Underground Sewage Monitoring System using Internet of Things: A Review Paper

Aishwarya Atakari[1], Pooja Gangurde[2], Leena Mahajan[3], Shruti Deshpande[4], Prof. Jagruti Dandge[5]

***Abstract*- These Safety plays a major role in today's world and it is necessary that good safety systems are to be implemented in places of education and work. This proposed system modifies the existing safety model installed in industries and this system can also be used in homes, villages, cities and offices. Most of the drainage and unused wells are forming toxic gases. The main objective of this system is designing microcontroller based toxic gas detecting, alerting system and gas purification. The hazardous gases like H2S, CO and Methane will be sensed and displayed each and every second in the web based application. If these gases exceed the normal level then an alarm is generated immediately and also an alert message (SMS) is sent to the authorized person through the wifi. The advantage of this automated detection and alerting system over the manual method is that it offers quick response time and accurate detection of an emergency and in turn leading faster diffusion of the critical situation using gas purification process convert a toxic gases into pure air. The garbage alerting system is used to control the air pollution. All the gas sensor values are continuously monitoring through the mobile application using wifi module. This system is very much useful to make a city smart as well as reduce the human death.**

***Index Terms*- Drainage, Nodemcu, Mq-7, Ultrasonic Sensor, Mqtt.**

I.INTRODUCTION

The increase in the development of technology and the human race, we failed to take care about the surroundings in which we live in. Thus, the environment got polluted and thereby, the quality of the living place has been reduced. Even though there are several aspects of pollution such as soil, air and water pollution. Out of these, air pollution acts as the serious aspect as the other can be detected visually; but the polluted air cannot be detected as it can be odorless, tasteless and colorless. Hence, there is a growing demand for the environmental pollution monitoring and control systems. In the view of the ever-increasing pollution sources with toxic chemicals, these systems should have the facilities to detect and quantify the sources rapidly. Toxic gases are one that causes serious health impacts; but are also used in industries in large quantities. These gases have to be monitored; such that increase in the normal level of them could be known and proper precaution measures can be taken; but the current systems available are not so portable and are costly and difficult to implement. So, an embedded system is designed using Microcontroller, for the purpose of detection of hazardous gas leakage, which in turn avoids the endangering of human lives. The hazardous gases like Hydrogen Sulfide, Carbon monoxide and Methane were consider. erred here. If these hazardous gases level exceeds normal level that isH2S is greater than 1000 ppm or Methane is greater than 10000 ppmthen an alarm is generated immediately and a SMS is sent to the authorized user as an alert message, which leads to faster diffusion of emergency situation. The system is a fordable and can be easily implement in the drainage and in unused well area which is surrounded by the chemical industries or plants, to avoid endangering of human lives. The system also supports to provide real-time monitoring of concentration of the gases which presents in the air. As this method is automatic, the information can be given in time such that the endangering of human lives can be avoided. Drainage networks are hybrid complex large-scale systems composed by several processes including collection, transport, storage, wastewater and/or rainwater treatment and final disposition of treated water. UDS involve most of these processes inside cities and urban areas. UDS have a considerable social, economic and environmental impact, so a correct and efficient urban drainage management to prevent ooding and polluting discharges to the environment is extremely important. Depending on how wastewater and rainwater are managed, UDScan be either combined or separated. Combined sewage systems (CSS) carry wastewater and storm water in a single pipe; where as the separated sewage systems (SSS) transport wastewater and storm water through independent pipes. During a rainstorm, wastewater flows can overload the CSS, producing flow discharges out from the network known as combined sewer overflows (CSO). Furthermore, some overflows incorporate back to the system after some external stages, e.g., an