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A Novel Smart Jacket Implementation in Sewage Workers

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ABSTRACT

Many cities in India have underground drainage system which requires proper maintenance. The drainage systems are mostly maintained by the Municipal Corporation in various cities. In most part of the city, sewage workers are employed for cleaning the drainage system by various corporations. The sewage workers face various issues while working inside the manhole like exposure to toxic gases and shortness of oxygen due to more presence of methane. Sewage workers monitoring system monitors the health status of these workers and also they monitor the level of toxic gases inside the manhole which helps the workers to escape in case of any increase in the gas levels. This system is also used to detect any blockage inside the manhole and prevents clogging. This system makes use of sensors like air quality sensor, hydrogen sulphide sensor and gas sensor for monitoring the levels of various gases. The health status is monitored with the help of pulse sensor. The system provides real time monitoring of these data through Internet of Things. This real time monitoring is done through the thing speak software which sends data to the cloud from the controller. The whole system consists of two units one is to monitor the gases inside the manhole and the other is used to monitor the pulse rate of the involved worker. This system can be used in manholes were the workers perform their work which will assist them by monitoring their pulse and also alert if there is any deviation from the threshold

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limit. So this could help various Municipal Corporation in cities for their maintenance and other related works related to underground drainage system

INTRODUCTION

India has been undergoing rapid urbanization since independence. Drainage system and sewage system has become an important priority in the Indian context due to various factors like increase in population growth, urbanization and industrialization. These factors affect the basic drainage and sewage system of our country. The sewage system is maintained by Municipal Corporation in India. The sewage workers or manual scavengers face various issues like diarrhoea, asphyxia and respiratory system problems due to absence of any safety measures taken by them. This system plays a major role for sewage workers by taking care of their work and also alerts them in case of raise in the level of gases beyond the threshold limit. The various paper developed earlier has provided many simplistic approaches but this system is very cost effective and executes real time monitoring of various data through the help of Internet of Things. Several papers have executed Wireless sensor networks for real time implementation but IoT is far better when compared to this technology and this system can be used for the safety of sewage workers. After Urbanization, there has been great increase in the population of major cities in India which has direct impact on the drainage and sewage system. The maintenance of the sewage system is very crucial in the present days because if they are not maintained properly, it could affect the environment. A survey has showed that 60% of the waste water has sewer network in India while remaining are untreated and are released into the water bodies[6]. Most of the times, the sewage or drainage is mostly cleaned with the help of sewage worker or manual scavengers without considering the health impacts and other relates issues while working inside the manhole. There is an estimate that around 1.2 million scavengers in our country and government have taken various steps to prevent manual scavenging in India.

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Government has also enacted an act for this issue. The major problem which is associated with the sewage workers is that they are exposed to toxic gases and they die when they are over exposed to these gases. According to the Ministry of Social Justice and Empowerment, a survey has been conducted on the number of deaths due to manual scavenging. The Ministry has pointed that Tamilnadu has more number of deaths in our country due to many manual scavenging and Uttar Pradesh has more persons who are involved in manual scavenging . Government takes various steps for the upliftment of these manual scavenging by providing cash subsidy and help in developing life saving skills for employment in any other field. This issue can be solved only through complete mechanizing of the cleaning process and also to take care of workers by providing them with safety equipment's. The various toxic gases which the sewage workers are exposed inside the manhole are hydrogen sulphide, carbon monoxide and methane. These gases mostly deplete the oxygen which is present inside the manhole and hence there will be less availability of oxygen which affects the worker The regular practice is used to open the manhole half an hour before starting the work so that there will no suffocation for oxygen inside the manhole. Most of these workers develop sub- acute symptoms like sore throat, breathlessness, sweating, irritability and cough. The major health concern is the musculoskeletal disorder like the osteoarthritis. When large amount of Hydrogen sulphide is inhaled by the person, it can cause anoxia which results in death by asphyxia. Hydrogen sulphide causes problems in the respiratory tract [7]. Exposure in the range of 10-500 ppm can cause slight poisoning. If they exceed 700 ppm, it can cause coma. The National Institute for Occupational Safety and Health (NIOSH) has suggested the safety range for methane will be 1000 ppm for 8 hours

LITERATURE SURVEY

Sudhanshu Kumar et al [1], Proper maintenance of the drainage system increases with the growth of cities. The real

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time health monitoring system helps the Municipal sewage workers in very critical situations. It monitors the pulse of the involved person through pulse oximetry sensor and also checks the levels of various toxic gases which will be very harmful for man like methane. Arduino UNO is the microcontroller used in this system. The sensor assembly communicates with the display unit via the UART communication. There are various led used for various purposes like red led symbolizes when any of the parameters are not in the safe range and green led symbolizes that all the parameters are within the safety range and the yellow light symbolizes urgent attention needed.

