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A Study on Estimation of Liquid Leakage Using Wide Angle Camera Based Angled of Arrival Algorithm in Bio Plant

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Abstract

In addition to the instability of energy import costs caused by the depletion of petroleum resources, which is a representative energy resource, and the strengthening of various regulations such as the convention on climate change, the plant for bio energy production, which is being watched as the next generation energy, and became subject of various complaints. In order to solve this problem, the bio-plant is underground and the ground is parked, making the convenience and accessibility of citizens more and more accessible. In this situation, the development of bioenergy production technology also increases the risk factor in bioenergy production process. Accordingly this paper explains method about apply the wide angle camera based AOA algorithm to the bio plant to prevent the accidents from spreading due to the lack of facilities and safety devices and the aging of the facilities and suggests a technique that can quickly identify the location and direction when it occurs.

Keywords: *Bio Energy, Bio Plant, Liquid Leakage, Wide Angle Camera*

1. Introduction

In order to eliminate the instability of energy import costs due to the increase of energy import costs due to depletion of fossil fuels around the world, the direct landfilling of organic wastes and marine discharges were totally prohibited by the Kyoto Protocol and the London Convention. Therefore, new and renewable energy that produces methane gas and electric power using organic waste is suggested in Korea as a way to

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solve these problems at the same time [1][2].

As such problem solving needs, advanced countries steadily promoted R&D and supply policies, and Korea has set a mid - to long-term goal of distributing 11 % of renewable energy in 2035. As part of its efforts, it aims to increase its energy consumption rate to 23 % by 2018 by promoting the energy conversion of waste resources into a resource circulation society and establishing an advanced recycling system [3].

In particular, bioenergy is a major source of renewable energy to be distributed in the future, with the benefit that it can be used as the only gas fuel among renewable energy sources. A report by Global Intelligence Alliance (GIA), the market analyst in 2010, shows that biogating and oversharing of the value pipeline into one of the most attractive areas in biogating business is the future [4].

However, despite the fact that the bio-plant capable of producing biogas is an eco-friendly facility capable of producing remarkable reductions in final throughput and producing renewable energy such as methane, It is recognized as a facility, and there are many difficulties in operation and operation. Especially, odor generated in the facility is a top priority of civil petitions, and thorough measures must be established. The concept of ventilation, exhaust and deodorization must be introduced by the enclosure of the facility.

In order to respond to these complaints, we have recently undergrounded the environmental infrastructure and provided the upper space as a green space and it has been transformed into a resting space in the city center by enhancing the utility as a cultural space for education and environmental facilities that have been recognized as past evasive facilities. However, due to the free access to residents, the possibility of mass casualties is high in case of an accident.

2. Analysis of leakage accident cases

Considering the complaints and safety of the residents about environmental facilities including the biogas plant, many environmental facilities are underground in many cities and are handling various wastes generated in the downtown area. In addition, as the market of biogas grows, the efficiency of biogas production is increased through the development of biogas production process technology. In this process, the risk of biogas separation, purification, and production has also been increased to produce high purity biomethane.

However, it is still in the developing industrial field and there is no systematic safety technology development and empirical research, and the following accidents are occurring. In the case of the biogas plant in Pocheon, the construction and operation of biogas production facilities utilizing food and animal manure produced many concerns and complaints about odor.

The Daegu Sincheon Sewage Treatment Plant was not producing biogas, but gas explosion occurred during repairing, replacing and supplementing piping of the anaerobic digester, which is a necessary process for producing biogas. In addition, explosion accident occurred in bio energy based power generation system of Goyang city, and it was pointed out that the leak of meta gas due to the failure of the end of the pipe end was the cause of the explosion although the 3 step shutoff valve was installed.

The causes of such problems are pointed out as the main cause of the deterioration of facilities due to inadequate management or leakage of gas and explosion due to safety devices and inadequate standards.

Therefore, biogas plant operation and safety management are more emphasized for safe biogas plant operation. In the case of urban areas, because it is made like a park, the outside personnel can access the facility nearer, and population density is high, which can lead to poor results even in the case of small management failures[5][6].

