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Intelligent Human Free Sewage Alerting and Monitoring System

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ABSTRACT
The proposed method aims at the development of an inexpensive autonomous drainage system using Internet of Things (IoT) and without human intervention. For efficient operation of sewage system real time data, determination of the level of silt and water is very essential. More the runoff volume, with high impenetrable ground, the aggressive growth of population with enormous monsoon has over affected the sewerage system causing overflow and also clogging, these all obstacles can be eliminated if an intelligent system which identifies both the level of water and correspondingly redirect the water with the help of sensor controlled gates is installed. Using the present Artificial Intelligence(AI), IOT principles along with suitable survey of the sensor information, a smart system can be implemented which provides a real time detailed observation and informing the data to Municipality Organization or the concerning authority. This process will avoid physical drain examination and allows the instant reaction in the absence of human involvement or delay.

Keywords: *Sewerage system, Underground Drainage and Manhole Monitoring System (UDMS), Wireless Sensor Networks (WSN), IoT.*

1. INTRODUCTION

An important part of any sewage system is the approach points to it when it implies to cleaning, inspection process and inspection process. Metropolitan cities have acquired an underground drainage system and the city's municipal corporation must maintain its cleanliness. If the sewage maintenance is not done properly, the ground water gets polluted which results in causing infectious diseases.

Blockages in drains during rainy season, causes problems in the routine of the public. Therefore, there should be a facility in the city's corporation, which alerts the officials about the blockages in sewers, their exact location. Underground drainage consists of a sewage system, gas pipeline network, water pipelines, and manholes [1]. Temperature sensors are used to monitor the electric power lines that are installed underground. Pressure sensors are deployed to avoid manhole explosions due to chemical release and electrical energy. Paper presents the architecture and design of an Underground Drainage and Manhole Monitoring System (UDMS) with separate transmitter and receiver models. The important considerations of the implemented design is of cost friendly, less maintenance, fast implementation, and more quantity of sensors, life-time and also high service quality. The Paper mainly acknowledges in the field of alerting the people about the gas explosion, increase in the water level. It uses IoT to make the drainage monitoring system in a highly automotive by using sensor for detecting and sending alerts through audible alarms with glowing of LED light and messages via Wi-Fi module to the authorities, storing the data in the cloud and displaying the details in the web browser. The proposed method overcomes the demerits by detecting drainage the water blockage by installing water flow rate sensors at the intersection of nodes.

When there is a blockage in a particular node, there is variation in the flow of the drainage water which when it crosses the set value, it will display the alert in the managing station. [2] Also, the de merits are solved by detecting the temperature variations inside the manhole and alerting the same to the managing station

through the automatic mail. Also, flow rate sensors are used to detect the over flow of the drainage water and alerting the same to the managing station through automatic mail. So, the main focus of this project is to provide a system which monitors the level of water, temperature of the atmosphere, flow of water along with the harmful gases. If the sewerage system gets clogged and sewage water over spills, it is sensed by the sensors and this data is sent to the corresponding managing station via transmitter located in that area. Maintenance of manholes manually is tedious and dangerous due to the poor environmental conditions inside. It is, therefore dangerous to go inside the manholes for inspection of its current state. To solve all the problems related to underground sanitation, a remote alarm system is necessary for transmitting data collected by the sensors inside the manhole to the managing station. This method uses the Wireless Sensor Networks (WSN) to implement this system. These nodes are composed of controller, memory, transceiver and battery to supply the power. The main objective of this project is to monitor the temperature, pressure, water level and the presence of chemical gases in the manhole [15-19].

2. RELATED WORKS

In [1], represents the development and design of Smart Sewer Asset Information Model (SSAIM) for sewerage networks. This system consists of the physical infrastructure of pipes, manholes, pumps, screens and channels that transport sewage water to sewerage operation works for cleansing purpose. Concept of IOT holds a aim of omnipresent network, in which sensors, displays, actuators and the present components are classified ideally to the world in order to donate to the development and administration of the urban area. This model makes a way for the benefits of the drainage system such as potholes, pipes and also pumping stations.

In [2], discussed that the sensor network is used which is used to detect the changes in temperature, pressure, presence of harmful gases and also an LED is used which is used to detect the presence of gases. If LED turns on, it is confirmed that gases are present, else no gases are detected. If any changes detected by any of the sensors mentioned, the alert is sent to the respective municipal authority and the required actions will be further taken by the officials.

