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ADVANCEDPIPE CRAWLING CRACK SENSOR ROBOT

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ABSTRACT

This paper outlines the design of the robot which a compact and which can is used for the external side of the pipe crawling and the main advantage of this robot is, it can be used as where some bulk of pipes are placed which is hazardous to humans to check and also we can inspect the robot from nearer.The robot consists of a ring type actuators that will be connected while robot crawling on pipe which will be also easy to dismantle from pipe after operation. The robot moves in forward and backward direction on the pipe.The robot will be moving slowly so that it checks the parameters of the pipe . The wires are been guided by the the insulating rollers.The features in the robot is it has limited space to move and also guides the wires.The robot is activated from the transmiter side which controls the direction and halt funtion.The robot can crawl on pipe of 50-mm diameter pipe. Drive control system plays important roles in pipeline robot. In order to inspect theflaw and corrosion of seabed crude oil pipeline, an original mobile pipeline robot with crawler drive unit, power and monitor unit, central control unit. The implementation of the crawl robot demonstrates that the presented drive control scheme can meet the motion control requirements of the underwater pipeline crawl robot.

I. INTRODUCTION

Robots can be thought of as computers equipped with sensors, instrumentation, and mobility to interact with the environment. Most current models crawl on treads or maneuver on wheels under the guidance of a human operator employing remote-control via a communications and power tether. Some are mobile underwater, while some are amphibious. Several emerging models even walk in a manner similar to the gait of insects. Robots encompass several technologies, and will evolve as rapidly as advances occur in computer systems, electronics and motion controls. Miniaturization of cameras, high torque motors and integrated circuits allow designers to create very small-scale models. Most of today's robots are used for inspection, surveillance, and monitoring tasks in utility work areas. Some current applications are listed below.

* Remove humans from potentially hazardous work situations Allow inspection of inaccessible and/or hazardous equipment or work areas.

* Provide on-line inspection/maintenance without loss of equipment plant availability Provide information about the health and condition of critical plant components to facilitate decision-making regarding plant life management:

* Reduce equipment/plant downtime.

* Improve maintenance & inspection procedures through better coverage & documentations.

Industrial ductwork has been wildly used in metallurgy, petroleum, chemical engineering, water supply and other special professions. The formidable work environment makes pipeline easy to be eroded or fatigued which can lead to leaking accident, so the periodic maintenance and overhaul are necessary for industrial pipelines. Currently, in-pipe robot with tether, which enables the robot to have the enough energy supplies and promptly make up the power loss, still has important application value owing to avoid carrying a heavier energy devices, but the noticeable friction forces of tether restrict the traction force of robot, locomotion distance away from entrance, and the steering inside pipelines with elbows. Therefore, the development of autonomous in-pipe locomotion robot without it becomes urgent, such that the robot can be adaptive to the work of long and complicate pipeline . One of the key techniques to develop in-pipeline locomotion 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 in-pipe robot driven by six wheels for inspection the inner surface of seabed pipelines , this project focuses on the drivecontrol system of its engineering prototype without tether, including design drive control system based on engineering requirements, hardware design of the control system, intelligent crawling control .

Robots are being used successfully in nuclear and fossil power plants, and in electric and gas energy distribution. Significant resultant savings to users are often realized within one year or less of purchase. Public Service Electric & Gas (PSE&G) Company reports $2 savings in O&M costs for every $1 spent on robotic hardware. Additionally, many users report savings of $50,000 or more for each robot purchase. Tomorrow's advanced generation of robots will have more "brains on-board," with the ability to perform actual maintenance tasks. Designed with built in artificial intelligence, they may prove invaluable to industry, being used throughout entire energy generation and delivery systems.

