIC 16F877A microcontroller which orders the robot by getting the guidelines from the client through the remote. In view of the order from the client the microcontroller will run the engines in the robot through the driver circuit (ULN 2803). The working of the microcontroller is coded utilizing c language. The robot assists with tracking down the area of the issue in the line and keeps away from spillage and harm in a huge degree. This smaller and agreeable outer line slithering robot will basically go about as a Pipe Inspector.

I. INTRODUCTION

Robots have become important over a wide range of applications. A Robot is an automatically guided machine which is able to do task of its own due to electronically programmed instructions. The pipe crawlers are classified into two types: They are 1. Internal pipe crawlers and 2. External pipe crawlers. The Internal pipe crawlers crawls inside the pipe. The External pipe crawlers travels outside the pipe. The External pipe crawlers are classified into many types

based on the locomotion methods, as wheeled crawler, walk- ing crawler, sliding crawler, and inchworm crawler. Wheeled crawlers work well only on even surfaces. Walking crawlers require sensors and sophisticated control to have the necessary gait and to avoid obstacles. Sliding crawlers need tracks or treads. In comparison with other crawlers, inchworm crawlers are less cumbersome and are less affected by irregular- ities. Many of the crawlers reported in the literature are internal crawlers. However, the focus of this paper is not on internal crawlers. External inchworm-type pipe crawlers have received modest attention in the literature. This project presents a dynamic model for a pipeline robot which obtain power from 12V battery. The robot is designed to move both in forward and reverse direction. This bidirectional capability makes it very valuable to many industries. This robot includes several mechanical features, including designs for its chassis. One of the key techniques to develop pipeline crawling robot is electrical drive. More driving spots, more flexible action, lower power consumption and other special requirements are making the motor driving technique very challengeable. Based on simulation prototype of crawling robot driven by solinoid gunn for inspection the outer surface of seabed pipelines, this project focuses on the complient mechanism which gives the exact location of the fault in the pipe, including design drive control system, hardware design of the control system, intelligent crawling control and experiments. (Vasanthy and Jeganathan 2007, Vasanthy et.al., 2008, Raajasubramanian et.al., 2011, Jeganathan et.al., 2012, 2014, 2020 & 2021 , Sridhar et.al., 2012, Gunaselvi et.al., 2014 & 2020, Premalatha et.al., 2015, Seshadri et.al., 2015, Shakila et.al., 2015, Ashok et.al., 2016, Satheesh Kumar et.al., 2016 & 2019).

II. OBJECTIVE

Although the appearance and the capabilities of robots vary vastly, all robots share the feature of a mechanical, movable structure under some form of control. Designing a robot chassis will be the first objective of this project. The Control of robot involves three distinct phases: - perception, processing and action. Generally sensors/or command receivers are preceptors mounted on the robot, processing is done by the on-board microcontroller, and the task is performed using motors or with some other actuators. We need to design a complaint mechanism for finding the exact fault location and need to design a robot that will function in both forward and backward direction.

III. MOTIVATION

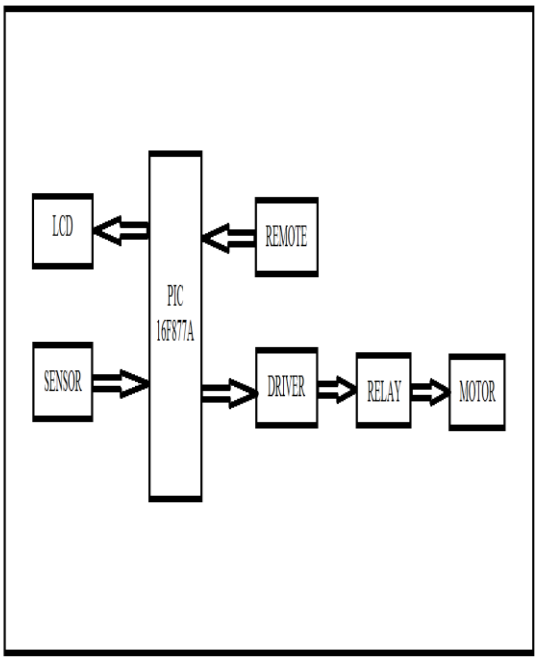
In order to inspect pipes, a robot is developed. Here we designed a robot that can be used for finding the fault in the pipe. The main components used in this are: DC gear motor, driver, relay, 12V battery .Basically, the robot is controlled through the remote by the user. Our prototype of ‘Crawling Robot for Fault detection in Pipes’ has the capability to move on the pipes and

