UNIVERSITI TEKNOLOGI MARA

PARAMETRIC COEFFICIENT GENETIC ALGORITHM FOR DOMESTIC WATER CONSUMPTION

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ABSTRACT

Residential water consumption is influenced by various factors. Household routine parameters involving water-using appliances and fixtures such as number of times the occupants of a household took bath and shower, doing laundry, watering plants and other routines ultimately regulate the amount of residential's monthly water consumption. Accurately and effectively estimating and classifying the amount of residential water consumption is a tremendously challenging task as these parameters differ from one another with one household routine may be more influential and vice versa. Previous method which employs per capita water consumption (PCC) basically finding average of water consumption in different state of Malaysia which is largely inaccurate. This research therefore proposes the employment of Genetic Algorithm (GA) to optimize the coefficient of micro-components of water consumption (CMWC) values to determine high influential household routine parameters. This is accomplished by encoding the chromosome data in GA to incorporate the CMWC values to minimize the residential water consumption estimation error rates and subsequently enabling increased accuracy towards estimating and classifying the amount of residential water consumption. Using household's characteristic data and average monthly water consumption from 80 households in Seremban, it is discovered that CMWC values for bath and shower, flush toilets, personal hygiene, laundry by washing machine and food preparation are more influential towards the water consumption compared to laundry by handwashing, water plants, wash car and miscellaneous routines. In addition, the estimation done by the proposed algorithm has indicated that DWC-GA using high and medium pre-determined water consumption (PDWC) values produced 0.82 and 1.05 error rates respectively when compared to PCC method's error rates of 9.49. Furthermore, CMWC values enables the households to be classified into non-excessive (24 households), normal (29 households) and excessive (27 households) consumption. This research also discovered that estimating and classifying the amount of water consumption can be accurate and effective due to the CMWC values able to cater to different households and its unique household routine parameters. This research benefits both household consumers and water companies to manage the water efficiently by acknowledging and monitoring the water consumption using the estimation and classification of the household water consumption.

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CHAPTER ONE
INTRODUCTION

1.1 Chapter Overview

This chapter begins with a brief overview of research background and problem statement. This is followed by research question and objective of the research. A discussion on research limitation and significance is presented at the end of this chapter.

1.2 Research Background

Recent climate changes cause severe droughts and major floods make clean water exceptionally precious especially for domestic consumption. It is important to monitor monthly household water consumption to avoid water wastage. Water wastage could be caused by water hoarding during water rationing, pipe bursting, leakages and carelessness. Irregularity in monthly domestic water consumption can be detected based on its average.

Remote monitoring of domestic water consumption using sophisticated devices has been increasingly available. However, it is expected that the availability of such devise in residential household in most part of the world is still very low due to its cost. Currently, the government in Malaysia uses Per Capita Consumption (PCC) of domestic water from the National Water Services Commission in determining water management strategies. According to Florida Department of Environmental Protection in 2014, PCC is the average amount of water consumption each person in a particular area uses on a daily basis. Every state in Malaysia has different PCC values as it is calculated by averaging the amount of water consumption with total number of populations for each respective state.

It is known that there are various determinants of domestic water consumption. For instance, one of the determinants is household routine or activity involving water-using appliances. These household routine parameters directly influence and results in high impact to the overall water consumption in a residential household. These parameters are often overlooked in a favour of static value such as current PCC that can provide satisfactory estimation towards water consumption. Household routine