IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 6, June 2023

DOI: 10.17148/IJARCCE.2023.12691

DESIGN AND MOTION PLANNING OF A TWO MODULE COLLABOARTIVE PIPELINE INSPECTION ROBOT

Prof. H Umadevi[1],

Kruthik Gowda[2], Likith Gowda G M[3], Prashanth G M[4], Sridhara A[5]

Professor, Electronics and Communication, Dr. Ambedkar Institute of Technology, Bangalore, India [1]

Student, Electronics and Communication, Dr. Ambedkar Institute of Technology, Bangalore, India[2-5]

Abstract: Pipelines are very significant tool as they are used in many different industries for various applications such as transportation of gas, water, fuel, oils, etc. Over time, they are prone to aging, corrosion, cracks, mechanical damage etc., and ignorance of these problems leads to accidents which incurs huge losses in terms of both economy and lives.

This highlights the inevitable need to inspect pipes at a regular interval for the purpose of security and improved efficiency in industrial plants. Now there is many ways of inspecting pipes such as X-rays, magnetic particle inspection method etc., but these methods do not give a full proper internal inspection of pipes. This pipe inspection robot aims 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.

Keywords: Pipeline inspection, Crack detection and Blockage clearance.

I. INTRODUCTION

The growth of robots is tremendous in this technologically advanced era. Robots are conceptualized to eliminate the human factor from labour intensive or dangerous and inaccessible work environment. The use of robots is very common in this age of automation and it is no longer exclusively used by manufacturing industries.

Since the dawn of industries, pipelines are tools for transporting oils, gases and other fluids. Many defects occur in pipelines and a majority of them are caused by aging, corrosion, cracks, mechanical damages due to improper installations. If ignored, these troubles translate into major chemical disasters which harm both human life and environment equally.

Thus, the inspection of pipes is extremely important for improving the reliability and security of the industries. The pipelines are the major tools for the transportation of drinkable water, effluent water, fuel oils and gas. A lot of troubles caused by piping networks aging, corrosion, cracks, and mechanical damages are possible.

II. METHODOLOGY

Designing a methodology for a pipeline inspection robot involves several key steps that should be followed to ensure that the robot can effectively and efficiently inspect the pipeline. Here are some steps that can be followed:

