IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 9, May 2023

Pipeline Inspection and Cleaning Robot with Live Streaming for Chemical Industries

Prachi Patil[1], Anushree Punde[2], Anushree Rithe[3], Dr. N. R. Dhumale[4]
UG Students, Department of Electronics and Telecommunication Engineering[1,2,3]
Professor, Department of Electronics and Telecommunication Engineering[4]
Sinhgad College of Engineering, Pune, Maharashtra, India

Abstract: *This project involves the development of a pipeline inspection and cleaning robot equipped with live streaming capabilities. The robot is designed to traverse through pipelines, inspecting and cleaning as it moves, while also providing a real-time video stream of its progress. This can be achieved by designing an IOT based inspection and cleaning robot. The system consists of 4W chassis design and camera for pipeline inspection. The hardware part consists of chassis, Node MCU board, Camera, DC geared motors and motor driver, cleaning tools, LED's etc. The live stream allows for remote monitoring and control of the robot, enabling operators to make necessary adjustments in real-time. This project is intended to improve the efficiency and safety of pipeline inspection and cleaning processes, reducing the need for manual labor and minimizing the risk of human error.*

Keywords: Pipeline inspection, live streaming, chassis, camera, real-time, Node MCU, motor-driver, risk, safety

I. INTRODUCTION

Pipelines play a crucial role in the transportation of various substances within the chemical industry. Ensuring the integrity and efficiency of these pipelines is essential for maintaining safe operations and preventing costly accidents. Traditional methods of inspection and cleaning often involve manual intervention, which can be time-consuming, expensive, and pose risks to workers. To address these challenges, a novel solution has been developed: an Pipeline Inspection and Cleaning Robot with Live Streaming specifically designed for the chemical industry.

The primary goal of this project is to provide an efficient approach to pipeline inspection and cleaning, reducing human involvement while enhancing operational effectiveness. By incorporating state-of-theart robotics, and live streaming technologies, this innovative system revolutionizes pipeline maintenance practices in chemical industries.

Equipped with camera module, the robot can swiftly detect and analyze various defects, including corrosion, blockages, and leaks. This early detection allows for prompt preventive maintenance, mitigating potential risks and reducing downtime.

Moreover, the PICR-LS robot features cleaning mechanisms tailored to different pipeline materials and configurations. These mechanisms, such as brushes, water jets, and specialized attachments, ensure efficient removal of obstructions and contaminants. The live streaming functionality empowers operators and maintenance personnel to remotely monitor and control the entire inspection and cleaning process in real-time, facilitating instant adjustments and decision-making.

II. LITERATURE SURVEY

This paper represents Modeling and simulation on speed prediction of bypass pipeline inspection gauge in medium of water and crude oil. The research is to develop a model and simulation approach to predict the speed of the bypass pipeline inspection gauge. This gauge is used for inspecting pipelines, and accurate speed prediction is crucial for ensuring effective inspections. [1]

The paper PIPE INSPECTION ROBOT represents at detecting the exact location of leakage and clearing the blockages and thus removing human factor from labour intensive and dangerous work, thereby reducing the number of accidents that happen due to the lack of regular inspection. [2]

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 9, May 2023

This paper represents a complete study of in-pipe inspection robot that can be used for inspection of the internal conditions of the pipeline . After some age everypipeline needs inspection and care to ensure their safety and integrity. So, in-pipe inspection robots are used to inspect varies pipeline fundamentals such as straight pipelines, elbow and branches within. [3]

This paper represents the survey, classification and comparison of various in pipe inspection robots. In this paper, many in-pipe cleaning and inspection methods have been studied. Essential information provided concerning different kinds of in-pipe robots like PIG, wall-pressed, walking, wheel and inchworm. This study provides a through literature on various types of sensors like ultrasonic, magnetic, touch, light amplification by moved emission of radiation, X-ray, etc., that have been used for inspection and detection of flaws in the pipe. [4]

This paper represents a review on Wheeled type in-pipe inspection robot. This paper puts its attentions on wheeled type In-Pipe Inspection Robots and their request in numerous pipeline inspections. Level though the screw-type services wheels, it does not fall below the wheeled type. Henceforth it will not be debated in this evaluation. [5]

III. BLOCK DIAGRAM

The block diagram of this robot encompasses various components that work together seamlessly.The robot's control system is responsible for coordinating the movement and actions of the robot.