Interestingly, a recent survey of utility and robot vendors identified pipe crawling robots as one of the largest current applications. Of 192 areas surveyed, 33% were pipe inspection applications. This paper discusses pipe crawling robots and highlights several new applications. Well-functioning water networks are essential to the sustainability of a community. Large transmission and distribution water mains are often the most sensitive components of these networks since their failure can be catastrophic. Furthermore, due to the high cost of these pipes, the system does not usually provide redundancy to enable decommission for maintenance and rehabilitation. Hence, failure of such water mains often carries severe consequences including loss of service, severe damages and water contamination. Aging water mains often suffer from corrosion, tuberculation or excessive leakage. These problems can affect water quality and decrease hydraulic capacity of the mains contributing to water loss. In some cases, the main may be structurally weak and prone to breakage. Prevention and/or early detection of such catastrophic failures need a comprehensive assessment of pipe condition. A proactive inspection approach is critical to the condition assessment as well as cost-effective repair and renewal of water mains. Regular cyclic inspections can provide information on the physical conditions of the pipes and on the rates of material deterioration. Nondestructive technologies for evaluating pipe condition are essential tools for the early detection.

II. ROBOTS AND PIPE SYSTEMS

Every utility, whether electric or gas, hydro, nuclear or fossil fuel, has its share of piping systems. Regardless of the materials, fluids, or gases carried through them, piping systems have a limited life cycle. They are vulnerable to, and are often damaged by vibration, shock loading, thermal cycling, corrosion, cracking, pitting, joint failure, etc. Equipment damage and plant outage costs resulting from the above can be minimized if

(1) utility engineers can better anticipate failures .

(2) a method is available for more timely, comprehensive inspection of piping system interiors.

One method of pipe inspection involves insertion of a borescopic/fiber optic device linked to a TV camera to view a selected pipe area. Another involves insertion of push rods with a camera attached to the end for inspection ' of a longer length of pipe.Not long ago, small power plant workers even crawled into pipes for welding, grinding, cleaning, inspection, and retrieval.

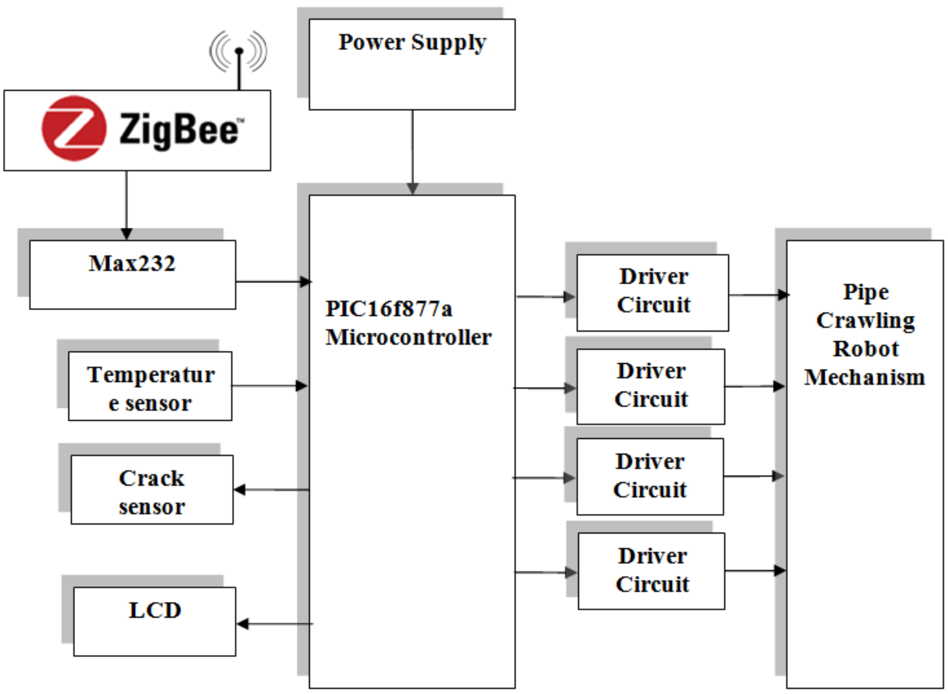
These methods, while useful, are incomplete. With robots, inspections of entire piping systems are now possible, exposing previously undetected faults and potential problems. Current technology allows robots to be built small enough to traverse pipes with diameters of 4 in. or greater. Advances in technology will soon enable robots to enter diameters as small as 2 to 3 inches. Micro-robots, like those under development at Massachusetts Institute of Technology and other academic centers, may, within ten years, traverse pipes as small as human arteries. Most pipe crawling robots easily negotiate level pipe runs, and can climb and descend pipes with inclinations of 30 degrees or less. Vertical pipe runs are more difficult to achieve and few robots today perform this feat. Robots may also have difficulty maneuvering through pipes with sharp 90 degree turns or those with sections. Often, the robot's shape and size is the most critical factor in determining maneuverability.

