Proposed Novel Methodology for Automatic Drainage Block Identification in Smart Cities Using Internet of Things

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Abstract. Internet of Things (IoT) is the dynamic multi-dimensional web of technological heterogeneous artifacts. It is changing smart style of human life into ultra tech vibrant multi style of life. The usage of technology in the layman's life and profession is the ultimate objective of modern scientific inventions. The drainage block is one of the tedious problems faced by all the developing countries. The drainage block yields many sanitation problems, highly infected diseases and flood monsoon seasons. The maintenance of drainage systems is highly expensive; the humans are involving the cleaning and maintenance activities. This is killing thousands of humans every year. This research article is proposing a new technique and giving the solution for finding the blockage of drainage using air, temperature and pressure constants. The sensors are used to identify the values for each parameter. The Automatic Drainage Block Identification Algorithm (ADBIA) is analyzing the values and predicting whether the drainage is blocked or not.

Keywords. Internet of Things (IoT), Sensors, Drainage System, Drainage Block, Real Time Application of IoT

1. Introduction

The emerging industrial paradigm 'Industry 4.0' is based on Internet of Things (IoT) that enables the intercommunication of electronic devices and sensors through the Internet. This novel industry is facilitating the life of people in this smart world.The interconnected electronic devices are solving the issues of various Governmental, Private, Banking, scientific and social problems [1].

The devices on it are existing in our regular life for simplifying our life and also do various risky jobs into smart works [2].The smart city and smart home concepts are

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emerged in the world after the invention of IoT devices. These are using many interconnected electronic devices with sensors and actuators. And it is performing smart and efficient way [3].The communication in between devices increases, the lifestyle of the people in different aspects. This research is trying to solve one of the major issues of the society, the urban people of developing as well as developed nations also facing this problem. That is, none other than, the blocking of drainage.

The demographic explosion of the world, especially in urban sectors, around ten persons are using the infrastructure of a person. The drainage system is highly essential like that road communication system. Due to the population explosion, human wastes and some of the natural calamities, the drainage system is getting blocked. The human beings are involved in removing the blocks of the drainage system. It is taking the lives of thousands of workers every year. To identify the place of block is the highly challenging task in the narrow drainage system. velocity of the air. Based on these parameters and using the laws of gas existing in Physics are used for identifying the blocked surface of the narrowed drainage system.

1.1 Problem Statement

The blockage of drainage is the regular problem happening in the entire cities existing in the world. To identify the location of the block is a difficult task; mostly the humans are involving these activities. This is taking the lives of thousands of people over a year. This is a novel technique is used to identify the place of the block in the drainage system.

1.2 Motivation

This method is fully automated using natural resources like air, temperature and its factors. The sensors are used to find the influential values of the natural sources. A computer program is responsible for identifying the place of a block and size of the block. The human interaction is not required for this novel approach.

2. Associate Researches

The IoT devices are used by the senior citizens in their regular life like identifying body temperature, blood pressure, sugar level, etc. and contacting the medical doctors and suggesting the remedies for their problems. So that, the IoT devices are increasing the life expectations of aging people [6].The IoT devices are playing a great role in transportation and traffic controlling. The electronic devices and sensors present in the modern vehicles are identifying the traffic free routes, safety measures, traffic rules etc. It is giving advices for better transportation [7].In smart home applications, identifying the lost IoT components are also tracked by applying the machine learning approaches..Khajinasiri et al. [10] A reliable, efficient and user friendly it system is required for smart city applications. It is saving the money and time of the people. The smart home business of the world will cross hundred billion dollars in 2022.The smart home applications, not only working at home. It is reducing the consumption of energy and fuel of all the electronic and mechanical devices we are using. It is increasing the economic level of the families [11].In smart transportation application, the communication in between car to car and driver to the car is increasing the efficiency

of the driver and vehicle [12].Alavi et al. [13] The rapid growth of population in the urban sectors affecting transportation, communication, migration, sanitation, drainage, healthcare, energy and all other sectors. So that, the smart city applications of it must address these problems and find the solutions. Weber [14] suggested that, privacy and security is a global issue in this informative world. Therefore, a monitoring framework is required for the data security and privacy of IoT devices.Heer et al. [15] The Internet Protocol (IP) based IoT devices, the authentication and layered architecture is required for security and privacy policies of IoT information.

2.1 Sensors Used for Measuring Pressure, Velocity and Temperature of Gas

The BME680 [16] and MS 4525 DO [17] sensors are used to identify the pressure, velocity and temperature of the gas. These are Raspberry Pi and Arduino-compatible.

3. Automatic Drainage Block Identification System (ADBIS)

The drainage system in most of the countries looks like the following figure 1. It is having the ground level opening during a specified interval. It is helpful for doing the maintenance works, to open the lid and allow the water in that area.
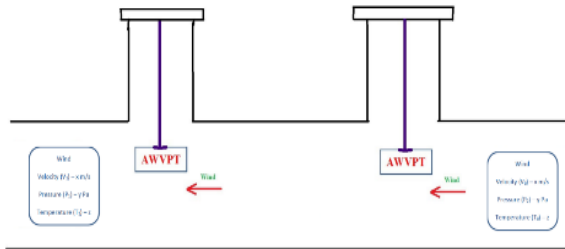

