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IOT based manhole detection and monitoring system

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ABSTRACT

In developing countries, manholes are not monitored properly. These unsupervised manholes can prove themselves to be a threat to lives in various ways. This paper presents an intelligent automatic manhole monitoring system which detects harmful chemicals and toxic gases inside the manhole, absence of the lid of the manhole and generates an alarm to the passersby in that situation, alerts the authority about the system state. The system can improve overall quality of the surroundings. Hence, the concerned authorities can take proper measures to maintain the manhole. The system has been implemented in an academic environment to carry out the automated monitoring of a manhole to evaluate the proposed features. The system consists of microcontroller ATmega8 which acts as the central unit that controls all the sensors and speaker. The system can detect the obstacles, water, potholes and sounds it via the speaker. By testing, the system can recognize obstacles such as pedestrians, trees, bricks and so on with the help of an infrared sensor. The proper environments to use are also identified. The electronic kit will help the blind person by providing more convenient means of life. The main aim of this paper is to contribute our knowledge and services to the people of blind and disabled society

Keywords: Ultrasonic sensor, LCD, Manhole

INTRODUCTION

Manhole which is meant to carry out inspection, cleaning and removing obstruction in the sewer line is also becoming the reason of accidents, taking lives and affecting them. Most of the systems in the developing countries are not automated. Most of the cities is currently using a poor underground drainage system and it is the duty of managing station to maintain cleanliness of the cities. If the drainage maintenance is not thorough, the pure water gets contaminated with drainage water and infectious diseases may get spread. The drainage gets blocked during rainy season, it might overflow and create problem for routine life such as traffic may get jammed, the environment becomes dirty, and consequently public become upset. Usually, manholes are covered with metal lids that keep it safe for passersby. If the lid is not closed properly, then there is a chance of accidents and also people may get fall into the drainage. Often during dark, people may not notice an open manhole which increases the number of accidents. There are several accident occurred in the past all over the world because of falling into the manholes. In 2016, a sanitary sewer cleaner was found dead after falling in a manhole [1] in Humble, a city in Texas, USA. Another accident happened in Bengaluru, India, where four motorists fell due to damaged manhole cover in July 2017 [2]. In 2017, teenage girl died after falling into an open manhole in Gazipur, Bangladesh [3]. In Bangladesh, it is reported that there are many open and unprotected manholes in the capital city and many accident occurrences has come to light. The manhole cleaning process is a big issue. The article here [4] depicts that manhole gas mixture found in the sewerage pipes is mainly containing toxic gases like, Carbon Monoxide(CO), Hydrogen Sulphide(H2S), Methane(CH4), Ammonia(NH3), Carbon Dioxide(CO2), Nitrogen Oxides, etc. Exposure to these gases may cause threats to human lives. Usually to clean the sewerage, a cleaner has to go down through the manhole and the presence of the toxic gases leads to serious health issues including Carbon Monoxide poisoning that causes death. Explosions in sewer have been occurred in almost every large cities. In 1916, an explosion occurred in a gate valve manhole in Montreal [5], in which two men were injured which was caused by an illuminated lantern that ignited the gases of manhole. Such explosions are usually followed by high rise in the temperature and pressure inside

the manhole which can lead to smoke explosion. Giving less emphasis on monitoring manholes all over the country causes greater problems than it is realized. Automated manhole monitoring system lessens these problem stated above to some greater extent. The automated manhole monitoring system proposed in this paper will help the officials of Municipal Corporation by informing them immediately after garbage overflow and the exact location where the sewerage or manhole needs to be cleaned up. If at any time, the cover of the manhole gets lost or stolen, then the authority will be notified immediately by using the system. By using a motion detection system, human presence near an open manhole can be recognized and the system can warn people by triggering an alarm system. Thus, the manholes can be kept secured. The system will detect presence of poisonous gases and let the cleaners know the current state of the manhole environment by using an LED indicator. It will also monitor the fluctuation of temperature and pressure inside the manhole. The presented system in this paper creates an user friendly environment to make life easy for every person walking on streets as well as people related to the maintenance of manholes, i.e. municipal officials, sweepers, cleaners etc. [6-9]

LITERATURE SURVEY

"Pedestrian navigation algorithm using inertial-based walking stick", Norliana Binti Yusof, Norhayati Soin, Siti Zawiah Md.Dawal, 2010, IEEE.

