

IoT-Based Solution for Sustainable Mitigation of Urban Heat Island (UHI) Through Implementation of Green Infrastructure (GI)

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ABSTRACT

Urban Heat Island (UHI) is a critical issue worldwide due to its negative effects and is mainly caused by the modification of energy balance in urban areas brought about by rapid urban development and also consequences of global climate change. Implementing Green Infrastructure (GI) including both natural and designed greening including green roofs and walls can mitigate the problem. However, implementation of green wall and green roof is still limited especially in Malaysia due to high variability of data which mostly relates to the different characteristics of the GI system, building parameters, surrounding environment and local weather conditions. In this work, the researcher aims to analyse the energy performance and cost-benefit for implementation of GI particularly green wall in mitigation of UHI effect and use IoT solutions as a tool to help decision makers. A building in Putrajaya has been chosen for the case study. Firstly, air temperature data is obtained from various sources for Putrajaya, and UHI Index is determined. Then a cost-benefit analysis is conducted for the implementation of green wall for the identified building. A prototype web application is then developed to enable fast data visualisation and simple project evaluation. Results shown that there is an increase between 2 to 3 °C of temperature from the year 2010 to 2020. This correlates to UHI index of 1.06 which means that the UHI is at a significant level. The building in the case study is an office block, and therefore the major electrical loads are the air-conditioning units. Based on this load, the cost-benefit analysis was performed. The economical cost-benefit analysis has shown that the project has positive Net Present Value and Internal Rate of Return – thus indicating that this is a profitable investment. The Payback Period is also calculated to be reasonable at six years. The prototype application has been designed and implemented for Android system, and is able to perform according to the designed functions. However, this is a case study of a particular building, and the calculations are done based on the design parameters for that building only. Cost benefit analysis for other buildings would require further analysis with parameters specific to the particular building. This project has enabled a simple evaluation of the GI implementation as a method of mitigating UHI problem in Putrajaya, and the outcome of this work can be used as a basis for similar buildings in Malaysia.

Keywords: Urban Heat Island; Green Infrastructure; Cost-benefit; IoT solution;