3. Research of AOA algorithm technology based on wide angle camera

In order to secure the settlement of the urban center of the bio plant facility, it is necessary to prevent and respond quickly to odor and explosion accidents. For this purpose, it is important to maintain the stability of each facility and prevent the complaints and accidents by monitoring the connection parts and the bio energy transfer pipes for the movement of methane gas and hydrogen sulfide generated from the anaerobic digestion of bio energy.

In the case of liquid leakage, it is possible to detect at the stage of leaking by using various sensors, but it is difficult to confirm accurate leaking direction at a precise position of a leaking plant. In order to confirm the directionality, a larger number of sensors should be installed in the plant facility.

However, in this case, the position of each sensor or the method of managing and positioning by using the absolute position requires much manpower and time in the process of database conversion. To solve this problem, in this paper, location determination techniques Among TOA(Time of Arrival) technique, which is a positioning technique using the arrival time of radio wave, TDOA(Time Difference of Arrival) technique using arrival time difference of two radio waves and AOA(Angle of Arrival) technique using a measuring the arrival angle of a signal, AOA technique based on FOV(Field of View) of wide angle camera was used. As shown in Fig. 1, the conventional AOA positioning method is a method of estimating the position of a terminal using each information of a signal transmitted from the AP, receiving a number of an antenna for transmitting a signal, where the direction of each AP antenna and signal source meets [7].

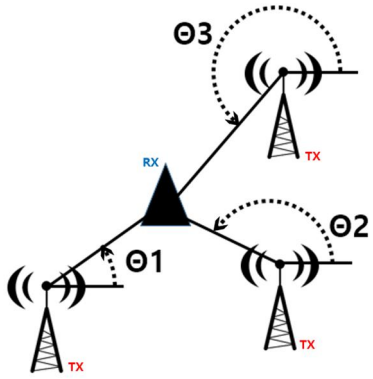

Figure 1. AOA Positioning Method

The AOA method is applied to the wide angle camera, and the absolute position of the camera is set as a reference, and the position of the pixel on the image is confirmed through image processing of each camera.

In this case, it is possible to compare the image information received from a number of cameras, so that not only the location of leakage but also the direction of cracks in the biogas transfer pipe can be checked.

Therefore, it is possible to precisely position as compared with the safety management system using only the sensor, and also to manage the biogas plant remotely, it is possible to confirm the deterioration of the equipment and the conveyance pipe as well as the post- It is also superior in maintenance and management.

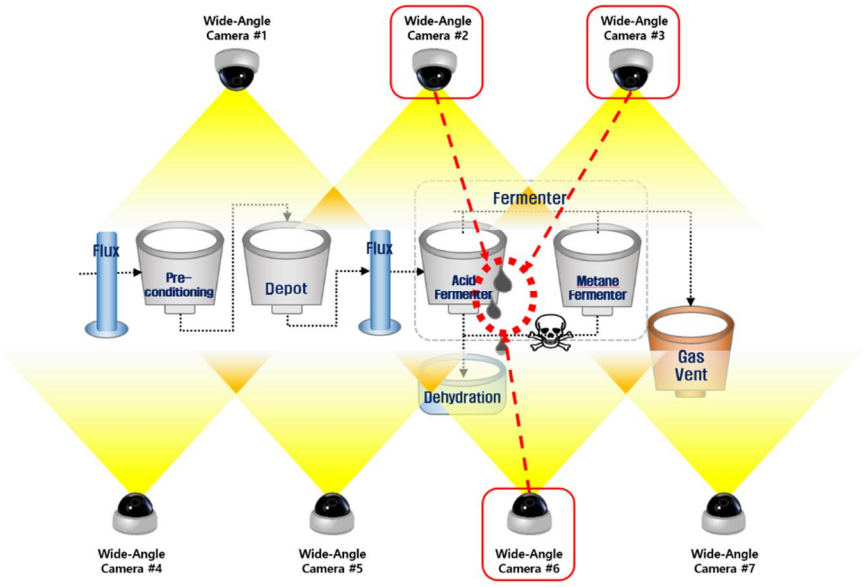

Figure 2. AOA based on wide-angle camera

If the Leakage Prevention and Monitoring System as shown in Fig. 2 is adopted, not only remote monitoring of the biogas plant facilities will be possible, but also image processing can be applied to the parts that people can miss through image processing. Also there is an advantage that the deterioration of facilities can be detected and prevented in advance.

