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Design and Development of in-Pipe Inspection Robot

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ABSTRACT: A multipurpose manipulator, the robot was created to lessen the need for human power. A gadget called a pipe inspection robot is placed into pipes to look for obstruction or damage. The objective of this project is to inspect the internal structure of the pipelines defects, using a robot. The robot detects the major defects like cracks, dents, corrosion, welding defects etc. The performance of robot was improved by redesigning the electronics control systems by utilizing the existing mechanical platform. The mobile camera fixed with the robot gives online video about the defects. The benefit of this inspection robot is that can be travel in dark in pipelines.

KEYWORDS: Pipeline; Crack; Leakages; Corrosion; Declogging; Smartphone; WIFI.

I. INTRODUCTION

Any industry needs do pipe inspection on a regular basis to ensure the efficient and secure operation of their operations. Manual Since inspecting pipes requires a lot of time and effort, robots have recently taken over this labor-intensive activity. The primary goal of the proposed work is to construct a robot for pipe inspection that can find and identify different pipe anomalies, like blockages. In-pipe inspection robot (IPIR) design is a challenging undertaking, thus the designer must consider design considerations such mobility, steering among others, flexibility, stability, turning radius, adaptability to size and shape, online adaptability, autonomous operation, and obstacle avoidance. Efficiency on a crooked surface, safety, material choice the nature of the work to be done inside the pipe, various actuators, operation in a running pipe, bringing back a robot, a user-friendly control and navigation system, the scope of operation, quantitative evaluation of pipe defect levels.

This model is a wheeled in-pipe inspection robot of the rover type. It can readily flow through the elbow of a pipe line and through horizontal pipes. The three components that make up this model are the rotor, stator, and control unit. The wheels of the rotor go along the route on the inside of the pipe as they revolve longitudinally. In-pipe inspection (IPIR) robots are widely utilised in the fluid transportation, water supply, and petrochemical sectors. By developing new in-pipe robots, several scholars have tried to enhance many aspects of in-pipe inspection robots, such as vision and control

II. METHODOLOGY

- A) First considering the size of the robot should be according to the pipe size and then deciding the requirements of the project.
- B) Getting the recent researches about the pipe inspection robot and acting on the new methods also checking for the components to be used and their need and work into the project.
- C) Running the simulation on the software and checking the working of all the devices required for pipe inspection robot.
- D) After simulation further manufacturing of the base assembly, electronic and software begin and assembled all parts together to make a robot.
- E) Fixing a camera, motors and electronic parts together on the rover,
- F) Testing it through the 350mm pipe and checking the working of the robot and capturing the video of it.

III. EXPERIMENTAL SETUP

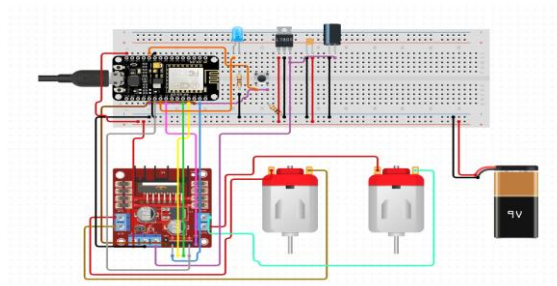


Fig 3.1 Experimental setup

IV.WORKING

1. After giving supply motor 1 and motor2 running in forward direction that means robot moves forward.
2. When motor 1 is reverse and motor 2 is forward robot moves right side.
3. When motor 1 is forward motor 2 is reverse robot moves left.
4. When both motors move in reverse robot moves in backward direction.

BLOCK DIAGRAM

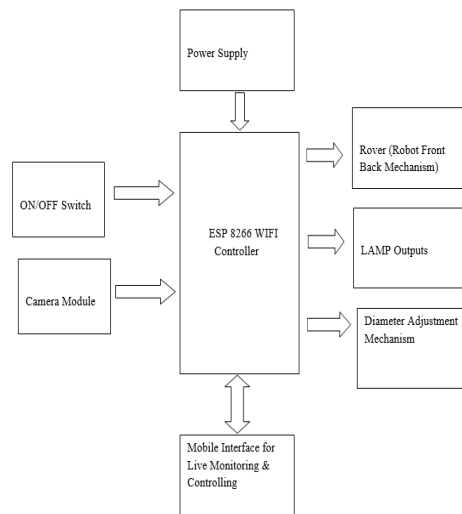


Fig 3.2 Block Diagram

The ESP8266 WIFI controller is initialized as the power supply is turned on. The switch is turned on to start the rover/Robot and placed inside the pipeline. As the robot starts moving the camera module And headlight are turned on so that the live streaming can be viewed on a screen where we can inspect the internal condition of the pipeline. This rover is controlled through an mobile application Blynk IOT.