Properly-designed pipe crawling robots should include:

- A quality camera and TV for image viewing.
- Variable lights to illuminate pipe interior.
- A reliable method of mobility.
- A communications and power.
- A fail-safe method of manual retrieval.
- Videotaping capability of camera images.

III. WORKING PRINCIPLE

3.1 Block Diagram



IV. ROBOT SECTION

4.1 PIC: PIC 16F877 Architecture

PIC 16F877 is a 40-pin 8-Bit CMOS FLASH Microcontroller from Microchip. The core architecture is high-performance RISC CPU with only 35 single wordinstructions. Since it follows the RISC architecture, all single cycle instructions take only one instruction cycle except for program branches which take two cycles. 16F877 comes with 3 operating speeds with 4, 8, or 20 MHz clock input. Since each instruction cycle takes four operating clock cycles, each instruction takes 0.2 μs when 20MHz oscillator is used. It has two types of internal memories: program memory and data memory. Program memory is provided by 8K words (or 8K*14 bits) of FLASH Memory, and data memory has two sources. One type of data memory is a 368-byte RAM (random access memory) and the other is 256-byte EEPROM (Electrically erasable programmable ROM).

The core feature includes interrupt capability up to 14 sources, power saving SLEEP mode, and single 5V In-Circuit Serial Programming (ICSP) capability. The sink/source current, which indicates a driving power from I/O port, is high with 25mA. Power consumption is less than 2 mA in 5V operating condition. The peripheral features include:

(a) 3 time blocks: Timer0 for 8-bit timer/counter; Timer1 for 16-bit timer/counter; and Timer2: 8-bit timer/counter with 8-bit period register, prescaler and postscaler.

(b) Two Capture, Compare, PWM modules for capturing, comparing 16-bit, and PWM generation with 10-bit resolution.

(c) 10-bit multi-channel (max 8)Analog-to-Digital converter module.

(d) Synchronous Serial Port (SSP) with SPI (Master Mode) and (Master/Slave)

(e) Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI) with 9-bit address detection

(f) Parallel Slave Port (PSP) 8-bits wide, with external RD, WR and CS controls

(g) I/O ports.

