A CRITICAL LITERATURE REVIEW ON WIRELESS SAFETY DEVICE FOR MANHOLE CLEANERS

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Abstract - *This work shows the real situation-based problem which relate to the manhole cleaners who works in manhole. Due to excessive proportion of poisonous gases in manhole such as Ammonia, methane, carbon monoxide etc. can leads to the major injury to the workers of manhole and also cause to the death. Aim of the study is to develop a wireless safety device for manhole workers. A wireless safety device is used for the safety of manhole cleaners which provides safety to the workers by detecting the poisonous gases which are present in the manhole. This safety device helps to detect poisonous gases by indication of buzzer and LED to the manhole cleaner. This safety device can provide with worker as an arm belt so he will immediately get to know the presence of poisonous gas in the manhole so according to it he will rescue from manhole easily. The safety device which provided to the manhole cleaner will connected to another worker which outside of manhole. Both workers get the indication of poisonous gases at same time so it will be easy to rescue the worker who will working in manhole. This is the way of providing solution to the real problems by using technology, therefore technology needs to as simple as possible so it can easily use it and understand it. This safety device will be very easy to handle and use for workers, so they will not avoid it when they are going in manhole for cleaning or maintenance of manhole.*

Key Words: Manhole, gas detectors, gas sensor, safety device.

1. INTRODUCTION

There are various types of safety equipment are provided in construction industry for the safety of workers. In various construction area where different type of safety equipment has been used for different type of work. Whereas, while working in manhole at time of cleaning or maintenance of manhole different type of safety equipment being used by workers. After providing all necessary PPE, the rate of sudden death or accidents of manhole cleaners have not decreasing. The workers lack of knowledge about safety equipment leads to the major injury or illness. The death rate of workers while working in manhole and sewer work have not been stopping at all. Day by day the number of accidents had increased. By using safety equipment also this problem is not solved totally. All the incidents which are occurred due to workers negligence towards safety equipment and lack of knowledge about safety equipment, which leads to major injuries. And because of these injuries they may become disabled and unable to work, and this situation not only burden of them but also their family respectively.

Most of the illness and sudden death are occurred due to gases which are present in manhole. In manhole generally, Ammonia (NH_3), Carbon monoxide (CO), Methane (CH_4), etc. are found. These gases are highly toxic and poisonous. Sometimes the proportion of these gases are very high which can be dangerous to worker while working in manhole. Many types of sensors are used for detecting the sewer gases which are helpful but then also accidents are occurring which is the main issue of sewers to work in it. In past years manhole accidents have increased. To work in manhole is very risky work, there is need to decrease these accidents. Safety of any worker is very important. There is need to develop safety devices for increasing safety of workers while working on site.

For the safety of manhole cleaners developing a safety device which provides safety to the workers by detecting the poisonous gases which are present in the manhole. This safety device helps to detect poisonous gases by indication of buzzer and LED to the manhole cleaner. This safety device can provide with worker as an arm belt so he will immediately get to know the presence of poisonous gas in the manhole so according to it he will rescue from manhole easily. The safety device which provided to the manhole cleaner will connected to another worker which outside of manhole. Both workers get the indication of poisonous gases at same time so it can easy to rescue the worker who will working in manhole. This is the way of providing solution to the real problems by using technology, therefore technology as simple as possible so it can easily use it and understand it. There are various types of sensors are present in the market for detecting sewer gases. Many of them are used before working in manhole to check the proportion of gases. But after testing all the gases and providing sensor also manhole accidents have not much decreased. Hence for the convenience of manhole worker the safety device design will

provided with them, so they can find out about gases with help of sensors and rescue from manhole easily.

In this study, the different type of sensors is used to detect the gases present in manhole. Manhole cleaner will get the indication of gases through LED and buzzers which are provided on their body as an arm belt. The worker whose standing outside the manhole will also get indication at same time by this device. Both devices are simultaneously working and connect with each other. This safety device will be very easy to handle and use for workers, so they will not avoid it when they are going in manhole for cleaning or maintenance of manhole. they can easily understand it and buy it by themselves because of low cost which can affordable to them.