In [3], It briefs about development of system which monitors water level, atmospheric temperature, water flow and toxic gases. If drainage gets blocked and the water overflows, manhole lid opens, it is sensed by the sensors and this data is sent to the corresponding managing station via transmitter located in that area.

In [4], In this paper provides a system which checks and regulates the sewage monitoring which helps to detect the changes in parameters such as pressure, temperature, water level and also detects the opening of any manhole lid. It makes use of sensors which detects changes and then sends alert to the municipal authority and also maintains the underground electrical wiring.

In [5], made use of rainfall sensor, water level sensor and also the water discharge sensor. Node sensors communicate with each other using the Radio Frequency module (XBeeTM). Communication between gateway and server use GSM module. The recorded data will be stored into a database that is visualized by Geographical Information System (GIS).

In [6], discussed about Metal identification is most used way in underground pothole setting. In the underground drainage condition, AC pavements is generally higher than ten centimeters. Not only the distance reaches the maximum of usual RFID reading distance, also the AC pavement is also the barrier of the RF carrier. The tag environment that is below the AC pavement for higher than ten centimetres can be filled with the water. In model here, the design of RFID tags which is attached with a metal, long-distance reading, and deducts the interface properties of the water called as Ground Tag (underground label).

In [7], the model design and implementation of low costly system for real time monitoring of water quality and controlling the water flow is done with the help of IoT. The proposed system has sensors for water quality detection and a solenoid valve which controls the water flow in the pipeline. Then, it is connected to both Raspberry pi core controller and the IoT module. At last, the sensed values are observed and the controlling is done by internet and the Wi-Fi to the mobile phones. The monitoring and controlling process can be checked at any time and everywhere.

In [8], The paper represents the development and design of the robot in a small space implementation. Fuzzy Logic Control is displayed in the mobile robot which enables the robot to operate manually or automatically for the completion of the tasks assigned. Also, the mobile robot is developed within four wheels' skid and steering driving mechanism system supplies with instant and the fine turning to avoid problems.

In [9], this paper shows a successful approach of IoT to keep track on a Sewage Treatment Plant (STP) condition with the help of set of sensors that are connected to Arduino Microcontroller boards using Wi-Fi. The methodology used here makes use of three sensors which detects the sewage plant's condition and transmit the information to a cloud- based regional server in the real-time. The sensors are used to measure hotness or coldness, thickness and the pH level. Also, the STP's power usage statistics is also taken care of in order to find out purposeful close of the system. The information obtained is collected in a protected cloud system for additional study of the process.

In [10], This paper briefs on achieving a smart sewerage system monitoring and operation with the help of LoRa. The intelligent manhole monitoring system

consists of shift trigger which controls the real time monitoring of the manhole along with sending and collecting information to the manhole cover. The concentrator helps in storing and analyzing the data and sends information to the remote server and acts as intermediate connection where uplink is responsible for information gathering and data processing whereas downlink is responsible for transmitting and receiving the upper instructions and LoRa communication is used between trigger and concentrators.

3. CONCEPTUAL DESIGN

Any blockages, rise in temperature, explosion due to toxic gases, overflow, manhole lid left open is detected by the sensors [20-23].

3.1. COMPONENTS

3.1.1. GSM Module 800

It can transmit Voice, SMS and the data information with low power usage. SIM 800 module is used to transmission and receiving of the messages, here, we make of this module to send the messages regarding the abnormal events which are appeared in the manhole.

3.1.2. Flow Sensor- YF-S201

The module consists of pins such as Power, Ground, and the Analog output. Flow sensors are mainly used to measure the quantity or the rate of flow of liquids. We are using it to detect overflow.

3.1.3. Temperature sensor-DHT 11

It is easy to use, but requires a careful timing to get data. This is a device that is used to find out the hotness or coldness of an object.

3.1.4. Gas Sensor-MQ2

Grove - Gas Sensor (MQ2) finds out the combustible gases and smoke. It can find out the combustible gas and flame. The resultant voltage from the sensor maximizes when the gas concentration, it detects combustible gasses and smoke.

3.1.5. LCD Display

LCD Display (16X2) the display is used to print the data on the display to view, here we make use of the display to represent the abnormal events near the drainage manhole.

