

Regenerative battery for human electric hybrid bicycle engineering essay

[Business](#), [Industries](#)



In this study, a proposed undertaking, the human-electric intercrossed bike, besides known as `` Pedelec '' driven chiefly by human bicycling force with extra aid force from the battery powered electric motor that has a regenerative power characteristic during worsening inclines.

Introduction

Cars have ever been indispensable for people populating in metropoliss as a signifier of transit to transport out their day-to-day modus operandi.

Harmonizing to the International Organization of Motor Vehicle

Manufacturers, a astonishing figure of 77, 609, 901 autos and commercial vehicles were produced in the twelvemonth 2010. A 25. 8 per centum alteration comparison to the old twelvemonth (OICA, 2011) . Based on a research study of the Fifth U. S. Climate Action Report, transit activities contribute 33 per centum of the universe 's emanation of C dioxide in 2007 and about up to sixty per centum of emanation came from the burning of crude oil from personal transit (U. S. Climate Action Report, 2010) .

Consequently, it is without uncertainty, autos are one of the major causes of planetary warming due to the emanation of green house gasses. Presently, intercrossed and electrical vehicles seems to be the leading solution to counter the job that arises from gasoline powered cars without extinguishing its advantages. However, electrical powered vehicles have its ain disadvantages as it requires a certain sum of bear downing clip. On the other manus, electric bike are doing immense moving ridges among town communities because it is less strenuous comparison to the standard bike, therefore, enable users to go longer distance without utilizing much energy.

Amount of clip needed for bear downing still arises in electric bikes. The

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Regenerative Battery for Pedelecs on worsening terrains is able to work out the job by enabling the user to automatically bear down the bike battery during declivitous inclines.

Literature Review

Electric bike, Hybrid Bicycle and Human-Electric Bicycles or Pedelecs have merely late go a world-wide phenomenon due to the rise in crude oil monetary values. The engineering of these types of bikes is still comparative new and research popularity has simply get downing to lift in the past recent old ages. Therefore, there is deficiency of research documents and literature available in the country of intercrossed or electric bike in scholarly diaries or professional organisation such as the IEEE. The undermentioned literature reappraisal evaluates on eleven scholarly diaries to clarify the engineering involved in developing electric, Hybrid or Pedelecs bikes and its public presentation features.

Among the 11 diaries included, a study by Muetze and Tan (2007) gave a elaborate and organized study based on the word picture of electric bike, both theoretically and by experimentation. The study includes every bit good the demands of different public presentations ideal for electric bikes and obstructions faced to back it. Regulations and safety factors for electrics bikes in states such as Japan, Europe, China and United States are outlined. Research was done to detect the advantages and disadvantages of proficient public presentations for different portion type of the bikes such as the aid type, motor, motor assembly, motor arrangement, accelerator and battery type. The study besides includes a power over velocity graph collected from

consequences collected with different parametric quantities such as the influence of weight, influence of the incline and influence of air current. Consequences gathered from the study is able to supply a guideline for developing an electric bike suitable for the market tendency and better the public presentations of electric bikes for future developments.

While the appraisal on the public presentation of electric bike is indispensable, energy direction excessively must be given consideration. Morchin (1998) identifies the energy consumed by electric bike and emanation of green houses gasses can be reduced by two methods. Such facets can be achieved by optimising the evaluations of the battery and engine while presenting power end product by each beginning under expected drive conditions (Morchin, 1998) . In the study, an on-board " energy director " was mounted on an electric bike to track the energy degree in the battery and efficaciously split tonss between the battery and the engine. The Lagrange 's theorem was used to cipher the energy consumed under impacting parametric quantities of air retarding force, hill inclines and clash. However, the survey done merely applies to electric powered bikes and non for intercrossed bikes or Pedelecs. Research can be done to widen for assorted types of bikes and different type of terrains. The term " intercrossed " used in the paper is instead deceptive because the paper focuses on to the full electric bike while the term " intercrossed bike " frequently refers a bike that runs on both crude oil gas and electricity or human pedal force with a battery powered motor.

