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Self-Regulated Pid Controller For Improving Ev Charging Station Performance By Harris Hawk Optimization Technique

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ABSTRACT

The most modern charging stations right now are for electric vehicles. Due to their better efficiency, electric vehicles may be charged more affordably with electricity than with fuel or diesel. When employing renewable energy sources, driving an electric car can be highly environmentally benign. The most crucial component of such an electric car is its charging mechanism. The current system cannot be more effective because it lacks self-regulation. To achieve a goal, such as increasing efficiency and reducing process time, etc., the system constant cannot be changed independently of the system parameters. The proposed work uses a self-regulating PID controller to enhance the performance of EV charging stations, and it is based on the Harris Hawk Optimization Method. The Harris Hawk Optimization Technique enables quick EV battery charging. The key benefit of the suggested method over other traditional ways is the decrease in billing expenses and time

Keywords: Harris Hawk Optimization Method, MPPT, Converter, PID controller, PWM duty cycle.

INTRODUCTION

Cloud computing is a platform that provides on-demand access to the computing resources such as applications, networks, storage, servers and additional services using pay-on-demand model. It is rapidly establishing itself as the model for distributed on-demand computing. On-demand capabilities, resource pooling, measurable service, resource pooling, and extensive network access are some of the features of cloud computing. By utilizing the idea of virtualization, cloud computing is becoming a crucial foundation for numerous internet businesses. The e-Company, on the other hand, is swiftly emerging as one of the most prosperous business models in the contemporary era. Computing is being transformed into a paradigm of commercialized Rather than using fossil fuels like diesel or petrol to refuel their batteries, electric vehicles use electricity. Electric vehicles are becoming more affordable than petrol or diesel, which results in lower charging costs. An electric vehicle's operational costs are significantly lower than those ofa comparable fuel or diesel vehicle. The environmental friendliness of electric vehicles can be improved by using renewable energy sources. If charging is carried out using sustainable sourcesof power, such as solar panels installed at home, the cost of electricity could be further reduced. Along with the popularity of electric vehicles, the market for charging stations for them is expanding.

Currently, well-known EV brand manufacturers are making significant investments in the infrastructure for EV charging. Additionally, they are investing in R&D to create quicker and more efficient charging methods. Even though many users install charging equipment in their homes and apartment buildings, public charging stations are in greater demand globally. Many B2B network operators have established an infrastructure for electric vehicle charging and are currently selling it as a services with a configurable engagement strategy to empower fleet operators.

The difficulties facing the developing market might be greatly eased by enhancing the user experience at electric vehicle charging stations.

In order to reduce the cost of charging for owners of electric vehicles, the charging method in this issue is automatically modified in accordance with the price of power. The suggested solution, which can lower the charge price in compared to other benchmark procedures [1], is utilized along with a range of different approaches to the charging issue. The goal of the study in this area was to create technology that would be clever and use predictions of the lengths of time required to charge electrical vehicles in order to reduce customer charging requirements. As a result, this study suggests using deep learning to determine charging session length [2]. This issue presents a novel Bayesian deep-learning day-ahead load forecasting approach for predicting loads at electric car charging stations. The suggested methodological approach makes use of a lengthy short-term memory system and Bayesian probability theory to account for uncertainty in predictions [3]. A simple multi-objective optimization problem is used to illustratehow challenging it is to choose the best charging station for a single PEV in need of infrastructure. The goal is to locate a station that ensures the least amount of processing times, travel time, and charge expense [4]. To estimate the demand for charging electric vehicles, deep learning (DL) was utilized to develop a special long- short-term memory neural network recurrence prediction. The outcomes demonstrate that the prediction metrics created using cutting-edge methodology are successful for the test data sets when compared to other methods from earlier publications [5]. One of the numerous prototype techniques already in use, reinforcement learning (RL), has proved essential in managing this issue of EV charging. The examination of the most advanced, ideal energy management systems suitable for charging electric vehicles is the main goal of this work [6]. The suggested electric vehicle charging stationuses easily accessible energy from solar and wind technologies to charge a fixed battery. This work also introduces a management strategy for power supply for electrical vehicle charging stations and associate with nursing power management [7]. The study looks into how electric vehicles are charged and shows that traffic flow predictions (TF) may be used to analyze simplya charging load using a novel probability queuing theory that considers driver behavior and charging service limits. Utilizing actual TF data, the proposed models are assessed, and the results show that it is possible to completely absorb the uncertainties of electrical vehiclecharging loads, indicating a significant potential applicability in the present [8]. To recognize denial-of-service (DoS) attacks against the EVCS. A sophisticated deep learning-based intrusion detection system. Deep neural networks and techniques for long-short-term memory are used by the EVCS to identify and classify DoS threats [9]. Data-driven modelling approaches for EV charging have attracted more attention recently. Deep neural networks and both unsupervised and supervised machine learning are used in this study to assess and forecast charging behavior. The goal is to give a comprehensive overview of these methods [10].

