SYNOPSIS

Project Reference Number	: 46S_BE_3544
Title of the Project	: Vision Based Clog Remover in Narrow Sewer Pipelines
Name of the College	: C.M.R. Institute of Technology
Department	: Electronics and Communication Engineering
Name & USN of Students	: 1. Name: N NIKHIL GOWDA USN No.: 1CR19EC118 Email id: nnig19ec@cmrit.ac.in Ph. No.: 8277293414 2. Name: NAVEENA M G USN No.: 1CR19EC121 Email id: namg19ec@cmrit.ac.in Ph. No.: 8088275261 3. Name: SANATH BHAT S M USN No.: 1CR19EC162 Email id: sabh19ec@cmrit.ac.in Ph. No.: 9964382459 4. Name: THEJUS P S USN No.: 1CR19EC202 Email id: thps19ec@cmrit.ac.in Ph. No.: 8762452534
Project Guide	: Dr. SUSHMA B Email id: sushma.b@cmrit.ac.in Ph. No.: 9900315918
Keywords	: Vision-bot, clog remover, Robot, Sewer Pipes,

1. Introduction:

"Vision-based sewer pipe inspection robot for blockage detection " by K. Vijayakumar and R. Ananthakrishnan. This paper describes the design and development of a vision-based robot for sewer pipe inspection. The robot uses a combination of cameras and sensors to detect and remove blockages in sewer pipes. The vision-based clog remover in a sewer pipe with a churning mechanism offers several advantages over traditional methods of cleaning sewer pipes. The camera vision system enables the operator to remotely monitor the inside of the

pipes in real-time, making it easier to identify blockages and plan the cleaning process. The prototype for vision-based clog remover in sewer pipes can be implemented by categorizing it into two units, a robot unit which travels inside the sewer pipe and a control unit to control the robot externally. The robot unit is implemented by building the model with the hardware components interfaced and which performs commands from the controlling unit based on the programmed raspberry pi instructions. Controlling unit can be smartphone/computer through which we can control the robot with the aid of Wi-Fi. Controlling mechanism is done using the GUI application which controls components

2. Objectives:

As the name specifies “Vision based clog remover in narrow sewer pipelines” is a robot developed for removing and cleaning sewer pipes. This project deals with the problem of sewer pipes blockages. The sewer pipelines are the major tools for the transportation of effluent water. A lot of troubles caused by blockage in sewer pipe. It will lead to overflow of effluent water and sanitation problems. So, a new robotic vehicle has been designed and developed for cleaning sewer pipes. Equipped with a camera and LED lights, it can send live video to the operator. The operator can use the video to locate blockages and use a churning mechanism to clear them. This robot is capable of traveling inside narrow pipes and cleaning them effectively. The video feed provides real-time information to the operator, which can save time and money.

