Engineering an Energy-Efficient, Adaptable, Hybrid Bike Motor

Stated Objective: The objective of this project is to master the science of power electronics in order to engineer a "hybrid" motor that will be adaptable for any bicycle frame. This idea is based on the recent burst in popularity of hybrid cars that utilize the combination of a combustion engine and battery power for optimum efficiency. I will be designing a motor that will create a similar union between human power and electric power, turning a bike into an efficient and effective machine for long distance travel. The motor will have an onboard computer making constant calculations with respect to current speed and inputted desired speed, and then will act accordingly. There are two general scenarios in which the motor will act. When peddling or traveling faster than the desired speed, the motor will store the extra energy provided by the peddler in a battery for later use, slowing the bicycle down more efficiently than brakes. When traveling at less than the desired speed, the motor will provide the extra power required to achieve the desired speed. The result will be a machine that effectively combines the strength of man and electricity.

Project Content: In order to design this hybrid motor, I need to first learn and gain an in-depth knowledge of power electronics. The entire project revolves around my understanding of energy efficiency, energy exchange and energy storage. Once I have obtained the required background knowledge, I then need to research the availability of essential materials, their respective prices and their respective specifications. With this research, I will be able to calculate and establish my desired motor, generator and battery requirements, and therefore, establish a design for my motor.

The onboard controller also must be chosen, along with its functional sensors. From previous projects, I own a 68HC11 "Handy Board" Computer that can be programmed in "Interpretive C," and I believe that it will be suitable for this project.

Three sensors will also be required: a velocity sensor placed on the front wheel of the bicycle to determine its current speed, a safety-off sensor to be placed on the brake system of the bicycle and activated whenever the brakes are pressed, and a speed control toggle sensor in order to increase or decrease the desired speed.

With all of the collected materials, I can construct the mechanical aspect of the project. With this completed, I will then move onto the software aspect, and before I do that I need to improve my "C" programming skills through reading and building practice programs. When my skills are up to par, I can specify the program requirements and write the program. With the mechanics of the motor intact and the software operational I have to create the mounting arrangement. But, since I want it to be adaptable for virtually every bicycle, I need to understand the common design parameters of the various bicycle companies. With sufficient knowledge of various designs, I can create a universal mounting arrangement, mount the motor on my own bicycle and finally test my project. As troubleshooting is an extremely important aspect of engineering, the rest of my project will be solving unexpected problems and malfunctions.

Summary: The purpose of this project is to transform an ordinary bicycle into an efficient vehicle for long distance travel. There are four main facets to the final product. Most importantly, this hybrid motor will be highly efficient, storing extra energy for a

later time when it is truly needed. The motor will also be highly adaptable, mountable on almost any bicycle. Furthermore, it will be simple to operate. Once mounted on a bicycle, it will only be necessary to input the wheel radius in order to calibrate the speed sensor, and then the motor is ready to be used. You will be able to easily adjust the desired speed by pressing a toggle switch up or down. At all times, an LCD screen will display the current speed, the desired speed, the direction that energy is being transferred, and the current amount of energy remaining in the battery. Finally, the hybrid bicycle will be safe. There will be two methods to immediately disengage the motor: there will be an off switch and there will be a sensor on the brakes. By simply pumping the handbrakes, the hybrid motor will immediately shut down.

In order to successfully complete this project, I will need to research and become an expert in many areas. First, and most importantly, power electronics: the science behind energy efficiency, energy storage, and energy exchange. I will also need to become an effective programmer in "Interpretive C" to be able to create the software portion of this project. And finally, I will need to understand the basics of bicycle design, in order to create a device that will be applicable for all bicycles.

In summary, to complete the project I will need to draw upon and increase my knowledge in the areas of physics, mathematics, chemistry and programming, following the engineering process from start to finish.