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ACOUSTIC SENSORS TO DETECT CLOGS IN SEWER PIPELINES

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Abstract- Blockages in sewage pipelines are difficult to be cleaned or extracted. In order to manage sewer blockage proactively sewer managers needs to be able to identify the location of blockages precisely. As of now, only humans do this sully job of cleaning the sewages. Many human right organizations have been advocating to stop this inhuman activity. Even the highest court in the land has admonished the government to stop forth with this job of cleaning. Respective government's corporation is adapting cleaning machines to suck the clogs and sewage water from respective blockage points. As an alternative solution, using modern technology, we present our paper on how an acoustic based sensor could be used to detect the blockages automatically as well as transmitting this information using the wireless sensor network to the centrally monitored server system. This will help in taking immediate action of removing the clogs instantly. This will not only save cost but also enable instant solution.

Keywords- *acoustic based sensor, wireless sensor network, djikstra's algorithm and data mining.*

I. INTRODUCTION

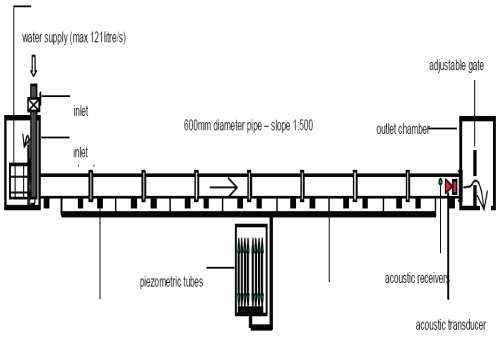
Sewer is an artificial conduit or system of conduits used to remove sewage and to provide drainage. Sewage is mainly liquid waste containing some solids which typically consists of
-washing water
-faeces
-urine
-laundry waste
-other materials from household and industry
In the 20th century, Sewers are usually pipelines that begin with connecting pipes from buildings to one or more levels of larger underground horizontal mains, which terminate at sewage treatment facilities.Vertical pipes, called manholes, connect the mains to the surface. Sewers are generally gravity powered, though pump may be used if necessary.

Most drains have a single large exit at their point of Discharge (often covered by a grating to prevent access by humans and exit by debris) into either a canal, river, lake, reservoir, ocean and spread out into smaller branches as they move up into their catchment area.

In India, manual blockage clearance seems to be the only solution which involves scavengers having to go down the manhole to clear this inexplicable problem. In this 21st century, with automation dominating every field, it is a very pathetic state for India which still incorporates cheap labour for accomplishing this task.Our technology seeks to solve this predicament by using wireless sensor networks composed of acoustic sensors that directly gives a consensus report on the identification of the blockage in a particular locality.
This eliminates the tiring efforts of the scavengers from venturing into the manhole.

II. CONCEPTUAL DESIGN OF OUR METHODOLOGY:

The Acoustic sensors placed at intermediate points detect the clogs present in the pipeline intensively using the ultrasonic waves that get reflected across the pipe diameter. The wireless sensor network effectively transmits the data to the server system for further manipulation. Though this technology can be substituted with scanner technology that makes use of the infrared rays to scan the pipe and provide an efficient information about the presence of blocks in terms of its size and roughness co efficiency, it cannot be implemented since each scanner must be independently connected to the server system which is a very costly approach taking the economy of India into consideration. So, in looking for an economically feasible technology that aids in providing a successful solution, we arrive at this technology which does not compromise on its efficiency.



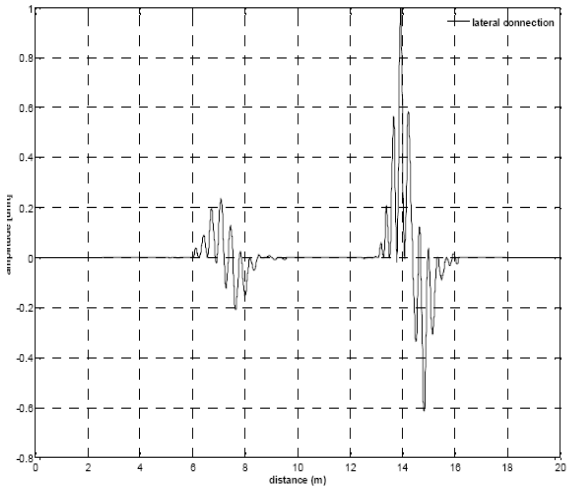
III. SENSORS TO DETECT BLOCKAGES:

SENSOR:
A sensor (also called detector)is a converter that measures a physical quantity and converts it into a signal which can be read by an observer or by an

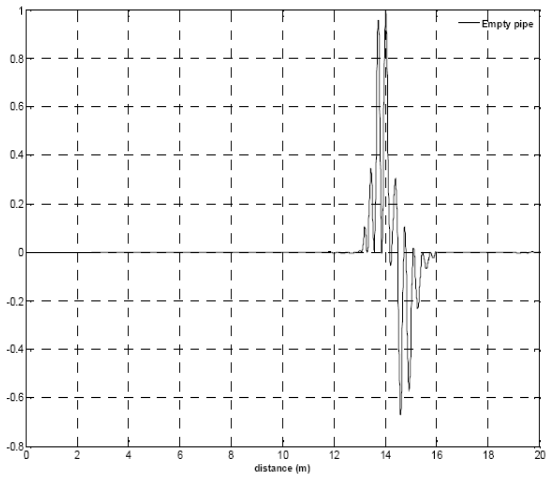
(today mostly electronic) instrument. For example, a mercury-in-glass thermometer converts the measured temperature into expansion and contraction of a liquid which can be read on a calibrated glass tube. A thermocouple converts temperature to an output voltage which can be read by a voltmeter. For accuracy, most sensors are calibrated against known standards.