In a related research on power direction in electric aided bike, Brand and Ertugrul (2007) examines and discover that an in-hub direct thrust located on the front wheel of the bike could give better public presentation by electric braking and stable manoeuvring. Furthermore, the study conducted experiments on 17 riders from different classes. All riders are equally divided based on gender, weight, age, regular and irregular bicycler. The study is comprehensive and able to confirm the effectivity of the in-hub direct thrust. Additionally, the study dressed ore on measuring siting conditions of assorted type of rider group to find the optimal power demand and does no focal points on planing an option for electric bikes. It is noted in the study that aerodynamic streamlining and development of a high efficiency inverter can be a farther developed from the study.

Most of the survey done about electric bikes revolves around the battery storage system. Solutions may compromise of electric regeneration (Liu et al. , 2008) ; (Somchaiwong & A ; Ponglangka, 2006) , or petroleum-electric bike (Nagendran & A ; Senthil, 2010) ; (Xiong, et al. , 2010) . Liu, et al. , (2008) designed four regenerative braking schemes by turning mechanical energy into electrical energy to widen the battery life-p. Matlab and Simulink were used to make a theoretical account of the electric motorcycle and the four proposed regenerative braking schemes. The four braking control schemes are Most Feedback Power (MFP) , Most System Efficiency (MSE) , Fixed Torque Control Strategy (FTC) and Fixed Feedback Current Control (FFC) (Liu, et al. , 2008) . Clear description and illustration were given on all the four purposed schemes. The study illustrates theoretically utilizing

computing machine simulations and there were no paradigm physique or practical experiment conducted with bike users.

Alternatively, Somchaiwong and Ponglangka (2006) proposed a regenerative power control system to work out the increase of rhythm velocity of motor that are excess for illustration, during a declivitous way. The research experiments on the relationship between the electromotive forces supplied and motor velocity. The consequence shows that if the rhythm motor runs on the specific velocity demand, the motor would in bend generate a specific end product electromotive force.

Another prevailing solution battery jobs faced in electric bikes are petroleum-electric intercrossed bikes. Nagendran and Senthil (2010) proposed a Hybrid Bicycle with Three Speed Transmission System to work out jobs faces in current electric bikes. The purposed thought of the intercrossed bike tallies on both electric and crude oil to reload the bike 's battery storage system. An added characteristic to the purposed thought is a three velocity cogwheel for effectual control the velocity of the motor and IC (Internal Combustion) engine. The bike runs like an ordinary electric bike on Phase One. When the battery storage system is depleted, the motor would so runs on the internal burning engine. A Change Over is installed to link and disconnects the motor from the IC engine or vice-versa. A shaft coupling is used to link the concatenation thrust while a concatenation thrust is used to obtain balance of the bike. The research does non exemplify the practical building of the three velocity transmittal system.

In a related subject, Liu, et al. , designed a LPG (Liquefied Petroleum Gas) - electric intercrossed bike that is able to run on to the full engine driven, to the full electric motor driven or intercrossed manner. Due to infinite restriction in the bike a four-stroke flicker ignition LPG engine power system is introduced in the research. The gasoline engine was modified into a LPG engine by increasing the compaction ratio, enlarging the flicker progress angle and increasing the ignition energy. The research besides includes the design of the transmittal system and control system of the intercrossed bike. A paradigm of the design was developed and several trials were conducted on metropolis traffic conditions.

While most surveies focuses on a individual bike type such as electric bike or Pedelecs, Indulal & A ; Nair (2007) incorporates both types of bike and the execution of Fuzzy Logic as a control system. The bike runs on three different manners, Manual Mode, Power Mode and Automatic Mode. Manual Mode works like an ordinary where pedalling is required with no excess aid. Power Mode to the full runs on electricity and does non necessitate any paddling while Automatic Mode provides electric aid on top of manual pedalling. Fuzzy Logic is implemented to supply comfy equitation and sufficient thrust aid under any conditions. After the completion of the design, arrays of inputs were fed to the Fuzzy Logic Controller utilizing Matlab Simulation to analyze the end products. Consequences from the simulation found that the public presentation of the system over assorted conditions were acceptable. The research states that the design can be farther extended into larger vehicles.