overflow going to streets might get back to the system throughout a different point within the network[1]. In contrast, all the overflow discharges released to the environment without return to the system are flows that cause pollution. Consequently, CSO scan become pollution in case they do not return to the network; where as the pollution is irreversible, i.e., a CSO might become into pollution but not the opposite. From now on, CSOs are clearly differentiated from the pollution concept and these two factors are treated independently for control objectives. Over the last decades, climate change and the constant growth of cities and urban areas have had a considerable impact on UDS. On the one hand, population in cities has grown much faster than the infrastructure of its drainage networks[2]. The population growth in cities has required an increase in the construction of buildings, roads, and other civil infrastructures. As a result, the soil in these areas has lost rainwater absorption capacity, making cities more vulnerable to ooding in the presence of heavy rain events [3,4]. Additionally, weather phenomena such as global warming have increased the frequency, intensity and duration of rain events in many areas [2,5]. All these circumstances have caused considerable increments in both wastewater and rainwater within cities, thereby increasing the risk of CSO and ooding events. Then, the minimization of the risk of CSO becomes an objective of great importance. To attain this objective, three main alternatives might be considered. The most evident solution consists in enlarging the infrastructure of the sewer system (either by adding more channels, pipelines and storage tanks [6] or by expanding the capacity of the existing ones), in order to transport water and sewage away from cities in a faster way and avoiding ooding. However, this solution generally involves high costs and the implementation times may be also high, making this solution unfeasible in many cases. Other alternatives are related to the well known storm water source control approaches, which are aimed to reduce and/or delay runoff volume (i.e., provide rainfall capture) by managing in a suitable way the local water balance (IoT, promoting infiltration and evaporation, or delaying the runoff by means of greenroofs). Source control options (e.g., pervious paving, pervious pecks, rainwater reuse) can be complemented by the proper management of green infrastructures (e.g., parkland, forests, wetlands, greenbelts, oodways) [7].Notice that techniques based on stormwater source control options might be effective according to the time scale considered and the dimension of the whole system. Their implementation should beanalyzed according to the particular methodology, which in turn determines the associated costs with respect to the achieved goals[8,9]. The previous discussion leads to the latter alternative, which consists in the reduction of the number and magnitude of overflows in UDS through an efficient management of the sewer system using the already existing infrastructure, requiring none or minimal volumetric expansion of the system. Such objective can be achieved by applying intelligent control systems to handle the UDS Urban development in western Washington has altered runoff processes in many stream basins resulting in modified stream flow patterns. The hydrologic consequences of urban development have deleterious effects on people and stream ecosystems including increased ooding and bank erosion, the redistribution of water from periods of base flow to storm flow, and physical disturbance of and changes to aquatic habitat (Hammer, 1972; Orser and Shure, 1972; Ebisemiju, 1989; Booth,1990; Konrad, 2000). The hydrologic effects of urban development and the storm water management activities intended to mitigate those effects are not easily evaluated because variability in stream flow patterns, over time ranging from hours to decades, is not necessarily a consequence of anthropogenic activities (Lins and Slack, 1999). A cooperative investigation between the U.S. Geological Survey (USGS) and the Washington State Department of Ecology (DOE) was initiated in 2001to evaluate methods for monitoring the hydrologic effects of urban development and management activities intended to mitigate those effects. The results of this investigation identify stream flow statistics that exhibit trends in response to urban development but, otherwise, have relatively low inter-annual variability. These statistics may bein corporated as monitoring requirements in the National Pollutant Discharge Elimination System, Phase I, Municipal General Storm water Permit issued by DOE.