A. ESP 8266 WIFI CONTROLLER

The ESP8266 is a low-cost, Wi-Fi-enabled microcontroller that is widely used for Internet of Things (IoT) applications. It is a highly integrated system-on-a-chip (SoC) with an embedded Wi-Fi module, making it easy to connect to Wi-Fi networks and communicate with other devices over the internet. The ESP8266 microcontroller is equipped with a powerful 32-bit Tensilica Xtensa LX106 processor, which runs at a clock speed of 80 MHz It also features a generous amount of flash memory (typically 512 KB or 4 MB) for program storage and RAM for data manipulation.

Programming the ESP8266 can be done on a variety of platforms and in a number of different languages. The Arduino programming language, which offers a comfortable and familiar authoring environment for code, is the most popular programming language used with the ESP8266. Additionally, there are specialised software development kits (SDKs) that offer more sophisticated features and functionalities, like the ESP8266 Non-OS SDK and the ESP8266 RTOS SDK.

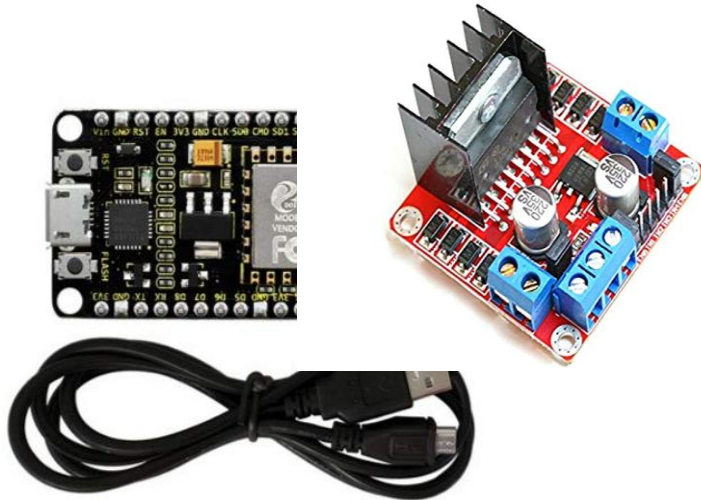


Fig 3.2 ESP8266 WIFI Controller

What is the ESP8266 Wi-Fi Module?

The SOC microprocessor known as ESP8266 Wi-Fi Module is mostly employed in the creation of IoT endpoint apps..It is extremely affordable and is considered a standalone wireless transceiver. Through its use, many built-in system applications can connect to the Internet.Express if Systems has developed the ESP8266 Wi-Fi module to provide both microcontroller access to any Wi-Fi network and TCP/IP functions.

➤ Features & Specifications.

- 2.4 GHz WLAN (802.11 b/g/n, compatible with WPA/WPA2)
- (16 GPIO) Generic I/O.
- I2C (Inter Integrated Circuit) serial communication protocol.
- Analog-to-digital conversion (CAN 10 bit).
- A serial communications standard known as Serial Peripheral Interface (SPI).
- Inter-IC Sound (I2S) and Direct Memory Access (DMA) share the pinout of their interface.
- UART (multiple GPIO2s can be used on some pins to allow for a transmit-only UART).
- PWM or Pulse Width Modulation

B. L298N Motor Driver

The L298N is a dual H-bridge driver, it has the ability to independently operate two motors or a single motor with higher power needs. Each H-bridge has two sets of transistors, commonly NPN and PNP, that let current to pass through the motor in either direction, allowing control over the motor's direction (forward or backward) and speed.



Fig 3.3 L298N Motor Driver

➤ Features & Specifications.

- Model of Driver: L298N 2A

- Double H Bridge L298N driver chip
- Maximum Motor Supply Voltage: 46V
- Maximum Motor Supply Current: 2A
- Voltage of Driver: 5-35V
- Vehicle Current: 2A
- Current Logic: 0-36mA
- The maximum power is 25W.
- Sense of current for each motor
- Heatsink for improved efficiency.

C. DC MOTOR

DC motor is used to run the robot in the forward, backward, left and right direction which will be used to run the wheels of robot inside the pipe. Also the dc motor is used to run the front blades which will clear the blockage or sludge inside the pipe by the rotating motion of the blades due to motor.

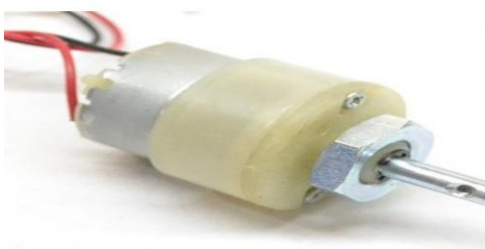


Fig 3.4 DC Motor

➤ Features & Specifications

- RPM: 100.
- 12 V DC operating voltage
- Gearbox: Plastic (spur) Gearbox attached.
- Internal hole and 6 mm shaft diameter
- No-load current maximum: 60 mA
- The maximum load current is 300 mA.