2. LITERATURE REVIEW

Eduard Llobet, 2001, studied that FFT has better results than discrete wavelet transform (DWT) and it shows the quantitative analysis of NO2 & CO mixture present in air. This study presents that by use of only one gas sensor which is operated in temperature mode can be identified two gases simultaneously. From the responses of sensor, it is found that DWT outrange the fast Fourier transform in the extraction of applicable feature. [1]

B. Baraboi, 2001, studied for the analysis of gas mixture of design and implementation of system. To locate the gases like methane, isobutane, and hydrogen is the aim of study. This system is capable to perform online analysis of gas mixture and it is designed by using LABVIEW. This study gives a prototype gas analysis system which developed in their laboratory to identify and quantify analytes in mixtures of gas. [2]

Benjamin O. ALLI, 2008, focuses on the topics essential to the OSH activities in which Part I represents an overview of all OSH activities, Part II gives the policy perspectives, and Part III has an operational aspect for applying occupational safety and health. [3]

Rajesh Kumar1, 2009, shows that to detect the concentration level of poisonous gases like, ammonia, carbon monoxide, methane, hydrogen sulfide, etc., the different types of taguchi gas sensor (TGS) has been studied. By analyzing the danger, results of study are help to use the sensor for measure concentration level in the air. [4]

Maxime Ambard1, 2009, propose a bio-inspired signal processing method for odor discrimination. The spiking neural network is used to identify the analogue outputs from a monolithic 4×4 tin oxide gas sensor array which are implemented in their in-house 5 µm process. This system has been tested on 4 gases such as hydrogen, ethanol, carbon monoxide, methane successfully. This method can easily use for building dedicated hardware for processing data from gas sensor arrays. [5]

Chatchawal Wongchoosuk, 2010, gives report on an E-nose based on hybridized CNT-SnO2 gas sensors prepared by electron beam (E- beam) evaporation, which is inexpensive, fast, portable, reliable & both solid and liquid samples. Features extraction techniques including integral & primary deviation are proposed for improving classification performance by principle component analysis (PCA). [6]

J. Kathirvelan, 2011, developed a system to detect minimum four gases by use of noble material and suitable intelligent techniques to prepare electrode and electrolyte. This process is a complex procedure to study and examine because of gases coming from reactions and it also can cause measure inaccuracy in value of gases. use of electrodes or electrolyte with multi metallic electrodes can increase the sensitivity towards particular gas which present in gas mixture. [7]

Varun Kumar Ojha, 2012, presents a concept which can implement an Intelligent System to detect the of proportion of various components which are present in manhole. In manhole, there is presence of poisonous gases like methane, ammonia, carbon dioxide, hydrogen sulfide, carbon monoxide, nitrogen oxide therefore it is very important to get proportion of components in manhole gas mixture. Human can risk their life because of limited time in manhole while working in manhole. A gas sensor array can use to recognize multiple gases simultaneously. This study gives cross-sensitivity because of multiple sensor usage. [8]

Varun Kumar Ojha, 2012, studied for detection of gases found in manhole gas mixture by analysis of neuro genetic algorithm. The neural network (NN) are instruct by using genetic algorithm (GA) so it can use to implement an intelligent sensory system to detect the gases present in manhole gas mixture. In manhole gas mixture there is presence of various toxic gases like carbon monoxide, methane, nitrogen oxide, etc. A semi-conductor-based gas sensor array is use to sense the manhole gas components which is an integral part of the given intelligent system. Multiple sensors of various gases use to detect gas mixture of multiple gases which give results in cross-sensitivity. This study is mainly focused on multiple gas detection. [9]

Varun Kumar Ojha, 2012, presents that in manhole, to detect the proportion of component gas present in manhole gas mixture by analysis of neuro swarm optimization algorithm, where each gas sensor has capacity to sense gas elements. The result shows in cross-connectivity. [10]

Eungyeong Kim, 2012, studied use for the collecting intelligent odor detector which is selected to increase the selectivity of gas sensor arrays. This was achieved using an odor monitoring system with a newly developed neural-genetic classification algorithm (NGCA). The system describes the enhancement in the sensitivity of gas which is detected. The experiments show that the proposed NGCA can give better performance than the other used genetic

algorithm (GA) and artificial neural networks (ANN) methods. It can also use PCA for data visualization. Its suggested system can increase the reproducibility, reliability, and selectivity of odor sensor output; therefore, it is anticipated to be applicable to diverse environmental problems which includes air pollution, and monitor the air quality of clean-air required buildings such as a kindergartens and hospitals. [11]

Varun Kr Ojha, 2014, studied that for analysis of each gases from mixture of different toxic gases considering a sensor array which consist four individual gas sensors (methane, carbon dioxide, carbon monoxide, hydrogen sulfide, ammonia) has been developed. From different areas manhole gas has been collected and then analyzed by chemical process in lab. The sensor array is developed using gas sensors such as Methane, Carbon monoxide, Carbon dioxide, Hydrogen sulfide and Ammonia, which are frequently present in manhole gas mixture. For cross sensitivity of the sensors an intelligent system is being developed to find out the actual concentration of gas from a gas mixture. [12]