Vijayalashmi.R et al [2], Simulation gives an imitation of the operation of the process which represents the operation over time and it is the best approach before designing a product or prototype so that any modifications or changes can be made as per the requirement and the detection system is also a simulated tool. IOT based detection system has created a new path for creating a system for sewage workers based upon Internet of Things. The system detects the various toxic gases like methane, carbon monoxide and hydrogen sulphide which are harmful to the human beings through various sensors inside the manhole. The ultrasonic sensor is used to detect any blockages in the manhole and the pulse sensor is used to detect the pulse rate of the individual inside manhole. Arm microcontroller has been used in this system for better results. The data is sent to serial communication network through the help of GSM module. The sensors provide the data to the microcontroller and the controller processes it and sends output. If the digital output is below the threshold limit then there is no indication.

Gaurang Sonawane et al [3], this system has been executed in real time through the help of Wireless Sensor Network technology (WSN) which is under a part of Internet of Things (IoT). The main objective of the system is used to identify the blockage so as to prevent clogging of water and to check the level of various gases

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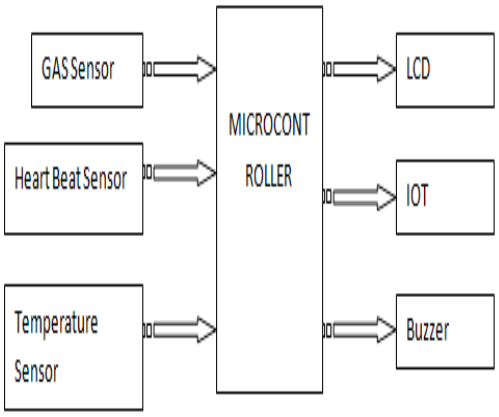
and also the water level at any period of time through water level sensor inside the tunnel or any manhole. This system provides the data of water level, gas level and any blockages inside the manhole in the server so that the location of the place is identified through the id of the place.

METHODOLOGY

Sewage workers smart monitoring system consists of two main units namely the sewage monitoring unit and the health monitoring unit. The sewage monitoring system is used to monitor the level of various gases like carbon monoxide and also to check for sewage workers. comprises of all sensors which are used for gas level measurement and also sensor to detect any blockage inside the sewer. MQ-7 sensor is used to detect the concentration of carbon monoxide. These sensors are then connected to the main controller along with LCD display for displaying their gas level. This unit also has a buzzer which is used to alarm the user when there is any deviation from the threshold limit. The data which are collected are pushed to the cloud through the IoT server. Health Monitoring Unit This unit consist of pulse sensor which monitors the pulse rate of the involved sewage worker along with a LCD display for displaying the values which are then connected to the controller and data collected from the controller are then pushed to cloud using the IOT server.



WORKING

Sewage monitoring unit of the system is designed for two main purposes, one to detect any blockage inside the sewer and the other function is to monitor the level of toxic gases inside the manhole. The various sensors which are used in this unit

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are MQ sensor, r is used to detect the concentration of carbon monoxide at any places. This sensor uses a gas sensing material like which has a lower conductivity in the clean air. The working principle of this sensor is that when there is any presence of carbon monoxide in the air of certain density then the conductivity of the sensor increases. So there will be increase in the conductivity of the sensor with respect to the increase in the concentration of carbon monoxide. The sensor has good long term stability and has a life of 5 years with a pre heat time of 48 hours. The output is obtained across the load resistor in the form of voltage. MQ – 136 sensor is used for the detection of hydrogen sulphide and works on the principle similar to that of the MQ -7 gas sensor where the conductivity of the sensor increases with respect to the increase in the concentration of hydrogen sulphide. It is more stable and becomes invalid when they are exposed to silicon beam and should not be allowed for the exposure of high corrosive gases. Ultrasonic sensor is deployed for the purpose of detecting any blockages inside the sewer. This works on the same principle as of a radar system and the distance is calculated using the acoustic waves. The controller used in this system is ESP 8266. It has a memory of 128 Kbytes and a storage space of 4 Mbytes which is open source IOT platform. The board accompanies a LDO voltage controller to keep the voltage enduring at 3.3V, as the working voltage scope of ESP8266 is 3V to 3.6V.It can dependably supply up to 600mA, which ought to be all that anyone could need when ESP8266 pulls as much as 80mA during RF transmissions. The advantage of this controller is that it consumes very low power. It gives good integrated support for the Wi-Fi network and the size of the board is very small and they are low cost. The nodemcu contains only one analog pin A0.Therefore an analog multiplexer is used to connect multiple analog sensors. The components are connected as per the block diagram of sewage monitoring unit (Fig 1). The MQ7 sensor is connected to nodemcu via an analog multiplexer (CD 74 HC 4067).If the