IV. ACOUSTIC BASED SENSORS

The acoustic based sensors are epoxy coated so as to have longevity of life even in case it is submerged fully in the water sewage lines. The measurement technique is based on the analysis of reflected acoustic signals, as it was believed that these reflections carry sufficient information to identify pipe structural defects and blockages created by sediment and other materials such as rubble and fats. By generating ultrasonic waves and passing them across the pipe diameter, the blockage is determined if there is any change in the velocity of the ultrasonic wave that is received.



a) Reflection from pipe end of an empty pipe



b) Reflection from lateral connection and pipe end of an empty pipe.

V. METHODOLOGY

The input electrical signal is converted into ultrasonic waves through transducer present in the sensor. The ultrasonic waves generated are passed across the pipe. The reflected ultrasonic waves are converted back into electrical signal through the transducer. This data is sent to the server system by forming a wireless sensor network.

MOVEMENT OF THE DATA FROM SENSOR TO THE SERVER SYSTEM:[1]
Here the wireless sensor networking principle is used.

WIRELESS LESS SENSOR NETWORKS:
A wireless sensor network (WSN) consists of spatially distributed independent sensors to monitor whether the sewage pipe is clogged and to cooperatively pass their data through the network to a main location i.e., the server system.

The wireless sensor network is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node consists of radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique that is implemented between the hops of the network is routing.

The network topology that is implemented here is the "Wireless mesh network". A wireless mesh network (WMN) is a communications network made up of radio nodes organized in a mesh topology. Wireless mesh networks often consist of mesh clients, mesh routers and gateways. The mesh clients are often laptops, cell phones and other wireless devices while the mesh routers forward traffic to and from the gateways. It has a planned configuration and can be deployed to provide cost effective and dynamic connectivity over a certain geographic area.

VI. ARCHITECTURE

Let us assume that for our experimentation, 5 to 6 acoustic sensors for every 10 km span since each sensor will definitely have a range of around 2 kilometers. Since we are using acoustic sensor, it will be compatible for pipes of any diameter. Here, each sensor is considered to be a node. The network consists of a number of nodes that act like peer radio devices and therefore they don't have to be connected using cables. Mesh architecture sustains signal

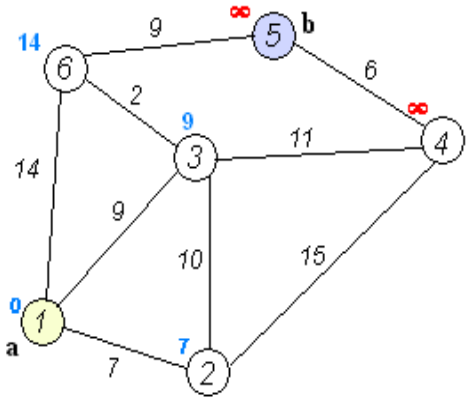
strength by breaking long distances into a series of shorter hops. Intermediate nodes not only boost the signal, but cooperatively make forwarding decisions based on their knowledge of the network, i.e. perform routing. This type of architecture can be centralized or de-centralized both are resilient and reliable. Here the nodes act as routers to transmit data from nearby nodes to peers that are too far away to reach in a single hop, resulting in a network that can span larger distances. As each node is connected to several other nodes even if one node drops out of the network, due to hardware failure or any other reason, its neighbors can quickly find another route using a routing protocol.

The principle is similar to the way packets travel around the wired Internet data will hop from one device to another until it reaches its destination. Djikstra's routing algorithm implemented in each device allows this to happen. To implement such an algorithm, each device needs to communicate routing information to other devices in the network. The routing algorithm used should attempt to always ensure that the data takes the most appropriate (fastest) route to its destination.

VII. TRANSMISSION ON DATA BETWEEN SENSORS TO THE SERVER SYSTEM

Djikstra's RIP algorithm is used here for transmitting the data across the wireless sensor network. For a given source node (sensor), the algorithm finds the path with lowest cost (i.e. the shortest path) between that vertex and every other vertex. It can also be used for finding costs of shortest paths from a single vertex to the server system is determined from the routing table.

By using the UDP (user datagram protocol),the above algorithm is implemented. The last node will send the collected data to the server system.



CONCEPT OF DATA MINING:[5] [2]& [6]

Data mining techniques are the result of a long process of research and product development. This evolution began when business data was first stored on computers, continued with improvements in data access, and more recently, generated technologies that allow users to navigate through their data in real time. Data mining takes this evolutionary process beyond retrospective data access and navigation to prospective and proactive information delivery.

The concept of data mining is used here for the generation of Action report which will help us to identify the location of the blockage without human intervention. From the electrical signal which is received by the receiver, which in this case is the server system we can get the relevant information by analyzing the wavelength, frequency, velocity, compressibility using the relay clustering data mining algorithm.

VIII. CONCLUSION

Thus by installing acoustic sensors at regular intervals in the pipeline system, the details pertaining to the presence of clogs is collected and transmitted across the network of sensors and to the server system. Thus the analyzed data through data mining principle will enable removal of clog through the quickest means by using available latest technology like Sewer Jetting Cum Suction Machine, Trailer Mounted Suction Machine (Gully Emptier), Mindjet Sewer Cleaning Machine thus entirely avoiding human hand in cleaning the sewage inside the pipes.

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