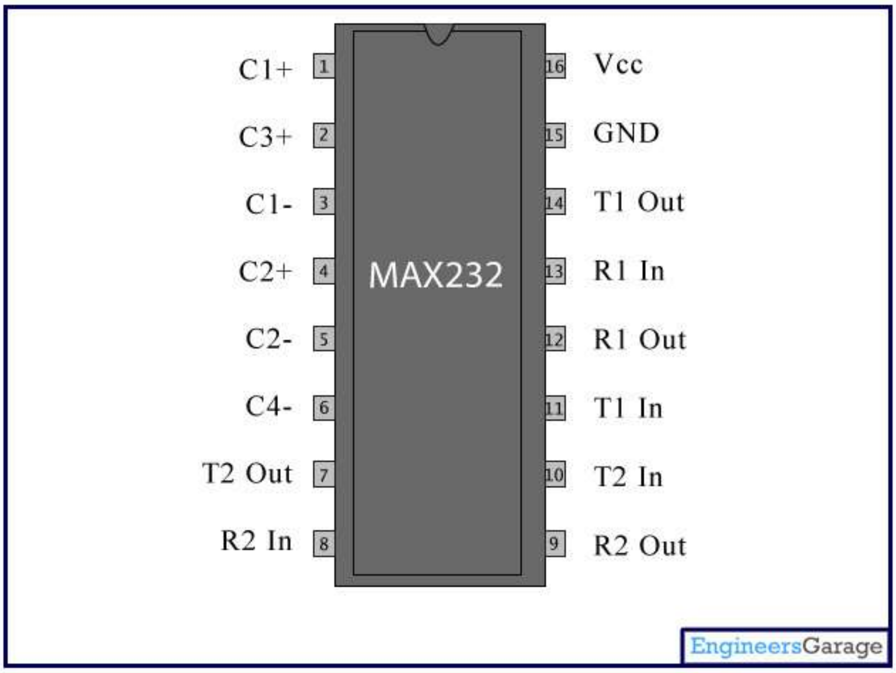
4.2 Pin and Package

There are three package types are available: DIP, PLCC, and QFP. This book assumes that we all use the DIP because of its best fit to breadboard or proto-board.

FLASH Program Memory (14-bitword)	8K Words
Data Memory (RAM)	368 BYTES
Data Memory (EEPROM)	256BYTES
Inturupts	14
I/O Ports	PORTS A,B,C,D,E
Timers	3
Capture	2
Serial communication	MSSP,USART
Parallel communication	PSP
10-bit Analog-to-Digital Module	8Channels
Instruction set	35 Instructions

4.3 Max232

A standard serial interface RS232C for a PC uses voltage levels in a range between -12V and +12V. For the serial signal used by this standard, a voltage ranging between -3 and -12V stands for a logic one (1), whereas a voltage in a range between +3V and +12V stands for a logic zero (0). In order to adjust this signal to voltage levels present on the microcontroller pins (TTL standard), it is necessary to use a voltage level converter.



The MAX232 board features a built-in circuit MAX232 used to perform necessary adjustment. This circuit is powered with a single 5V voltage. It is used to convert a serial signal from TTL to RS232C standard and vice versa by means of a built-in voltage generator. There are two connectors provided on the MAX232 board. The female connector DB9 enables connection with devices that use RS232 standard (usually a PC), whereas the 6-pin connector enables connection with the microcontroller pins intended for serial communication (USART). The MAX232 additional board can be connected to a microcontroller provided on the development system. In this case, a PROT0 board should be used for connection with the development system's I/O port. If the MAX232 board is connected to some other device, the connection is established via the appropriate 6-pin female connector or a flat cable.The board is connected to a PC via a standard serial cable provided with a pair of male-female connectorsDB9.

4.4 Temperature Sensor

There are a wide variety of temperature sensors on the market today, includeingThermocouples, Resistance Temperature Detectors (RTDs), Thermistors, Infrared, and Semiconductor Sensors. This paper will discuss three of these alternatives: the RTD, thermistor, and semiconductor sensors.Thermistor Similar to the RTD, the thermistor is a temperature sensing device whose resistancechanges with temperature. Thermistors, however, are made from semiconductor materials Resistance is determined in the same manner as the RTD, but thermistors exhibit a highly nonlinear resistance vs. temperature curve. Thus, in the thermistor's operating range we can see a large resistance change for a very small temperature change. This makes for a highly sensitive device, ideal for set-point applications.

LM75 Features:

•-55 to +125°C operating range

•±3°C accuracy (higher accuracy: available in the LM76 & LM77)

•0.5° resolution (higher resolution: available in the LM76 & LM77)

•I2C Bus interface

•SOP-8 and Mini SOP-8 (MSOP) packages save space

•Open-drain output pin operates as interrupt or comparator/thermostat output

•Register readback capability

•Power up defaults permit stand-alone operation as thermostat

•Shutdown mode to minimize power consumption

•Up to 8 LM75s can be connected to a single bus

•Readable at any time (new temp. conversion available every 100ms.