PROBLEM STATEMENT

Battery's exceedingly slow charging rate wastes the customer's time and money, the market for electric car charging is now particularly competitive. Because the current system lacks self- regulation, it cannot perform better. To achieve the objective, such as increasing efficiency and cutting down on time consumption, the system constant cannot be maintained just by the system parameters. As a result, consumers may be impacted by lengthier EV battery charging periods and higher upfront costs. In the end, fast charging was chosen to address this issue.

PROPOSED SYSTEM

Harris Hawk Optimization (HHO) delivers an appropriate duty cycle value for the charge controller and converter in order to receive excellent precision and efficiency on the load side. Here, the suggested approach is employed to maintain output stability under rapidly varying illumination, and Harris Hawk Optimization (HHO) controls the MOSFET trigger of the charge controller and converter to boost the fast charge state with greater efficiency. Using Harris Hawk Optimization to shorten processing times and improve efficiency.

Grid, rectifier, solar panel, MPPT, converter, PWM duty cycle, HHO, PID controller, and battery are all included in the recommended block design solar panel takes in sun energy. The solar panel's output is delivered to the MPPT. The MPPT is utilized to obtain the maximum amount of electricity. The sun will rise and set because of the weather; it is not a constant. As a result, the MPPT waits to generate its maximum power. The output of MPPT is given to the converter. Because a solar source is unstable, we have used the grid inside the block. The supplies will be sourced from the grid because the solar source willfluctuate with changes in the weather. The grid output is sent to the rectifier. Using a rectifier,the grid's ac supply is converted to a dc supply. The rectifier's output is sent to the converter. The gate pulse is started by this PWM duty cycle. The output of the PWM duty cycle is received by the MPPT andconverter. An electric vehicle's battery receives the converter's output current and voltage.Overall, the block diagram for a self-regulated PID controller for enhancing the performance of EV charging stations utilizing the Harris Hawk Optimization approach offers a potent instrument for doing so. By using the HHO approach to optimize the PID controller parameters, it can aid in reducing charging times, increasing charging efficiency, and extending the lifespan of battery packs.

METHODOLOGY

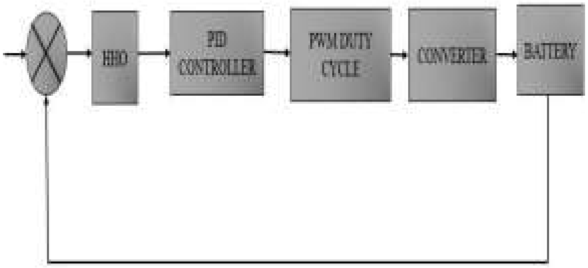

Figure 2: Methodology of Proposed System

The technique of the suggested system is shown in Figure 2. Before presenting the HHO with all of the input data, read the input parameters, including the converter input and output voltages, battery current and voltage, SOC, grid voltage, solar output, and battery voltage. HHO is used to modify the PID controller's parameters. The PID controller receives the output from the HHO. A PID controller was used to determine the ideal duty cycle. The PWM duty cycle receives the output from the PID controller. The PWM duty cycle, which regulates the converter's duty cycle,starts the gate pulse. The converter receives the PWM duty cycle output. The converter transmits the output voltage and current of the battery. The process must be stopped if the battery reaches that set point; else, it must be continued until the set point is reached.

HHO ALGORITHM

Initialization: Randomly create a population of hawks. Each hawk stands for a potential answer to the optimization issue at hand. Evaluation: Calculate each hawk's objective function value to determine its fitness level. Leader Selection: A leader should be chosen by considering the fitness values of the hawks. The top hawks are chosen to serve as leaders.

Collaboration: The leadership hawks work together to update the population's status of the other hawks. Based on how Harris's hawks hunt, where it leader hawks coordinate the hunt by communicating with one another, the positional report is based on how hawks hunt.

