Research Article

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Internet of Things-based smart vehicles design of bio-inspired algorithms using artificial intelligence charging system

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Abstract: Artificial intelligence (AI) is a machine intelligence technology with vast potential for a smart industrial revolution. This study aims to create new electric-powered transportation such as bicycles, motorbikes, and other vehicles. The combination of high-speed, resiliency, and low-latency connection, as well as AI and Internet of Things (IoT) technologies, will enable the transformation to fully autonomous vehicles. This electric motorcycle tracks its speed, location, and other data using IoT logic. A smart charging system has also been developed to keep them ready to use efficiently. The proposed research also reduces the damage to the environment efficiently.

Keywords: electric motorcycle, artificial intelligence, bio-inspired, Internet of Things, evolutionary-based algorithms, swarm intelligence-based algorithm, smart charging

1 Introduction

In recent decades, there has been an ever-increasing interest in nature-inspired algorithms [1–3]. With the development of convolutional neural networks [4], the popularity of machine learning technology and the rise in deep-learning technology [5] have formed part of this. This shows a drastic need for alternative ways of transportation, in which the logic of electric bike or motorcycle design is attaining a giant development around the globe. A model that can be tested for electric bikes is being developed in this project, and it may be used for all types of motorcycles. All parts of an electric motorbike are designed for their unique traits and qualities, combined to create a fully electric vehicle model. The characteristics of the invention may be readily adjusted to suit the concept and requirement using the prototypical model. When comparing model findings with a realistic test suite, a computer model can efficiently rebuild the electric vehicle’s (EV) physical qualities, like speed, distance, and power efficiency.

A model can give helpful information for modeling and developing electric motorbike concepts by analyzing the modeling outcomes. Equipment and growth development could be used to trigger the action of new autos. The purpose of building this electric motorbike is to provide scientists and engineers with a flexible and adaptable framework to study and practice safe ways to operate an electric drive train in alternative fuels. Using the electric motorbike as a learning feature enables learners to get experience working with manufacturing technology to promote jobs in alternative fuels and reduce road accidents, which are substantially increasing [6].

1.1 System background study

Before beginning design work, educating yourself on current commercial EV models and their features was critical.
The final design’s limitations, needs, and goals were defined by evaluating the leading electric bikes on the market during the study. The maximum speed, velocity, and other quality measures were approximated using a road beam, a structural member estimate based on the motor’s horsepower (hp) and performance potential, and the current battery power flow. Because of this, the entire front forks and suspension system of a contributor motorbike was used to make the construction process go more quickly, while also producing a look that is more similar to commercially accessible cars and motorcycles. The source vehicle’s vertical component and 3-dimensional spatial measurements were used to build these objectives. Developing the motor, especially creating a countertop engine and transmission technology solutions, confirmed its viability using an alternative power source such as a lithium-ion battery and all the circuitry required for connectivity. Components were bought, and manufacturing the systems began once the structure and engine specifications were finalized. Components and associated systems cohesiveness are outlined in the subsequent portions of this article.

1.2 Performance measurement of the electric motorcycle

The assessment conducted by the researchers gives insight toward establishing motorbike service offerings and documented the type, version, and year of availability in the market and accessible automobiles and efficiency criterion scores. These characteristics offer guidelines for the motorbike’s development and testing and evaluation. The specified performance information is depicted in Table 1.

1.3 Internet of Things (IoT) and artificial intelligence (AI) association with EV

The IoT logic is associated with EVs or motorcycles to globalize the features and information regarding motorcycles. Once the details are pushed into the server end, the IoT module can easily be monitored from anywhere worldwide without any range restrictions. The logic of the IoT is adapted to the EV design. This IoT module properly accumulates the motor’s speed, direction in which the motorcycle moves, exact longitude and latitude specifications, and traveling periods. Furthermore, this module alerts the respective individuals regarding the accident scenario.
Using the IoT logic, the system and the associated performance are standardized to the next level. The technology of IoT is a boom to the information technology-related and automobile industry, in which it provides a standard bridge between the local entity and the remote server, so that anyone can access the field related data from anywhere in the globe at any time without any intervention and delay. Figure 1 illustrates the logical association of the IoT module with the present electric motorcycle design.