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 6, June 2023

DOI: 10.17148/IJARCCE.2023.12691

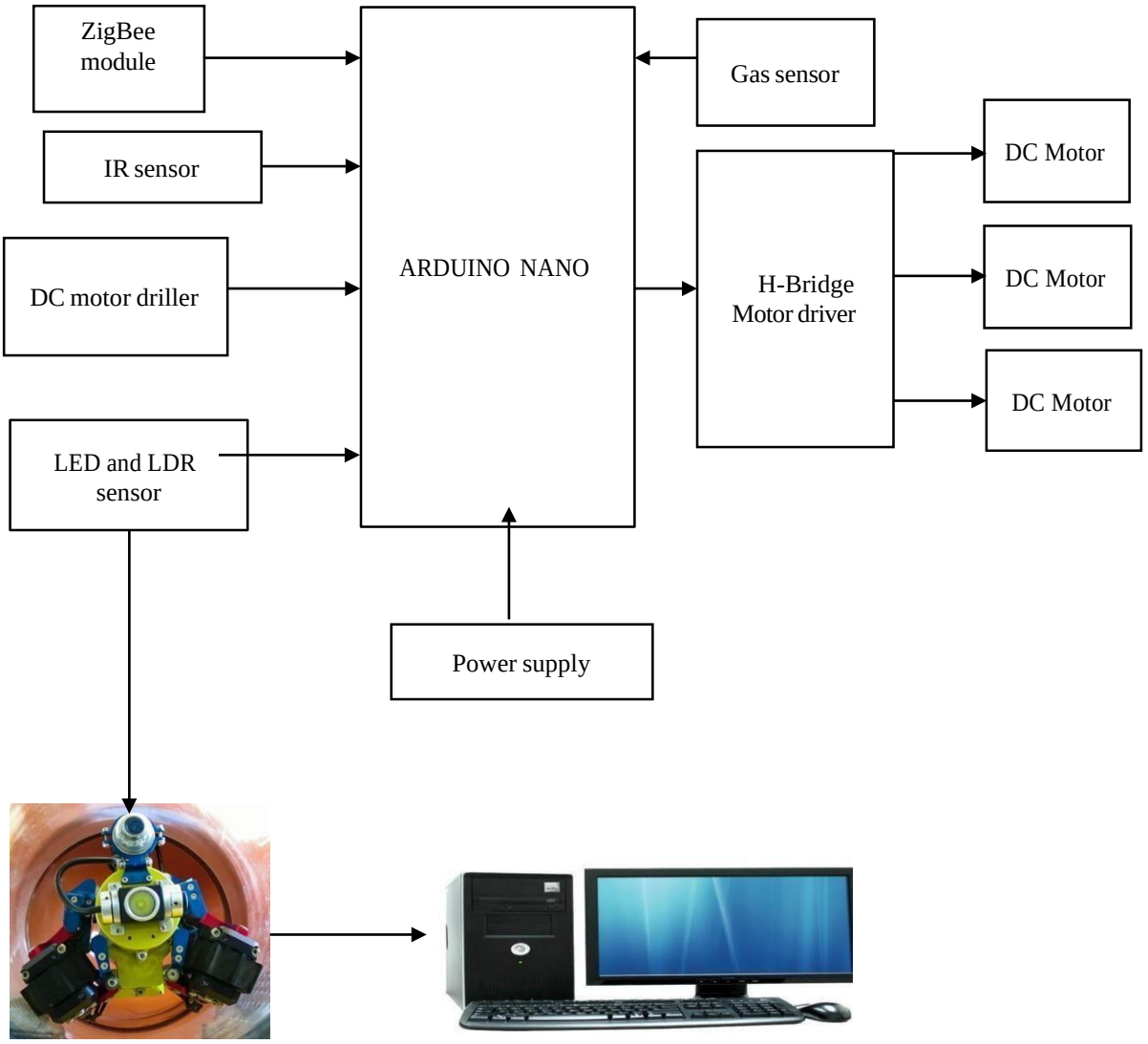

Fig 1: Block Diagram of the system.

Define the objective of the pipeline inspection robot, such as what type of inspection is required, what type of data needs to be collected, and what are the end goals of the inspection. Based on the objective, determine the specifications of the robot, such as the size, weight, shape, and mobility. Choose the appropriate sensors for the robot, such as Cameras, Ultrasonic sensors, LDR and IR sensors to collect the required data. Develop the control system for the robot, which includes the software and hardware components, to control the movement and data collection of the robot. Test the robot in a controlled environment to ensure that it can move through the pipeline, collect data, and transmit data to the control system. Optimize the robot based on the test results to improve its performance and efficiency and finally, Deploy the robot in the pipeline to perform the required inspection.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 6, June 2023

DOI: 10.17148/IJARCCE.2023.12691

Analyze the data: Analyze the data collected by the robot to identify any issues or anomalies in the pipeline.
Take necessary actions: Based on the data analysis, take necessary actions to fix any issues or anomalies found in the pipeline.