1.1 Motivation

Many people in India still lack access to improved sanitation facilities, which is causing malady. The main objective of the anitation system is to protect human health by providing clean environment designed using various methods. Sanitation of a city reects health, education, awareness and responsibility of its citizens. Generally, sanitation refers to facilities available for the safe disposal of human excretion in a proper way. In slum areas of cities, Open defecation, due to lack of toilets, causes the spread of Diarrheal diseases. These diarrhea related diseases lead to the death of many young children in untidy places of cities. Infection with enteric pathogens adversely affects children's growth and health [1]. In India, it is observed that diarrheal diseases kill nearly 1,000 Indian children each day [6].A prime reason for the spread of these diseases is due to the humans coming in contact with feces containing harmful bacteria making the way to contamination of drinking water and food. This open defecation is due to lack of latrines and awareness. Consequently, city sanitation administration has to look into conducting programs to facilitate them with toilets. In a smart city, water availability and sanitation measures must be considered prominently. In sufficient water supply provisions and poor sanitary measures can have a detrimental impact on household outcomes[2]. Major water wastage in domestics is observed to be for toilets because of the poor design of the toilets. The modern efficiently designed toilets promise of good sanitation, reduction in water usage and production of bio fertilizers. In India, an average family home consumes 18 percent of its total daily water usage for toilets[7]. Toilets water consumption, being third major home water consumption, needs attention for adopting smarter methods to consume relatively less water. Domestic water consumption proportions The drainage system plays a key role in the development of a city and it is crucial for the community in the urban areas as this reduces the foods by carrying away the water. Improper maintenance of drainage system causes many people to suffer and the existing drainages are not functioning up to the expected standards. Now a day's most of the cities are adopting underground drainage systems which should be smart. If drainage system is not designed properly, then water will mix up with pure water and contaminate the pure water it causes spreading of diseases. In rainy season, the blocking of drainage system causes significant disturbances in normal human life while leading to heavy traffic jam. The selected drainage system operates with connected devices for continuous monitoring and controlling to take necessary actions using sensors and Internet of Things [4].Most of the cities adopted the underground drainage system and itis the duty of managing station (Municipal Corporation) to maintain cleanliness of the cities. If the drainage maintenance is not proper, the pure water gets contaminate with drainage water and infectious diseases may get spread. The drainage gets blocked during rainy season and it will create problem for routine life such as traffic may get jammed, the environment becomes dirty, and totally it upsets the public. Suppose if there should be a facility which would be there in Municipal Corporation (managing station) that the officials come to know immediately after blocking of drainage in which area and the exact place, where it is blocked and it also informs if the manhole lid is open. Underground installed electric power lines also monitored through temperature sensors. Pressure sensors are used to avoid manhole explosions, explosions can be are sult of the release of chemical and electrical energy [1]. So, our main focus is monitoring manholes using sensors. If drainage gets blocked and water overflows, and if manhole lid is open, it is sensed by the sensors, then that sensor sends information via transmitter which is located in that area to the corresponding managing station. The underground drainage system is an important component of urban infrastructure. It is considered to be city's lifeline. Most management on underground drainage is manual therefore, it is not efficient to have clean and working underground system also in such big cities, it is difficult for the government personnel to locate the exact manhole which is facing the problem. Therefore, it is essential to develop a system which can handle underground drainage without human intervention. Underground Drainage involves sewerage system, gas pipeline network, water pipeline, and manholes. This project describes various functions used for maintenance and monitoring of underground drainage system. It provides a system which is able to monitor the water level, atmospheric temperature, waterflow and toxic gasses. If drainage system gets blocked and water overflows, it can be identified by the sensor system and that sensor sends information via the transmitter which is located in that area to the corresponding managing station.

1.2 Problem Definition

To design and develop the sewage water monitoring and notification system using internet of things and cloud computing to avoid the underground drainage issues in smart cities.

II. LITERATURE SURVEY

Embedded system is a field in which the terminology is inconsistent. A real time system is one in which the correctness of the computations not only depends on the accuracy of the result, but also on the time when the result is produced. This implies that a late is a wrong answer. A hard real time system should always respond to an event with in the deadline or else the system fails and endangers human lives but in soft real time system, failing to meet the deadline produces false output and does not endanger the human lives. All embedded systems or not real time systems and vice versa. And our designed embedded system is a soft real time system.[1] A presentation of a large-scale experimentation of smart sewage system, which was conducted at the Scientific Campus of the University of Lille, which stands for a small town. The experimentation concerned both the stormwater and wastewater systems. The monitoring system included water level, velocity and turbidity sensors as well as weather station. In addition, Automatic Meter Reading (AMR) were used to record the water consumption in buildings. Data were recorded atone minute time interval and sent to a server via GPRS. This system allowed a real-time tracking of the storm water and sewage systems. Data analysis allowed a better understanding of the stormwater and wastewater systems. It allowed to detect some anomalies, which are responsible of the poor performances of these systems duringin tense rain events[2]. A new mathematical model for estimating oil drainage rate in rising and expanding steam chamber stages in