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CO level in air exceeds or equals to 100 PPM an alert is sent to the Thingspeak server and the manual scavenger. When the H2S concentration in air exceeds or equals to 100 ppm, an alert message is sent to the manual scavenger and the thingspeak server through an active wireless network. The ultrasonic sensor sends sound waves to calculate the distance of the object. This can be calculated by the formula distance = duration*0.034/2, here the duration refers to the time taken for the sound waves to hit and reflect back to the receiver. If the distance exceeds or equals 30cm a warning is sent to the Thingspeak server regarding the blockage in the sewer. We can create channels for every sensor data. These channels can be set as private channels or we can share the data publically via Public channels. First we have to create an account in thingspeak and also create a new channel with unique channel id. After the creation channel, a unique API key has been generated. Add that API key in the embedded code for accessing the channel which shows the sensor data in Thingspeak. After the creation of separate channel in thingspeak, the channel number and API keys are added in the embedded code. The Wi-Fi id and password also be added to the code in order to establish a connection between the processor and the Thingspeak .After that, based on the sensor's data, the output will be displayed in the thingspeak channel (private view).The continuously uploading data are real time data The components are connected as per the block diagram of the health monitoring unit of the system (Fig 2). The pulse sensor is attached to the index finger of the person who enters the man hole. This pulse sensor is very cost effective when compared to other sensors which are used for heart rate measurement. The pulse sensor uses a principle called photoplethysmography to measure the pulse rate of the manual scavenger. These raw data are sent to the nodemcu using the analog pin A0.These data are sent to Thingspeak server using an active network connection. For using Thingspeak first we have to create an account in thingspeak and also create a new channel with unique

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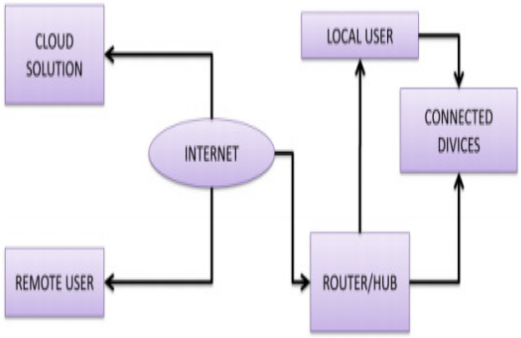
channel id. After the creation channel, a unique API key has been generated. Add that API key in the embedded code for accessing the channel which shows the sensor data in Thingspeak. There these data are monitored and collected. The pulse rate can also be viewed by the manual scavenger using an LCD display that is connected to the nodemcu. If the pulse rate exceeds 110 beats per minute a warning is sent to the manual scavenger and a warning message is sent to the Thingspeak server connected to the nodemcu.

Block Diagram of IoT

Internet of things is a structure that which is used to interconnect computing devices, machines, objects, animals or peoples that are provided with unique identifiers and their capability to transmit data over a network without human– to-human interaction or even human –to– computer interaction [10]. The internet service is the fundamental system linked to the local user, router/hub and the cloud. The signal is transferred to the IoT module where the local user and the router interact and pass on the message to the early fed input



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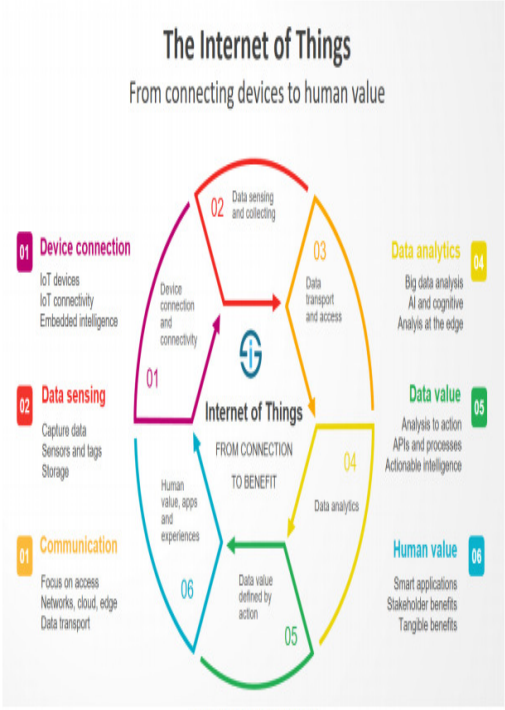

Figure 5 Structure of IoT

IoT, or the Internet of Things, can be simply briefed as a network of small, low-cost, lowpower, electronic devices where sensing data and communicating information occur without direct human intervention . Each device serves as a "smart node" in the network by sensing information and performing low-level signal processing to filter signals from noise and to lessen the bandwidth required for node-to-node interactions. The nodes need to communicate with a centralized "cloud" in a secure manner to protect, store and process data, and bounce actionable information down to humans. The technology deals with six major fields.

CONCLUSION

A precautionary system avoids or eliminates the issue of sewage overflow on roads which is being a major problem in many cities. The level sensors are efficiently used and system is designed in a social relevant idea thus to create an impact on hygiene and cleanliness by simply avoiding the problem of overflow on streets and also to ensure compulsory cleaning of blockage which causes the increase the sewage level by registering repeated complaints to random departments unless action is taken.

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