3.1.6. Buzzer

A buzzer is a sound alarming device, which can be mechanical or piezoelectric. Buzzers are the alarm devices and confirmation of user input.

3.1.7. Arduino Microcontroller:

Arduino uno which is the microcontroller that are interfaced. The signals received by the Arduino uno from the sensors is converted from analog signals to digital signals with the help of ADC located in the Arduino board and further is processed and sent to the controller, takes this as input data. An alert is displayed in the managing station and a message is sent to the respective authority. The authority can take the photo and location of the respective drainage holes. [13]

4. BLOCK DIAGRAM

The block diagram consists of Arduino Microcontroller, GSM Module along with the sensor network and also the transmission station.

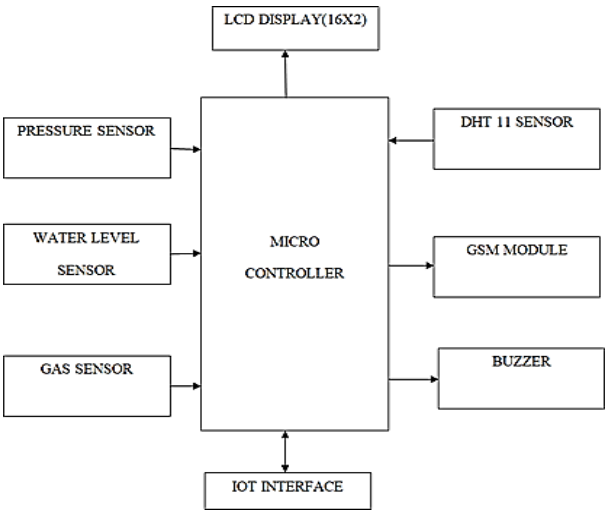


Figure 1 Block Diagram.

Any blockages, rise in temperature, explosion due to toxic gases, overflow, manhole lid left open is detected by the sensors. The signals from the sensors are fed to the controller, which is programmed to generate alerts. In this we use sensors to detect blockage, floods, and gases. The sensors will identify the clogging inside the drainage system and will give information about the location and further actions will be taken care by the municipal. This system consists of Sensor network and Transmission station [9]. Sensor network consists of the sensing inputs and applications like detection of the changes that takes place in the manhole. Transmission station is used to send the messages and alerts to the municipal authority with the help of response app and alert app.

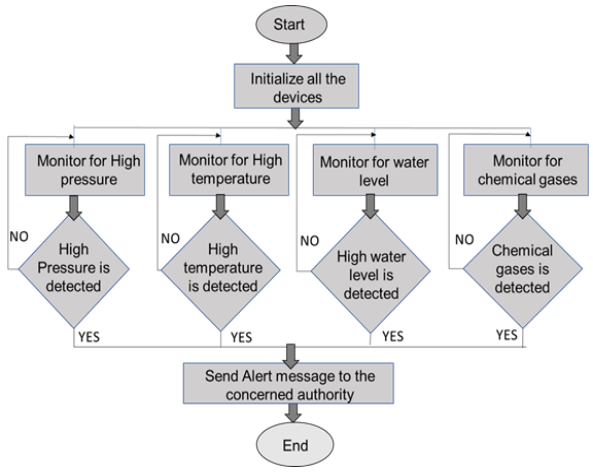


Figure 2 Flow Chart.

The figure 2 shows the flow chart of the project. This explains the operation of the system. At first, the process is initialized which turns on all the devices and sensors used. Then, the monitoring process for the pressure, high temperature, water level sensor and chemical gas sensor takes place which is used to detect any sort of changes in the drainage system [14]. If any physical changes like temperature, water level and chemical gases are detected, then an alert is sent to the authority regarding the changes and it turns on the buzzer. If no changes take place, then the buzzer remains off and no alert is sent to the authority. [11]

The 16*2 Display shows the output of the different sensors which detects the changes in the manhole conditions like changes in the manhole like temperature, pressure, water level and chemical gases which is displayed in the LCD and turns on the buzzer.[12] The alert is then sent to the municipal authority's mobile device using the microcontroller with the help of Android Development Application and the location of the Manhole is detected with the help of GPS that is present in the mobile and thus the clogging can be cleared before it reaches a level which is harmful for both humans and the environment.[24-28]

5. RESULTS AND DISCUSSION

Step 1: The hardware implementation of the project is done with all the requirements and the circuit is turned on to check any unusual changes in the physical parameters. If any changes are occurring, the sensors detect the changes and it is sent to the microcontroller through which further actions will be taken.

