

## **Internet of Things Based System for Optimizing Medical Waste Management – A Case Study in Taiwan**

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**Abstract**

The collection and disposal of medical waste, if not handled meticulously, pose a significant risk of secondary contamination to healthcare facilities and the broader community. With the high density of large healthcare institutions in Northern Taiwan, the daily volume of medical waste continues to rise, making its management increasingly critical. Effective planning and continuous monitoring of waste disposal processes have become labor-intensive tasks and a substantial challenge. This study focuses on a private hospital in Taiwan as a case study for handling various types of medical waste generated within the facility, specifically in its 30 Intensive Care Units (ICU) rooms. Currently, the cleaning staff follows a schedule to manage waste collection three times a day from patient wards. However, the waste production in ICU is variable, often not necessitating such frequent collection or encountering situations where waste bins are full but not promptly emptied. Notably, items like diapers can be recycled, and proper categorization can reduce recycling costs. To address these issues, this research aims to significantly reduce the operational costs of the ICU at a private hospital in Taiwan and improve overall waste management efficiency by developing an Internet of Things (IoT) system for the collection of diaper waste. The system employs IoT sensors to monitor real-time diaper waste levels, addressing inefficient waste scheduling. Additionally, the system includes weight sensors to measure diaper weight directly, eliminating the need for separate weighing and reducing unnecessary handling. This system also prevents non-diaper waste from being disposed of in diaper bins, ensuring correct waste categorization and reducing recycling costs. Based on the preliminary results from February 2024, nurses or medical staff no longer need to weigh each diaper individually, as this information is accessible through the database.

**Biographies**

**Yun-Chia Liang** is a Professor in Industrial Engineering and Management Department, Yuan Ze University. He obtained his first master's degree from the Mechanical Engineering, Carnegie Mellon University, the second master's degree from the Industrial Engineering, University of Pittsburgh, and the Ph.D. degree from the Industrial and Systems Engineering, Auburn University. His research interests focus on metaheuristics, scheduling, supply chain management, and artificial intelligence applications. He is member of IEEE, ORSTW, and CIIE.

**Vanny Minanda** is a PhD candidate in Industrial Engineering and Management, specializing in the cutting-edge intersection of technology and optimization. Her research focuses on the application of metaheuristic algorithms in solving complex transportation and optimization problems. Most recently, her work focuses on the integration of the Internet of Things (IoT) and deep learning algorithms to enhance transportation and routing efficiency.

**Zi-Yi Wu** is a master's student in Industrial Engineering and Management, specializing in IoT technology. Her research focuses on integrating hardware, software, and online APIs to achieve real-time monitoring. Recently, her work has concentrated on the use of hardware sensors to implement IoT technology across various industries, thereby enhancing management efficiency and operational effectiveness.

**Wei Fu** is a seasoned professional in the field of occupational safety and hospital administration, currently serving as the Director of the Occupational Safety and General Affairs Office at Far Eastern Memorial Hospital in New Taipei City. With a career spanning over nine years in this role, He has demonstrated exceptional leadership and expertise. In addition to their hospital administrative roles, Wei-Fu has been actively involved with the New Taipei City Health Bureau as a Supervisory Committee Member for the past six years, contributing their extensive knowledge and experience to public health oversight.

**Ming-Shu Chen** who is a Professor in the Department of Healthcare Administration, College of Healthcare & Management, Asia Eastern University of Science and Technology, and Research & Interests in healthcare system quality control, health promotion in the elderly, and long-term care. He used to be Medical Technologist and worked in different hospitals for 20 years and was in charge of the Health Management Center, Far Eastern Memorial Hospital for almost 12 years. Prof. M-S Chen passed the national examination for medical technologist and graduated from the Institute of Hospital and Health Care Administration, National Yang Ming Chiao Tung University, and got his Ph.D. degree in Industrial Engineering and Management, Yuan Ze University.

**Hou-Tai Chang** is an Associate Professor in Industrial Engineering and Management Department, Yuan Ze University. She obtained her Ph.D. degree from the Health policy and Management, College of Public Health, National Taiwan University. She now is serving as the chief of medical intensive care unit and hyperbaric oxygen center at Far Eastern memorial hospital. In addition to the hospital administrative role, she also has study interests focusing on critical care and hyperbaric oxygen therapy, and healthcare financing.

**Chih-Yung Hsu** is an assistant administrative officer of Far East Memorial Hospital, is responsible for managing the hospital's medical waste removal and environmental cleaning affairs. He has served in the Occupational Safety and General Affairs Office of Far East Memorial Hospital for nearly 16 years. Graduated from the Department of Marine Environmental Engineering of the National Kaohsiung University of Science and Technology and a bachelor's degree in Environmental Engineering of the private Kunshan University of Science and Technology.