To optimise the potency of battery storage system, Sousa, et al. , (2007) developed an electronic convertor powered by two type power supplies, the battery and ace capacitances. Batteries are the primary storage while capacitances are used to avoid deep discharging of the battery and as a backup storage. In this research, supercapacitors are used alternatively and can able to function as a primary storage beginning. The developed system was built on the electric bike and consequences were gathered. A determination circuit is needed because the design is capable in increasing the liberty of electric vehicles to avoid high current extremum and fast discharges of the batteries. The research unfastened doors for future work such as bettering power circuit to increase efficiency and analyze the liberty by changing the function of the battery and supercapacitor. Coates and Charkey (2002) states that batteries proving on Sealed Nickel-Zinc Batteries are conducted for electric bike applications because it provides the same sum of energy with half the weight comparison to the standard lead-acid batteries.

Hsu, et al. , (2011) poses a solution to supply comfort and safety step in different types of Pedelects sitingenvironmentwhile optimising the public presentation of the battery. The quality of siting conditions can be improved by get the better ofing three forces of nature, air retarding force, clash and hill retarding force. The key to the solution is the bicycling power and entire power of the needed power should be changeless and sufficient extra power is provided to get the better of any of the three forces. The design is besides able to work out instability job in Pedelects when the motor suddenly occurs

by maintaining the instantaneous acceleration of the aided power be kept within the Safety Zone and Comfort Zone. Real environment simulation scenarios were conducted on different route types and pedal force in urban countries. Consequences confirms the design has better energy use comparison to bing conventional and delta acquisition regulation based assisted power methods. The study provides room for farther research on work outing the method to automatically set the motor to the different type of physical conditions of the riders.

After the rating of all the 11 diaries, it can be concluded that most of the diaries focuses on work outing the jobs presently faced by electric bike that provide deficient energy in the battery storage and deficient power aid. There are ample room for farther development on electric bikes and Pedelecs because it engineering is comparatively new. Further research done on this country would profit societies populating in urban country to be used as a signifier of environmental friendly transit as opposed to conventional autos and bikes.

Problem Statement

Based on old research done on electric bikes, most surveies concur that the depletion of crude oil and the rise in the emanation of nursery gasses are the factor that contribute to the promotion of electric bikes (Brand & A ; Ertugrul, 2007 ; Hsu, et al. , 2011 ; Indulal & A ; Nair, 2007 ; Morchin, 1998 ; Nagendran & A ; Senthil, 2010 ; Sousa, et al. , 2007 ; Xiong, et al. , 2010) . In malice of this, there are still plenty of room for farther development and sweetening in the country of electrical bikes. The battery storage system

incorporated in electric bikes provides deficient energy for long distance travels and does not transport self-charging capabilities (Coates & A ; Charkey, 2002 ; Nagendran & A ; Senthil, 2010) . Electric assisted bikes or Pedelects confront jobs such as an disconnected drive force when the motor is triggered (Hsu, et al. , 2011) .

Undertaking Background

The undertaking focuses on bettering the overall public presentation of electric aided bike or Pedelects. Since there is a demand on electric bikes, it would be good for society and concern organisation to inscribe the development of Pedelects. In a study by Time News, most electric bikes run on lead-acid batteries and are unsuitable for the lifting demands of day-to-day transit (Ramsy, 2009) . Numerous solutions were established by assorted applied scientists and organisations to counter these jobs. Some research workers focus on the regeneration of electricity from external beginnings (Somchaiwong & A ; Ponglangka, 2006 ; Xiong, et al. , 2010) . While some dressed ore on utilizing typical signifiers of power direction (Brand & A ; Ertugrul, 2007 ; Hsu, et al. , 2011 ; Morchin, 1998 ; Nagendran & A ; Senthil, 2010) . For the proposed Regenerative Battery for Pedelects undertaking, it confronts both of these methods to work out the battery jobs that arise from conventional electrical bike. In add-on to replacing autos to cut down the emanation of nursery gasses, the regenerative power during a worsening gradient reduces the dependence on electricity. The coevals of electricity from Independent Power Producers (IPP) indirectly affect the environment. For case, the building of Hydroelectric Plant requires big

