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Optimized Pipe Inspection Robot by Using IOT

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***Abstract* - The project describes the prototype of pipe line inspection robot by IoT that can detect various pipe cracks internally by using sensors and camera at very low cost. The economic value of pipe lines which are used in industry for various purposes is very large and pipe line inspection has become an important issue as replacement of defected pipe line is more costly as well as more complicated. Here the unique four wheeled chassis design using a combination of wireless sensor network and IoT to monitor and detect the faults in pipe lines. Using IoT technology, the proposed system eliminates the human efforts from inaccessible environment by acquiring useful information about cracks that exists in the pipe lines by transmitting the data wirelessely. The system acquires necessary data regarding detection of crack and status of water flow inside the pipe through wireless sensors internally and indicating flaws of the pipelines to the smart devices of using IoT for the connectivity of devices. Information received is used for further rectification of the pipeline. Wireless sensors-based systems are the new generation systems where these sensors are used to monitor the environment to detect any slight variations in any specified values.**

Keywords: Internet of things, Ultrasonic sensor, GSM, GPS Module.

I. INTRODUCTION

The pipeline inspection robots are highly useful to detect the pipelines or small tunnels internal cracks. It is more important for increasing performance and life of pipelines. There are many pipeline inspection robot systems have been developed, and this pipeline inspection robots which are classified into several elementary forms according to the movement mechanism. Thus, many kinds of mechanisms have been developed, such as wheel type, inchworm type, legged mobile type, screw type, crawler type, PIG type, caterpillar type and passive type. Among them, wheel type and caterpillar type pipeline inspection robots were mostly popular.

Robotics is one of the fastest growing engineering fields, presently they are used for wide variety of works specially in manufacturing industries. Primarily robots are designed in such way that they reduce human intervention from labour intensive and hazardous work environment. Sometimes it is also used to discover inaccessible work place which is generally impossible to access by humans.

The complex internal geometry and hazard content constraints of pipes require robots for inspection purpose. With these constraints, inspection of pipe becomes more necessary that, tolerating it may lead to some serious industrial accidents which contaminates environment and also results in loss of human lives. For inspection of such pipes, robot requirement is must in order to check corrosion level of pipe, recovery of usable parts from pipe interior, for sampling of sludge and scale formation on pipe internal surface etc.

Pipelines have the purposed for transferring liquids and gases from one point to another point such as water, oil, sewage and natural gas. With these daily activities, pipes are prone to defects such as corrosion, stress and aging which cause the pipes to leak, crack or break. When leaks occurs in pipelines, large volume of liquid or gas will lost, causing impact on the production industries and common people's routine. Since the pipes are invisible and unreachable, identification of cracks is not possible. Hence finding the leakages and replacing the defective pipe is very crucial during the distribution of liquid and gas. Therefore implementation of pipeline leakage detecting system has importance in domestic application and industries.

II. LITERATURE SURVEY

A robot is the combination of engineering and science that includes mechanical engineering, electrical engineering, computer science, and others. Many robotics come from the design, development, operation, and use of robots, as well as computer systems for their control, sensory feedback, and information processing. All robots have a mechanical structure, a frame, form or shape designed to accomplish a specific job. For instance, a robot developed to move across heavy dirt or mud may use caterpillar tracks. The mechanical feature is mainly the designer's answer to achieving the designated work and handling the physics of its surroundings. As more robots are developed for particular tasks, this approach of categorisation becomes more significant. For instance, some robots are developed for fabrication task, and so they could not be used for other purposes; they are known

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as "assembly robots". The robots with flexible structures may be the most adaptable to the surroundings, particularly to the pipe diameter, with an improved efficiency to man oeuvre in dangerous settings. Wheeled robots have highest qualities in terms of simplicity, energy efficiency, and capability for long range. When wheels are loaded with springs, the robots also give some benefits in maneuverability with the capability to go through uneven surfaces in the pipe and remain steady without sliding in pipes; they are also miniature in size.

Pipe inspection robots are used extensively to operate maintenance in the pipelines. The pigging type, generally used in the oil and gas pipelines, is inertly propelled by liquid or gas going within the pipe. A different kind is the wheeled robot, which is commonly used for commercial purposes. Wheeled robot system with active manoeuvring ability is created for internal inspection of urban gas pipelines. One other kind of pipe inspection robot is the caterpillar type robots that are applied in indoor pipe inspection. Each of these robots has benefits and drawbacks, causing a specific robot to operate only in a specific environment.

III. OUTCOME OF LITERATURE SURVEY

Literature survey provides the idea about design parameters of different pipeline inspection robots to detect the problems and adaptability improvements. The idea of designing the pipe line inspection robot by using camera and sensor facilitates working personnel for effective observation, detection of cracks, quick analysis and diagnosis of faults in pipelines can be achieved.

IV. PROBLEM STATEMENT

In industry there are several problems arise related to pipelines like corrosion, cracking, dent mark, metal losses. In power plants and gas pipe lines human inspection is impossible. The underground water pipe line leakage detection and monitoring system includes indispensable labour effort from dangerous work and to act in inaccessible environment.