Therefore, it is possible to reduce civil complaints of urban biogas plant facilities, to provide green space, and to maintain and repair biogas plant facilities that are used for relaxation, education, and cultural space more safely.

4. A Study on Estimation of Liquid Leakage Using Wide Angle Camera Based Angled of Arrival Algorithm in Bio Plant

Intelligent leakage detection using the function of wide angle camera is also possible by applying efficient bio-plant process through AOA position estimation algorithm based on wide angle camera.

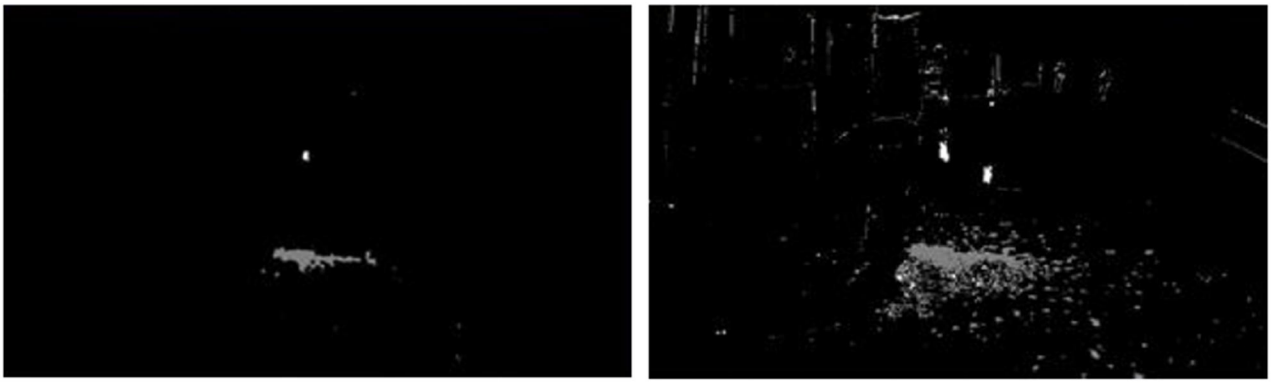

Figure 3. Leakage detection based on Image Processing

As shown in Figure 3, the AOA-based position recognition through the wide-angle camera, as well as

additional image processing, enables early response at the time of leakage occurrence. And can be safely processed by leakage.

In order to achieve this, we deployed an efficient wide angle camera arrangement so that images captured between cameras are partially redundant, and the remote management of the biogas facility is enabled by the algorithm shown in Fig 4. Through the wide-angle camera, it continually checks and detects whether it is leaking or not, and confirms the state of the equipment and the degree of deterioration from time to time. If leakage occurs, analyze the leakage state and type through image processing. Then, if two or more wide-angle cameras detected two or more wide-angle cameras, it is determined that leakage is detected based on the position of the wide-angle cameras and informed to the manager.

The liquid leakage detection on wide-angle camera captured visual frame follows the computer vision based object detection and object tracking techniques to find associated interested region for leakage position and leakage type. The captured visual frame enhanced using Contrast Limited Adaptive Histogram Equalization (CLAHE) filtering method before applying liquid object detection techniques. The main goal of liquid leakage detection is to estimate the liquid object's trajectory in every captured frame. This liquid object trajectory is estimated using Lucas-Kanade optical flow techniques which assumes that a pixel's intensity does not vary much from frame to frame when there is no change in the camera monitoring region. In this approach, computes the displacement of pixels within the visual frame and estimate a displacement field. The displacement field provides detailed information on the change in the monitoring by a liquid object and is used to track the liquid leaks throughout successive captured visual frames.

