Original Research Article

REAL-TIME ALERT SYSTEM FOR OPEN MANHOLES

*** Swapnil Suryakant Kosalge**

*** Assistant Professor, Department of Physics, Guru Nanak College of Arts, Science and Commerce, G.T.B Nagar, Sion (E), Mumbai-400037, India.**

Abstract

Numerous serious problems are brought on by improper manhole maintenance. Periodical checking of manholes is necessary to maintain proper hygiene in our society. Sometimes manhole cover is damage or not in place. During the monsoon, manholes are not visible to predators due to the waterlogged conditions in the region around them, and pedestrians fall into these unsuspected, open manholes. Additionally, improperly closed manholes cause serious damage and vicious injuries to people. In order to control these issues, a secure manhole management system is required. In this article, different monitoring systems used to alert to open manholes are discussed and a proposed alert system to indicate the status of manholes.

Keywords: *Manhole, manhole monitoring system*

Introduction:

Removal or lack of manhole covers will cause safety hazards for pedestrians and vehicles. During the monsoon, it is necessary to remove the manhole to drain the water in metropolitan areas such as Mumbai and Bangalore. Pedestrians and vehicles fall into these unsuspected, open manholes. The deaths due to these manholes have been numerous. They are also a threat to pedestrians. These open manholes cause road accidents. In addition, improperly closed manholes cause serious damage and vicious injuries to people. Improper closing of manholes in India led to the loss of 157 lives in 2020–2022. At least two people die each day due to open pits and manholes. The death count of normal pedestrians keeps on rapidly increasing year by year. In order to control this issue, a secure manhole management system is required. The traditional method of displaying signs such as the red flag, danger open manhole portrait is time-consuming, labour-intensive, and inefficient. During heavy rain, manhole removal is unavoidable in order to drain water. The management department is put under considerable strain in such a situation. A real-time automatic manhole management system is now possible because to technological advancements.

Approaches to Open Manhole Detection:

Researchers have explored two primary approaches to detecting open manholes: one involves an in-car system that identifies and monitors open manholes or potholes on the road, while the other incorporates a system attached to or placed within the manhole itself. Byeong et al. [1] developed a manhole detection system utilizing Light Detection and Ranging (LiDAR) technology along with a camera. This system is integrated with a computer imaging program to enhance detection accuracy. Similarly, Mae et al. [2] introduced a method based on image processing, in which a camera-equipped system is directly

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installed in the vehicle. This system operates using a Raspberry Pi microcontroller. However, both approaches face challenges in distinguishing between manholes and potholes. Wesem et al. [3] addressed this issue by presenting a computer vision-based manhole detection system, improving the accuracy of identification.

Other researchers have focused on embedded sensor-based detection systems which is inserted inside the manhole. Haswani et al. [4] proposed a sewage monitoring system utilizing a light sensor to detect open manholes and a level sensor to identify potential drain overflows, thereby preventing flooding. If the sensor readings exceed the threshold value, the system automatically sends a text alert to municipal authorities. Nataraja et al. [5] introduced an Arduino-based system employing ultrasonic sensors to monitor temperature and pressure variations inside manholes. This system not only notifies municipal officers via text message but also activates an alarm to alert nearby pedestrians. Anjum et al. [6] proposed a similar approach for real-time monitoring.

Additionally, LiLei et al. [7] and Zhand et al. [8] developed manhole monitoring systems based on LoRa (Long Range) technology. Both systems use accelerometer sensors to detect manhole displacement, ensuring prompt notification of any irregularities.

While existing systems primarily focus on informing municipal authorities about open manholes, they do not effectively alert pedestrians and vehicles, leaving them vulnerable to accidents. To bridge this gap, this paper proposes a system designed to provide real-time warnings to pedestrians and drivers, ensuring enhanced public safety.

Proposed System

When a manhole is opened, the proposed system automatically activates, triggering a rod to

extend from the manhole. At the top of the rod, an LED lamp illuminates to visually indicate the open manhole, providing a clear warning to pedestrians and vehicles
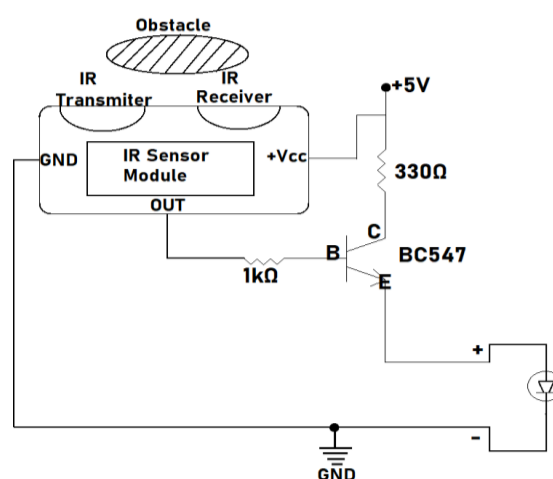

Figure 1: Electronic circuit to glow LED when manhole is open.

The system automatically activates when a manhole is opened or improperly closed. It operates using a circuit based on an IR sensor and a transistor, as illustrated in Figure 1. The circuit is connected to a metal indicator, which extends when the manhole is open, while simultaneously triggering an LED indicator to illuminate. This glowing LED serves as a visual warning to pedestrians and vehicles, alerting them to the presence of an open manhole and enhancing safety

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