An algorithm for estimating the walking stick movement information is proposed using an inertial sensor attached on the stick. A standard inertial navigation algorithm using an indirect Kalman filter is applied to update velocity and position of the walking stick during movement. The proposed algorithm is verified with three-meter walking experiments.

"Autonomous walking stick for the blind using echolocation and image processing", LuayFraiwan, KhaldonLweesy, AyaBani-Salma, Nour Mani, 2011, IEEE.

The smart walking stick, the Assistor, helps visually challenged people to identify obstacles and provide assistance to reach their destination. The Assistor works based on the technology of echolocation, image processing and a navigation system. The Assistor may serve as a potential aid for people with visual disabilities and hence improves their quality of life. There is a lot of work and research being done to find ways to improve life for visually challenged people. There are multiple walking sticks and systems which help the user to move around, indoor and outdoor locations but none of them provide runtime autonomous navigation along with object detection and identification alerts. The Assistor uses ultrasonic sensors to echo sound waves and detect objects. An image sensor is used to identify the objects in front of the user and for navigation by capturing runtime images and a Smartphone app is used to navigate the user to the destination using GPS (Global Positioning System) and maps.

As a response for this issue, we propose a checking structure to be presented in mechanical offices. With this structure, we will have the choice to screen fundamental security parameters of the work environment in these mechanical offices so we are particularly mindful of the prosperity condition and the possibility of occurrence of any misfortune. For the structure of this system, we use an ESP8266 Wi-Fi chip engaged microcontroller Node MCU. To this are related three sensors - one to screen temperature and suddenness (DHT sensor), a ultrasonic sensor (HC-04) and a smoke sensor (MQ2 sensor). These sensors constantly screen the earth in the workplace and move the data onto the Losant IoT Platform, which is one of the most amazing cloud stages which help screen data by different portrayals and further game.

Automated Detection of Manhole Covers in MLS Point Clouds Using a Deep Learning Approach, IEEE, 2019

Road manhole cover works as an important part of road construction. Timely detection can make a great progress in the development of road management. This paper proposes a rapid road manhole detection method using mobile LiDAR with state-of-the-art computer vision and deep learning techniques. Firstly, the road surface data is extracted from mobile laser scanning system(MLS). Then, the 2D geographic reference feature(GRF) images are formed from 3D point cloud. Finally, the object detector using deep learning technology was applied to locate and annotate the road manholes. Also, we adjusted the training model to present the better result with high confidence over 0.90. Compared with the previous method, the proposed method can correctly detect the manhole cover with higher rate of precision and FI-feature at 0.952 and 0.975 respectively, especially in the complex road situation.

Automated Detection of Road Manhole and Sewer Well Covers From Mobile LiDAR Point Clouds, IEEE, 2019

A novel object detection algorithm is developed for automatically detecting road manhole and sewer well covers from mobile light detection and ranging point clouds. This algorithm takes advantage of a marked point process of disks and rectangles to model the locations of manhole and sewer well covers and their geometric dimensions. A reversible jump Markov chain Monte Carlo algorithm is implemented for simulating the posterior distribution obtained using a Bayesian paradigm. The detection results obtained from the road surface point clouds acquired by a RIEGL VMX-450 system show that the manhole and sewer well covers can be detected automatically and accurately. The performance achieved using the proposed algorithm is much more accurate and effective than those of the other three existing algorithms.

EXISTING WORK

Blind Cane

- Awkwardness.
- Recognition of obstacles up to knee level.
- Does not protect from obstacles at torso and face level.
- Prone to injuries.

Trained Guide Dogs

- 1% usage.
- Expensive to Train Dogs ($40k in USA).
- Training period on an average 6 months.
- Difficulty in dog up-keeping costs and lifestyle changes.

Human Guide

- Dependency.
- Feeling of being a burden.