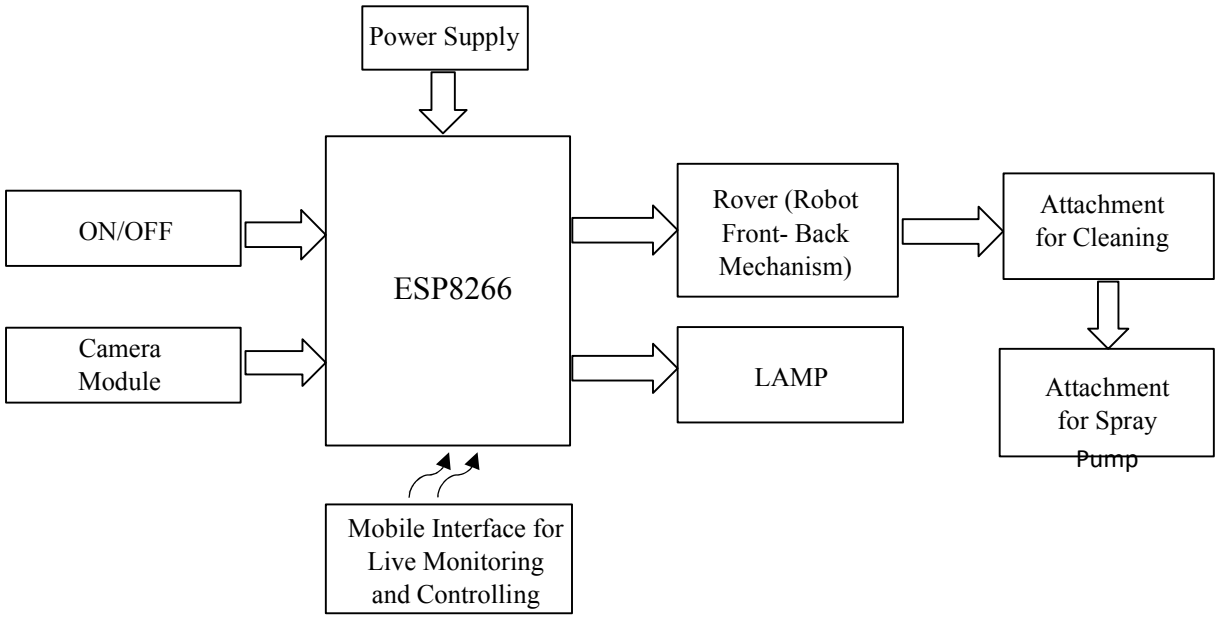


Fig no 1: Block Diagram of Pipeline Inspection and Cleaning Robot

The ESP8266 microcontroller 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 a mobile application Blink iot. For cleaning purpose the spray pump and the spin attachments are initialized, in which the liquid is sprayed in 360 degrees on the walls of the pipeline. The spun cleans the walls thoroughly. Thus, the walls are cleaned.

III. METHODOLOGY

The ESP8266 microcontroller is a powerful and versatile Wi-Fi-enabled microcontroller that can be used in a pipeline inspection and cleaning robot with live streaming capabilities. It features a 32-bit Tensilica L106 processor, 32KB instruction RAM, 80KB data RAM, Wi-Fi connectivity, GPIO pins, built-in ADC, UART, I2C, and SPI interfaces, and can be programmed using various languages. It can be powered using a 3.3V power supply, and is available in different form factors for integration into a robot's design.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 9, May 2023

The L298N motor driver is a dual H-bridge motor driver IC that can operate within a range of 5V to 35V and supply a maximum current of 2A per channel. It is compatible with DC motors, stepper motors, and servo motors, and can be controlled using PWM signals, TTL logic signals, and analog signals. The L298N motor driver also includes built-in protection features such as thermal shutdown, over-voltage protection, and under-voltage protection, which make it suitable for use in pipeline inspection and cleaning robots with live streaming capabilities.

