The Electric Bicycle Computer with CAN

Introductory Description:

The shortage of natural resources and global warming are current problematic environmental issues partly resulted from the use of combustion engines. As the price of fossil fuels hit the all time high, an alternative form of transportation is needed. Automobile manufacturers have been designing hybrid vehicle systems for years. Therefore, the idea for a bicycle utilizing free energy from human power should be considered.

With this stated, Patrick and I propose to build an electric bike with an onboard bike computer. This project consists of incorporating a controller system that manages an electric motor mounted onto the back wheel of a mountain bike. Patrick will be in charge of this controller system and I will be in charge of the bicycle computer. The bike computer will gather the signals from the CAN Bus and display the information on a LCD screen. The electric motor will provide additional power to the back wheel when extra power is needed making pedaling optional. The bike computer will measure, compute, and display the battery level, current speed, total distance, and power delivered to the wheel. It will also include an onboard light system, allowing the user to be able to turn the headlights/taillights ON and OFF and activate the turn signals.
**Description:**

The bike computer will use a Motorola MC9S12C microcontroller (MCU) to gather signals sent by the CAN Bus. The preliminary block diagram for the basic functions of the bike computer is displayed in figure 1. The CAN Bus from the motor controller will transmit four types of signals to the MCU. Then, the MCU will use these analog output signals from the motor controller and convert them into digital signals. Afterwards, these digital signals will be used to display information to the user on the LCD screen.

The LCD screen will display the current speed, total distance, and battery level. More feedback functions can be added during the testing process if they are useful to the user. Inserting more functions to the computer requires reprogramming the MCU. The current speed of the rider will be displayed at all-time on the first line of the LCD display. The second line will give the user the choice of feedback that the user desires to display by pressing a select button. When the throttle switch on the hand bar is pressed, the bike computer will send a signal to Patrick’s controller, and then it will engage the electric motor.

The onboard light system consists of a series of LEDs mounted in the front and the back of the bike. The activation of the lights is made from the bike computer. The bike computer will use a keypad to change the mode, which switches one display option to another and all the input signals, sensor data, and keypad entry will be converted and computed to print in the onboard LCD display. The bike computer will use the battery as its power source.
Benefits:

The primary application of this electric bike with an onboard bike computer is to provide the user with extra power on the wheel when climbing hills and increasing the average speed. The onboard computer helps the user to improve its training by generating feedback, such as speed and distance traveled. It also has the advantage of monitoring the battery level and interfacing with the motor controller.

The benefit of the bike computer implementing a bike lighting system is to provide a safety for the rider because automobile drivers rarely see cyclists who are not equipped with a front headlight and rear taillight. In addition, it will have signal lights that inform automobile drivers the biker’s direction.

Finally, the bike computer with user interface will be easy to use while biking. The bike computer will only have four main switches to control the signal lights, the motor ON/OFF, and the throttle.
Comparison:

Current bike computers are a lot more advanced, more compact, and cheaper than two to three years ago. A basic bike computer can be found for as little as $20 and as much as $100. They are usually compact in size; display the current and average speed, trip distance etc… Moreover, the bike computer that I will be building will be interfacing with my partner’s motor controller. This part of the design cannot be found on any bike computer in the market. Below are some critical specifications for a basic bike computer (Sigma Sport BC 1600 Cyclometer) that are sold for $28 at www.rei.com as an illustration.

- Weight  2 ounces
- Dimensions  4cm x 3.5cm x 1.5cm
- Display  large, clear LCD display
- Command  3 buttons
- Units  Miles and Kilometers
- Operational Temperature Range  -10°F to 150°F
- Power supply  Lithium 3V – CR2032
- Trip distance limit  automatically resets after 999.99 miles

Project development and demonstration:

The project development will take place in the ET 340 lab because it will involve a lot of programming of the Motorola MC9S12C microcontroller. This will include converting signals using the built in A/D converter function in the microcontroller. Some of the steps will be done at home where more tools are available to assemble the motor. Patrick and I are planning to build two electric bikes, for each of us to keep. For the demonstration day, we are planning to bring the bike to ET 340 lab where people can see and test the whole system.