SLUDGE TRAVERSING ROV

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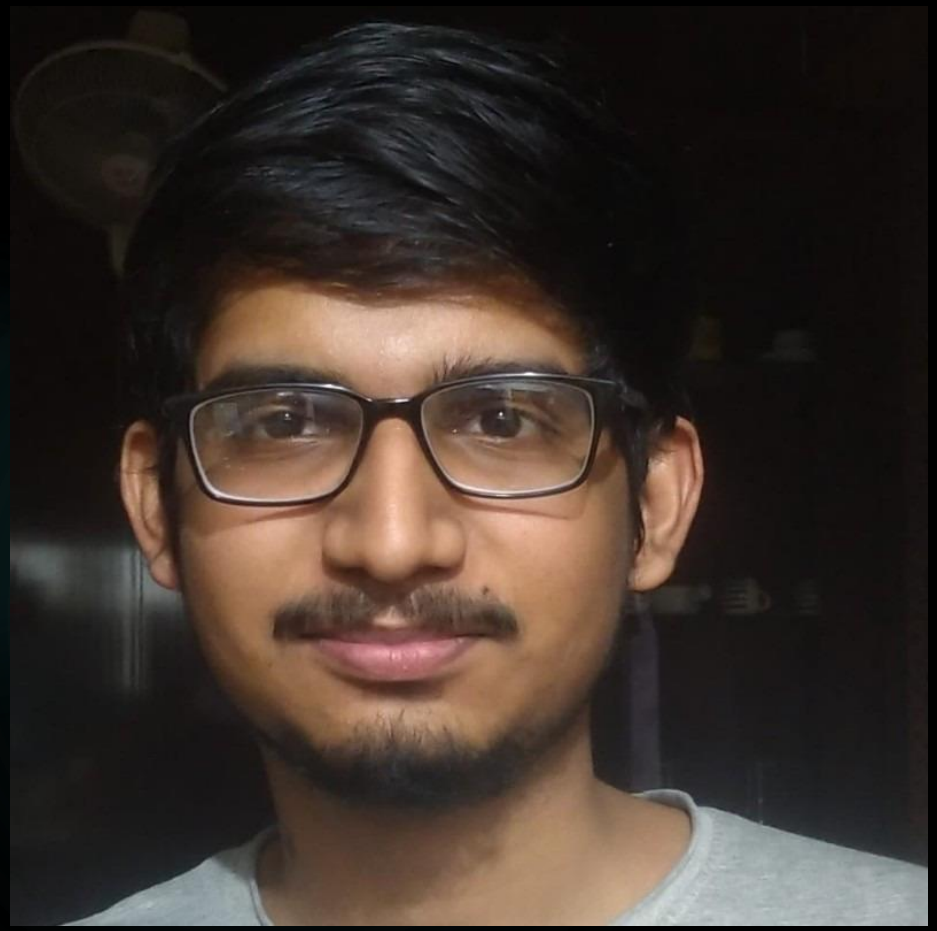

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ABSTRACT

1. Underground pipe systems are a key to any modern 21st century settlement.
2. They can vary from **gas pipes to water supply** and it is key to ensure that the pipes are maintained to be kept in good condition which can otherwise lead to **explosions in case of gas systems and loss of water or water supply poisoning** in case of water systems.
3. These pipeline networks can be extensive and difficult to survey for ordinary human and human tools especially in third world or developing countries where funds and resources for such an endeavour is scarce.
4. Human effort is not the solution to 100% to a country like India where faults and error rate is quite high and on the other hand we have only human labour to rely on.

PROBLEM STATEMENT/ CHALLENGES

To navigate sewers in order to find structural faults/cracks and also to lay pipes for cleaning.

1. While toilets are a necessary part of the solution, an arguably bigger yet often overlooked issue is how to contain and treat India's sewage.
2. Untreated sewage is the leading polluter of water sources in India, causing host of diseases. In some places, the cleaners are generally very poor men who dive into the toxic sludge to clean it.In others, manholes are lifted and pumps are used to clean the sewers.
3. A total of 631 people have died in the country while cleaning sewers and septic tanks in the last 10 years, the National Commission for Safai Karamcharis (NCSK) said in a response to an RTI query in 2020.
4. -Sewers in Indian cities are not well-developed. There are no pathways in the sewage system along which people can traverse.
5. While India's largest cities have centralized sewage systems with underground pipes, pumping stations, and treatment plants, these systems are expensive to build and to operate, requiring uninterrupted power, skilled operators, and extensive maintenance which are not organised well in the country.
6. -Such sewer lines prevent engineers from examining them and the entire architecture from within.