countries peculiarly in distant countries and significant measures of fossil fuels are used to power up machineries (McKinney, et al. , 2007) . The natural home ground, place to both vegetations and zoologies would be destroyed in the procedure. The proposed regenerative power is designed to cut down the power ingestion in the battery storage while supplying rechargeable power supply at the same clip. The regenerative power incorporated in the design would be able to work out issues associating to the deficient power in the battery storage system. It would be able to spread out the life rhythm of the battery for longer distance travels. Most electric bike proprietors today complain that electric bikes do non supply sufficient power aid. The latest Pedelecs today has power-assistance during hill mounting or on irregular surface roads to supply the extra encouragement without holding the rider to exercise much force. However, Hsu, et al. , (2011) states that there are deficient power aid to get the better of three forces, air retarding force, clash and hill retarding force. Air retarding force and clash does non necessitate much power comparison to hill retarding force. The motor of the power aid provides adequate force to get the better of hill retarding force, clash or air drag while the bicycling power by the rider remains changeless. This would be enable riders to conserve energy for longer equitation.

Most seniors find that conventional bikes are strenuous and unsafe. Therefore, some seniors would instead remain in the comfort of their places without acquiring much exercising and fresh air. Pedalects would be able to promote seniors to get the better of their fright towards conventional bikes.

In urban town countries, acquiring out purchasing some food markets would sometimes be a fuss particularly if the food market store is non within walking distance. Most people today would instead drive their auto out to purchase some fruits and veggies or to bring the day-to-day newspaper. It is a really unhealthy wont that began to attest among the town citizens. Little did they know that acquiring fresh air by cycling or taking a day-to-day amble would better the wellbeing of the individual and reduces wellness hazard such as diabetes and cardiovascular disease. Harmonizing to a Congressional Report, less than one trip in one hundred per centum is by bike (Congress, 2002) . The study besides mentioned that frequent motorcycle trips would besides bring around the dependence of tobacco users and alkie.

Regenerative braking in electric bikes is deriving popularity excessively. The Panasonic Vivi RX 10-S characteristics a braking system that recharges a 10AH Li-ion secondary battery located following to rise up wheel of the bike (Toto, 2008) . Liu, et al. , (2008) mentioned that braking control can be used to change over mechanical energy to electric energy by bettering battery life-p. Using the same theory, the proposed design is able to do usage of hilly countries to bring forth electricity. Since no energy is needed for bike traveling downhill, the bike still moves downwards due to the forces of gravitation. For certain instances, with the regenerative power, braking is non required because the regenerator is able to cut down the velocity of the overall bike while traveling downhill.

Methodology

The range of this research is divided into five phases. The clip range of the undertaking is expected to be completed in 9 months.

Research

At the beginning of the Final Year Undertaking, intensive research on the country of electric bikes must be done before designing of the undertaking takes topographic point. Research would be an explanatory research in the beginning to obtain an overview on the research country and to detect options to the research aim. Evaluation on other research documents done to place the new developments in engineering and suites for farther surveies is noted. Solutions can be developed by admitting the job faced by the society today. Qualitative Research such as studies and Questionnaires can be conducted to place the current job faced for farther development. This is of import because the success of a merchandise is determined by run intoing the demand of society today. Brainstorming Sessions are required after the gathered information is evaluated to find the feasibility of the undertaking and to get assorted options to the job. This phase is expected to finish within a month.

Design

The designing procedure takes topographic point after the rating of the collected information is finalised. A basic construct should be achieved at this phase. All the cognition on mechanics, electronics and scheduling is required to plan the proposed thought. Computer simulations are to be

usage to design and prove the feasibility of the thought. Autodesk Inventor can be used to build the model and supply a 3D overview of the bike. Matlab and Labview can be used in the scheduling development of the regenerative power system. Computer simulations are used before the building of the bike to virtually imitating the design while cut down unneeded outgo. This phase is expected to finish in 2 months.