The logic of AI is included in this approach to provide a smart charging facility to the electric motorcycle and make a smart auto-cut-off option to the charger to protect the battery life in a good manner. This auto-cut-off option provides a shield to the battery cells to avoid overcharging and cuts off the charge once the battery is filled. Figure 2(a) illustrates the perception of the electric motorcycle charger unit, and Figure 2(b) clearly illustrates the inside perception of the electric motorcycle charger.

2 Literature review

Ning et al. (2021) [2] proposed an EV design and analyzed the challenges in a future scope manner. The paper [2] reveals that transforming into an all-EV demands advanced performance and capability features, including increased fuel economy (measured in mileage of gas) and more extended range, as well as the ability to charge more quickly. For a given full battery, increased electrification and changed transportation drive upmarket for high power; more economical electrical drive engine systems can reduce fuel use. The US Environmental Protection Agency and the automobile industries have established 2,025 technical objectives for gentle EVs to speed up the widespread adoption of electric transport. This article addresses the latest advances in commercially accessible electric drive technologies such as components, electrical machines, converter architectures, and top acceleration for passenger and hybrid cars. Also, it covers components conditioning and energy efficiency. The developing materials...
and technology for electric engines satisfy the demand for upcoming EVs. These highlight difficulties and possibilities for further radical architectures. The US Environmental Protection Agency reported that 2,025 goals could be met by utilizing cutting-edge transmission and motor technologies mentioned in the paper [2].

Shao et al. (2020) [3] studied the EV influence and the effect of optimization-based designing methodologies. The paper [3] illustrates the logic: with silicon composite systems, the arrangement of electrical components is very important. Optimizing the intrinsic characteristics in electric architecture can reduce power losses and enhance nonlinear response. The warm threshold can be reduced by lowering the thermal performance and regulating the thermal capacitors in heat layouts.

Designing variations centered on human skill and understanding are standard practices in the layout industry. On the other hand, automated optimization techniques have the disadvantages of offering a small pool of possibilities, being time-consuming, and lacking consistency. These problems may be solved by implementing an automated layout design, reducing current and temperature mismatch. A national influence and effect conceptual design technique for EVs is presented by reviewing the component description, positioning, transportation, suitability assessment, and optimization methodologies.

Bai et al. (2020) [5] proposed a study that looked at several design methods and management approaches for economic power devices that can power EVs. The paper [5] described that EVs would have a far competitive advantage over their competitors in the next decades and centuries. Furthermore, the range of EVs is still somewhat limited. Automotive researchers are working hard to make batteries more energy-dense, charge batteries faster, and improve the efficiency of electric drive trains. An EV’s primary source of power loss is its electric machine.

This study of the literature [5] examines how electrical motors for EVs may indeed be designed and controlled to be more energy efficient. As per the guidelines of major government entities, motor design specifications and requirements are specified in terms of power efficiency, operating efficiency, and price. It addresses the factors of stator and rotor design, winding and construction technologies, new materials, and control systems that greatly impact standard traction machines’ power loss characteristics. It also discusses: (a) new machine topologies with the potential to improve efficiency in real-world situations and (b) operating cycle for traction motor design approaches.

Malek et al. (2020) [7] developed plug-in charge system-based hybrid EVs and the related things. The paper [7] described that an EV’s plug-in hybrid energy state’s component size and power be optimized using a multi-layer dimension optimization model and a modular power management technique. A conceptual design with an energy storage system using the battery is utilized as a comparative reference to estimate the efficiency of specific functions and energy improvement. The system programming-based technique is employed as a baseline for comparisons. With the size optimization method, one may find the best configuration settings by looking at transmission systems, batteries, and energy storage strength and endurance. By comparison, the size optimized system decreases capacity utilization by 31.3%, while increasing efficiency by 37.8%.

The system [7] can reduce the battery life, while also improving fuel economy. The system programming methodology is used for fuel efficiency, and the linear programming method is used for battery life. The battery efficiency and life were stabilized by 48.9% depending on the size minimization findings, and the vehicle efficiency was increased by 21.2% compared to the reference.