III. IMPLEMENTATION

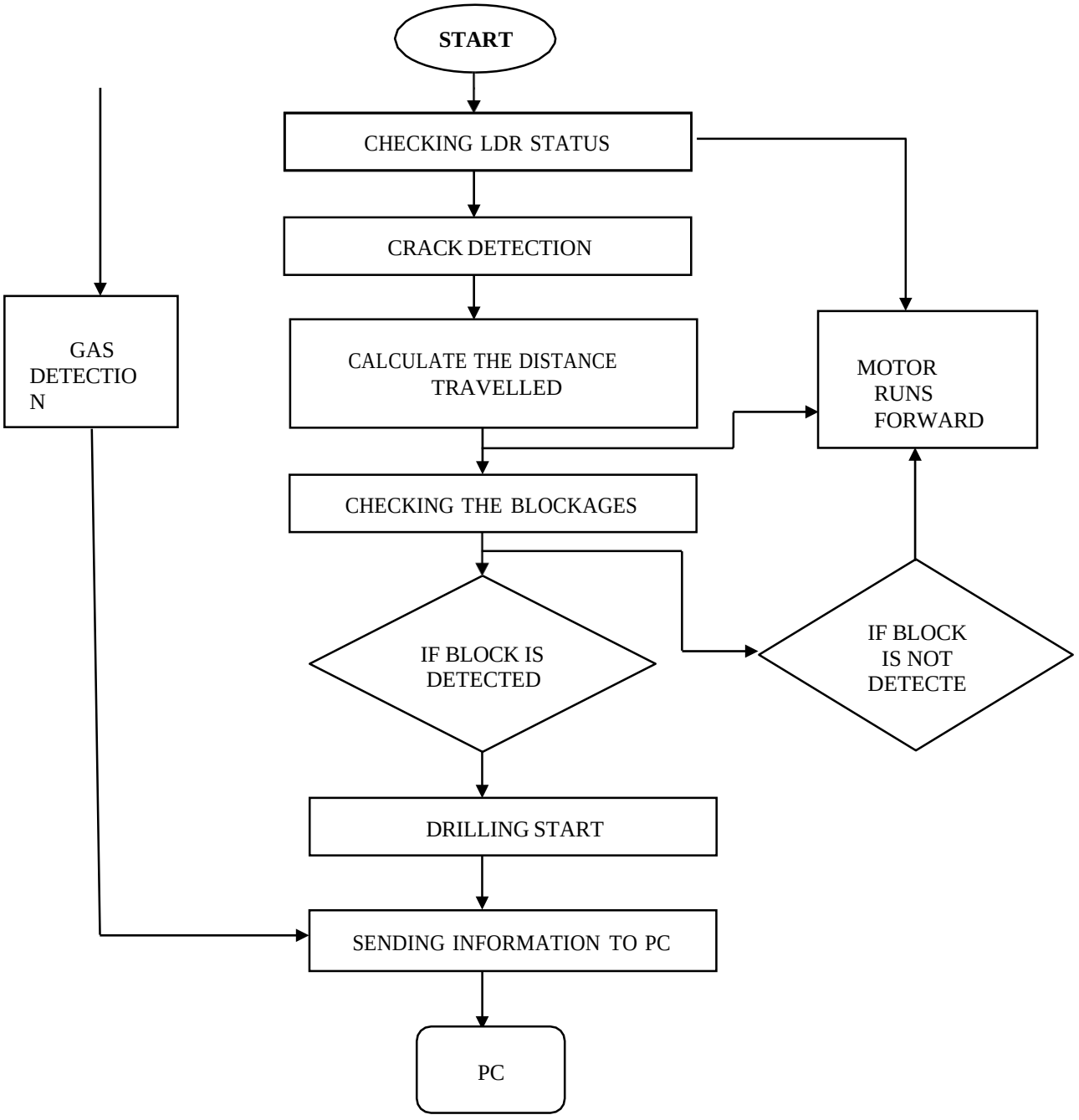

Fig 2: Implementation of Pipeline inspection robot

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 6, June 2023

DOI: 10.17148/IJARCCE.2023.12691

IV. RESULT ANALYSIS

Fig 3.1: Proposed Pipeline Inspection Robot

The robot is ready for the inspection of pipe.

Fig 3.2: Pipeline Inspection

The robot starts detecting the crack, gas and obstacles.

Fig 3.3: Crack in the pipe

The LDR sensor which is interfaced with the Arduino uno is used to detect the crack when the external light falls on it.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 6, June 2023

DOI: 10.17148/IJARCCE.2023.12691

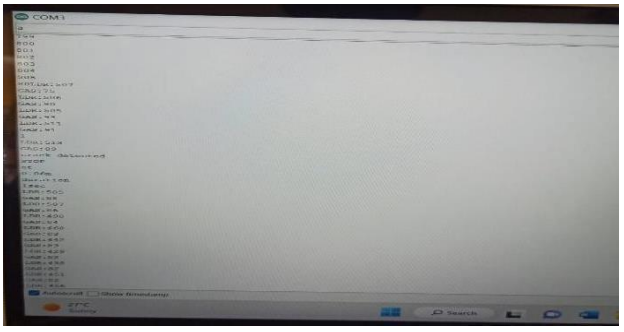

Fig 6.4 Crack detected.

Detection of crack can be seen through the Arduino IDE software i,e displayed on the monitor.

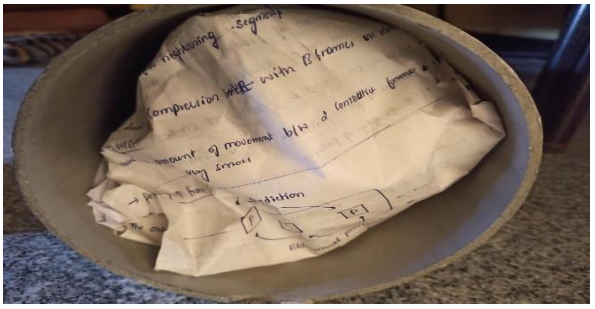

Fig 6.5 Blockage in the pipe.