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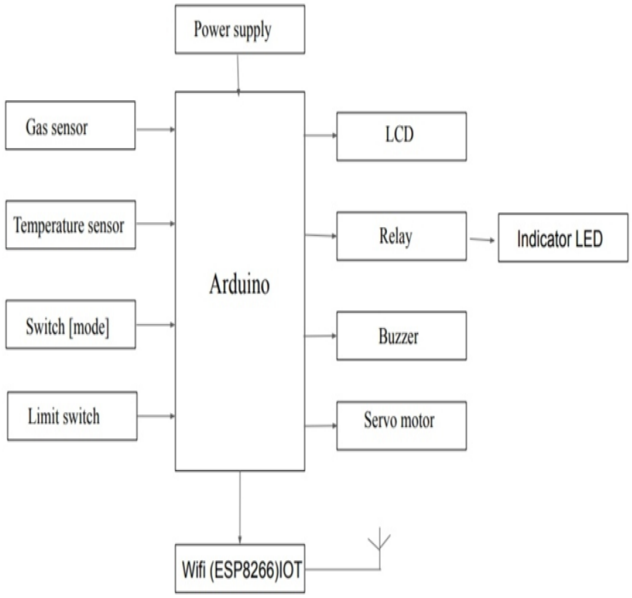
PROPOSED SYSTEM

- The proposed walking stick configuration involves a Arduino system that acts as the central processing unit
- Infrared sensor is used for obstacle avoidance and pathole detection.
- A voice is played through the speaker when an obstacle is encountered which helps in alerting the blind person and allows enough time to change their path.
- Water sensor is used to detect the presence of water and provide an alert in time for path change so as to avoid slipping.
- A heatbeat sensor is used to measure the heartbeat of the person contiuously
- Incase of any abnormality an alert sms is sent via the GSM(Global System for Mobile communication) module to the family members or the hospital along with the locational coordinates(lattitude and longitude) of the corresponding location.



HARDWARE MODULES

- FIRE SENSOR
- OBSTABLE SENSOR
- HUMIDITY
- RELAY
- BUZZER
- IOT MODULE
- ARDUINO MICROCONTROLLER

FIRE SENSOR

This fire sensor circuit mishandles the temperature distinguishing property of an ordinary sign diode IN 34 to recognize heat from fire. At the present time it recognizes heat, an uproarious alarm reproducing that of Fire separation will be made. The circuit is unnecessarily unstable and can distinguish a climb in temperature of 10 degree or more in its locale. Ordinary sign diodes like IN 34 and OA 71 shows this property and the inside restriction of these contraptions will lessen when temperature rises. The fire sensor circuit is exorbitantly sensitive and can recognize a rising in temperature of 10 degree or more in its locale. Standard sign diodes like IN 34 and OA 71 showcases this property and within restriction of these devices will lessen when temperature rises. In the pivot uneven mode, this effect will be progressively basic. Ordinarily the diode can make around 600 mille volts at 5 degree centigrade. For each degree rise in temperature; the diode makes 2 mV yield voltage. That is at 5 degree it is 10 mV and when the temperature rises to 50 degree, the diode will give 100 mille volts. This voltage is used to trigger the remainder of the circuit. Transistor T1 is a temperature controlled switch and its base voltage depends upon the voltage from the diode and from VR and R1. Commonly T1 conducts (as a result of the voltage set by VR) and LED sparkles. This shows run of the mill temperature.

In this project, the values of multiple sensors are taken into account and the manhole cover is maintained and monitored all the time. For this purpose we use Arduino for the simulation process. Then all the values are checked and then the steps is followed as follows

Step 1:First the crack sensor checks whether the crack is present or not. If yes it sends the message to the corporation office through IoT or else it goes for the next step.

Step 2: Then the gas sensor will check the presence of gas inside the manhole and if there is any leakage of gas, it informs the corporation office, or else it goes to the next step.

Step 3: The next sensor is that it checks for the temperature increase, if there is a huge increase in temperature, it reports to the authority, or else it goes to next step.

Step 4: The next step is the tilt sensor checks for any anle inclination. If it is 0 degree, it goes for next final step.

Step 5: The final sensing material is that it checks for the overflow of drainage water, if it is yes, it informs the authority or else it continues to monitor.

WORKING PRINCIPLE

The smart city will be definitely the most important challenges are. The mass concentration of individuals at cities creates many opportunities, but it carries to share of the urban management problems are: Pollution, Poverty, Security and the mobility, etc.