Liu et al. (2021) [8] proposed applying a multimodal learning strategy for estimating the power of the electric automobile. The paper [8] described various uses for estimation accuracy in the planning and installation of transportation systems, notably in security and roadway performance. Optimal continuous vehicle energy conservation is the most variable characteristic of electric mobility. On the other hand, predicting the speed of moving vehicles is a difficult problem since the estimation is strongly linked to different characteristics, which may be divided into two groups, intrinsic and extrinsic characteristics. Independent factors, like traffic, temperature, and road surfaces, reflect the environmental components, while internal information indicates the characteristics of EVs. The long short-term memory is used in paper [9] to anticipate the system’s performance. It is trained using actual traffic simulation information and a database from a transportation emulator. Multivariate statistical methods are designed and evaluated in terms of overall performance predicting reliability. For both short- and long-term predictions, simulations demonstrate that various ranges beat the univariate approach.

Bio-inspired optimization and emerging computing paradigms: In addition to the numerous research directions outlined above [10], the entire community should keep a close eye on the impending arrival of new computing paradigms, ranging from the MapReduce model that underpins big data architectures to ephemeral computing, exascale computing, and quantum computing. We
did not expect computing technology to evolve as quickly as it has in the last decade, resulting in the development of data-intensive technologies capable of ingesting, storing, and managing massive volumes of data.

### 2.1 Artificial algae algorithm (AAA)

AAA is a new bio-inspired algorithm replicating microalgae’s living habits and behavior. This algorithm was created using microalgae lifestyles to modify the dominant species, such as algal inclination, reproduction, and adaptation to the surrounding environment. As a result, there are three basic processes that algae go through, namely, evolution, winding, and adaptation. Algal colonies make up the population in this algorithm. If an algal colony receives adequate light, the algal cells will develop, and the colony will grow to a larger size. However, the algal colony may not expand sufficiently during the growing period due to insufficient light. Finally, each algal colony will travel towards the best algal colony in spiral movement.

### 3 Prototypical design

In this work, a novel electric motorcycle design is focused on and the ways of achieving the design practically with the help of the latest technologies is described. These technologies provide a pathway to attain the best performance and usability of electric motorcycles in real time. This section portrays the performance and specification of electric motorcycle modeling and the battery designs according to the needs of electric motorcycles in a clear manner. This working prototype utilizes an old bike’s gearbox and chassis. Directly linked to the redesigned crankshaft of the gearbox is the Brushless-DC (BLDC) motor, and the battery is located above the gearbox and covered by a metal box that is firmly joined with the chassis.

The concept behind this model is to convert motorcycles powered by internal combustion engines to electric ones. The motorcycle reached a top speed of 60 km/h at 2,982 rpm during road testing with varied weights. This model has a 120 kg weight limit, but even three 60 kg weight Indians can ride on it with no problem. High power loss was found to be a problem after being compared to other EVs. In this instance, the maximum range is merely 70 km. This loss must be minimized, and the battery’s power consumption must be decreased. There are many drawbacks associated with using a gearbox, including that a motor running at 3,000 rpm in an ideal scenario generates only 2,982 rpm while drawing 55 A, which results in maximum power dissipation. It is a big loss in power transfer because the chain drive, which is constructed of heavy metal and vibrates a lot at high rotations per minute, makes it difficult for the user to ride efficiently. This makes the bike less ergonomically designed and less suitable for the future. Figure 3(a) illustrates the perception of the prototypical model of the electric motorcycle design and Figure 3(b) illustrates the perception of electrical chassis design in a clear manner.

Generally, this kind of vehicle is powered by an electric motor. In every automobile, the chassis is the backbone, supporting the whole system, including the engine, transmission, and suspensions. Chassis focuses on providing a vehicle its overall performance by absorbing fatigue loads from the built components, centrifugal forces during cornering, and large loads such as dump trucks and barges. Chassis are typically steel; however, alloy metal is sometimes used to keep the vehicle’s weight while maintaining its durability. Batteries are EVs’ primary energy content.
source since they store and provide electric charge while the vehicle's motor runs.