V. LCD

LCDs use voltage-sensitive organic molecules with a helical structure that either block or permit the passage of polarized light. Areas filled with molecules that form parts of the display are called segments or pixels. For proper function, alternating current (AC) has to be applied to the segments. Depending on their operation mode, LCDs are usually categorized as:

•Static Drive: LCD Glass or LCD Modules with a simple segment displays are the only parts that have an option of Static Drive. The Static Drive configuration means that there is an individual control line to select each LCD segment and there is only a single common line that connects to them all. This configuration produces the best display with the widest temperature range, but it requires more interconnections that a multiplexed display would require.

•Multiplexed Drive: The Multiplexed Drive configuration means that each control line selects several LCD segments and that the final selection is made by selecting the correct common signal that also connects to several LCD segments. This configuration uses fewer interconnections which is cost effective for smaller displays. This configuration degrades the temperature and image performance slightly. LCD Mode When configuring the LCD, the first parameter that has to be defined is the LCD operation mode.

VI. LCD MODE

The operation mode depends on the type of the LCD that is used with the 71M651X chip. For the 651X Demo Boards, the operation mode is 001, or 3-states, 1/3 bias. A maximum of four states to a minimum of one state (for static display) can be configured.

LCD Operating Voltage.The type of LCD used for a particular implementation will determine whether 3.3VDC or 5VDC will be used for driving the LCD. As explained in the previous section, the 71M651X provides a charge pump capable of boosting the 3.3VDC supply voltage up to 5.0VDC. The boost circuit is enabled with the LCD_BSTEN register.

6.1 Driver Circuit

The UC3717A is an improved version of the UC3717, used to switchdrive the current in one winding of a bipolar stepper motor. TheUC3717A has been modified to supply higher winding current, morereliable thermal protection, and improved efficiency by providing integrated bootstrap circuitry to lower recirculation saturation voltages. Included are an LS-TTL compatible logic input, a currentsensor, a monostable, a thermal shutdown network, and an H-bridgeoutput stage. The output stage features built-in fast recovery commutating diodes and integrated bootstrap pull up. Two UC3717Asand a few external components form a complete control and driveunit for LS-TTL or micro-processor controlled stepper motor systems.

The UC3717A is characterized for operation over the temperature
range of 0°C to +70°C

The UC3717A's drive circuit includes the following components.

(1) H-bridge output stage

(2) Phase polarity logic

(3) Voltage divider coupled with current sensing comparators

(4) Two-bit D/A current level select

(5) Monostable generating fixed off-time

(6) Thermal protection

VII. OUTPUT STAGE

The UC3717A's output stage consists of four Darlingtonpower transistors and associated recirculating power diodes in a full H-bridge configuration. Also presented, is the new added feature of integrated bootstrap pull up, which improves device performance during switched mode operation. While in switched mode, with a low level phase polarity input, Q2 is on and Q3 is being switched. At the moment Q3 turns off, winding current begins to decay through the commutating diode pulling the collector of Q3 above the supply voltage. Meanwhile, Q6 turns on pulling the base of Q2higher than its previous value. The net effect lowers the saturation voltage of source transistor Q2 during recirculation, thus improving efficiency by reducing power dissipation.

VIII. ZIGBEE

Technology & Standard (global wireless sensing and control network)Focus Relatively Simple Devices

- Low cost (open standard, multi-vendor availability)
- –Low data rate
- –Low power (years on a AA battery/ batteryless)Robust, reliable,simple deployment and maintenance (mesh,self-organizing,self-healing)

InteroperabilitySense and ControlTrue Wireless Networks that Scale (not simply wireless links).

ZigBee is a specification for a suite of high-level communication protocols used to create personal area networks built from small, low-power digital radios. ZigBee is based on an IEEE 802.15.4 standard. Though its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics,[1] ZigBee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. ZigBee is typically used in low data rate applications that require long battery life and secure networking (ZigBee networks are secured by 128 bit symmetric encryption keys.) ZigBee has a defined rate of 250 kbit/s, best suited for intermittent data transmissions from a sensor or input device. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that requires short-range low-rate wireless data transfer. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or Wi-Fi.

