Design and Implementation of In-Pipe Inspection Robot

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Abstract: This Paper proposes is to plan a pipeline inspection robot that can spot innumerable pipe flaws internally by using camera at very low cost. The economic value of pipelines which are used in industry for various purposes is very large. Pipeline inspection has become an significant issue as replacement of escaped pipeline is more costly as well as more difficult. Here the unique 4W chassis design and camera is designated for pipeline inspection robot. The hardware part consists of bot chassis, NodeMCU board, CMOS-Camera with SD card slot, DC geared motors and motor drivers, LED’s etc. We successfully develop the in-pipe inspection robot has revolutionized the field of infrastructure maintenance. With its advanced capabilities and precise data collection, this technology ensures efficient monitoring and assessment of pipelines, leading to improved maintenance strategies and enhanced longevity of critical infrastructure.

1. INTRODUCTION

The internet of things or IoT, is a system of unified computing devices, mechanical and digital machines, objects, animals or people that are provided with elite identifiers (UIDs) and the ability to transfer data over a network without necessitating human-to-human or human-to-computer interaction[6]. An IoT ecosystem consists of web-enabled smart devices that use embedded systems, such as processors, sensors and communication hardware, to gather, send and act on data they gain from their environments. IoT devices share the sensor data they collect by connecting to an IoT gateway or other edge device where data is either sent to the cloud to be analyzed or analyzed locally. Sometimes, these devices interconnect with other related devices and act on the information they get from one another. The devices do most of the work without human intervention, The devices do most of the work without human intervention, although people can collaborate with the devices -- for instance, to fix them up, give them instructions or access the data.

Robot is a machine which is capable of carrying out a complex series of actions automatically. A robot can be directed by an external control device, or the control may be embedded within. Robots may be constructed to evoke human form, but most robots are task-performing machines, planned with an emphasis on stark functionality, rather than communicative aesthetics. robot, any automatically functioned machine that replaces human effort, though it may not resemble human beings in appearance or perform functions in a humanlike manner. By extension, robotics is the engineering discipline dealing with the design, construction, and operation of robots. Robots eliminate dangerous jobs for humans because they are capable of working in hazardous environments. They can handleeating heavy loads, toxic substances and repetitive tasks. This has helped companies to prevent many accidents, also saving time and money.

The assimilation of IoT and robotics has reduced human tasks’ complexities and has enabled humans to perform their daily life activities with ease. Hence, the merger of these technologies has created the Internet of Robotics Things (IORT) to represent intelligent devices that can monitor events, gather data through sensors and conclude the best action accordingly.

Zigbee is a standards-based wireless technology developed to enable low-cost, low-power wireless machine-to-machine (M2M) and internet of things (IoT) networks. Zigbee is for low-data rate, low-power applications and is an open standard. This, theoretically, enables the mixing of implementations from different manufacturers, but in practice, Zigbee products have been protracted and modified by vendors and, thus, plagued by interoperability issues. In contrast to Wi-Fi networks used to connect endpoints to high-speed networks, Zigbee supports much lower data rates and uses a mesh networking protocol to avoid hub devices and create a self-healing architecture.

Zigbee is used by a variety of cable and telecommunication companies in their set-top boxes, satellite transceivers and home gateways to provide home monitoring and energy management products to their customers. Chemical industry pipelines carry various chemicals hence there may be chances of glitches like corrosion, cracking, metal losses and leakages. These difficulties are expected. The blockage inside the pipe can decrease the productivity of the chemical flow. The conventional method is very difficult, tiring and expensive. These problems are not only seen in industry but also in houses and power plants. To overcome this, the pipelines can be inspected and with the help of “PIPE INSPECTION AND CLEANING ROBOT.”

2. LITERATURE REVIEW

Authors of paper [1] intended a pipeline inspection robot with belt driven ribbed pinecone shaped skate model and applied. In this paper author established a pipeline inspection robot with a linkage mechanical clutch, which contains a novel belt driven ribbed cone shaped skate model that can be used to defeat unequal environmental barriers. The mechanical clutch is a 3-bar linkage mechanism. The robot was planned to be conformal to the environment: each chain being in touch with the walls of pipeline or tunnel. Thus, the robot can be functioned in various configurations and sizes of pipeline, and can utilize the belt
driven corrugate-ridged cone shaped skate model to advance in uneven barriers of pipeline. The prototype of the robot system has been developed, and experiments were carried out to verify the validity of design[6].