Based on the positions of the various other hawks in the group, the location of the prey (thebest option), and the hunting habits of Harris's hawks, the leader hawks adjust their position.

The positional update is computed using the formula below:

$$x\_i\ (t+1) = x\_i\ (t) + r*(x\_j\ (t) - x\_k\ (t))$$

where x_i(t+1) is the updated location of hawks i at time t+1, x_i(t) is the current situation of hawk i at time t, x_j(t) and x_k(t) are the locations of two additional hawks chosen by the leadership hawks, and r is a random number between 0 and 1.

Position Update: Use the determined position updates to update each hawk's location.

Termination: Verify the stopping criteria, such as achieving a certain fitness value or reaching a predetermined number of iterations. Return to step 2 if the stopping requirement is not satisfied.

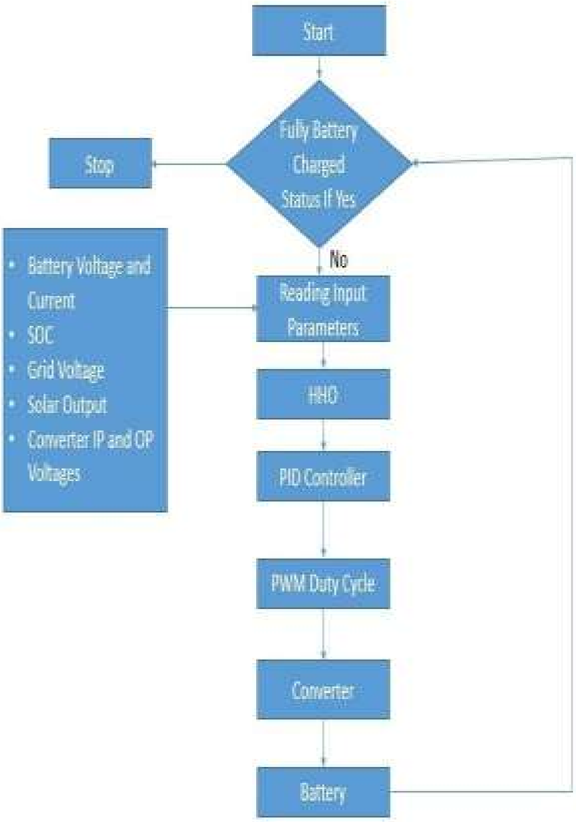

Figure 3: Flowchart of Proposed System

RESULT AND DISCUSSION

The test results show that the self-regulating PID controller can successfully control the output power of the charging station for electric vehicles and maintain the necessary charging rate. This controller was optimized utilizing the Harris Hawk optimization technique. It was found that the controller performed better than a conventional PID controller. It was found that the Harris Hawk optimization method performs well for boosting charging station performance and optimizing controller parameters.

The solar irradiation initially progressively drops from 1000 to 900 before starting to rise continuously at time t = 0.7 seconds. In Figure 4, it reaches its peak level at t = 1 seconds.

OUTPUT AND ANALYSIS

The essential requirements for an electric vehicle are represented in Table 1 by the voltage, motor current, power, speed, torque input voltage, and battery current. Only the motor current is satisfied by the GTO algorithm; otherwise, all other parameters are superior to the HHO algorithm. In addition, Table 2 represents HHO algorithm has a charging time that is 36 minutes less than GTO algorithm and an efficiency that is 2.5% greater than GTO method, therefore these papers imply that HHO algorithm is superior to GTO algorithm in all comparative status analyses.

CONCLUSION

An electric car rapid charging station with such self-regulated PID constants was successfully built and tested using HHO approaches in a MATLAB programme to enhance EV charging station performance. Results from the simulation were created using MATLAB-Simulink tools. The effectiveness of the entire process of performance enhancement has enhanced with the usage of renewable energy sources. The results demonstrated that the accuracy of the batteries was improved by the suggested HHO method. The battery charger's precision raises the overall efficiency of the charging. In 98.5% of the comparisons, the HHO algorithm beat other iterative phases of charge. According to the statistical results of this study, the HHO approach has a better solution and better convergence than its competitors. The experimental results demonstrate that the HHO technique can be used to analyses real-world case studies. This method can also beused to address multi-objective optimization problems. Given that met heuristic algorithms are used to handle a wide range of obstacles, HHO can be studied in the future and used to address recombination optimization concerns as well as diversified issues with different anchors.

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