Bike Dash

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Sponsor:
*Duke Energy
*pending approval

A. Project Description

Bike Dash is a product idea that implements an easy to use bike monitoring system that provides the user with a more enjoyable experience by keeping them informed of their current biking conditions. Bike Dash will implement features such as GPS location, speed, distance traveled, current temperature, altitude, and a few other features outlined below. Bike Dash is intended to target all bike riders and will provide its own power by utilizing the riders momentum through the use of a generator. The ability to sync data via bluetooth to a bluetooth enabled PC (or via USB) will allow the user to see data in a rich GUI format.

The intention to make Bike Dash light, yet durable is of utmost importance. Because of the terrain traveled on a bicycle, and the possibility of inclement weather,

we must ensure that the system is waterproof as well as shock resistant. Ideally, the device would be housed in durable plastic, possibly ABS, and sealed with silicone.

In order to move forward with the “green” effort in today’s society, our device will utilize the power generated by pedaling through the use of an AC power generator. To ease in the design process, a generator will be purchased as a COTF (Commercial Off The Shelf) unit. It will be fitted on to our bike and outfitted with power connections for our microcontroller and sensors.

After a ride is completed, the user may sync their data via bluetooth or USB to their PC. The data will then be viewable in a rich GUI layout and will also be stored on the phone to be viewed at a later time. The user will be able to see data graphically as well as comparisons from previous runs. The PC application will be the center for data collection and analyzation. Though the user will be able to see real time data on the LCD mounted on the bike, the PC application will have a much richer interface and will be able to achieve much larger amounts of data.

The motivation for this product stems from the idea of today’s society moving forward towards a healthier lifestyle. Many people today are overweight and lack the exercise a human should receive regularly. Hopefully, with the development of a low cost fitness tracker, more consumers will be able to ride their bike into a healthier future.

B. Specifications

1. Microcontroller- *Microchip PIC32MX450F128L*

- 80 MHz/ 105 DMIPs, MIPS32®M4K® core
- 32 KB SRAM memory
- Temperature Range -40^{o} to 105^{o} C
- 128 KB Flash Memory plus an additional 12KB of boot flash
- Hardware Real-Time clock
- USB 2.0 compliant full speed OTG controller
- Parallel Master Port for graphics interfaces
- Low power management modes (sleep and idle)

· 0.5mA/MHz dynamic current

Source: Microchip Technology, Inc.

2. GPS Unit- *maestro GPS receiver A2035-H410*

· Frequency: 1.575 GHz

· Sensitivity
  - Tracking: -163 dBm
  - Navigation: -160 dBm

· Temperature Range -40^{o} to +85^{o} C

· Ultra low power consumption and low assembly cost

· Supply voltage: 3.0 to 3.6 VDC

· Internal antenna for easy integration

· Dimensions (L x W x H): 1.2” x 0.65” x 0.2” = 30.5 x 16.5 x 5.0 mm^3

· Weight: 4.0 g/ 0.14 oz.

· UART Communication Baud rate 4,800

Source: Maestro Wireless Solutions Limited

3. Gyroscope- *InvenSense MPU-6050 Six-Axis (Gyro + Accelerometer) MEMS Motion Tracking^{TM} Devices*

· Low power, low cost, and high performance

· VDD supply voltage range of 2.375V to 3.46V

· Dimensions (L x W x H): 4 x 4 x 0.9 mm^3

· Temperature Range -40^{o} to +85^{o} C

· Operating current: 3.6 mA

· External sync signal connected to the FSYNC pin support image, video and GPS synchronization

Source: InvenSense, Inc.

4. Bluetooth Module- *HC-06 Bluetooth module*

· Dimensions(L x W x H): 28 x 15 x 2.35 mm^3

· Possible communication baud rates: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 11520

· Can be used as wireless UART communication from PC to any µC

· 34 PINs

· Standard voltage is 3.3V and can work at 3.0 to 4.2 V

Source: HC Serial Bluetooth Products User Instructional Manual

5. Accelerometer- *Xtrinsic MMA8451Q, 3-Axis, 14-bit/8-bit Digital Accelerometer*

· Real-time orientation detection

· 14-bit and 8-bit digital output

· Supply voltage: 1.95 to 3.6 V and Interface voltage: 1.6 to 3.6 V

· Output data rates from 1.56 Hz to 800 Hz

· Current consumption: 6 µA to 165 µA

· Dimensions (L x W x H): 3 x 3 x 1 mm^3

· Sensitivity accuracy: +/- 2.64 %

Source: Freescale Semiconductor, Inc.