Execution

The execution phase involves constructing the paradigm based on the finalized design. A conventional bike is required as the chief construction of the design. Motor, Lithium Ion Battery and Transmission System is needed to modify the bike into an electrical-assisted bike. Torque Sensors, Slope Sensors or Tilt Sensors are installed to feel when the motor is needed. The Slope or Tilt Detectors can be replaced by Apple Application known as Gyroscope for an excess appealing characteristic. Additional hardware such as a state-of-charge index, power check hub and throttle switch can be added subsequently on. This phase is expected to finish in 3 months.

Testing

The proving stage involves the practical appraisal on the now to the full built bike. Assorted trials would be performed to find the public presentation of the full system. Two types of proving can be conducted, laboratory testing and field testing. Laboratory proving involves a set of variables such as power, efficiency, rhythm velocity, life-p of the rechargeable battery and the motor. For field testing, a laptop with a PCMCIA card is incorporated to the

system to get the information. The proving would affect around 20 voluntaries from different age group, gender, weight and physical fittingness degree. All voluntaries have to travel through a predetermine way with different type of terrain in an urban country. The laptop is used to enter informations such as bicycling torsion, bike velocity and applied power. The information collected is to be used to measure the public presentation of the system. A set of feedback signifiers could be given out at the terminal of the proving to estimate the satisfactory degree of each voluntary towards the system. This phase is expected to finish in 2 months.

Report

Report authorship is to be conducted at the terminal of all the four phases. The range and design procedure in constructing the system are to be complied. The information collected are tabulated in graph and figures to exemplify the results. This phase is expected to finish within month.

Restrictions

There is some restriction that would be encountered in the procedure of implementing the system. Budget constrain would be a factor due to the dearly-won hardware needed to build the bike. A life-size paradigm is more appropriate because a smaller-scale paradigm would non be functioning its intent. In a newspaper study by The Star, due to safety issues, electric bikes may be taken off the route if the Cabinet accepts a recommendation from the Transport Ministry (Kong, 2011) . If the amendment of censoring

electric bike is implemented throughout the state ; it may besides impact the field-testing of the system.

Research Aims

This survey embarks on the undermentioned aims:

To bring forth an environmental friendly transit as an option to petrol ingestion autos

To work out instability issues affecting the disconnected acceleration when the motor is turned on

To supply an alternate regenerative power on worsening inclines to lengthen the life-p of the battery storage system

To better the overall public presentation to Pedelecs that are available in the market today

To plan a signifier of transit for suited in dense populated urban countries

Research Question

What are the current impact on the environment and ways to work out the job?

What are the current issues faced by electric bike?

What add-on or alternate regenerative power can be installed to conventional electric bikes?

What can be done to appeal to the market section to purchase the merchandise?

How to work out issues affecting unhealthy wants of the society by trusting on autos for short distance travels?

Significance of the Undertaking

The proposed regenerative bike would be able to function as a stepping rock for farther development on electric assisted bikes. Surveys by other researches can be done by mentioning of the design system used and the information collected. Restrictions and jobs identified can be solved by future research. The proposed design hopes to significantly cut down the emanation of greenhouse gasses emitted by gasoline powered autos. If the design meets the demands of the society, industries would get down bringing forth more electrical assisted-bicycles which in return, reduces the market monetary value of the system to make out to all sections of the society.

Expected Consequences

The expected result of this undertaking is to successfully develop a working existent size electrical aid bike paradigm capable of changing overing mechanical energy to electrical energy. From the undertaking, fresh theories can be established that would indirectly profit other countries of scientific disciplines. Furthermore, the theories presented would take to implementation for future possible applications. The tabular matters of informations collected from the undertaking is to besides promote possible research workers particularly budget constrain research workers to

prosecute in the country of electric powered vehicles. A stable managing electrical assisted bike is expected to be built to supply safe and comfy siting experience. In return, physically fit or unphysical tantrum riders would be able to make full the joy of siting a bike for going or recreational usage. The design and engineering incorporated in the undertaking is expected to appeal to the society and supply as an option to autos and bikes. This would straight cut down C footmark and slower the procedure of planetary heating.