8.1 Device Types and Operating Modes

8.1.1 Zigbee Devices are of Three Types

ZigBee Coordinator (ZC): The most capable device, the Coordinator forms the root of the network tree and might bridge to other networks. There is exactly one ZigBee Coordinator in each network since it is the device that started the network originally (the ZigBee LightLink specification also allows operation without a ZigBee Coordinator, making it more usable for over-the-shelf home products). It stores information about the network, including acting as the Trust Center & repository for security keys.ZigBee Router (ZR): As well as running an application function, a Router can act as an intermediate router, passing on data from other devices.ZigBee End Device (ZED): Contains just enough functionality to talk to the parent node (either the Coordinator or a Router); it cannot relay data from other devices. This relationship allows the node to be asleep a significant amount of the time thereby giving long battery life. A ZED requires the least amount of memory, and therefore can be less expensive to manufacture than a ZR or ZC.The current ZigBee protocols support beacon and non-beacon enabled networks. In non-beacon-enabled networks, an unslotted CSMA/CA channel access mechanism is used. In this type of network, ZigBee Routers typically have their receivers continuously active, requiring a more robust power supply. However, this allows for heterogeneous networks in which some devices receive continuously, while others only transmit when an external stimulus is detected.

IX. CONCLUSION

According to special requirements of pipeline detection in oilfield, a novel crawl robot is developed, and the drive control system is studied. The drive control characteristics of the robot are tested, and experimental results prove the feasibility of the presented drive control scheme.

X. ACKNOWLEDGEMENT

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REFERENCE

[1] K.Suzumori,T.Miyagawa,M.Kimura,andY.Hasegawa,"Microinspec- tion robot for 1-in pipes," IEEE/ASME Trans. Mechatronics, vol. 4, no. 3, pp. 286–292, Sep. 1999.

[2] S. G. Roh and H. R. Choi, "Differential-drive in-pipe robot for moving inside urban gas pipelines," IEEE Trans. Robot., vol. 21, no. 1, pp. 1–17, Feb. 2005.

[3] H. T. Roman and B. A. Pellegrino, "Pipe crawling inspection robots: An overview," IEEE Trans. Energy Convers., vol. 8, no. 3, pp. 576–583, Sep. 1993.

[4] A. Zagler and F. Pfeiffer, "MORTIZ, a pipe crawler for tube junctions," in Proc. IEEE Int. Conf. Robot.

Autom., Taipei, Taiwan, Sep. 13–14, 2003, pp. 2954–2959.
[5] J.A.Ga´lvez,P.G.deSantos,andF.Pfeiffer,"Intrinsictactilesens- ing for the optimization of force distribution in a pipe crawling robot," IEEE/ASME Trans. Mechatronics, vol. 6, no. 1, pp. 26–35, Mar. 2001.

[6] D. K. Haas, "Small diameter pipe crawler," Savannah River Nat. Lab. Tech briefs, U.S. patent 6 427 602, 2002.

[7] P. Breedveld, D. E. van der Kouwe, and M. A. J. van Gorp, "Locomotion through the intestine by means of rolling stents," presented at the Amer. Soc. Mech. Eng. Design Eng. Tech. Conf. Comput. Inf. Eng. Conf., Salt Lake City, UT, Sep. 28/Oct. 2, 2004, Paper DETC2004/MECH 57380.

[8] H. Schempf, E. Mutschler, B. Chemel, and S. Boehmke, "BOA II & Pipe Taz: Robotic pipe-asbestos insulation abatement systems," in Proc. IEEE Int. Conf. Robot. Autom., Albuquerque, NM, Apr. 1997, pp. 52–59.

[9] T. Fukuda, H. Hosokai, and M. Otsuka, "Autonomous pipeline inspection and maintenance robot with inch worm mobile mechanism," in Proc. IEEE Int. Conf. Robot. Autom., Mar. 1987, pp. 539–544.