D. Communication

A free online application called OBS Ninja lets you make a room where you may invite other viewers to the broadcast. The service also gives you URLs that you can add to OBS as additional sources.

Steps to be followed:

1. Create a Room
2. Name the room
3. Guest invites
4. Configuring OBS.



Fig 3.5 OBS Ninja Dashboard

E. Blynk App

Users of iOS or Android smartphones can remotely operate devices like the Arduino, Raspberry Pi, and NodeMCU with the help of the Internet of Things platform Blynk. You can assemble widgets and give them the appropriate addresses using this application to build a graphical user interface (GUI) or human machine interface (HMI).

The Blynk app supports a wide range of hardware platforms and communication protocols, making it versatile and accessible for various IoT projects. It offers an intuitive way to build mobile interfaces and control IoT devices without the need for extensive app development knowledge.

Steps to be followed:

- Make a Blynk account
- Start a new project
- Select your hardware
- Acquire an Auth token
- Add the widget
- Complete the project.



Fig 3.6 Blynk app communication

➤ Features & Specifications.

- All supported hardware and devices have similar APIs and user interfaces, and WIFI is used for cloud communications.
- Ethernet and Bluetooth Low Energy.
- GSM USB (Serial).
- a selection of widgets that are easy to utilise.
- sending emails, tweets, push notifications, etc.

IV. EXPECTED RESULTS

- a) The rover mechanism should properly work in forward, backward direction etc.
- b) The communication using the OBS ninja works properly and satisfactory.
- c) The speed control of the rover should be adjusted according to the requirement.



Fig. 4.1 Top view



Fig 4.2 Front view

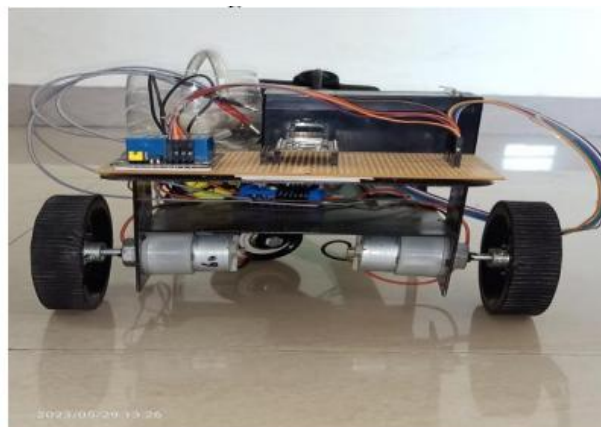


Fig. 4.3 Back view

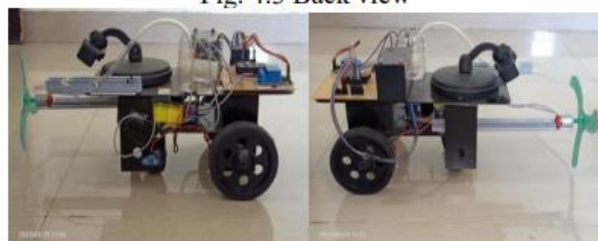


Fig.4.4 Side view

V. FUTURE SCOPE

Although the project is restricted in a number of ways, its features and applications can still be developed. Several of the possible advancements are listed below.

- For navigating twists and curves in pipes, use wheels that are slanted and guiding wheels.
- Lighter materials are used to minimise weight.
- Using infrared and ultrasonic inspection to find faults more effectively.
- The use of long-range sensors.
- Use as a robot that can rescue people from bore wells. A different design without linkages might improve motion.

VI. CONCLUSION

In the upkeep and repair of internal pipe networks, robots are crucial. Some of them can carry out certain jobs for pipes with constant diameters, while others can adjust to the fluctuation in the structure function of the inspected pipe. A modular robotic system for inside pipes is suggested here. This robotic system's adaptability to pipe inner diameters is one of its key design objectives. The provided prototype enables the visualisation of the in-pipe inspection using a smartphone camera. Using Bluetooth connectivity, a smartphone may wirelessly control this prototype. The main benefit is that it may be employed with the straightforward mechanism when the pipe diameter changes.

A pipe inspection robot that works with pipeline between 8 and 15 inches has been designed. To examine the viability of this robot for internal pipeline inspection, an actual prototype was created. The various inspection responsibilities are quite diverse. It was thought that a modular design would be simple to modify for new settings. It is a challenging problem when there are obstructions inside the pipelines. The proposed approach involves installing a declogging device at the front of the robot to address the issue. The robot is made to be capable of moving across horizontal pipes. For the pipe inspection small robot, various sorts of modules have been presented. The Pipe inspection robot's design objectives have been met in large part.

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