Figure 1. Drainage system without Block

In the above figure 1, in each ground level opening a sensor circuit is connected (the circuit is having the sensors for finding temperature, pressure and velocity of air). The AWVPT (Apparatus for Wind Velocity, Pressure and Temperature) instrument is used to find the velocity, pressure and temperature of air at each slit. It is the connected circuit of BME680 and MS 4525 DO sensors through Arduino. The sensor data is connected to the computer through Wi-Fi and cloud storage. If the drainage is having any blockage, then the VPT (Velocity, Pressure and Temperature) readings will be changed. Based on these values, we can predict the size and place of the blockage present in the drainage. The following figure 2 explains the blockage and wind directions.
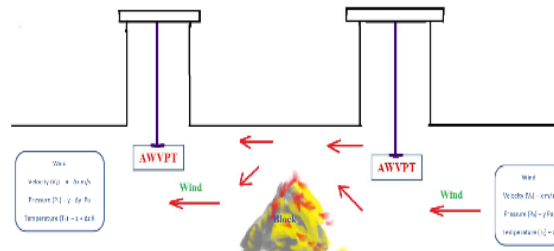

Figure 2. Drainage system with a Blockage

The above figure 2 explains the actual working principle of Automatic Drainage Block Identification System (ADBIS). The AWVPT device at first opening is measuring the VPT of the wind inside the drainage. That is, the initial Velocity, Pressure and Temperature of the wind are V_0, P_0 and T_0 respectively. Then the VPT is measured at second opening. The Velocity, Pressure and Temperature at OP-2 are V_1, P_1 and T_1 respectively.

3.1 AWVPT Hardware Implementation

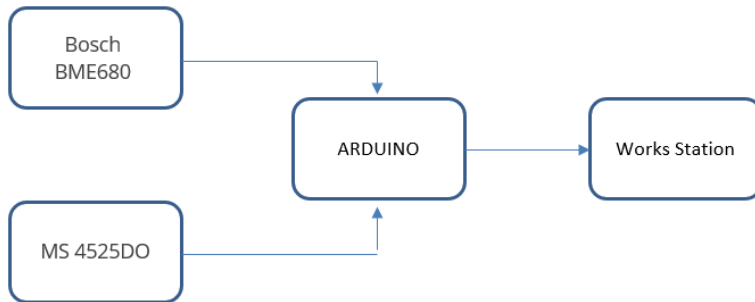The following figure 3 explains the architecture of ADBIS.

Figure 3. ADBIS Architectural Diagram

The BME680 and MS 4525D0 are the two sensors are used for identifying VPT value of the wind. These sensors are connected with workstation through the Arduino interface. The program present at the workstation will identify the block is present at the surface or not.

The VPT values at   two openings are same then we can identify that no any block is present in the drainage. When the difference present in the VPT values at these two openings may result the existence of block at that place.

3.2 Algorithm Implementation

The implementation of this algorithm is based on the Gay-Lussac's law. The normal flow of air or wind is to be stopped by an obstacle and passed through a narrow gap, then the temperature of the gas is reduced and the pressure and velocity are increased. Like that, the air or wind flow from the narrow gap to wide space, then the temperature of the gas is increased and the pressure and velocity are decreased.

Algorithm ADBIS
1. To find the initial parameters before the place where the block is to be suspected
    To identify the pressure (P_0) using BME680 sensor
    To find the temperature (T_0) of air using BME680 sensor
    To find the velocity (V_0) of air using MS 4525D0 sensor
2. To find the final parameters after the place where the block is to be suspected
    To identify the pressure (P_1) using BME680 sensor
    To find the temperature (T_1) of air using BME680 sensor
    To find the velocity (V_1) of air using MS 4525D0 sensor
3. Difference in pressure (P) = $P_1 - P_0$

4. Difference in temperature (T) = $T_1 - T_0$
5. Difference in velocity (V) = $V_1 - V_0$
6. If (P < 0) And (T > 0) And (V < 0)
    The block is present and initiate the process for removing the block
7. Else
    The block is not present with in the particular site and continue the step 1 to step 6 on another site.
8. The process is continued until the block is identified.
9. Stop

In this algorithm, the VPT readings are taken from OP-1 and OP-2 with AWVPT sensors. The VPT values at OP-1 are V_0, P_0 and T_0. The VPT values at OP-2 are V_1, P_1 and T_1. To find the VPT differences in between OP-1 and OP-2 are V, P and T. When the block is present, then (V > 0), (P < 0) and (T > 0), otherwise no block is present in that space. The process will be repeated until all the values received from the drainage system are analyzed.

4. Applications

In the smart city projects and its applications, it is an inevitable technology. The major advantages of these applications are,

➢ It is reducing time complexity. The time required to identify the block is negligible comparatively human interaction.
➢ The space complexity also less. The instrument a small pocket device. So, the portability of the product is also high.
➢ The results received from the device is accurate based on-air flow inside the sewage.
➢ The installation of the system is easy.
➢ The device is easily connected through Wi-Fi or Cloud. So, the automation is possible.
➢ The interconnection of these devices will give complete automated results to the sewage block problem.
➢ It is highly cost effective. So, the developing nations can adopt these techniques easily.

5. Future Enhancements

Automation and robotics are playing very important roles in the smart city projects. This research only solves the problem of the identification process. That is, to identify the area of the block in the drainage system. The removal of blocks in the drainage system is not possible by this method.So that, a new novel research is required for solving the block removal process of drainage system automatically.

6. Conclusion

The human involvement in the drainage cleaning and monitoring is killing the lives of thousands of people in the world. Every human life in the world is precious. All are

equal by birth (Ancient Tamil Book, "Thirukkural" at AD 50). To remove the discriminations in the society through modern innovation is the best thing of all the researches. This is the initial innovative research work which is giving the solution for automatic block identification in the drainage systems. The future researches of these will give a better solution for the entire tasks in the drainage block identification and removal.

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