Mobile Phone Remote Controlled Wastewater Treatment Equipment Used in Tribe

Hsiao-Ming Chang¹; Chun-You Lin²* and Mao-Chun Chiu³

¹School of Physical Education, Putian University, Putian City, Fujian Province, ZIP code: 351100, China
²Guangdong-Taiwan College of Industrial Science & Technology, Dongguan University of Technology, Dongguan City, Guangdong Province, ZIP code: 523000, China
³Department of Recreational and Sport Management, Tajen University, Zip code: 90741, Yanpu Township, Pingtung County, Taiwan Province, Taiwan

*Corresponding author’s e-mail: lincy@dgut.edu.cn

Abstract. This study developed the data acquisition module which involves electronics control hardware and mobile phone APP software, the module could control and monitor wastewater treatment equipment by the APP software running on mobile phone for wastewater treatment in the tribe of eastern Taiwan. The APP user of the tribe can keep abreast of the situation of wastewater treatment and discharge to maintain the water resource with a good water quality.

1. Introduction
In recent years, the urban residents' awareness of environmental protection for water pollution is increasing, and there are many environmental protest activities in Taiwan. The eastern area of Taiwan has a relatively small population density and a lower level of urbanization, and also has many beauty natural landscapes and original tribes[1,2], causing lots of tourists like to visit this area. Due to more and more tourists coming, their activities such as barbecue and camping will cause water pollution near water resource protection area of original tribe in the eastern area of Taiwan. Therefore, at present, people pay more attention to three major issues: water pollution impact assessment, water resource protection and sewage treatment. Through the investigation of this study, in the eastern area of Taiwan, the residents of the original tribes very care and treasure about the water resource for their domestic use[3]. The economic value of water is associated with the benefits generated by its use and conservation, the costs associated with its storage, treatment, distribution, purification and return to natural ecosystems[4].

Wastewater treatment equipments are used to remove toxic and harmful substances from wastewater, and it must has control and monitor functions for equipment operation use. The traditional monitoring method for equipment operation is through equipment-side monitoring, and there are some research results, including the real-time data acquisition and monitoring for NC machining[5], the vision system online quality monitoring for parts manufacturing[6].

Lack of public trust might lead to protest from water resource users[7]. For building public trust, besides equipment-side monitoring of wastewater treatment equipment, more innovative method is...
through remote monitoring by mobile phone. This study proposes a method that mobile phone to control and monitor the wastewater treatment equipment when operating wastewater treatment.

Mobile phone is a modern communication product. In decades, development of smart phone is very fast, and almost everyone has one. In this study we developed a mobile phone remote controlled wastewater treatment equipment that can be used in original tribes for wastewater treatment. The mobile application software can control and monitor the running state of the device. Using this APP software, the equipment operation status is disclosed, and APP software users can understand how many amounts wastewater is generated, how many amounts wastewater is treated and other operations parameters of the equipment.

2. Methods

2.1. Experiments

2.1.1. Setup of data acquisition module. This study developed a data acquisition module which was installed in a wastewater treatment equipment. The data acquisition module could control and collect data from each operation unit of the wastewater treatment equipment, and its schematic diagram is shown in Figure 1. The data acquisition module was comprised of printed circuit boards control card that mounted with micro controller chips and other electronic components, and a mobile phone operation software was developed to communicate with the data acquisition module. Using the operation software running on a mobile phone, it could collect operation signal for tracking and monitoring, and it could also provide electrical actuation signal to control operation condition and turn-on or turn-off the power for equipment running or stopping.

![Figure 1](image1.png)

Figure 1. Schematic diagram of the data acquisition module in the wastewater treatment equipment developed in this study. In the equipment, there are three operation units such as wastewater filtration and evaporation, and solid pollutant solidification. Each operation unit could generate many operation signals, and the signals could collect by the data acquisition module. Through internet communication between the data acquisition module and the mobile phone, the signal data generated from the equipment operation could be calculated and treated on the mobile phone, and the result data could be show on the screen of the mobile phone.

2.1.2. Setup of wastewater treatment equipment. This study developed a wastewater treatment equipment as shown in Figure 2, which involves three operation units such as wastewater filtration and evaporation, and solid pollutant solidification. The data acquisition module mentioned above was installed in the wastewater treatment equipment.
2.2. Test
Using the mobile phone APP software developed in this study, the wastewater treatment equipment operation status and control parameters were listed on the screen of mobile phone, including power consumptions, temperatures, water amounts in storages, circulation pumps condition, valves condition, as shown in Figure 3.
3. Results
After operation test, it demonstrates the developed data acquisition module and APP software could make the communication between wastewater treatment equipment and the APP software user. The user could see the operation status and parameters when the wastewater treatment equipment was operated. By mobile phone, the user could get the equipment operation conditions including temperatures, power consumptions and others; besides the user could adjust the process parameters of each unit operation such as power, working time and others.

4. Conclusions
Using the mobile phone control and monitoring module developed in this study lets APP software user easily and efficiently operate the wastewater treatment equipment in off-line operation mode to track the operation situation and to modify the operation condition for well running. Therefore, the mobile phone APP user of the tribe can keep abreast of the situation of wastewater treatment and discharge to maintain the water resource with a good water quality.

Acknowledgments
This study was supported by a grant from National Social Science Foundation of China (No.18BMZ130).

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