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"I pledge my honor that I have abided by the Stevens Honor System"

Kinetic Self-charging Battery for Automobiles

Observed Problem:

Often times we see cars or motorcycles run out of battery power because we forget to bring them to the auto-shop for repair and maintenance and get the battery charged or refilled. It would be frustrating for automobile owners when they could not get their vehicles turned on before they get to work in the morning. Sometimes some people are too busy to get their vehicles checked out and serviced. Apart from that, there is also the problem of the battery running out of power due to excessive usage of the battery power for audio playing and charging mobile phones. So I figured out that a self-charging battery mechanism would solve these problems.

General Idea:

The fundamental idea for this system is to solve the problem caused by dying battery power in an automobile, let it be cars, trucks or motorcycles. The purpose of the system is to provide a continuous source of battery power to the automobiles. The self-charging battery will have a small dynamo or electrical generator that utilizes the rotating axle of the automobile. The kinetic energy from the rotation of the axle of the automobile will generate electricity that would continuously recharge the battery of the automobile. This mechanism will ensure that the battery power of an automobile will not run out.

Suggested Implementation:

The system is universal as it can be implemented in a wide variety of vehicles. Thus, the installation of the system will vary from different brands and models of vehicles. The main battery will be a rechargeable battery. However, considering a typical automobile to have a rotating axle to drive the wheels, the following set up will be used:

- The main battery of the automobile will be coupled with a small dynamo or electric generator that will then be connected to the rotating axle of the automobile. The electric generator will utilize the kinetic energy produced by the rotating axle. The generated electricity will then be stabilized and filtered before being charged back onto the main battery. This will ensure a constant flow of electricity for a constant recharging as long as the axle is rotating. During a long travel by the automobile, it is possible that the battery will reach its maximum charging capacity thus the system will take that into consideration. Once the battery reaches its peak charging capacity, the system will automatically stops the charging process. Customization can be made to the system as to what capacity of the battery; the system will start charging the battery again by setting a threshold amount of power left in the battery.
- Since different automobiles have different configuration of generating kinetic energy, different automobiles will utilize different set-ups as long as the battery is using a kinetic mean to charging itself. For example, a vehicle not using an axle system to operate can use a battery that will utilize the rotating of the wheels or gears or chains.

Potential Impact:

The system will have a direct impact on any vehicle owners. It can be implemented on almost all kinds of automobiles such as cars, trucks, motorcycles, ATVs and military vehicles. Not only vehicle owners need not worry about running out of battery power for their vehicles, they will also have a limitless amount of electricity that will drive the vehicles electrical components such as audio player, lightings, and charging docks. The greatest impact when the system is commercialized is the reduced spending on servicing or replacing the battery for their vehicles. Installing the system and using it for a few years will be more cost-efficient rather than having to replace the battery a couple of times per year.

Product Sales:

The system can be manufactured and utilized for all vehicle owners thus it is available for usage by individuals. The system can be implemented by the manufacturers of automobiles as part of the production process of the automobiles thus the customers will be buying vehicles already implementing the system. Apart from that, vehicle owners can also buy the system themselves and get it installed at a professional auto-shop. The system can also be allowed to be customized in such a way that the owners can select the charging rate of the battery to make sure their vehicles can operate the amount of electricity the owners wish to use from the vehicles battery power.

Stakeholders' Analysis:

To develop and to implement the system publicly, several stakeholders will be involved directly and indirectly. There are three different stakeholders namely the user, client and the designer.

i. Client

Client is an organization who is interested in funding the project: its research and its development. Organizations which will be directly involved in this project are the automobiles manufacturers, battery manufacturers, automobile and sensor system or even the government. These companies could all be the investor in this project. Some of the potential investors for the project are the car manufacturers such as Toyota and Dodge and government agencies that prioritize the usage of efficient energy such as The Department of Energy. These investors are crucial for the project since it involve the implementation of their idea, parts or perhaps patents for this system. In addition, their objectives and their concerns can be the key components for the system. Indirect clients could be from the environmental agencies and other state or local agencies. To implement the newly created system into the production of an automobile, consultation from The Department of Safety is needed. If the system possess more danger which compromise the safety of others, the system has to be terminated. In addition to that, if the performance of the new battery is not very efficient, the

project may have to be terminated too as it has defeated its purpose. Other indirect client can also be the organization who will run and maintain the system once it has been implemented. These clients have to be considered in the development of the project because the market value, the safety, the challenge, the estimated time for completion or the physical of the system can easily be pointed out and improved.

ii. Designer

Designer is a group of people responsible for the development of the design project which includes problems solving and ideas generations. For this project, designer with mechanical engineering and electrical engineering backgrounds are needed as those two fields are the dominant fields needed to implement the system. Nevertheless, engineering management specialty is also needed so that the design is pre-examined. Other designer involved in this project could also be from the automotive side since we want to implement the system to a car and so on. Apart from that, there are also other engineering fields required to experiment with the system.

iii. User

The user is a group of people who will be using the system and gain benefits from the implemented system. The targeted user for the system will be the automobiles owners especially car owners. The system will not only save the hassle of having to go to the auto shop often but it can also help to minimize cost spent on dead car batteries. The brief descriptions regarding the operation of the system is discussed in the earlier section.