Krishnan Murugappan, 2015, presents that for the methylamine and hydrogen chloride gas detection the point screen printed electrodes (SPEs) are employed as electrode material. The use of SPEs is to know the highly toxic gases behavior at low concentration which also includes graphs then the analytical study is carried out. Electrochemical techniques are used such as linear sweep voltammetry (LSV), differential pulse voltammetry (DPV) and square wave voltammetry (SWV), and between these three techniques there is equality in the limits of detection (LODs). On Pt SPEs, the LOD reach are lower which is suggesting that Pt SPEs can successfully be combined with RTILs to be used as cheap alternatives for amperometry gas sensing in applications where these toxic gases may be released. [13]

K.S. KamaleshKumar, 2016, studied the death rate of manual scavengers to know the evidence of the death rate and safety procedure questionnaires in India. In manual scavengers it is suggested that the technology safety precautions to end the dead rate. To reduce the death rate, new methods by simplest way. are surveyed and suggested. The poisonous gas can be utilized positively to produce energy for domestic and commercial applications because of its flammable nature. Thus, produced methane gas is the source for diesel generator to produce electricity which will be a big crisis in near future. [14]

R.Maniarasi, 2017, studied the sewage poisonous gas monitoring which presents the effective solution. It uses for different type of sensors to check parameters present in sewage like gas, temperature, etc. Analog values from sensors are converted into digital values using analogue digital convertor and these values are given to signal conditioning circuits and are monitored using field programmable devices. Alarm buzzer are used when threshold value become less than sense value. This type of indication will help sewer employee to protect their lives from risk and harmful disease. [15]

Varun Kumar Ojha, 2017, studied gas detection of sewer pipeline for the sewage workers by use of classification-based approaches. This study is to recognize toxic gases from sewer pipeline for the safety of workers.to design this model different dataset are collected from laboratory tests. Different types of algorithms are being used to design this model and their performances calculated and compared using collected dataset. The result of this study gives instance-based algorithm which are better than other algorithms. This solution is use for the safety of sewage workers and to protect them from non-hazardous gases of sewer-pipeline. Many accidents and death can easily avoid by using this solution. [16]

Andreas Hierlemann, 2017, gives the results that for the performance of sensor array, it is very beneficial to use the transducer types arrays. In many cases, the data analysis of sensor-array or "electronic nose" instruments have been limited to an empirical qualitative analysis or the drawing of PCA plots. While useful for rapid visualization purposes, PCA plots are not very representative for higher-dimensional measurement/feature spaces because the data are projected onto a two-dimensional plane irrespective of the original or intrinsic dimensionality and PCA only captures directions of maximum variance which do not necessarily contain analytical information. Thus, it is not always clear which compounds or chemical effects lead to a discrimination of the different samples. [17]

V. D. Ambeth Kumar, 2018, use wireless sensors system to identify toxic gases which cause death. Calibration procedure is use for this system for higher accuracy. This sensor system can be modified according to environmental conditions. It has features which gives warning to the user. In this sensor system a monitor system is use to track the heartbeat of labors. This system can detect multiple gases which are responsible for the death. [18]

3. NEED FOR THE STUDY

According to various experimental study it is mainly observed that the manholes are very risky place to work in it. Using PPE also accidents have occurred mostly. The workers who works in manholes have increasing the risk of major accidents or illness or death. In manhole there are presence of highly toxic gases and poisonous gases which are injurious to health. This study shows that the device which we are developing is to reduce the accidents or illness of manhole cleaners. The study shows the gas sensor detection device which would be useful for the manhole cleaners from toxic gases present in manhole for their safety purpose.

4. OBJECTIVES OF THE PRESENT STUDY

- To study the various gases, present in the manhole.
- To study the various gas sensor which will be needed to detect the toxic gases which presents in manhole.
- To develop the safety device using gas sensors for manhole cleaners.

5. THEORETICAL METHODOLOGY

- The study of literature survey by referring research papers, books carried out to know the basic concept of the topic.
- Identification of need of research topic.
- Collection of data from authentic sources.
- Design the safety device using gas sensors.
- Demonstration of safety device for manhole cleaners.

6. CONCLUSIONS

1. The gas sensors with signal processing algorithm based on MLP artificial neural network system can be used to detect gas components in three gas mixtures and estimation of total gas concentration with good accuracy. [2]

2. A bio-mimetic algorithm system is used which is based on spike time calculation for to demonstrate odour discrimination. [5]

3. To develop a sensor which can measure minimum four gases, suitable intelligent techniques and noble materials to prepare electrodes and electrolytes are used. [7]

4. Manhole gases can detect using intelligent sensor system comprising semiconductors which is based on gas sensor array and neural network algorithm. [8]

5. The analysis of real valued neuro genetic algorithm is applied to detect the proportion of gases which are found in manhole gas mixture.[9]

6. The methane gas which is produced in manhole is the source for diesel generator to produce electricity which can will be used for future. [14]

7. The poisonous gas identified and methane gas can be used to produce electricity and to rotate turbine of a generator. [15]

8. The use of various transducer types array is beneficial with regards to performance of sensor array. [17]

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