perform the desired task smoothly. For moving outside the pipes, robot should have a efficient crawling mechanism. Enough pressure should be applied for gripping mechanism to create sufficient friction to hold the robot on its place. (Manikandan et.al., 2016, Sethuraman et.al., 2016, Senthil Thambi et.al., 2016, Ashok et.al., 2018, Senthilkumar et.al., 2018, Sundar and Jeganathan 2019 & 2020, Anandan et.al., 2019, Murugavel et.al., 2019, Arokiaswamy et.al., 2019 & 2020, Ganesh Babu et.al., 2020, Gomathi et.al., 2019 & 2020, Manju et.al., 2020, Leema Rose et.al., 2020).

IV. DESCRIPTION OF WORKING

The major concepts/components used in this project are DC gear motor, driver, relay, Crawling - designing, power circuit and power transmission etc. We designed a Remote based control system to control Robot. The command from the user is decoded by the microcontroller, on the basis of which driver will turn on the corresponding relay of the robot and robot crawl on the pipe. The crawling mechanism consists of two rings that hold the pipe tightly when there is no actuation. It crawls like an inchworm by alternately releasing the grip of one of its rings with actuation, and moving to and fro with a linear actuator that connects the rings. Hence, it necessitated a compact mechanism and actuator. Since multiple dedicated crawlers are needed for all the pipes, it is also imperative that the cost is kept low. This implies that the design should be simple, use as few parts as possible, and minimize assembly. This challenge is met by a unibody compliant ring actuator actuated by screw thread mechanism. The screw is driven by the DC gear motor. As the robot moves on the pipe the fault in the pipe is sensed by the sensor and intimated to the user on the LCD display.

V. BLOCK DIAGRAM



VI. DESCRIPTION

The constructed robot is designed in such a way that it can move in pipe. The robot is Remote controlled. The complete working of Remote based system can be divided in the following blocks for easier understanding:

a) Components list:

- PIC 16F877A
- ULN 2803
- RELAY
- DC GEAR MOTOR
- SOLLINOID GUNN
- LIMIT SWITCH
- FAULT DETECTING SENSOR
- FALLING SENSOR

b) Component details:

PIC 16F877A :

PIC is a family of Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC1640. Originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to **"Programmable Interface Controller".** PICs are popular with both industrial developers and hobbyists alike due to their low cost, wide

availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability.

The PIC16F877A CMOS FLASH-based 8-bit microcontroller is upward compatible with the PIC16C5x, PIC12Cxxx and PIC16C7x devices. It features 200 ns instruction execution, 256 bytes of EEPROM data memory, self programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, a synchronous serial port that can be configured as either 3-wire SPI or 2-wire I2C bus, a USART, and a Parallel Slave Port.

FEATURES:

- Operating speed: 20 MHz, 200 ns instruction cycle
- Operating voltage: 4.0-5.5V
- Industrial temperature range (-40° to +85°C)
- 15 Interrupt Sources
- 35 single-word instructions
- 33 I/O pins; 5 I/O ports
- 10-bit, 8-channel A/D Converter

ULN2803 DRIVER:

A ULN2803 is an Integrated Circuit (IC) chip with a High Voltage/High Current Darlington Transistor Array. It allows you to interface TTL signals with higher voltage/current loads. In English, the chip takes low level signals (TLL, CMOS, PMOS, NMOS - which operate at low voltages and low currents) and acts as a relay of sorts itself, switching on or off a higher level signal on the opposite side.