6. AC generator

· Utilize the riders momentum to convert motion into electricity

· Consists of some magnets and an armature wire

· AC generated by rotating a coil in the magnetic field

7. Solar Panel (optional)-*sparkfun electronics solar cell small-0.45W PRT-07845*

· Voltage: 4.5 V

· Current: 100mA

· Dimensions: 3.7” x 2.4”

Source: SparkFun Electronics

8. LCD Screen- *Crystalfontz America CFAH1604B-TMI-ET*

- Parallel character LCD (16 characters x 4 lines)
- 8-bit or 4-bit parallel interface
- Dimensions (L x W x H): 2.77” x 2.36” x 0.35” = 70.6 x 60 x 8.9 mm^3
- Viewing area (W x H): 2.36” x 1.28” = 60 x 32.6 mm^2
- Weight = 34g
- Temperature Range: -20^o to + 70^o C

Source: Crystalfontz America, Inc.

9. Android Phone- *LG Optimus L9*

- 4.5” qHD full touch screen
- Size and weight: 5.03” x 2.63” x 0.36” and 4.2 oz.
- Operating System: Android 4.2 (Jelly Bean)
- Memory: 1 GB RAM, 4 GB ROM
- Battery life: up to 15 hours talk time and up to 28 days standby time
- 1 GHz dual- core processor

OR *Samsung Galaxy S4*

- 5” full HD super AMOLED (1920 x 1080) display, 441 ppi
- 1.9 GHz quad-core processor / 1.6 GHz octa-core processor
- Operating System: Android 4.2.2 (Jelly Bean)
- Memory: 16/32/64 GB memory + microSD slot (up to 64GB) and 2 GB RAM
- Sensors: Accelerometer, Gyro, Barometer, Temperature & Humidity, Gestures, RGB light
- Dimensions and Weight: 136.6 x 69.8 x 7.9 mm^3 and 130 g
- Battery: 2,600 mAh

10. Bike Dynamo- *Shimano Alfine Dynamo Hubs EDHS501BL SAC*

- Axle-type: Quick-release

- Drilling: 32 Hole
- Hub width: 100 mm
- 3.0 watt power supply
- Dimensions (L x W x H): 15 x 18 x 10 cm^3
- Supply voltage for LCD: -0.3 to 13 V
- LCD Response Time: 200ms to 300ms

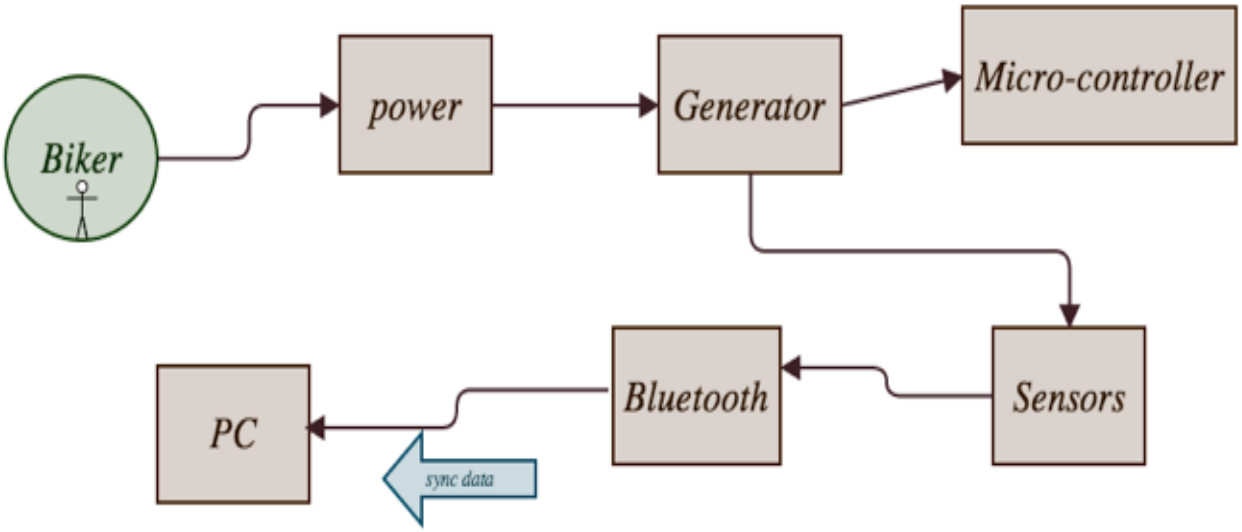
Source: Shimano Inc.

