Project Proposal: EX500R Digital Instrumentation Display (Ninja DIDy)

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Date: November 1, 2008
Abstract
The EX500R Digital Instrumentation Display (Ninja DIDy) is a digital instrumentation display for the Kawasaki Ninja EX500R motorcycle. The device will display key performance data, such as engine rotation speed (rotations per minute or RPM), vehicle travel speed (miles per hour or MPH), temperature gauge, odometer (total distance traveled through the life of the vehicle), trip-meter (distance traveled, which can be reset by the user) and clock. The device will also indicate the use of blinkers and high beams.

The device will replace the stock instrumentation cluster. The Ninja DIDy will apply various sensing techniques at various parts of the motor cycle, as well as use the circuitry and sensors employed by the stock instrumentation cluster to log, process and display relevant vehicle performance data. The display will be a single LCD screen.

Description
The tachometer will receive data from the primary side of the ignition coil. The voltage at this point, which is an irregular and noisy pulse, will need to be shaped to a digital signal via comparator. The Ninja DIDy’s on-board microprocessor will then count and time the pulses, take the average and calculate the RPMs.

The speedometer will employ an intermediate device between the Ninja DIDy and the current cable drive speedometer system. The current system uses a mechanical cable, operated by a device at the front wheel axle, to control the analog speedometer needle. The intermediate device will convert the cable data to an analog voltage, which may then be received as a digital value via analog to digital converter. The Ninja DIDy will convert the digital value to current vehicle speed in miles per hour (MPH). The MPH data will also be used to determine the odometer and trip-meter value, which will be stored in non-volatile memory of the Ninja DIDy’s MCU.

The temperature gauge will use the vehicle’s current thermocouple, which outputs an analog voltage corresponding to current operating temperature. This data will be converted to a digital value by ADC and interpreted to the current vehicle temperature in Fahrenheit by the Ninja DIDy’s microcontroller.

The turn signal, high-beam and neutral gear engagement will be detected by the Ninja DIDy using the current vehicle circuitry, used to drive LEDs on-board the stock instrumentation cluster. The clock will be implemented by the MCU with no external input.

All performance data will be displayed by a 16X4 LCD display with an associated driver, controlled by the MCU. The tachometer and speedometer data will be displayed both numerically in RPMs and MPH, respectively, as well as bar graphs with a range corresponding to the vehicle’s operating range. The odometer and trip-meter values will be displayed as integers corresponding to miles traveled.

The temperature will only be displayed as a bar graph with a range corresponding to the vehicle’s safe operating range. The turn signals indicator, high-beam indicator, neutral gear engagement indicator and clocks will be indicated by the LCD on a single row.
The organization of the various operational parameters will be selected by the user via single button input. A second button will be available to reset the trip meter, as well as set the clock in conjunction with the first button.

The microprocessor will necessarily have an input capture available with associated timers. The processor will require sufficient speed to process performance information while controlling the LCD driver for display. Onboard ADC and LCD drivers would be preferable.

Competing/Similar Products

Dakota Digital HLY-30
(http://www.dakotadigital.com/)
Adjustable 199 MPH speedometer
User selectable MPH or KPH
Compatible with both electronic and cable drive applications
Odometer with resettable trip odometer
Quick response bar graph tachometer with adjustable shift point warning
Adjustable shift point indicator with warning
Indicators can also display Turn Signal, High Beam and Neutral Indicators
Power consumption data unavailable
Retail: $469.95
Koso SP RX-1N
(http://www.kosonorthamerica.com/)
Adjustable 223 MPH speedometer
User selectable KPH or MPH
Odometer with resettable trip odometer
Both analog dial tachometer and digital display
Indicators can also display Turn Signal, High Beam and Neutral Indicators
Top speed target distance and max RPM record
Power consumption data unavailable
Retail: $349.95

**Background and Benefits**
The stock instrumentation cluster that accompanies the Ninja EX500R is aesthetically unpleasant, bulky and inflexible to various body modification/customization. Replacement devices are expensive and are usually geared toward high performance motorcycles. As the EX500R is typically considered an economy sport bike, the current replacement devices are not practical or desirable when comparing costs to the value of the motorcycle itself.

The Ninja DİĐy will be geared specifically for use with the EX500R, which are popular for low cost and high fuel efficiency. As many EX500R riders seek affordable customization options, the Ninja DİĐy will provide a low cost option for a smaller digital display.

**Societal Impacts**
As fuel prices continue to rise, more and more commuters are choosing travel by motorcycle as opposed to traditional automobiles. Many of these riders seek affordable and reliable bikes, such as the EX500R and seek options to make their motorcycles more aesthetically pleasing. The availability devices that make such options available may convince more motorists to switch to this fuel efficient and exciting mode of transportation.

**Development and Demonstration**
The Ninja DİĐy will be developed in the ETEC 340 lab of WWU’s Ross Engineering Technology Building, which provides PCs for software for development, hardware simulation (if necessary) and final design layout. Physical design and implementation, as well as analysis of input signals will require my own EX500R motorcycle.

Demonstration of the device will be in two parts:

- Visual demonstration of implementation with video footage of the product being used
- Final product including physical enclosure