3. Methodology:

Block Diagram of Robot Unit

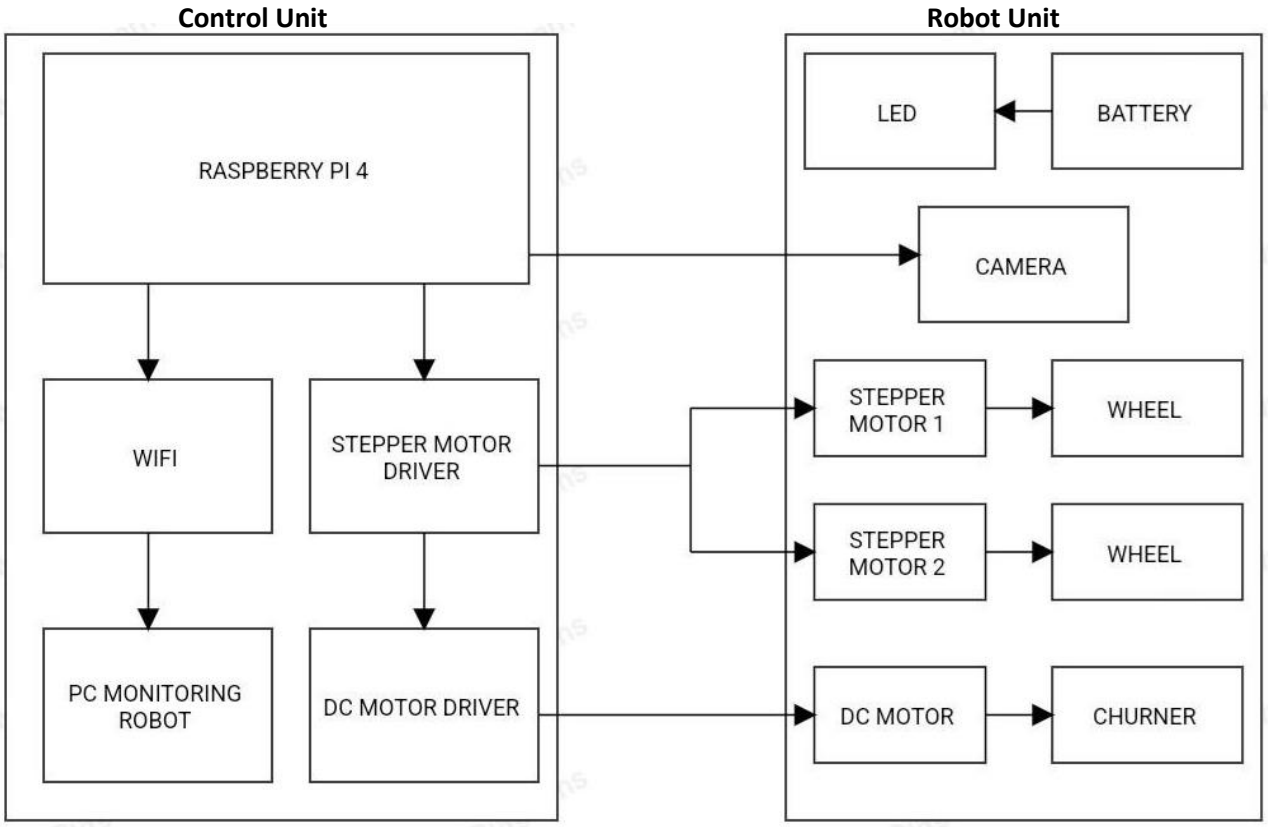

Fig. Block Diagram of Robot Unit.

The above figure represents the block diagram of the robot unit. The robot unit is developed by making use of the Raspberry PI with some other circuitry hardware components interfaced with it. The robot unit consists of:

- **Raspberry PI:** The Raspberry Pi is a low-cost computer that can run Linux & various other OS, and it also provides a set of general-purpose input/output pins, allowing you to control electronic components for physical computing and explore the Internet of Things.
- **L298N Motor Driver Module:** It allows speed and direction control of DC motor.
- **Easydriver v4.4:** It allows speed and direction control of Stepper motors.
- **DC Motor:** It is used for churning operation.
- **Stepper Motor:** It is used to control the robot's movement and direction in sewer pipes.
- **Churner:** It is used to perform churning mechanisms to remove the clog.

- **Web Camera:** It is used to monitor the sewer pipes for clogs. The camera module can be used to take pictures and high-definition videos. Raspberry pi board has USB port to which we can attach the pi camera module directly.
- **Power Supply:** We provide 5V DC for the motors, 3V DC for LEDs and 15V DC for the Raspberry PI.
- **LED:** For light source inside the pipelines.

Working Principle

A vision based robotic vehicle is designed which can travel inside sewer pipes and can churn the clog. Robot is fabricated inside a waterproof structure such that the robot can be travelled inside the pipes without worrying of damage of the robot. First, the system is sent inside the sewer pipe, through the cameras interfaced in the system. Movement of the robot is controlled by the operator of the robot. Real time video streaming from the robot can be seen in any of the mobile or the computer. Steamed video is monitored and robot is moved to detect the clog present in the pipes. If the clog is not detected, the robot is moved forward to detect the problem caused. If the clog is detected, clog is churned by activating the DC motor which is connected to the churner. This process is continued until the blockage is fully cleared.

Concept Diagram

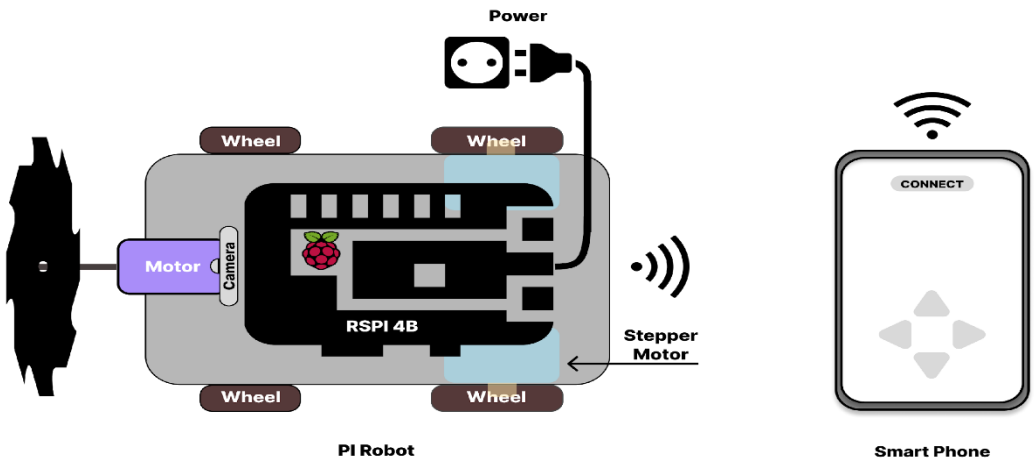

Fig. Concept Diagram of Robot Unit.