11. Temperature Sensor- *Texas Instruments LM35 Precision Centigrade Temperature Sensors*

- Calibrated in Celsius (centigrade)
- Provides typical accuracies of +/-0.25 ^oC at room temperature and +/-0.75 ^oC over a full -55 ^oC to +150 ^oC temperature range
- Suitable for remote applications
- Supply voltage: -0.2 to 35 V
- Output voltage: -1 to 6 V
- Output current: 10 mA

Sources: Texas Instruments, Inc.

C. Block Diagram



D. Financial

Item	Part Number	Cost	Quantity	Total
Microcontroller	PIC32MX450	$3.44	1	$3.44
GPS Unit	A2035-H	$18.55	1	$18.55
Gyroscope	MPU-6050	$16.50	1	$16.50
Bluetooth Module	HC-06	$12.50	1	$12.50
Accelerometer	MMA8451	$8.70	1	$8.70
Bike Dynamo	EDHS501BL	$130.00	1	$130.00
LCD Screen	CFAH1604B	$29.30	1	$29.30
Temperature Sensor	LM35DZ/NOPB	$1.57	2	$3.14

Solar Panel (optional)	PRT-07845	$15.95	1	$15.95
Miscellaneous Supplies	N/A	$100.00	1	$100.00
				$338.08
Tool	Cost	Quantity	Total	
Soldering Iron	$0.00	1	$0.00	
Oscilloscope	$0.00	1	$0.00	
Multimeter	$0.00	1	$0.00	
Power Supply	$0.00	1	$0.00	
Wire Cutters	$0.00	1	$0.00	
Drill	$0.00	1	$0.00	
PC	$0.00	1	$0.00	

E. Project Milestones

SENIOR DESIGN ONE

September 16, 2013 - Complete Initial Design Proposal
September 21, 2013 - Microcontroller selected
October 02, 2013 - Complete schematic for system at large
October 18, 2013 - First 30 pages of design proposal completed
October 22, 2013 - Revisions made and implemented on first 30 pages
October 29, 2013 - All sensors selected, as well as LCD and dynamo
November 5, 2013 - Final schematic completed
November 8, 2013 - Revisions to final schematic implemented
November 15, 2013 - Second 30 pages completed of final document
November 18, 2013 - Revision to second 30 pages implemented
December 3, 2013 - Final document complete
December 8, 2013 - Implement final document revisions
December 10, 2013 - Turn in Final Document

SENIOR DESIGN TWO

January 6, 2014 - Review Final Document and Schematic
January 13, 2014 - Order parts and board
January 27, 2014 - Begin coding of microcontroller
February 3, 2014 - Implement temperature sensor
February 10, 2014 - Implement accelerometer
February 13, 2014 - Code review to verify sensor integration
February 17, 2014 - PC program GUI complete
February 24, 2014 - Revisions to GUI implemented
February 24, 2014 - Implement gyroscope
March 3, 2014 - Code review to verify sensor integration
March 10, 2014 - Power generation system installed on bike
March 10, 2014 - Code revisions implemented
March 17, 2014 - Testing of current product(ie. sensors, data transfer, etc)
March 24, 2014 - Testing errors fixed
March 24, 2014 - LCD integrated into device
March 31, 2014 - Temperature and GPS integration complete
April 1, 2014 - Code review of first full release
April 8, 2014 - Bluetooth connectivity implemented
April 15, 2014 - LCD and power system fully integrated on bike
April 16, 2014 - Test/Review product
April 21, 2014 - Implement changes
April 22, 2014 - Test/Review product
April 29, 2014 - Turn in Final Project