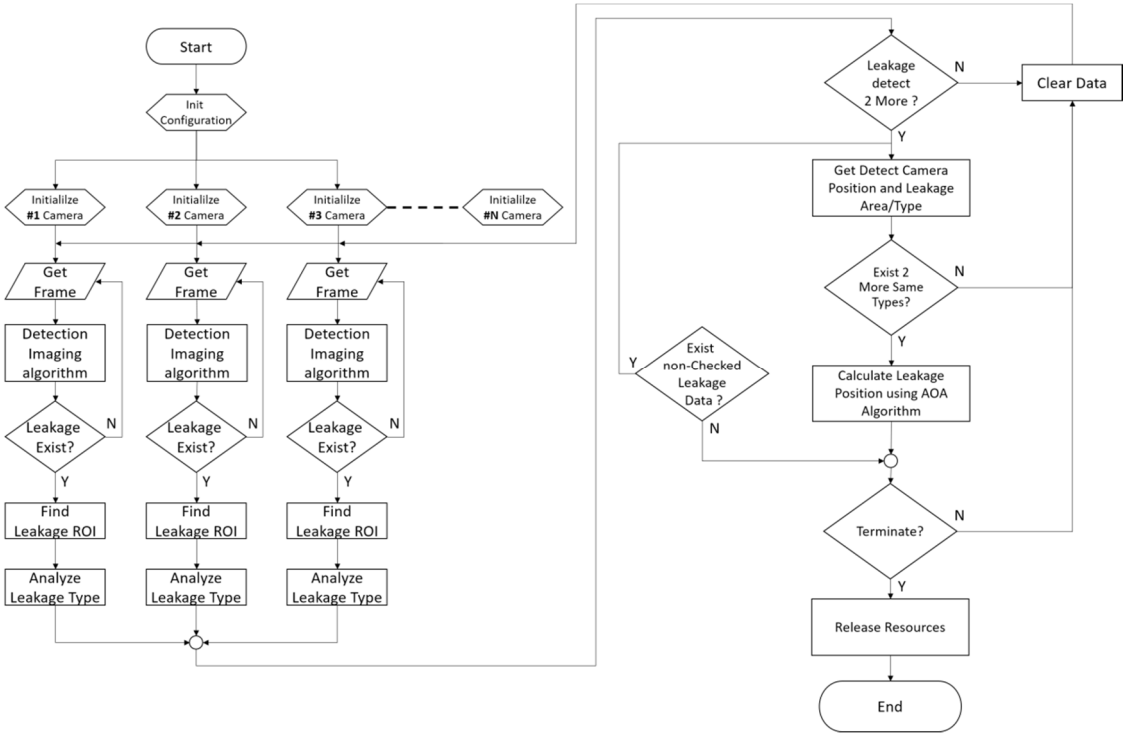

Figure 4. Flow chart of AOA algorithm using wide angle camera

In this proposed approach, possible to calculate the exact position, the direction of leakage and the leak severity. The wide angle camera based proposed AOA algorithm flow described in the Figure 4. The Lucas-Kanade optical flow methods provides the liquid leak region of interest (RoI) for each monitoring wide angle camera and the leakage type and severity of leak is estimated using Support Vector Machines

(SVM) machine learning methods. The Voting for Image Scoring and Assessment (VISA) algorithm applied on machine learned vector to estimate the exact position and leak severity on bio-plan to take prevention action in real-time.

5. Conclusion

Stable energy security has become a major goal of globalization countries due to the fluctuation of international energy resources and regulations under international agreements that are shaken in accordance with current international circumstances and bio-plant technology is an important strategy in the implementation of international treaties such as climate agreements. In particular, bio-energy is a good source of energy that can be categorized into stable energy sources that have both custody and efficiency, while utilizing livestock manure and urban foodstuffs.

Through the application of the proposed algorithm, it is possible to operate the plant safely in the urban area by applying the AOA position locating technique using the wide angle camera which can operate the bio - plant more stably and prevent aging in advance. Therefore, a virtuous cycle structure capable of efficient waste disposal is expected to be able to be established early, and the rate of implementation of international agreements is also expected to rise, making it possible to become a developed country.

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