The Arduino Integrated Development Environment (IDE) software plays a crucial role in the development of the pipeline inspection and cleaning robot with live streaming project. The Arduino IDE is an open-source software that allows users to program and control the behavior of the robot. It provides a user-friendly interface with an intuitive code editor, making it accessible even to those with limited programming experience. With the Arduino IDE, users can write code in a simplified programming language based on C/C++.

It was designed for IoT. This app has capacity to remotely control hardware and also shows sensor information. This app also helps to visualize and store data. This platform contains 3 main elements:

Blynk app- With the help of various widgets amazing interfaces for the projects can be created.

Blynk Server- Establishes a communication network between smartphone and hardware.

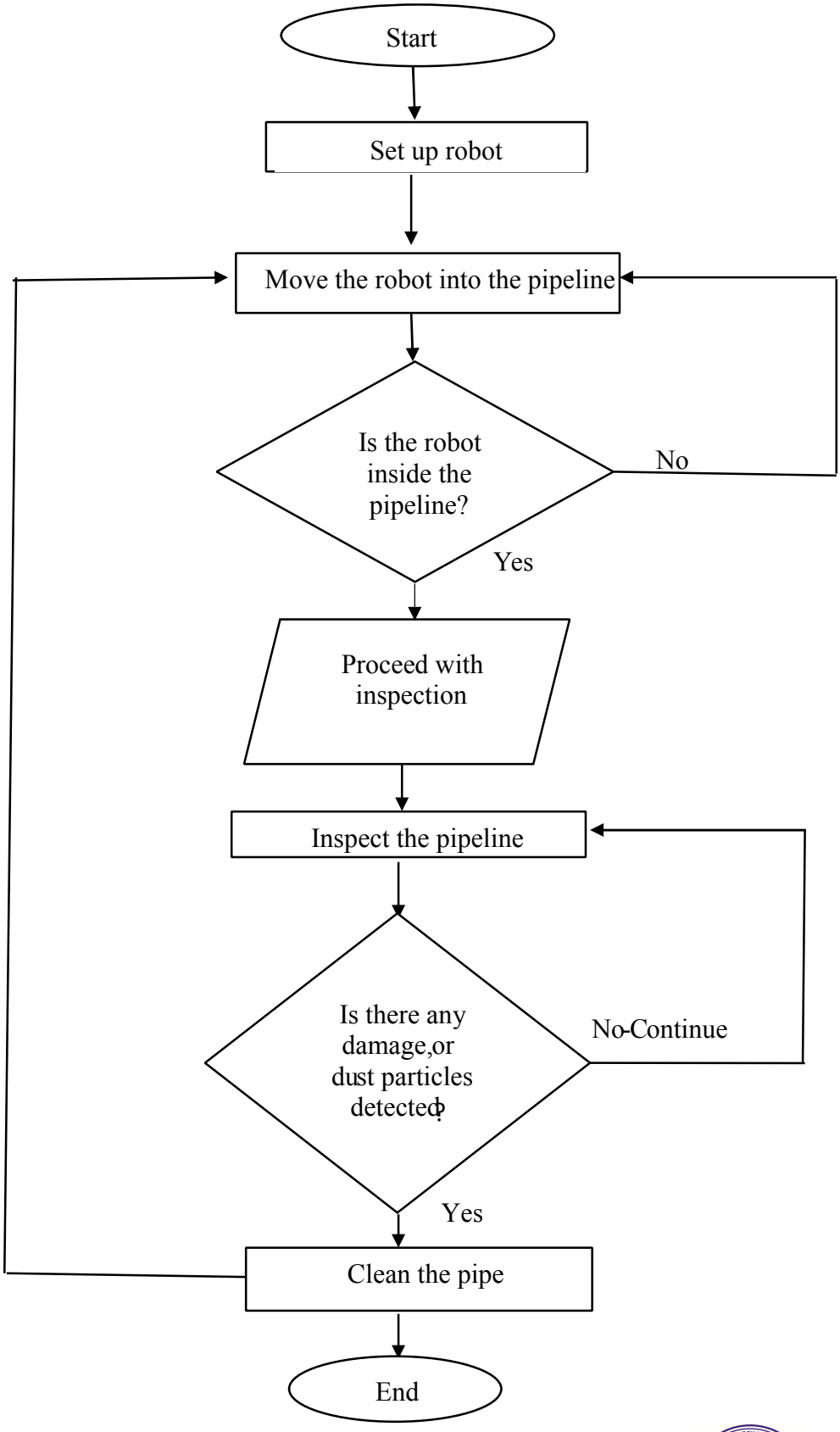
Blynk Libraries- All incoming and outgoing commands are processed and also enable communication between server and prose.