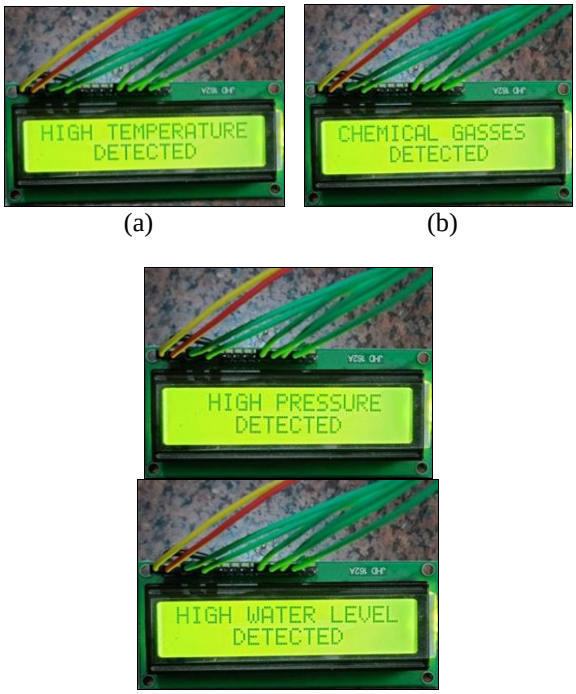
Step 2: A mobile application which is used to detect the location and also capture the image of the drainage where it is clogged (in fig 6).

Step 3: A application which will be used in the mobile and using this application images as well as the live location of the manhole will be sent to the authority's mail id on request from them (fig 7).

Step 4: On detection of clogging a alert message will be sent to the authority (fig 8).

Step 5: Android application used by municipal authority to request for a photo and the live location of the drainage.

Step 6: On request from the municipal authority for location of the clogged drainage, a live location details is sent.



(a) (b)

(c) (d)

Figure 3 (a) High Temperature Detection (b) Chemical gas detection (c) High pressure detection (d) High water level detection.

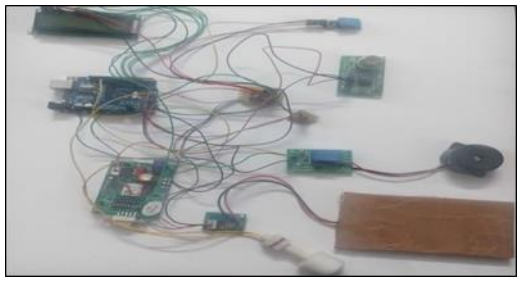


Figure 4 Hardware Implementation.

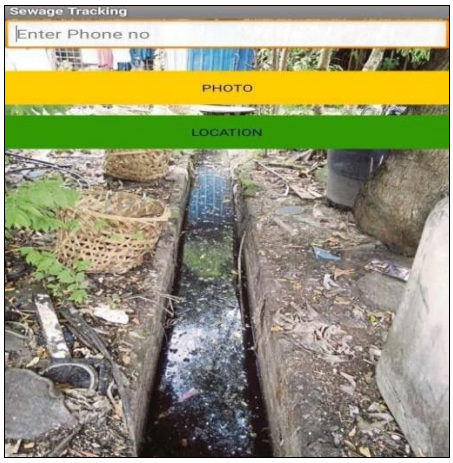


Figure 5 The android application for location detection of clogging.

Figure 6 Response App.

Figure 7 Alert Message sent to the municipal authority.