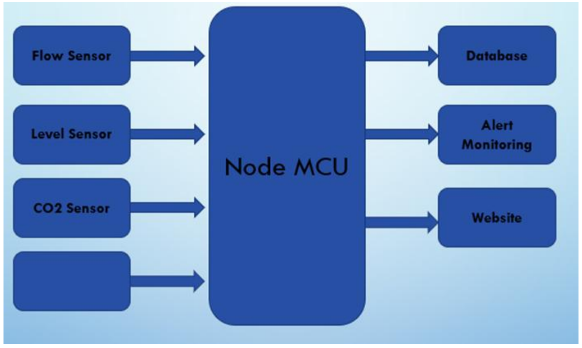
Steam-assisted gravity drainage (SAGD) process, more importantly, vertical wellbore/formation and horizontal-wellbore/formation coupling effects are taken into consideration. In this study, a function of steam chamber height is introduced and the expressions for oil drainage rate in the rising and expanding steam chamber stages are derived in detail. Then, an example is given to introduce how to use the proposed method. The results indicate that heat injection power per meter reduces gradually along the horizontal wellbore, which affects both steam chamber height and oil drainage rate in the SAGD process. Moreover, it is found that when production time is the same, the calculated oil drainage rate from the new method is lower than that from Butlers method, but the production period in the rising steam chamber stage for the former is longer than the latter.[3] The concept of smart city ensures availability of resources to all citizens while taking appropriate measures for good sanitation, rendering education, environmental sustainability and health care. Under Sanitation, availability and maintenance of toilets, and drainage system organization demand major attention. Existing toilets are in efficient in usage of water for flush. In the context of scarce resources, itis inevitable conserving them wisely so as to facilitate them to all citizens. As water is one of the major and must utilities of a city, its conservation is highly desirable in all possible aspects. One of the aspects of saving water is its usage in toilets. Current toilets in Indian cities consume much water, thereby causing a portion of scarcity of water. It is also required to design drainage systems satisfying cities requirements by employing Internet of Things technologies. The design of any smart city must ensure its sanitation, while adopting news marter solutions quickly. In this paper, we present modern toilet models suitable for Indian environment, requiring less water. In addition, it is shown how to use toilet flush as fertilizer. Hence, we also present in this paper, a new Internet of Things based drainage architecture as an innovative solution to address drainage clogging.[4]For this study, we have conducted a one month long data collection activity, through 2 volunteers and with Motorola Moto X 2nd generation Android mobile phones. The devices have been rooted and the tcpdump binary has been installed in each one of them. The Android Terminal Emulator app is used to trigger the trace recording and is left to run in the background while the volunteer uses the smartphone like a regular user. The phones have throughout been connected to the cellular network (mostly 3G) and the volunteers have used a large variety of apps on their devices like a regularsmartphone user would. The total trace is around 2 GB in size, and contains user activity logged during different times of the day, undervarious conditions of user mobility (such as, walking, driving, etc.)and user practices.[5] A novel method for recovering and utilizing the drainage power in a distribution transformer is proposed in this paper. The results of laboratory experiments conducted on a threekVA transformer shows that it is possible to recover about 80 wattswhen supplying usual non-linear loads. When the drainage power is recovered and utilized, it is found that apart from the improvement in transformer efficiency, the line side and load side power quality also gets improved, which is observed from improved power factor and reduced distortion level. For a distribution transformer of MVArating the power recovered could be much higher. The additional cost involved is only that of a tertiary winding and since tertiary can be designed for a lower power rating the cost involved will be less and can be recovered within a year in most of the practical cases[6]. Smart city is defined by Hall as "a City, that integrates science and technology through information systems, integrating the conditions of their critical infrastructures, to better optimize, plan and monitor resource utilization, and enhance the city management's decision-making processes (Hall et al., 2000). There is significant disagreement and concerns amongst different academic disciplines within the academic community concerning the implementation of Smart City technologies. Technology companies are marketing and selling the Internet of Things and how all these sensors can monitor every movement within a