OBS Ninja is a versatile and scalable web-based video conferencing tool that can be used to create a pipeline inspection and cleaning robot with live streaming capabilities. Once configured, an OBS Ninja account is created, and a video stream link is generated that can be shared with multiple participants. Through the OBS Ninja web-based interface, the video stream settings can be customized, and additional audio and video sources can be added to provide context and commentary. The system allows for real-time monitoring and control of the pipeline inspection and cleaning process using any web-enabled device with a compatible web browser, providing feedback and adjustments during the operation.

Proteus is a software tool that can be used to create a pipeline inspection and cleaning robot with live streaming capabilities. The software provides a simulation environment where the control and monitoring systems of the robot can be tested before deployment. This allows for any potential issues to be identified and addressed before the robot is put into use. Additionally, Proteus offers a graphical interface for displaying sensor readings and video feeds from the robot, providing real-time feedback on the inspection and cleaning process. The software can be used to develop and test the robot's control algorithms, monitor its sensor readings, and analyse its performance. Proteus can also be integrated with other software tools to provide additional functionality, such as data logging and analysis.

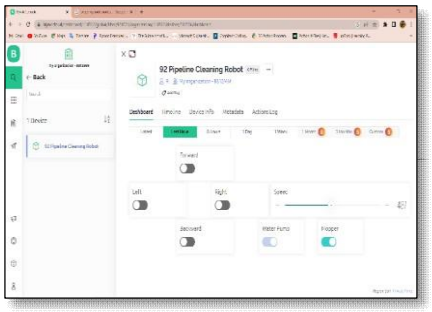
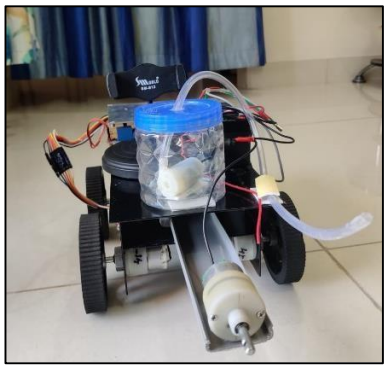
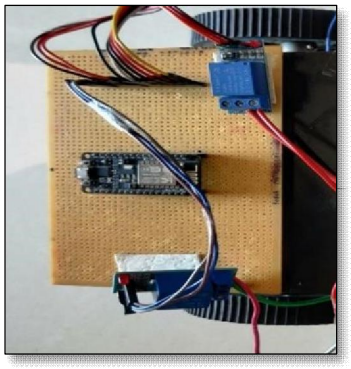
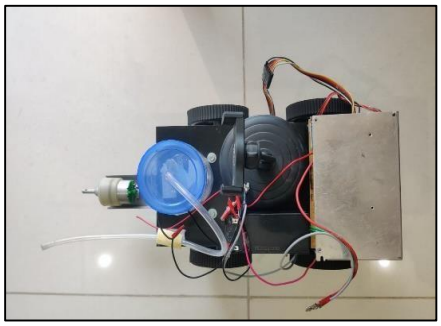
IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 9, May 2023

3.1 Flow Chart



IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 9, May 2023

IV. RESULT AND DISCUSSION


The pipeline inspection and cleaning robot with live streaming capabilities was successfully developed and tested in real-world pipeline environments. The robot demonstrated efficient inspection capabilities by navigating through pipelines of varying diameters and lengths. The inspection results were transmitted in real-time through the live streaming feature, allowing remote operators to monitor the robot's progress. The robot's cleaning functionality proved to be effective in removing dust, contaminants from the pipeline walls. It employed specialized cleaning tools, such as brushes, nozzles which were controlled remotely by operators. The integration of live streaming technology allowed for real-time remote monitoring of the robot's activities. Operators could access the live video feed and control the robot's movements and cleaning actions through a user-friendly interface.