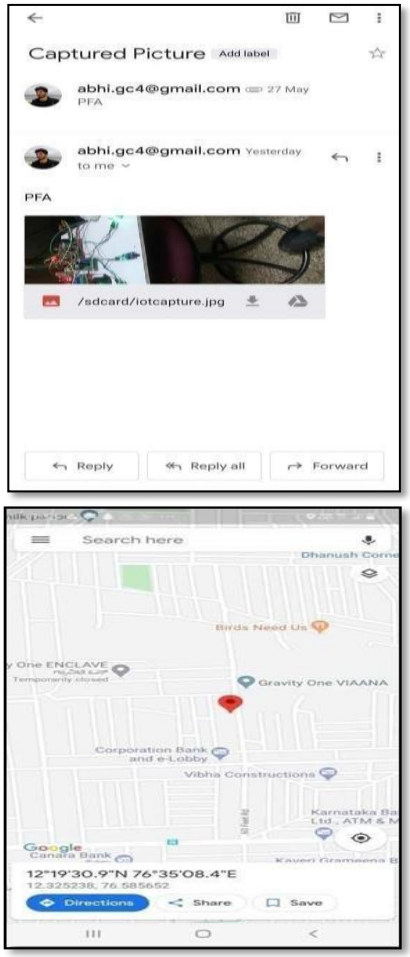


Figure 8 Captured Image and Location Details sent to the municipal authority.

6. CONCLUSION

Sensor unit is sensed automatically and updates the values of the physical parameters like temperature, water level, humidity, flow rate and clogging. WSN can be useful in designing of environmental monitoring architecture, which helps in detection of the volcanic activities and flood detections. By a small change in this pcan be used in agricultural fields or any other environmental fields to control the systems. Because of the expanding of uses, it is very much hard to mention the daily usage needs for the WSN nodes and other usable applications. This model is conveyed to all the automatic Internet of Things for Underground Drainage stages of the improvement of Underground Drainage Monitoring System (UDMS) using the applications of IoT for developing countries. Features of sensor network are structure of the platform, complaisance and renewability, improvement of the sensor nodes and interactions, inaccuracies from interactions and function, accessibility of service for every requirement, user server sureness along with the collaboration with IoT applications. The proposed model can be used to lead the information, expansion, and improvement of sensor web opportunities for different IoT application areas.

REFERENCES

[1] Vikki Edmonson et al, A smart sewer asset information model to enable an 'Internet of Things' for operational wastewater management, ISSN: 2278- 3075, Volume-8 Issue-8, June 2020.

[2] Saadnoor Salehin et al. An IOT Based Proposed System for Monitoring Manhole in Context of Bangladesh, ISSN: 3476-4903, Volume-3 Issue-3, February2020.

[3] Chandraprabha R et al, Smart real time manhole monitoring system ISSN: 2478-3254,Volume-17Issue-17, February 2019

[4] Muragesh S K et al, Automated Internet of Things for Underground Drainage and Manhole Monitoring System for Metropolitan Cities ISSN: 2478-3254, Volume-10 Issue-11,July 2019.

[5] Retno Tri Wahyuni et al, Design of Wireless Sensor Network for Drainage Monitoring System ISSN: 5946-6584 Volume-8 Issue-10, August2019.

[6] Allen Y. Chang et al, Search, Identification and Positioning of the Underground Manhole with RFID Ground Tag: ISSN: 5878-6947, Volume-7 Issue-8, February 2019.

[7] K.GOPAVANITHA et al, System for Real Time Water Quality Monitoring and Controlling ISSN: 5698- 3257, Volume-17 Issue-19, February 2019 Liu Bingbing et al, Manhole Cover Monitoring System Based on NB-IoT: ISSN: 4658-5749,Volume-12 Issue-13, May 2019

[8] By A.A.A. Razak et al, Development of Mobile Robot in Confined Space Application ISSN:6985-7548,Volume-15 Issue-16, June 2018.

[9] By Sifat Rezwan et al A Minimalist Model of IOT based Sensor System for Sewage Treatment plant Monitoring: ISSN: 8769-9785, Volume-20 Issue-21, August2018.

[10] Liu Xuan et al, Research on LoRa Communication Performance in Manhole Cover Monitoring:ISSN:5689-6554, Volume-17 Issue-18, January 2019.

[11] Bilal Arshad et al, Computer Vision and IoT-Based Sensors in Flood Monitoring and Mapping: A Systematic Review ISSN: 4587-5623, Volume-20 Issue-21, September 2019.

[12] Ganesh U L et al, Automatic Sewage Cleaning System ISSN: 7869-8990, Volume- 17 Issue-17, February2018

[13] Balachandra etal ,Automatic Drainage water pump monitoring and control system: ISSN: 8679-9643, Volume-18 Issue-19, April 2018.