city and analyze all videos in real time (Taylor et al.,2015). This level of mass surveillance has been criticized by many public policy researchers as technocratic governance with too much potential for abuse. In public administration disciplines, concern over personal privacy is generally seen to take precedence over the saving and storing any personal information for long term usage.This includes CCTV footage that includes personal identifying features and vehicle tag information (Shelton et al., 2015). In terms oftechnology, cities must adhere to local privacy laws and must havethe appropriate governance and processes in place to ensure theirinformation systems are in compliance with all local laws.[7] There has been extensive literature examining the independent effects ofLWMP on flow changes, but there have been few, if any, studies examining the net effect of multiple LWMP on flow changes across awide spatial scale. The analysis presented herein was made possibleby using a nationally consistent method to characterize flow changes. This study has identified major causes of flow changes among different competing LWMP in watersheds and identified those that were regional causes of the flow changes, such as roads and dams, and those that were more localized, such as agriculture, and wastewater discharges. It also was found that the changes to flows were prevalent even at low levels of road densities. However, often more than half of the variation in the models was unexplained by the LWMP variables used in this study, indicating that much more research is required to fully understand how LWMP affect flows. However, our results on LWMP flow relations were consistent with the findings in several studies that presumed the dominant LWMP in watersheds[10].Urban development has many potential effects on runoff processes. Urban development modifies hydrologic processes when vegetationis cleared from hillslopes, the land surface is graded and building and roads are constructed. These changes reduce interception, in filtration, subsurface flow, evapotranspiration, stormwater storageon hillslopes, and the time required for stormwater to travel overand through a hillslope to a stream (Savini and Kammerer, 1961;Dinicola, 1990; Burges and others, 1998). As a result, streams havemore frequent storm flow events with high peak discharge but rapidstorm flow recession (Carter, 1961; Harris and Rantz, 1964; Leopold,1968). Peak discharge rates of small, frequent foods in particular increase by a greater percentage of pre-development rates than large,infrequent foods (James, 1965; Hollis, 1975). Sawyer (1963) illustrated the redistribution of runnoff from base flow to storm flow foran urban stream on Long Island, New York. Simmons and Reynolds(1982) estimated base f low as a fraction of annual discharge on a partof Long Island, and found an inverse correlation with the amount of urban development. The greatest change in base flow occurred with the construction of sanitary and storm sewers, which decreased the base flow fraction of stream flow from 95 to 20 percent. When septic systems remained in urbanized (storm-sewered) areas, the base flow fraction of stream flow decreased to 84 percent. In comparison to estimates of recharge for predevelopment conditions on Long Island, New York, annual recharge is estimated to have increased by 12 percent in areas served by in filtration basins but decreased by 10 percent where storm sewers collect runoff and discharge if to streams or the ocean (Ku and others, 1992). The rapid recession of storm flow in urban streams leads to lower base flow on a unit-area basis during the winter wet-season than in suburban streams in western Washington (Konrad, 2000). Likewise, Klein (1979) studied 27 small catchmentsin Maryland and concluded that wet-season base flow decreased by as much as 90 percent in catchments with predominantly imperviousl and cover. The increase in storm flow and decrease in wet-season base flow represent the redistribution of runoff from subsurface flow and storage in depressions, the soil column, and on vegetation to overland flow and open-channel flow in culverts and ditches. The effects of urban development on dry-season base flow in some cases contrast to the effects of urban development on base flow during the wet season. Harris and Rantz (1964) determined that dry-season discharge in Permanente Creek, California, increased in response to urban development as a result of landscape irrigation.[11]