V. OBJECTIVES

- To design and build a prototype robot to detect faults in pipelines like corrosion, dentmarks, and metal losses by providing ultrasonic and visual inspection.
- The detected fault location (latitude and longitude) inside the pipeline will be sent to a registered mobile number by using GSM and GPS technologies.

VI. METHODOLOGY

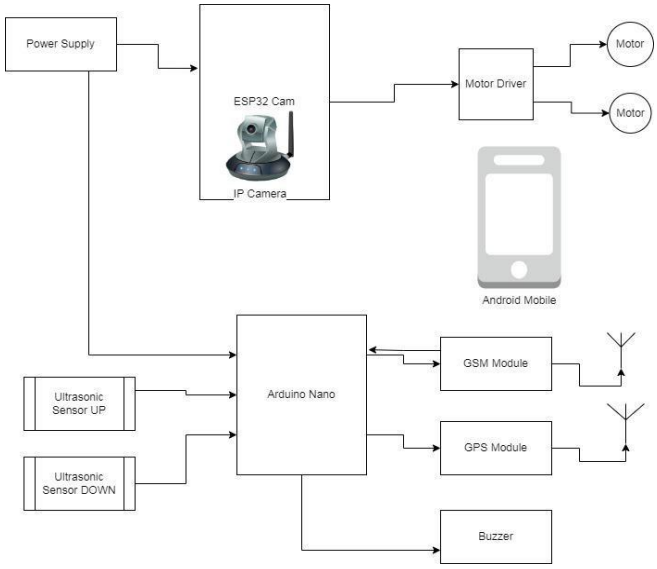

Figure 1: Block diagram of pipe inspection robot

The block diagram of pipe inspection robot by using IoT is as shown in figure. The robot consisting of two DC motors which is driven by motor driver connected with power supply.

For visualization purpose an ESP32 camera will be connected along with the sensors, to detect the crack inside the pipelines two ultrasonic sensors are used for both up and down position of the robot. To get the exact faulty point in the pipelines we used we used GPS and GSM modules that are controlled by using programmed Arduino. The movement of the robot and the live video recordings will be controlled by any android mobile or laptops with internet connectivity using IP address. To perform the all the function in the system a 12v dc power supply is used.

VII. RESULT AND DISCUSSION

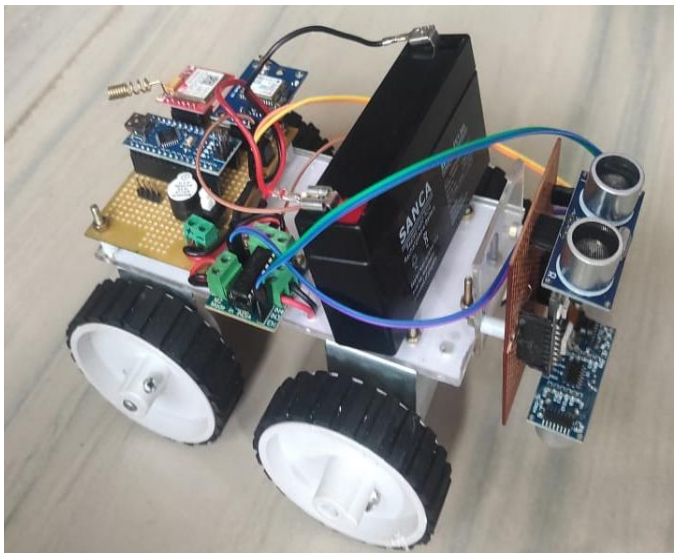

Figure 2: prototype model of pipe inspection robot

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Finally, this inspection robot will be used to detect faults and get to know internal condition of the pipelines. To detect faults in the pipelines ultrasonic sensors are used and for visual inspection ESP32 IP camera will be used, robot movement and IP camera will be controlled by connecting IP address through android mobile. The detected fault location SMS will be sent to a registered mobile number using GSM and GPS technologies.

VIII. ADVANTAGES AND DISADVANTAGES

Advantages

- Pipe inspection robot is used to inspect the situation inside the pipe which will be recorded and displayed on the monitor screen.
- This can be applied in gas industry pipe lines to make sure that the system is always monitored and excess gas leak is controlled.
- The only requirement is mobile device with internet to monitor and control the water or gas leakage.
- Illegal tapping can also be detected using this system.

Disadvantages

- Pipe inspection robots have such limitations as their ability to turn in a T-shaped pipe or move in a plug valve.
- This robot doesn't work inside the water.

IX. CONCLUSION

Robots play an important role in inside pipe-network maintenance and their repairing. Some of them are designed to realize specific tasks for pipe with constant diameters, and other may adapt the structure function of the variation of the inspected pipe. Here, inside pipe modular robotics system is proposed. An important design goal of this robotic system is the adaptability to the inner diameter of the pipes .the given prototype permits the usage of smart phone camera for visualization of the pipe inspection. This prototype is wirelessly controlled by a smart phone using GPS connectivity and sends the fault location inside the pipeline by GSM.

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