GRAPHICAL ANALYSIS

Item inspected		Description of inspection
Exterior condition	Ground surface	a. Check for crack, subsidence, and cave-in b. Check for overflow stream c. Check for any invaded pavement d. Check surrounding condition
	Manhole cover	a. Visual check for backlash, abraded surface, and corrosion (Check if any mark on external or internal surface of cover is erased.) b. Check for any malfunction of float preventive function, locking device, fall preventive function, etc. c. Others (damage on rising spacer, difference in grade of cover and grade ring, damaged grade ring, caved in manhole cover, offset, etc.)
Interior condition	Flow and sediment	a. Check for stagnant water or flow b. Check for any accumulation of sand and soil, pieces of wood, and mortar including remains of construction works and illegal disposals. c. Check for appearance of inverts such as scouring, damage, etc.
	Damage	a. Check steps for corrosion, rattling, and missing items (No.). b. Check blocks for damage, crack, corrosion, gap, and deteriorated caulking. c. Check barrel and base for damage, crack, and corrosion. d. Check for any improper joint of main sewers and laterals. e. Check for any irregular subsidence.
	Infiltration	Check for infiltration
Others		a. Check inflow for unacceptable or inferior quality. b. Check for toxic gases or odour.

REFERENCE-
https://cpheeo.gov.in/upload/uploadfiles/files/operation_chapter2.pdf

GRAPHICAL ANALYSIS

Technology		Sewer type			Pipe material	Pipe diameter mm	Defect detected			
		Gravity	Force main	Lateral			Internal condition	Pipe wall	Leakage	Pipe support
Camera	Digital cameras	•			Any	150-1500	•	•	•	
	Zoom cameras	•			Any	>150	•	•	•	
	Push-camera			•	Any	≤300	•	•	•	
Acoustic	In-line leak detectors	•	•		Any	≥100			•	
	Monitoring systems		•		PCCP	≥450		•		
	Sonar/ ultrasonic	•	•		Any	≥50	•	•		
Electrical / Electro-magnetic	Electrical leak location	•	•	•	Non-ferrous	≥75			•	
	Remote field eddy current	•	•	•	Ferrous, PCCP	≥50		•	•	
	Magnetic flux leakage	•	•	•	Ferrous	50-1400		•		
Laser	Laser profiling	•	•		Any	100-4000	•	•		
Innovative technologies	Gamma-gamma logging	•	•	•	Concrete	Not yet defined				•
	Ground penetrating radar	•	•	•	Any	Not yet defined			•	•
	Infrared thermograph	•	•	•	Any	Not yet defined			•	•
	Micro-deflection	•			Brick	Not yet defined		•		•
	Impact echo / SASW	•			Brick / Concrete	>1800		•		

REFERENCE-
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GRAPHICAL ANALYSIS

No.	Technology	Applicability		
		Sewer Size	Sewer Material	Sewer Condition
1	Light and Mirror	Up to 300 mm	Any	Empty
2	Closed Circuit Camera	Any size	Any	Empty
3	Sonar Systems	Any size	Any	Fully flowing

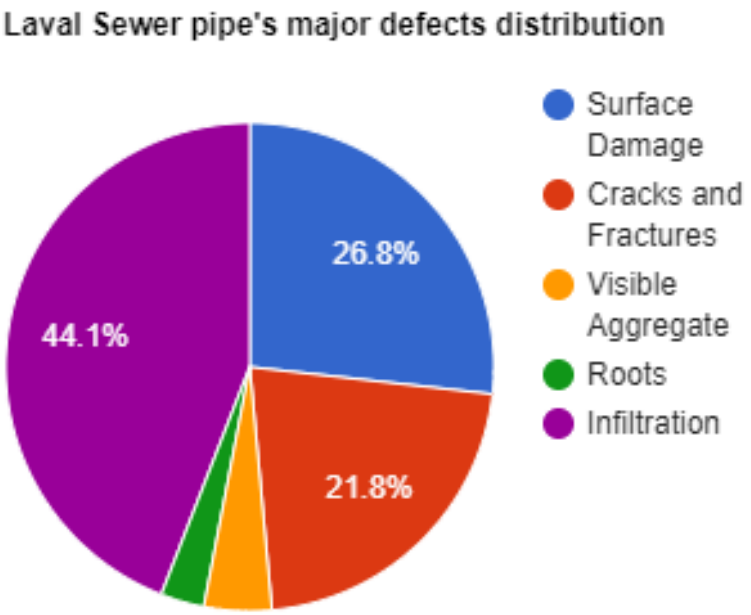
REFERENCE-
https://cpheeo.gov.in/upload/uploadfiles/files/operation_chapter2.pdf

