International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048
Volume 10, Issue 3, pp 175-178, March-2026
https://doi.org/10.47001/IRJIET/2026.103025

Design and Manufacturing of Device for Industrial Pipe Cleaning (Internal Cleaning of Circular Pipes)

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***Abstract* - Industrial pipelines used in sectors such as chemical processing, water treatment and oil and gas routinely suffer from internal fouling due to rust, sludge, scale and chemical deposits, leading to reduced flow capacity, higher pressure losses and possible contamination or failure. Manual internal cleaning of such pipelines is labor-intensive, time-consuming and often unsafe because it exposes personnel to confined spaces and hazardous media. This work presents the design and partial development of a compact device for internal cleaning of circular industrial pipes in the diameter range of approximately 250–300 mm. The proposed system combines a motor-driven rotating brush, a wheeled carriage and a water-spray subsystem to achieve simultaneous mechanical scrubbing and hydraulic flushing of deposits. A prototype chassis, control circuit and cleaning head have been fabricated and tested in a PVC pipe test rig, demonstrating controlled locomotion, brush rotation and water-assisted debris removal under manual command. The expected outcome of the completed system is an economical, portable and safer alternative to conventional manual cleaning, with potential for future upgrades such as sensor-assisted navigation, remote monitoring and operation from industrial AC supplies.**

Keywords: Industrial pipe cleaning; in-pipe robot; rotating brush mechanism; water-assisted cleaning; industrial maintenance, robotic cleaning, hazardous environment safety.

I. INTRODUCTION

Continuous and reliable operation of industrial pipelines is essential for transportation of liquids, gases and multiphase mixtures in process plants, utilities and manufacturing facilities. Over time, internal surfaces of pipes accumulate corrosion products, scale, sludge and other deposits that reduce the effective flow area, increase pressure drop and can compromise product quality or lead to unplanned shutdowns. Regular cleaning and inspection of pipelines is therefore a critical maintenance activity in industries such as oil and gas, water treatment, food processing and chemicals. Conventional internal cleaning techniques rely heavily on manual intervention, including pushing brushes through pipes, flushing with chemicals or water jets, or dismantling sections for access. These methods are labor-intensive, provide limited control over cleaning quality along long or complex pipe runs and expose workers to risks related to toxic media, high pressure, confined spaces and poor ergonomics. Bulky commercial machines and pigging systems exist, but they are often costly, require specialized infrastructure and may not be suitable for small- to medium-diameter pipelines or short bends typically found in compact industrial layouts. Advances in low-cost microcontrollers, compact electric motors and mechatronic integration have enabled the development of mobile devices capable of operating within pipes and executing cleaning or inspection tasks autonomously or under remote supervision. Such devices can improve cleaning consistency, reduce downtime and significantly enhance operator safety by relocating personnel away from the hazardous interior of pipelines. The present work proposes an Industrial Pipe Cleaning Device designed to travel inside circular pipes, generate tractive force through a wheeled chassis and perform internal cleaning using a centrally mounted rotating brush combined with a water-spray subsystem. This paper presents the problem context, reviews related work on in-pipe cleaning devices, details the design methodology and control architecture and documents the progress achieved so far. Expected outcomes and directions for future enhancement towards a fully autonomous industrial solution are also outlined.

II. METHODOLOGY

The development of the Industrial Pipe Cleaning Device was carried out through a systematic engineering approach involving requirement analysis, conceptual design, system modelling. Each stage was planned to ensure that the final device meets the practical needs of industrial pipe cleaning.

2.1 Conceptual Design

The device needed to be compact enough to operate inside pipes, capable of performing effective mechanical cleaning, easy to control, and economical to manufacture. With these requirements in mind, an initial concept of the device was developed. The design consists of a wheeled

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robotic platform equipped with a rotating brush and a water spraying arrangement to assist the cleaning process.

2.2 Material Selection

Material selection for the prototype was carried out by balancing strength, weight, manufacturability, corrosion resistance, and cost. PVC was used for body sections because it is lightweight, easy to machine, and resistant to moisture. Aluminum components were added at load-bearing areas for better stiffness. The cleaning brush uses flexible nylon bristles for effective scrubbing without damaging pipes. Mild steel shafts provide strength, while rubber wheels ensure good traction. Stainless steel fasteners and insulated electronic mounts improve durability and safety.

Figure 1: Metal Brackets

Figure 2: Metal Frame & Brackets

Figure 3: Wheel supports

2.3 Hardware Development

Mechanical hardware development focused on designing a compact chassis capable of operating inside pipes with diameters between 250–300 mm while accommodating the motors, brush system, water supply, and electronics. A six-wheel arrangement, with three wheels at the front and three at the rear, was selected to improve stability and distribute the load evenly. A centrally mounted nylon brush driven by a DC motor performs the scrubbing, while a 12 V mini pump supplies water near the brush to help loosen and remove debris.

Figure 4: Chassis

2.4 Sample CAD Model

Three-dimensional modelling of the Industrial Pipe Cleaning Device was performed using CATIA V5. Individual components—including chassis members, wheel assemblies, brush module, motor housings, pump support and electronic enclosures.