A TTL signal operates from 0-5V, with everything between 0.0 and 0.8V considered "low" or off, and 2.2 to 5.0V being considered "high" or on. The maximum power available on a TTL signal depends on the type, but generally does not exceed 25mW (~5mA @ 5V), so it is not useful for providing power to something like a relay coil. Computers and other electronic devices frequently generate TTL signals. On the output side the ULN2803 is generally rated at 50V/500mA, so if can operate small loads directly. Alternatively, it is frequently used to power the coil of one or more relays, which in turn allow even higher voltages/currents to be controlled by the low level signal. In electrical terms, the ULN2803 uses the low level (TTL) signal to switch on/turn off the higher voltage/current signal on the output side. The driver will drive the relay so that corresponding relay will give supply to the motors.

FEATURES:

- TTL, DTL, PMOS, or CMOS Compatible Inputs
- Output Current to 500 mA
- Output Voltage to 95 V
- Transient-Protected Outputs
- Dual In-Line Package or Wide-Body Small-Outline Package

RELAY:

A relay is an electro-magnetic switch which is useful if you want to use a low voltage circuit to switch on and off a motor connected to the mains supply. Here the motors are connected to the 12v battery directly through the relay. These relays are driven by the signal from the driver ULN 2803 The relay will drive the corresponding motors according to which it is progammed to the controller.

DC GEAR MOTOR:

A geared DC Motor has a gear assembly attached to the motor. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM .The gear assembly helps in increasing the torque and reducing the speed. Using the correct combination of gears in a gear motor, its speed can be reduced to any desirable figure. This concept where gears reduce the speed of the vehicle but increase its torque is known as gear reduction. This Insight will explore all the minor and major details that make the gear head and hence the working of geared DC motor. A single motor is used to for forward and backward direction of the Robot. The two rings in the motor will be is connected using the screw. As the motor runs the screw will operate in screw thread mechanism which will move one of the ring towords the another. By this the movement of the robot in the pipe is made.The motor will operate at 12v supply directly from the Battery.

SOLINOID GUNN:

The Solinoid gunn will grip the pipe when it is excited ahe will lose the grip when it is excited next time. In this project four sollinoid gunns are used. Two gunns are used in first ring and other two gunns are used in the second ring. When the motor runs he gunns in the first ring will grip as it is also excited. Then as the motor runs the screw rotates and the second ring come close to the first ring. Then the motor stops rotating , the first set of gunn release its grip and the second set of gunn will grip the pipe. Then the motor starts rotating. Then the first ring will move in forward direction. By this mechanism the crawling function is made to the robot.

LIMIT SWITCH:

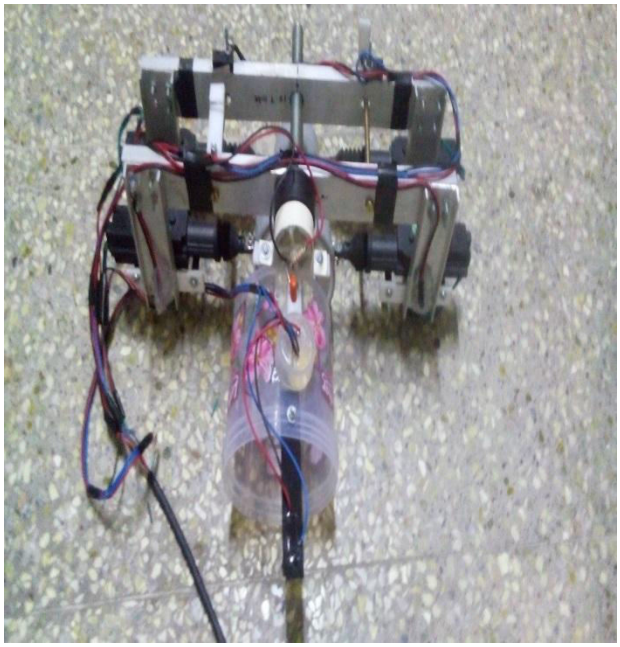
The limit switches are used to avoid the collision of the rings. As the second ring come closure to the first ring then, it hits the limit switch which is placed in the first ring. So the motor stops rotating and the next leep takes place.

