The implementation of Particle Swarm Optimization (PSO) algorithm in optimizing Proportional-Integral-Derivative (PID) controller’s parameters is a popular technique to improve the performance of a control system. A prevalent application is a Direct Current (DC) motor control system with variations in parameters value have been used. Moment of inertia is one of the essential parameters of a DC motor which can affect the transient response including rise time, settling time, overshoot and steady state error. However, the use of moment of inertia and other parameters of DC motor are mostly to complete the transfer function and no specific analysis was done on the effects of their variations to the control method. This research investigates the effect of moment of inertia on the performance of PSO algorithm utilizing the Weighted Transient Response Index (WTRI) based fitness function in optimizing PID controller parameters to control a DC motor. Five fitness functions were used in comparing the performance of PSO algorithm which includes Integral Absolute Error (IAE), Integral Time-weighted Absolute Error (ITAE), Integral Squared Error (ISE), Integral Time-weighted Squared Error (ITSE) and WTRI. It was also shown that a threshold for moment of inertia can be defined where the performance of PSO algorithm was affected only if the moment of inertia of the DC motor is more than the threshold value. The details exploration of WTRI based fitness function shows the significance of prioritized weight in Prioritize Single Non Zero (PSNZ) weight category towards its associated transient index was proven while for Prioritize All Non Zero (PANZ) weight category, the complex relationship between rise time, settling time and overshoot seems to interfere the ability of its prioritized weight in fully controls their associated transient response outputs.

This study proposed an effective method to miniaturize the printed monopole antenna using a double E-shaped meander line structure that were combination of several slots and a meander line. The proposed antenna was also incorporated with defected ground structure (DGS) at the bottom layer. The proposed design is intended to overcome the limitation of the wire monopole antenna, where the size of the wire monopole is quite bulky besides it is unable to be integrated into modern portable device. Flame retardant type 4 (FR-4) with dielectric constant, $\varepsilon_r$ of 4.3 and thickness, b of 1.6 mm was used as a base substrate. The design was simulated using electromagnetic simulation package software to analyze the antenna reflection coefficient, voltage standing wave ratio (VSWR), input impedance, bandwidth, antenna gain and surface current distribution. The design started from a typical square printed monopole as a reference antenna with overall size of 83.80x143.74 mm$^2$ covering 878 MHz for forward scatter radar (FSR) network. Parametric analysis has been carried out comprehensively to provide desired antenna performances at targeted frequency band. The miniaturization was achieved due to the fact that the slot and meander line increased the current distribution along the radiating area, in which, the effective capacitance and inductance of the radiator was increased as well. Hence, this led to the reduction in resonant frequency that allows miniaturization of antenna to obtain the targeted frequency. The new structure of the double E-shaped meander line patch reducing the overall size of the design to 46.80x74.00 mm$^2$ corresponding to 0.1373, 0=0.2173, 0 where $\lambda$ is a wavelength at 878 MHz. The results revealed that the proposed structure reducing the overall size of the antenna up to 71.2% compared to the reference antenna. Spectrum Analyzer with built-in Vector Network Analyzer function was used to measure the reflection coefficient and voltage standing wave ratio (VSWR) of the fabricated antenna while antenna radiation pattern was measured in anechoic chamber. Comparison between measurement and simulation results showed that both results matched with omnidirectional radiation pattern of simulated and measured gain of 0.948 dBi and -1.18 dBi, respectively. The performances of the proposed antenna have been compared to other antennas in literature where it is found that the proposed antenna achieve smaller physical size with sufficient antenna gain and efficiency. Design equations for the proposed antenna also developed based on the radiating patch configuration. For a proof of concept, the design equations has been applied to develop miniature printed monopole antenna operating at 155 MHz for Very High Frequency (VHF) applications. An equivalent circuit has been modeled for both UHF and VHF antennas using Advanced Design System (ADS) simulator for electrical theory explanation where both responses from ADS and CST having similar response. Throughout this study, there are four contributions towards the knowledge which are; the innovative design structure of the double E-shaped meander line printed monopole antenna with DGS, miniature and compact printed monopole antenna, design equations, and equivalent circuit model of the miniature antenna.