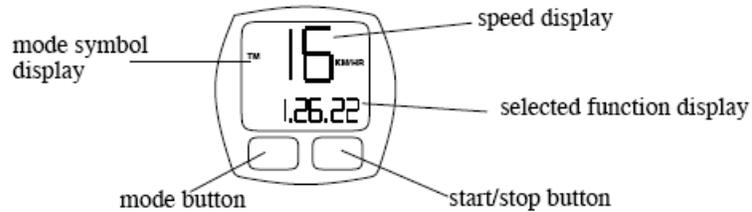


Simple Bicycle Computer System



Problem Statement

A simple bicycle computer system consists of a sensor, a magnet, a wire, and a control unit. A magnet is attached to a spoke of the bicycle's wheel. The sensor is attached to the front fork, so that it detects when the magnet passes the fork, designating one complete rotation of the wheel. A wire connects the sensor and the computer's control unit, which is attached to the bicycle's handle bar. The wheel sensor sends a signal to the control unit with every rotation of the wheel.

The control unit displays the bicycle's current speed in the upper right-hand corner of the display. In addition, the value of one other function (the elapsed time, maximum speed, distance, average speed, etc.) is also displayed. The user presses the mode button to change which of the functions is displayed. A mode symbol (e.g., TM, MXS, DST, AVS) indicates the current mode, so that the user knows which of the mode functions is being displayed. The mode symbol appears along the left side of the display, and the mode-function value appears in the lower right-hand corner of the display.

The control unit recalculates the values of the following functions every second, and updates the display for any displayed value. For example,

Speed - The current speed, in km/hr, is calculated using the previously stored value of the wheel size (the wheel circumference in cm) and the number of wheel rotations made in the last second.

Elapsed Time - The elapsed time, in seconds, is measured from the start time, when the control unit was last RESET, to the current time. The elapsed time is displayed in units of hours, minutes, and seconds. The display range is 0:00:00 to 9:59:59. When 10 hours have elapsed, the counter returns to 0.

Max Speed - The maximum speed, in km/hr, is the maximum of the current speed and the previously stored maximum speed.

Distance - The trip distance, in 0.01 km increments, is measured from the starting point, when the control unit was last RESET, to the current point. Distance is calculated using the wheel size and the number of wheel rotations made in every second since the starting point. The display range is 0.00 to 999.9 km. When 1000 km is reached, the trip-distance counter returns to 0.

Average Speed - The average speed, in km/hr, is calculated on the basis of the elapsed time and the trip distance from the starting point to the current point. The average speed is measurable up to 9 hours 59 minutes 59 seconds for the elapsed time and up to 999.9 km for the trip distance. If either is exceeded, "E" is displayed and calculation ceases.

The bicyclist interacts with the bicycle computer by pressing two buttons on the control unit:

Mode Button - The mode button is used to rotate through possible mode functions (i.e., elapsed time, maximum speed, trip distance, or average speed, etc.) that are displayed in the lower right-hand corner of the display. The initial mode, and the initial value displayed, is the elapsed time. Each time the mode button is pressed, the mode advances in the sequence: maximum speed, trip distance, average speed, elapsed time, maximum speed, etc.

Start/Stop Button - The start/stop button is used to temporarily suspend and to resume calculation of the mode functions. Each time the start/stop button is pressed, the behaviour toggles between "computation active" and "computation suspended". When the bicycle computer is active, it updates the current speed and all mode functions every second. When computation is suspended, the mode functions' last values are saved in memory and are not updated. When computation is resumed, all of the functions are again updated every second, starting with the stored values.

When the mode and start/stop buttons are pressed at the same time, the control unit is RESET: all mode-function values are cleared and are reset to 0.

Experience Project

One type of experience project would be to use some MBSE technology (e.g., EMF/GMF, GME, Kermeta, IBM Rational, MetaEdit) to create an environment that makes it easy to introduce new mode functions to the bicycle computer. This would involve:

1. developing the core of the bicycle computer program in a way that new mode functions can be easily added to the program
2. creating a modelling notation for expressing new mode functions that operate over existing input values (e.g., wheel rotations, time events) or mode function values
3. automatically transforming models in your modelling notation into source code that can be integrated with your program core (see step 1)