This project will be dealing with the safety protection of manhole covers in major cities. The important features are,

- A real-time monitoring system.
- The process of the manhole can be viewed anywhere at any time.
- As sensors are used, the size will be of less size.
- The damage in the manhole cover can be found very easily and in faster time the accidents can be avoided. Sensors Used the sensors used in this project are,
- Temperature sensor.

Explanation of Sensors

1. Temperature Sensor: This sensor is used to sense the temperature inside the manhole and indicate through IoT whether the temperature is increased or not. If the temperature increases above Celsius then the message is sent through the IoT.

2. Obstacle Sensor: This sensor is used to check the angle inclination of the manhole cover to the basement. If the angle is other than 0 degrees then the message is sent.

3. Crack Sensor: This sensor is used to check whether the manhole cover is broken or not. If there is any crack the message is sent.

4. Gas Sensor: This sensor is a important one because many people were dead because of the dangerous gases that spread from the manhole. This senses the gases and indicates the authority about the leakage of gases.

5. Overflow Sensor: The overflow sensor is used to indicate the overflow in the drainage system.

(figure showed up underneath), and the variable resistor is used to change affectability. Right when one of the above vaporous segments cooperates with the sensor resulting to warming, the sensor's resistances change. The alteration in the block changes the voltage over the sensor, and this voltage can be examined by a microcontroller. The voltage worth can be used to find the block of the sensor by knowing the reference voltage and the other resistor's restriction. The sensor has differing affectability for different sorts of gasses.

ACCELEROMETER

The MQ2 has an electrochemical sensor, which changes its impediment for different assemblies of vacillated gasses. The sensor is related in course of action with a variable resistor to outline a voltage divider circuit (figure showed up underneath), and the variable resistor is used to change affectability. Right when one of the above vaporous segments cooperates with the sensor resulting to warning, the sensor's resistance changes. The alteration in the block changes the voltage over the sensor, and this voltage can be examined by a microcontroller. The voltage worth can be used to find the block of the sensor by knowing the reference voltage and the other resistor's restriction. The sensor has differing affectability for different sorts of gasses.

RELAY (2)

Moves are the fundamental protection similarly as trading contraptions in a huge bit of the control strategies or equipment. All the exchanges respond to at any rate one electrical sums like voltage or stream with the ultimate objective that they open or close the contacts or circuits. A hand-off is a trading device as it endeavors to confine or change the state of an electric circuit beginning with one state then onto the following. Gathering or the sorts of moves depend upon the limit with regards to which they are used. A part of the classes consolidate cautious, reclosing, coordinating, right hand and checking moves. Protective exchanges diligently screen these parameters: voltage, current, and power; and if these parameters harm from set cutoff focuses they make alarm or detach that particular circuit. These sorts of moves are used to guarantee equipment like motors, generators, and transformers, and so forth.

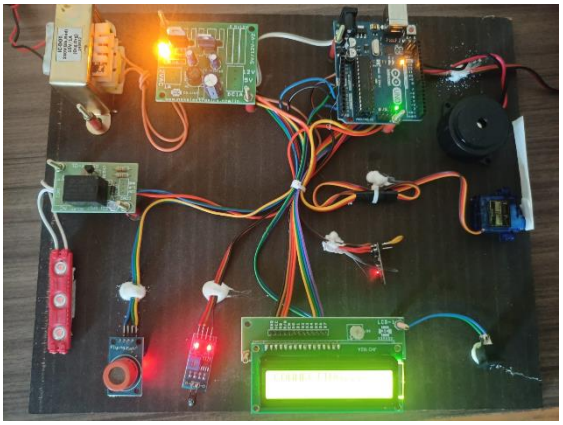
HARDWARE

- Power supply unit
- Microcontroller atmega8
- LCD display – 16x2
- Temperature Sensor
- GAS sensor
- Obstacle

SOFTWARE REQUIREMENTS

- Platform - AVR STUDIO
- Compiler – Win AVR

HARDWARE IMPLEMENTATION



CONCLUSION

This article proposed an intelligent system which can assist the blind to walk, which consists of a cane and an embedded system. After testing, the system proposed in this paper helps users walk in a relatively safe environment reliably, such as indoors, parks, and schools. The system not only makes them free, but also liberates their mind and throw away many worries and doubts. However, in some specific open environment, such as on the road, the blind still need someone accompany them if they have to take a long trip. What's more, the effect of the system will be reduced obviously in crowded environment.

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