GRAPHICAL ANALYSIS

Items		Rating					
		(a)	(b)		(c)		
Ruptured pipe	Reinforced concrete pipes, etc	Partially missing /holed pipe	Axial crack of 2 mm width or more		Axial crack of less than 2 mm width		
		Axial crack of 5 mm width or more					
	Stoneware pipes	Partially missed /holed pipe	Axial crack shorter than 1/2 of the pipe length		-		
		Axial crack of 1/2 of the pipe length and longer					
Cracked pipe	Reinforced concrete pipes, etc	Circumferential crack of 5 mm width or more	Circumferential crack of 2 mm width or more		Circumferential crack of less than 2 mm width		
	Stoneware pipes	Circumferential crack of 2/3 of the pipe circumference and longer	Circumferential crack shorter than 2/3 of the pipe circumference		-		
Gap at coupling pipes		Slip off (Joint displacement)	Reinforced concrete pipes, etc	≥70 mm	Reinforced concrete pipes, etc	<70 mm	
			Stoneware pipes	≥50 mm	Stoneware pipes	<50 mm	
Infiltration		Splashing in	Flowing in		Soaking		

REFERENCE-
https://cpheeo.gov.in/upload/uploadfiles/files/operation_chapter2.pdf

GRAPHICAL ANALYSIS



REFERENCE-
https://www.researchgate.net/figure/Defect-samples-for-a-visible-aggregate-b-visible-reinforcement-c-debris-d_fig3_301570683

SOLUTION

- A ROV can also be used for sewage inspection so as to spare humans from entering potentially dangerous places and also thoroughly inspect nooks and crannies of drains thus saving time and human effort.
- Manual inspections with outdated equipment result in a slow inspection rate with higher probabilities of errors.
- On the other hand, using ROV equipped with cameras can go into areas inaccessible to humans and detect corrosion. It can even expose structural problems and damages in drains and pipes.

SOLUTION

- Using computer vision the ROVs can analyse and process the video stream and detect the structural integrity of the sewage pipelines.
- Sensors can be fitted into the ROV to detect and measure the existence of harmful gases and substances.
- All the data will be transmitted to a software or an application where the ROVs can survey a large area in a relatively short period of time and can process and send the information using embedded systems in a relatively short period of time thus resulting in planning of an effective rescue operation whenever necessary.
- Smaller ROVs i.e. mini drones have the added advantage of being able to fit into smaller places where humans can't therefore produce more data for processing and even capturing higher quality images of every small fault in the sewage drains.
- This also results in production of a large amount of data for image processing and for future reference.

CONCLUSION

- Lastly our team would like to conclude that, living in the 21st century where we can utilise the concept of ROV , which will be able to detect any sort of failure in underground tunnels and be very well used for sewage inspection.
- In a country like India we need a upgradation to a level of benefit, to make the impossible happen with a very cost effective price for the government or the investor to invest in.
- The concept of making a water resistant mini ROV is what makes our project , our research work , our mission stay out of the crowd in the world of ROVs when it comes to our country, India.
- We often have come across many such ROVs for limited purposes, but here we want to come up with a concept that every country should put their investment in for a better, smart and a sustainable future.
- Our goal is to make an ROV , rather a sustainable one for our future generation to rely on in a quick and effective manner.

RESOURCES

Website
https://www.alliedmarketresearch.com/water-treatment-equipment-market

(PDF) Condition Prediction for Chemical Grouting Rehabilitation of Sewer Networks (researchgate.net)

Water and Wastewater Treatment Chemicals (WWTCs) Market 2021-25 - Technavio