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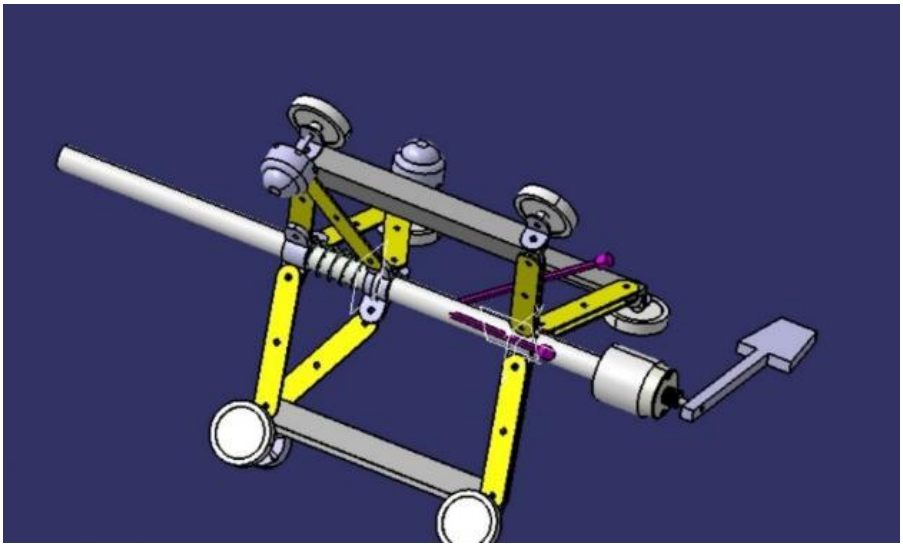

Figure 5: 3D Model

III. PROJECT COST ESTIMATION

Table 1: Costing table

Sr. No.	Components	Quantity	Specification	Cost (Rs)
1	Battery	1	12V, 7Ah 3hrs backup	1500
2	Motor	3	30 rpm	1150
3	Motor	1	100 rpm	500
4	Cleaning Brush	1	Nylon or hard bristle	500
5	PVC Pipe	1	Structural chassis	500
6	Tyres	6	Rubber	700
7	12V DC Water Pump	1	Flow rate appr. 3–5 L/Min	1200
8	Sprayer Nozzles	2	Steel	300
9	Machining			2000
10	Metal frame & Brackets		Steel	800
11	Miscellaneous (Wires, Switches)			2500
TOTAL				11650/- approx

IV. RESULTS AND DISCUSSIONS

The study presented the concept, design approach, and preliminary development of a device for cleaning the internal surfaces of circular industrial pipelines. Addressing the challenges of manual cleaning, the proposed system combines a compact wheeled chassis, a rotating nylon brush, and a water-spray mechanism. Initial development demonstrates the feasibility of the design and its potential to improve cleaning consistency.

V. CONCLUSION

Overall, the Industrial Pipe Cleaning Device represents a practical step toward adopting robotic solutions that enhance safety, efficiency, and reliability in industrial pipeline maintenance.

REFERENCES

[1] S. K. Singh, P. Sharma and R. Gupta, "Development of Automated Pipeline Cleaning Device Using Brush Mechanism," *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (IJAREEIE)*, vol. 7, no. 4, pp. 2150–2156, 2021.

[2] A.Kumar and V. Reddy, "Design and Fabrication of Pipe Cleaning Device Using Arduino," *International Journal of Emerging Technology and Advanced Engineering (IJETAE)*, vol. 9, no. 2, pp. 45–50, 2020.

[3] M. H. Rahman, N. M. Noor and F. Ahmad, "Automatic Cleaning Mechanism for Industrial Pipelines Using Mechatronic System," *in Proceedings of the IEEE International Conference on Mechatronics (ICM)*, pp. 233–238, 2019.

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Volume 10, Issue 3, pp 175-178, March-2026
https://doi.org/10.47001/IRJIET/2026.103025

[4] Y. Zhang and K. Li, "Design and Control of a Semi-Autonomous Pipeline Inspection and Cleaning Device," *Journal of Robotics and Automation*, vol. 35, no. 8, pp. 145–153, 2020.

[5] S. D. Pawar and A. D. Patil, "Arduino-Based Pipe Cleaning Device with Water Jet and Brush Mechanism," *International Research Journal of Engineering and Technology (IRJET)*, vol. 8, no. 6, pp. 1223–1227, 2021.

[6] IEEE Robotics and Automation Society, "Smart Maintenance and Inspection Robots for Industrial Applications," *IEEE Access*, vol. 10, pp. 24001–24010, 2022.

[7] P. K. Sharma and S. Tiwari, "BLDC Motor Application in Compact Cleaning Robots," *International Journal of Mechanical and Production Engineering (IJMPE)*, vol. 6, no. 3, pp. 67–72, 2021.

[8] R. S. Elankavi, D. Dinakaran, R. M. K. Chetty, M. M. Ramya and D. G. H. Samuel, "A Review on Wheeled Type In-Pipe Inspection Robot," *International Journal of Mechanical Engineering and Robotics Research*, vol. 11, no. 10, Oct. 2022.

[9] O. Ttar, D. Mndru and I. Ardelean, "Development of Mobile Minirobots for In-Pipe Inspection Tasks," *Mechanics*, vol. 68, no. 6, pp. 60–64, 2024.

[10] H. Yan, H. Niu, Q. Chang, P. Zhao and B. He, "Study on Dynamic Characteristics of Pipeline Jet Cleaning Robot," *Actuators*, vol. 13, no. 2, p. 49, Jan. 2024.

[11] P. Chattopadhyay, S. Ghoshal, A. Majumder and H. Dikshit, "Locomotion Methods of Pipe Climbing Robots: A Review," *Journal of Engineering Science and Technology Review*, vol. 11, no. 4, pp. 154 165, Nov. 2018.

AUTHORS BIOGRAPHY

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Citation of this Article:

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