However, the screening process utilizes a rapid charge supporting batteries, greater power absorption capacity, rapid charging/discharging cycles compactness, and lighter density. Numerous batteries have different features, and a 48 V 60 A h lithium–ion battery pack was utilized. In order to enhance the efficiency, the batteries are made up of a number of 3.5 V cells linked in series and managed by a battery management system. This system’s goal is to keep the energy consumption over each cell consistent, while charging all cells to the same level. Low efficiency occurs when the charge of a cell varies, affecting the battery's output power. A battery that supports quick charging must be fitted to charge the battery more quickly. Photovoltaic cells may be used to charge the bikes, reducing the number of fossil fuels such as coal used to create the electricity needed to run the prospective EVs. Figure 4 illustrates the perception of the proposed lithium-ion battery pack finely with the proper specification. Figure 5 illustrates the signal specifications of the electric motorcycle model clearly.

4 Discussion

This study aims to create new electric-powered operating transportation such as bicycles, motorbikes, and other vehicles. More attention was paid to electrically conductive motorcycles in this research. A 1,000 W high-torque BLDC motor with this motorcycle is in place, and an associative controller manages it. Lithium-ion batteries, formed of cells connected in series, are used to power

![Figure 4: Lithium-ion battery pack.](image)

![Figure 5: Signal flow specification of the electric motorcycle.](image)
a motorcycle. This motorcycle is built on lithium-ion batteries, which are made of cells connected in series. The combination of high-speed, resiliency, and low-latency connection, as well as AI and IoT technologies, will enable the transformation to fully AV that demonstrate the complementarity of real world and digital knowledge for industry 4.0. The charging requirements of the battery are intelligently designed with the assistance of the AI association. When the battery is fully charged, it automatically switches off the charger. This electric motorcycle is expected to travel between 90 and 110 km on a single charge. It will take 3.5–4.5 h in standard mode to finish the total amount, while rapid charging would take 15 min to fully charge the battery. The guideline, however, only applies to regular charging mode. These qualities are combined to create a strong electric motorcycle that saves money and protects the environment from pollution. This electric motorcycle tracks its speed, location, and other data using IoT logic from anywhere on the earth.

5 Conclusion

This study aims to create new electric-powered transportation such as bicycles, motorbikes, and other vehicles. More attention was paid to electrically conductive motorcycles in this research. This motorcycle is equipped with a 1,000 watt high torque BLDC motor controlled by an associative controller. Lithium-ion batteries, formed of cells connected in series, are used to power a motorcycle. The combination of high-speed, resiliency, and low-latency connection, as well as AI and IoT technologies, will enable the transformation to fully AV that demonstrate the complementarity of real-world and digital knowledge for industry 4.0. The charging requirements of the battery are intelligently designed with the assistance of the AI association. When the battery is fully charged, it automatically switches off the charger. This electric motorcycle is expected to travel between 90 and 110 km on a single charge. It will take 3.5 to 4.5 h in standard mode to finish the total amount, while rapid charging would take 15 min to charge the battery fully. The guideline, however, only applies to regular charging mode. These qualities are combined to create a strong electric motorcycle that saves money and protects the environment from pollution. This electric motorcycle tracks its speed, location, and other data using IoT logic from anywhere on the earth.

6 Future scope

In recent years, the rise of AVs has inspired a new trend of applying a variety of smart methodologies and technologies to improve the performance and quality of automated decision-making. Integrating AI and the IoT for AV enables high-performance embedded systems. Vehicle qualities like elegance, comfort, and efficiency need the synthesis of numerous vehicle components. This study was carried out to ensure that an electric motorcycle could manage heavy loads while functioning after a serious crash. The vehicle’s performance is optimum at an optimal speed of 180 km/h per hour, with a single-charge mileage of roughly 140–150 km. This motorbike is more dependable, effective, and low-maintenance than traditional motorcycles powered by an internal combustion engine. Thanks to developments in renewable technology, it is now possible to increase vehicle range on a single charge while reducing recharging time. This will help the environment by reducing carbon emissions by enabling greener transportation. In the coming years, existing electric motorcycle technology will be available to the general population, making them the best means of transportation for the future.

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