FAULT DETECTING SENSOR:

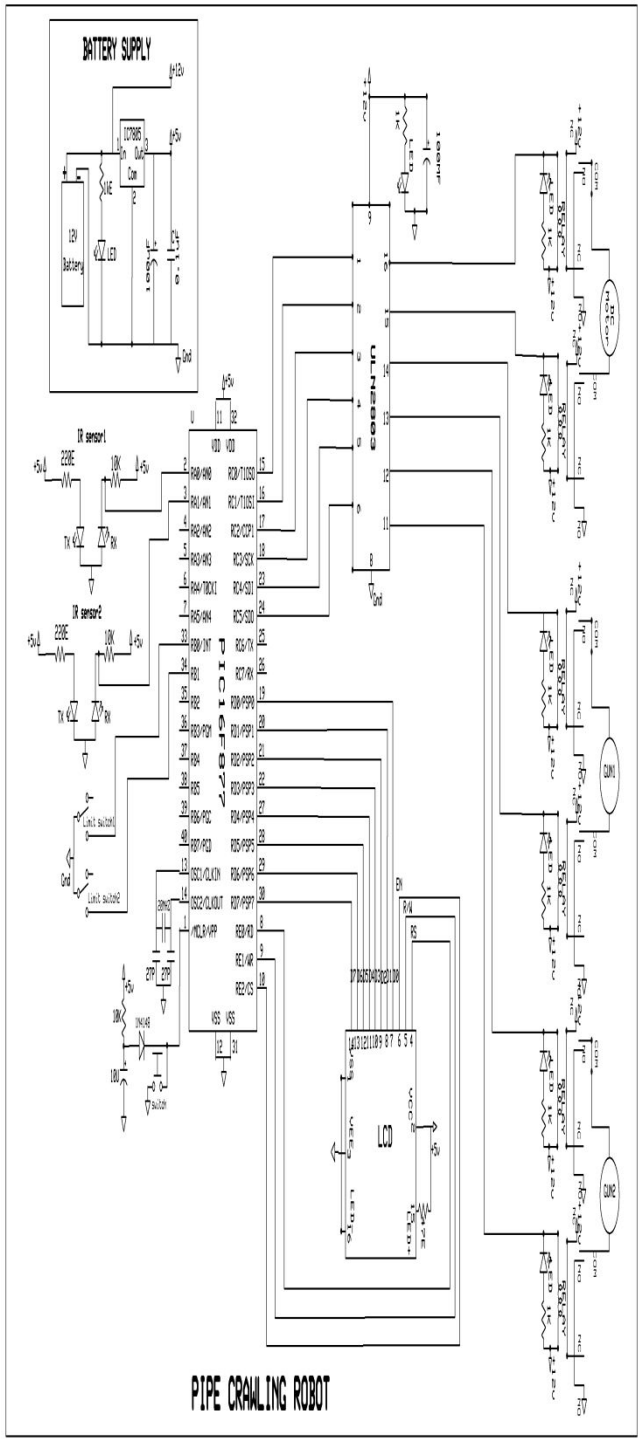
The fault in the pipe is detected by passing the air through the pipe, if there is a fault in the pipe then the air will leake and the leakage of the air is sensed by the sensor and intimated to the user with exact distance from the starting point of the robot.

FALLING SENSOR:

The Falling sensor is used to stop the robot at the end of the pipe to avoind falling down.



VII. CIRCUIT DIAGRAM



VIII. EXPLANATION

The PIC is coaded for specific functions. When it get the information from the remote, act according to the programed function and moves in the pipe. When it detects the fault, it will stop its operation and intimate about the fault with the distance of fault location to the user through the LCD display.

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