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Adaptive charging control using ANN-PID controllers on multiple DC loads with varying battery voltages

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ABSTRACT

Various rechargeable electronic devices currently have batteries with different capacities and voltages, while the available chargers are generally fixed for one device. This is considered less effective because different types of electronic devices will require different battery chargers. Therefore, the adaptive power charge is needed to recharge batteries with different voltages and capacities through a single port by adjusting the type of load connected. This system uses buck converter with duty cycle settings through microcontrollers to lower the input voltage to variable output voltage. When the load is connected, the limit switch will be depressed and the system will start the duty cycle tracking process. The voltage will be increased gradually until the current is read at a certain value to identify the load. After the current reads the duty cycle stops tracking, then the current and voltage characteristics are used as input variables for the artificial neural network (ANN) algorithm to determine the target setpoint voltage to be executed by the proportional, integral and derivative (PID) controller. The designed adaptive power charge can identify the connected load accurately. The average ANN output error is 1.46e-4% and the average PID controller error is 6.4e-2%. The system can reach a steady state at 0.01 s.

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1. INTRODUCTION

In this modern era, the development of portable rechargeable electronic devices is increasingly diverse. Rechargeable electronic devices use batteries as a crucial part to store electrical energy in the form of chemical energy [1]. The battery has a storage capacity limit so it must be recharged immediately when the stored electrical energy runs out, so that electronic devices can continue to operate.

Recharging the battery is important to maintain the availability of electrical energy in electronic equipment so that it can still be used [2]. In general, one equipment has a special charger that has been adjusted to the charging voltage of the equipment. However, the problem that arises now is the increasing variety types of electronic equipment circulating so that the chargers needed are also increasingly diverse. Conventional chargers that exist today have been adjusted to the voltage and capacity for a particular battery so that it cannot be used for charging other types of batteries [3].

From these problems, an adaptive charging system is needed. A system that allows recharging various types of electronic devices with varying battery capacities and voltages. In general, conventional charging is used specifically for one type of load [2]. With conventional systems the load cannot be detected. For make an adaptive charging device that can be applied to varying loads, a special control is needed. When different loads