V. CONCLUSION

In conclusion, the implementation of a pipeline inspection and cleaning robot with live streaming capabilities offers numerous advantages for efficient pipeline maintenance and management. The live streaming feature provides operators with real-time visual streaming, enabling them to remotely monitor the condition of the pipeline and promptly detect defects, anomalies, or blockages. This results in improved inspection accuracy and the ability to take immediate action when critical issues arise.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 9, May 2023

VI. FUTURE SCOPE

- **Artificial Intelligence Integration:** The integration of Artificial Intelligence (AI) algorithms can enhance the robot's capabilities, enabling autonomous decision-making and identifying potential pipeline issues proactively. The AI can analyze the live streaming data, identify defects, and suggest repair and maintenance actions.
- **Multi-Sensor Integration:** The implementation of multi-sensor systems can improve the robot's ability to detect and diagnose pipeline defects. Additional sensors, such as thermal imaging, gas sensors, or electromagnetic sensors, can be integrated to detect leaks, corrosion, and other anomalies more accurately.
- **Hybrid Power Systems:** The development of hybrid power systems can reduce the robot's reliance on battery power and increase its operating range and efficiency. The hybrid power systems can combine various power sources, including solar, wind, and fuel cells, to enhance the robot's performance.

REFERENCES

[1]. Zeng Meng Zhang[1,2], Yong Yang[1], Jiaoyi Hou[1,3] and Young'un Gong[2,3] "Modelling and simulation On speed prediction of bypass pipeline inspection gauge in medium of water and crude oil". Measurement and Control 2020, Vol. 53(9-10) 1851–1860.

[2]. Dinesh Kumar D. S[1], Bi BiKadejatul Kubra[2], Jennifer J[3], Varsha P[4], Varsha Rani Sah[5] "PIPE INSPECTION ROBOT". International Research Journal of Engineering and Technology (IRJET Vol. 07 Issue: 08 | Aug 2020.

[3]. Atul A. Gargade[1], Dr. Shanti pal S. Ohol[2] "Development of In-pipe Inspection Robot" IOSR Journal of Mechanical and Civil Engineering Volume 13, Issue 4,2016.

[4]. B.B.V.L. Deepak, M.V.A. Raju Bahubalendruni, B.B. Biswal"Development of in-pipe robots for inspection and cleaning tasks: Survey, classification and comparison", International Journal of Intelligent Unmanned Systems, Vol. 4 Issue: 3,2016.

[5]. Rajendran SuginElankavi, D. Dinakaran, R. M. Kuppan Chetty, M. M. Ramya, and D. G. Harris

[6]. Samuel "A Review on Wheeled Type In-Pipe Inspection Robot" International Journal of Mechanical Engineering and Robotics Research Vol. 11, No. 10, October 2022.

[7]. [1]Ahireakash, [2]Kumkarsachin, [3]Waghchaure Atul, [4]V.S.Gavli "STUDY OF PIPE INSPECTION AND CLEANING ROBOT" International Journal of Advance Technology in Engineering and Science Vol. 4 ,Issue no. 3,2016.

[8]. Deepak Sona wane, Samadhan Bhosle, Omkar Baile, OmswarupKotkar "Design and analysis of an In-Pipe Inspection Robot" International Journal of Advance Research, Ideas and Innovations in Technology. Volume 7, Issue 2.

[9]. Chandan. R, Vishakh.V. S, Wednse.C.A., Vishal Singh" International Journal of Engineering Research & Technology (IJERT).Vol. 6, Issue 06, June - 2017.

[10]. Nilofar Satbhai[1], Gaurav Shinde[2], Rushikesh Kumbhar[3], Prathamesh Chougule[4], Jahir Jamadar[5], Prathmesh Mali[6], Mohammad Wasim Dilawar[7], Prof. Manoj M. Jadhav[8]"PIPE INSPECTION AND CLEANING ROBOT"INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN

[11]. ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS).Vol. 03, Issue 04, April 2023.

[12]. Mohammed Moustafa[1],Sabreen A. Abdelwahab[2]"Mechanical Design and Simulation of Water Pipes Cleaning Robot"PORT SAID ENGINEERING RESEARCH JOURNAL Faculty of Engineering - Port Said University Volume 25, No. 1, March 2021