Cost and Time Analysis:

The self-charging battery can be utilized by two ways. The system can be installed during the production process of a vehicle in the manufacturing line or customers can buy the system at a workshop or automobile repair center and get technicians to install the system into their vehicles. Therefore, the time spent to install the system varies from the production line installation and a custom installation by technicians at a workshop repair center. For the production line installation, the time taken to install the battery into the vehicle should take around 1 to 3 hours since it's fairly easy for the manufacturers to install the system into the vehicles during pre-production process. As for the self-installation by technicians at the workshop repair center, the time taken to put in the new self-charging battery may take from 1 to 5 days depending on the models or brands of the vehicles and also the complexity of the installation steps. The estimated time for the completion of the project is about two months. Since the project involve public user, careful observation has to be made before reaching any decision. Most of the time will be spent to carry out survey, to collect data and to analyze the data. These data are crucial because it shows the public responses to such system. If public responses is not as expected, revision or changes to the system has to be carried out to deal with any problem raised by the user. An amount of time will also be spent on the development of the project. The development phase will include problem solving before and during the implementation of the system, system model testing and simulation. Additional time must also be considered to see the performance for the first two months after the installation.

For the cost analysis, the installation of the whole system is around $5000 to $10000, depending the capacity of the battery and also the complexity of the models of the vehicles. For customers who buy the system post-production, they will have to pay for the new system installation and other service fees charged by technicians responsible for the installation process of the system into their vehicles. Meanwhile, the system installed during the production process in manufacturing facilities of vehicles manufacturers will charge customers with the overall price of the vehicles and customers will pay the system with the monthly loan that they are paying for the vehicle. However, the cost for the system model is much lower, in the order of hundreds dollar. System model is prototype of the real system but scaled precisely to smaller module. In addition, cost can be reduced further when simulation tool is used. The disadvantages of using

simulation are complex scenario will take more time to finish and considering the limitations of the simulation tool such as variables and parameters, the simulation will give only an approximation or prediction to the real system. Fortunately, for this project initialization step by using simulation tool is considered relevant and reasonable.

Other Skills Requirement:

List of other skills required for the completion of the project are:

1) Automotive designing
2) Omnet++ programming
3) Engineering management
4) Systems theory
5) Thermodynamics system
6) Manufacturing engineering
7) 3D model programming

These skills are the pre-requisites for the development of the project. Note that Omnet++ is a simulation tool which will be used intensively during initialization phase. Little background in engineering management is also accepted.

Scopes:

a) Strength

The objective of the system is to reduce the cost of changing or re-charging dead batteries in a vehicle. Apart from that, the new self-charging battery will lessen the hassle of vehicles owners of having to go to the auto shop for any service on the batteries. Therefore, the implementation of such system in a vehicle, a car for example, will reduce the cost needed to change any dead battery. A typical car will need to have its battery changed or re-charged twice a year and that can cost a customer in the hundreds of dollars for personal cars and thousands of dollars for a big commercial vehicles like a container truck. The biggest

strength of the system is it can save hundreds of thousands of dollars for large corporations or companies who rely on ground transportation. Large companies that use a lot of vehicles for its operations will save money if the system is implemented into all of their vehicles fleet. Companies such as UPS and FedEx will be able to save money on battery service and replacement for all their ground fleet vehicles if they install the self-charging battery system into them. Apart from that, companies such as UPS or FedEx will never have to delay a package delivery or any shipment of package due to broken or dead battery of one of their delivery truck. Since those large companies have thousands of vehicles needed to run their business, a reliable battery system will save them money and time and increase profit at the same time. As for personal vehicle owner, they will never have to worry that they will be late to work in the morning due to dead car battery. Since they only need to service the self-charging battery once in 2 or 3 years, it will save them money and lessen the hassle of having to go to the auto shop.

b) Weaknesses:

The major weakness of the new system is complexity. It is known that every models and makes of vehicles are different. Therefore, it will be a challenge to develop a system that will fit all types of vehicles. The new battery system for a Toyota Camry, for example, will be different from that of a Subaru Impreza in term of installation steps and compatibility of components. One way to solve this issue is to have car manufacturers to fit and install all the new self-charging battery during production process as part of the assembly process of the vehicle. Apart from that, there will also be the issue of certified technicians to install and service the new system. Since the system is relatively new, it would be difficult for a broken or faulty system to be repaired if there are not trained technicians or mechanics to repair them. The issue of battery capacity and efficiency also plague the new system. In order to be a reliable new system, the self-charging battery needs to be very efficient in storing the electricity generated by the rotating axle. The battery capacity also needs to be large in order to store more electricity. Lastly, the added new system might add weight to the design of a vehicle. Since mileage of the vehicle will be affected by the weight of the new system, the

system needs to relatively light. Therefore a more compact version of the self-charging battery is required.

c) Opportunities:

Market opportunity can be established physically in term of the modules used by the system. These modules include the sensor, the processor, the monitoring devices, the battery and the charging components. Since the system is the combination of bunch of modules, custom design might be required depending on environmental parameters and hardware limitations. In addition to this is the job opportunity. Such intelligent system needs maintenance on a regular basis. Therefore qualified technician is needed that should guarantee the optimum performance of the system for long period of time.

d) Threats

One of the foreseen threats of the new self-charging battery system is energy storing capacity and efficiency. Since the objective of the system is to lessen the cost of having to frequently service a typical vehicle battery, the new self-charging battery needs to be very efficient in order to serve its purpose. If the self-charging battery does not store electricity generated form the rotating axle efficient enough, there will be less power generated for the use of the users. Therefore, the battery power will be depleted in a short time. The new self-charging battery also needs to have a large capacity to store energy (electricity) because it will ensure that the users will get a constant source of electrical power in their vehicles. Thus, a vehicle can play its vehicle entertainment system, power the charging docks for mobile phones and the use the front light for a longer period of time. The issue of energy storing capacity and efficiency will determine whether the system will be successfully implemented because if the system fails, the whole project will fail.