ABSTRACT

In general, public electric vehicle Battery Swapping Stations (BSS) are only specialized for one type of battery from a particular electric motorcycle. For example, in Indonesia, the electric motorcycle company such as Gesits and Volta have their own battery swap stations. At present, the ecosystem is still reliable because the use of electric motorcycle in Indonesia is still less than fossil fuel motorcycle. However, it does not rule out the possibility that electric motorcycle users will increase. In this paper, the proposed system designed allows BSS to provide battery swap services for more than one type of battery and electric motorcycle brand (Battery Heterogeneity). The number of batteries of each type of electric motorcycles are determined. The battery charging cost is determined in real-time and the station's profit is maximized by optimizing the battery swap scheduling. The problems are modelled with a Mixed-Integer Nonlinear Problem (MINLP) which then be linearized into a Mixed-Integer Linear Problem (MILP). Swap scheduling is optimized with the Rolling Horizon Optimization (RHO) approach which considers several constraints. These constraints include: battery type, vehicle, battery SoC (State of Charge), electric motor arrival time, electricity price from the grid at time t, and power usage by each battery. The arrival time of the electric motor at t+1 is predicted based on historical data using the Long-Short Term Memory (LSTM). The total profit in a day by optimization scheduling is more than by unscheduled swap. The total of battery swapped and motorcycle served are compared between RHO-LSTM and RHO-Polynomial. The result depict that the total of battery swapped and motorcycle served by RHO-LSTM are more than by RHO-Polynomial. The total profit is also the same.

Keywords: Heterogeneity of Battery Swapping Station, Electric Motorcycle, Mixed-Integer Linear Problem, Rolling Horizon Optimization, Long-Short Term Memory.