IR sensor which is interfaced with Arduino uno is used to detect the obstacles/blockage.

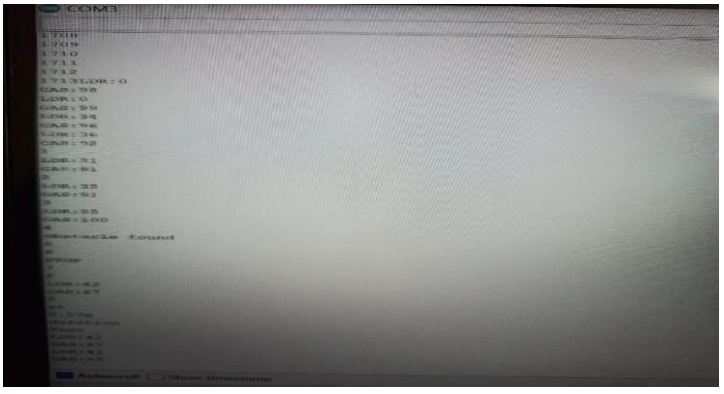

Fig 3.6: Obstacle detect

When the object is sensed immediately the message is displayed on the monitor.

V. CONCLUSION

We are implemented the pipeline inspection robot. Which is basically used to detect the crack, obstacle and blockage clearance in the pipe. Our robot can navigate through difficult terrains and perform inspections in hazardous environments without human risk. The data collected by the robot is analysed to identify the problems and plan maintenance or repair activities.

DOI: 10.17148/IJARCCE.2023.12691

REFERENCES

[1] Amr Bekhir, Abbas Dehghani, Robert Richardson, "Kinematic Analysis and locomotive strategy of a pipe inspection robot concept for operation in active pipelines", *International Journal of Mechanical Engineering and Mechatronics*, vol. 4, no. 1, pp. 15-27, 2015.

[2] E Navin Prasad, M Kannan, A Azarueen and N Karuuppasamy, "Defect Identification in pipe lines using pipe inspectionrobot",*International Journal of Mechanical Engineering and Robotics Research*, vol.1, no. 2, pp. 20-31,2016.

[3] Atul Gargade, DhanrajTambuskar, Gajanan Thokal, "Modeling and Analysis of Pipe Inspection Robot", *International Journal of Emerging Technology and Advanced Engineering ISO 9001:2008 Certified Journal*, vol. 3, no 5, pp. 120-126, May 2017.

[4] Edwin Dertien, Stefano Stramigioli, Kees Pulles, "Development of an inspection robot for small diameter gas distribution mains", *IEEE International Conference on Robotics and Automation*, Shanghai, China, May2018.

[5] Puneet Singh and G. K. Ananthasuresh, "A Compact and Compliant External Pipe-Crawling Robot", *IEEE Transaction on Robotics*, vol. 29, no. 1, pp. 251-260, 2018.

[6] Jaspreet Singh, Tajinder Singh, "Investigation of Design & Fabrication of In-Pipe Inspection Robot", *International Journal on Mechanical Engineering and Robotics*, ISSN 2321-5747, vol. 3, no. 4, pp. 120-135, 2019.

[7] Hanaa Said Salim Al-Hajry and G. R. Rameshkumar, "Design and Testing of Pipeline Inspection Robot",*International Journal of Engineering Innovation& Research*,ISSN: 2277-5668 vol. 2, no. 4, pp. 86-119, 2020.

[8] Hyouk Ryeol Choi and Se-gon Roh, "In-pipe Robot with Active Steering Capability for Moving Inside of Pipelines", *Bio Inspiration and Robotics: Walking and Climbing Robots*, pp. 376-402, vol. 3, no.2, 2021.

[9] V. Sharmiladeve, S. Ravi Prakash, "Embedded Based In Pip Inspection Vehicle", *International Journal of Advanced Research in Computer Engineering & Technology*, vol. 4, no. 1, pp. 52-61, 2020.

[10] Robin Badbeer, Stephen Harrold,"An underwater robot for pipe inspection", *Mechatronics and Machine Vision in Practice*, Queensland, Australia,Sept 2021.

