Surrogate human sensor for human skin surface temperature measurement in evaluating the impacts of thermal behaviour at outdoor environment

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ABSTRACT

The world is experiencing high rates of urbanisation and it has slowly become an alarming social process, especially in developing countries. This has demanded an urgent investigation on human thermal comfort, especially in tropical climates. In this study, a surrogate human sensor (SHS) was developed to establish a linkage between human skin surface and SHS with the surrounding environments. Black plastic corrugated cardboard was used in the SHS fabrication as its thermal conductivity was close to the thermal conductivity and emissivity of the human epidermal skin layer. The SHS was designed to correlate with human skin surface temperature and a regression model was developed. The regression equation was obtained for the human skin temperature prediction (T_h) by using SHS. Statistical analysis of the ANOVA ($F = 13{,}700$; $\rho < 0.05$) was significantly tested to show its reliability. The predicted and measured human skin temperature was compared and the results revealed that both temperature variations was found in range ±0.5 °C in temperature differences. The advantages of SHS as the sensor for the impact of thermal behaviour can be identified by observing the temperature difference as it can directly reflects the influences from the surrounding outdoor environment. Although it is proven valid statistically, however, SHS is only relevant as an initial indicator to investigate the impacts of thermal behaviour and discomfort level. It can further used to measure human thermal comfort by correlating surrounding environment condition with comfort sensation through SHS regression model.

Keywords: Thermal environment; Ergonomics; Thermal comfort; Human skin surface measurement; Outdoor environment; Surrogate Human Sensor; Thermal behaviour