[14] Prof.S A.Shaikh et al, Smart underground and drainage blockage monitoring and detection system using IoT ISSN: 7845-8974, Volume-19 Issue-20, August 2018.

[15] Kumar, M. Keerthi, B. D. Parameshachari, S. Prabu, and Silvia liberata Ullo. "Comparative Analysis to Identify Efficient Technique for Interfacing BCI System." In IOP Conference Series: Materials Science and Engineering, vol. 925, no. 1, p. 012062. IOP Publishing, 2020.

[16] Subramani, Prabu, K. Srinivas, R. Sujatha, and B. D. Parameshachari. "Prediction of muscular paralysis disease based on hybrid feature extraction with machine learning technique for COVID-19 and post-COVID-19 patients." Personal and Ubiquitous Computing (2021): 1-14.

[17] Do, Dinh-Thuan, Tu Anh Le, Tu N. Nguyen, Xingwang Li, and Khaled M. Rabie. "Joint impacts of imperfect CSI and imperfect SIC in cognitive radio-assisted NOMA-V2X communications." IEEE Access 8 (2020): 128629-128645

[18] Le, Ngoc Tuyen, Jing-Wein Wang, Duc Huy Le, Chih-Chiang Wang, and Tu N. Nguyen. "Fingerprint enhancement based on tensor of wavelet subbands for classification." IEEE Access 8 (2020): 6602-6615

[19] Naeem, Muhammad Ali, Tu N. Nguyen, Rashid Ali, Korhan Cengiz, Yahui Meng, and Tahir Khurshaid. "Hybrid Cache Management in IoT-based Named Data Networking." IEEE Internet of Things Journal (2021).

[20] Subramani, Prabu, K. Srinivas, R. Sujatha, and B. D. Parameshachari. "Prediction of muscular paralysis disease based on hybrid feature extraction with machine learning technique for COVID-19 and post-COVID-19 patients." Personal and Ubiquitous Computing (2021): 1-14.

[21] Rajendrakumar, Shiny, and V. K. Parvati. "Automation of irrigation system through embedded computing technology." In Proceedings of the 3rd International Conference on Cryptography, Security and Privacy, pp. 289-293. 2019.

[22] Subramani, Prabu, Ganesh Babu Rajendran, Jewel Sengupta, Rocío Pérez de Prado, and Parameshachari Bidare Divakarachari. "A block bi-diagonalization-based pre-coding for indoor multiple-input-multiple-output-visible light communication system." Energies 13, no. 13 (2020): 3466.

[23] Y. Sun, J. Liu, K. Yu, M. Alazab, K. Lin, "PMRSS: Privacy-preserving Medical Record Searching Scheme for Intelligent Diagnosis in IoT Healthcare", IEEE Transactions on Industrial Informatics, doi: 10.1109/TII.2021.3070544.

[24] N. Shi, L. Tan, W. Li, X. Qi, K. Yu, "A Blockchain-Empowered AAA Scheme in the Large-Scale HetNet", Digital Communications and Networks, https://doi.org/10.1016/j.dcan.2020.10.002.

[25] C. Feng et al., "Efficient and Secure Data Sharing for 5G Flying Drones: A Blockchain-Enabled Approach," IEEE Network, vol. 35, no. 1, pp. 130-137, January/February 2021, doi: 10.1109/MNET.011.2000223.

[26] L. Tan, H. Xiao, K. Yu, M. Aloqaily, Y. Jararweh, "A Blockchain-empowered Crowdsourcing System for 5G-enabled Smart Cities", Computer Standards & Interfaces, https://doi.org/10.1016/j.csi.2021.103517

[27] K. Yu, L. Tan, X. Shang, J. Huang, G. Srivastava and P. Chatterjee, "Efficient and Privacy-Preserving Medical Research Support Platform Against COVID-19: A Blockchain-Based Approach", IEEE Consumer Electronics Magazine, doi: 10.1109/MCE.2020.3035520.

[28] K. Yu, M. Arifuzzaman, Z. Wen, D. Zhang and T. Sato, "A Key Management Scheme for Secure Communications of Information Centric Advanced Metering Infrastructure in Smart Grid," IEEE Transactions on Instrumentation and Measurement, vol. 64, no. 8, pp. 2072-2085, August 2015.https://ieeexplore.ieee.org/document/7138617