III. SYSTEM DESIGN

A. System Architecture

This system is based on the Internet of Things for the implementation of the sewage water monitoring and manholes in the city. The system uses the different types of sensors like Ultrasonic Sensor andMQ-7 or MQ-135 sensor. The ultrasonic sensor is used to detect the level of the garbage collected in the pipelines and MQ-7 sensor detects the different gases generated in the manhole and pipes in due to sewage water. If the level of garbage is high then the system will notify to the MNC officer with proper locations of the manhole. This same type of alert notifications will be send if the gases are generated in pipelines. We also design the website to monitor the readings of these sensors from the remote place. So the sewage waterowing smoothly or not will be checked by the officers.

IV. RESULT



V. CONCLUSION

Internet of things reduces the human intervention by introducing device to device interaction. The monitoring system included waterlevel and gas sensors as well alert system. In addition, data were recorded at one minute time interval and sent to a server via WIFI. This system allowed a real-time tracking of the sewage water and sewage systems. Data analysis allowed a better understanding of the storm water and wastewater systems. It allows to detect some anomalies, which are responsible of the poor performances of these systems, during intense rain events.

APPENDIX

Appendixes, if needed, appear before the acknowledgment.

ACKNOWLEDGMENT

We sincerely express our deep sense of gratitude towards our respected guide and head of department Prof.Mrs.J.A.Dandge forher valuable guidance, profound advice, persistent encouragement and help during the completion of this work. Her time to time helpful suggestions boosted us to complete this task successfully. Shehas helped us in all possible ways right from gathering the materials to report preparation. We express our thanks to our guide andProject coordinator for providing all kinds of cooperation during thecourse. Our sincere thanks to the Principal Dr.Edlabadkar Sir forhis inspiration. Finally, we are thankful to the supporting staff ofComputer Engineering department and all those who directly or indirectly contributed to complete this work.

REFERENCES

[1] Prof S. A. Shaikh1, Suvarna A. Sonawane2, MonitoringSmart City Application Using Raspberry PI based on IoTInternational Journal of Innovative Science, EngineeringTechnology, Vol 5 Issue VIL, July 2017.

[2] Prof Muragesh SK1, Santhosha Rao2, Automated Internetof Things For Underground Drainage and Manhole Monitoring Systems For Metropolitan Cities. International Journalof Innovative Science, Engineering Technology, Vol. 2 Issue4, June 2015.

[3] Lazarescu, M.T., "Design of a WSN Platform for Long-TermEnvironmental Monitoring for IoT Applications," Emergingand Selected Topics in Circuits And Systems, IEEE Journalon, vol.3, no.1, pp.45, 54, March 2013.

[4] Berggren K., Olofsson M., Viklander M., Svensson G.and Gustafsson A.-M. (2012). Hydraulic Impacts on UrbanDrainage Systems due to Changes in Rainfall Caused byClimatic Change. Journal of Hydrologic Engineering 17(1),92-8.

[5] Brandes D., Cavallo G. J. and Nilson M. L (2005). BaseFlow Trend in UrbanizingWatersheds of the Delaware RiverBasin1. JAWRA Journal of the American Water ResourcesAssociation 41(6), 1377-91.

[6] Konrad C. P. and Booth D. B. (2002). Hydrologic trends associated with urban development for selected streams in thePuget Sound Basin, western Washington. US Departmentof the Interior, US Geological Survey.

[7] May W. (2008). Potential future changes in the characteristics of daily precipitation in Europe simulated by theHIRHAM regional climate model. Climate Dynamics 30(6),581-603.

[8] Ponce V. M., Lohani A. K. and Huston P. T. (1997). Surface Albedo and Water Resources: Hydroclimatological Impact of Human Activities. Journal of Hydrologic Engineering2(4), 197-203.

[9] Pons B., et Vernette, P. (2010). Supervision de la Tlgestion Lyonnaise de l'Assainissement (STELLA). NOVATECH 2010.

[10] Shahrour I., Abbas O., Amani Abdallah A., Abou Rjeily Y.,Afaneh A., Aljer A., Ayari B., Farrah E., Sakr D., Al MasriF. Lessons from a Large Scale Demonstrator of the Smartand Sustainable, Chapter , Book Happy City - How to Planand Create the Best Livable Area for the People, Editors:Brdulak, Anna, Brdulak, Halina,ISBN 978-3- 319-49898-0,Springer, 2017

[11] Wang L., Lyons J. and Kanehl P. (2003). Impacts of UrbanLand Cover on Trout Streams in Wisconsin and Minnesota.Transactions of the American Fisheries Society 132(5), 825.