Authors of paper [2] implemented semi-Automatic Pipeline Inspection Robot System. Here, author presented a new semi-autovmatic pipe inspection robot system for cleaning and inspection of the in- house pipeline which is small in size. It consists of a camera, a steering mechanism, and sensors to locate the robot inside the pipeline. The robot system is carried by an extension cable, which is in advance being penetrated into the pipeline by a compressed air. A lab prototype pipeline was developed to examine the viability of the developed pipeline inspection robot system and the viability of this semi-automatic pipeline inspection method was verified successfully through research. This semi-automotive pipeline inspection robot system enables user to inspect the state of corrosion and water leakage inside the pipeline. Thus, it can be used as a decision making tool whether it is essential to swap the pipeline with a new one or not.

Authors of paper [4] implemented A Flat Pipeline Inspection Robot with Two Wheel Chains. In this paper a new pipeline inspection robot that has multiple sensors for inspection of 80-100mm pipelines. The robot device contains of two wheel chains which has a level shape. The steering and moving motion can be produced by using just one robot module without having any singular motion. As another benefit, the flat shape of this robot allows mounting additional sensors on the both sides of the robot. The kinematics and three control modes are labelled i.e. driving mode, detecting mode and penetrating mode. Compared to popularly employed pipeline robots using three wheel chains, the new design allows simple robot control and easy user interface, especially at T-branch[6]

3. METHODOLOGY

4. Working
An in-pipe inspection robot, also known as a pipe crawler, is a device used to inspect the interior of pipes for defects, cracks, corrosion, or other anomalies. The robot is typically equipped with cameras, sensors, and other tools that allow it to gather data about the condition of the pipe.

The working of an in-pipe inspection robot involves several steps:
1. Preparation: The robot is prepared for the inspection by selecting the appropriate sensors and tools, configuring its settings, and ensuring that it is clean and functioning properly.
2. Insertion: The robot is inserted into the pipe either manually or using a deployment mechanism. Once inside, it moves along the length of the pipe, guided by tracks or wheels.
3. Inspection: As the robot moves along the pipe, it uses its sensors and cameras to gather data about the condition of the pipe. This data may include measurements of the diameter, wall thickness, and temperature of the pipe, as well as images and videos of the interior.
4. Analysis: The data gathered by the robot is analyzed to identify any defects or anomalies in the pipe. This may involve comparing the data to previous inspections or using machine learning algorithms to detect patterns.
5. Reporting: The results of the inspection are reported to the operator, who can use the data to plan maintenance or repairs. In-pipe inspection robots are commonly used in the oil and gas industry, as well as in municipal water and wastewater systems. They are an effective way to inspect pipes without the need for costly and disruptive excavation.
Outcome of the model:

Processing:
steps are
1. start the vehicle button
2. search for wifi on mobile phone, you will see car wifi
3. enter the password
4. in chrome browser url enter the ip address
   you can control the project using the chrome browser
5. CONCLUSION
In-pipe inspection robots are an essential tool for maintaining the integrity of pipelines. These robots are designed to perform various functions such as detecting defects, measuring wall thickness, and locating blockages. They are equipped with advanced sensors and cameras that can provide accurate data on the condition of the pipeline.

One of the key advantages of in-pipe inspection robots is that they can operate in hazardous and hard-to-reach areas without risking human lives. They are also cost-effective compared to traditional inspection methods, which can involve shutting down pipelines and excavating the ground to access the pipe. In conclusion, in-pipe inspection robots are a crucial part of pipeline maintenance and inspection. They provide accurate data, reduce inspection costs, and enhance safety by eliminating the need for human intervention in hazardous areas. As technology continues to evolve, we can expect to see more advanced and sophisticated in-pipe inspection robots in the future.

6. REFERENCE