4. Results:

The model of "Vision based clog remover in narrow sewer pipelines" robot is successfully designed and tested. The robot is implemented by categorizing it into two units, a robot unit which travels inside the sewer pipe and a controlling unit to control the robot externally. The robot unit is implemented by building the model with hardware components such as stepper motor, DC Motor, Churner, Crawler wheels and LEDs interfaced with Raspberry Pi and which performs commands from the controlling unit based on the programmed raspberry pi instructions. Controlling unit can be smartphone/computer through which we can control the robot with the aid of Wi-Fi and also the real time streaming can be seen. Controlling mechanism is done using the python program written for the hardware interfacing

The robot was able to travel through narrow sewer pipes and provide live video feedback to the operator with little delay in the streaming. The churning mechanism was effective in clearing blockages with some limitations in reach of churner, and the robot was able to do this without causing damage to the pipes. Functionality of Robot was experimentally verified with some limitations in terms of size of the robot. The robot demonstrated its potential to prevent sanitation problems and overflowing of effluent water caused by blockages in sewer pipes.

5. Conclusions:

The development of the "Vision based clog remover in narrow sewer pipelines" robot represents a significant advancement in sewer maintenance. With its ability to travel inside narrow pipes and provide real-time video feedback to the operator, this robot can make the task of cleaning sewer pipes much easier, efficient and cost-effective. The robot's churning mechanism is capable of clearing blockages without causing damage to the pipes. This invention can prevent sanitation problems and overflowing of effluent water caused by blockages in sewer pipes. The robot has the potential to save time and money for sewer maintenance, and can lead to a cleaner and healthier environment.

6. What is the innovation in the project?

The innovation in this project lies in the development of a vision-based sewer pipe inspection and cleaning system that offers several advancements and improvements over traditional methods. Some key innovations in this project include:

1. Vision-based detection: The system incorporates a camera for real-time video streaming inside the sewer pipes. This enables visual inspection and detection of blockages or other problems within the pipes. The use of vision-based detection eliminates the need for manual inspection, allowing for faster and more efficient identification of issues.
2. Remote control and monitoring: The system is equipped with a GUI application that enables remote control of the robot unit. Operators can control the movement and actions of the robot from outside the sewer pipe using a remote-control interface. Real-time video streaming allows operators to monitor the robot's activities and make informed decisions regarding blockage detection and cleaning.
3. Churner mechanism: The robot unit features a churner mechanism powered by a DC motor. This mechanism is activated when a blockage is detected, allowing the robot to churn and clear the clog. The integration of the churner enhances the effectiveness of blockage removal, providing a more efficient and thorough cleaning process.
4. Wireless connectivity: The system utilizes Wi-Fi connectivity to stream live video from the robot unit to any mobile or computer device. This wireless connection enables remote monitoring by operators, allowing them to view the real-time video feed and make necessary adjustments or interventions as required.

Overall, the combination of vision-based detection, remote control functionality, churner mechanism, waterproof design, and wireless connectivity makes this project innovative in its approach to sewer pipe inspection and cleaning. It improves efficiency, accuracy, and convenience while reducing potential risks associated with traditional methods.

7. Scope for future work:

Advantages of the current state of technology used for developing the prototype for vision-based clog remover in narrow sewer pipes include improved efficiency and effectiveness in cleaning sewer pipes and the ability to provide live video feed to the operator to identify and clear clogs. However, there are also some limitations to the current technology.

To overcome these limitations, future improvements could include implementing advanced image processing algorithms using deep learning techniques for improved clog detection and identification. Additionally, developing an android application to wirelessly control the robot using mobile devices can improve its ease of use and accessibility. Other possible improvements include equipping the

robot with a hammer drill to improve its ability to break up clogs. Designing a model to move the robot along vertical pipelines will improve the range of operation of Robot. Connecting the churner to a robotic arm and controlling it to increase the range of operation of the churner is another possible improvement. It is possible to miniaturize the robot to move in very narrow sewer pipes. This could be achieved by reducing the size of the robot's components, including the body, motors, wheels, and camera, and designing it to be more compact and lightweight. Additionally, the robot could be equipped with special features such as a flexible body or modular design to enable it to navigate through tight spaces and around obstacles. Miniaturization would allow the robot to access and clean sewer pipes that are too small or difficult for larger robots or human laborers to reach, thereby improving the efficiency and effectiveness of sewer pipe cleaning operations.

Overall, these improvements could help to address the current limitations of the technology used for the vision-based clog remover in narrow sewer pipes and improve its efficiency and effectiveness in cleaning sewer pipes.