GPS-Enabled Inhaler

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Abstract

Asthma is a disease of growing public health importance, and is unique in that inhalers and the medications they supply are often used at the exact time and location of exposure to environments that trigger attacks. By monitoring these factors in real-time instead of relying on the proper documentation and collection of data, patterns in symptoms could be deciphered and could help to identify common risk factors in populations. The goal of this project is to create a device that can store and transmit the time, date, and location of medication use by utilizing Global Positioning System (GPS) technology.

Problem Definition

Problem Statement:

Develop an attachment for an asthma inhaler which has the ability to record date, time, and location of the user at time of use.

Motivation:

- Tracking allergy/asthma symptoms is important for:
  - -Outbreak control
  - -General health studies in specific /broad areas
- Surveillance to this point has been limited to severe episodes that lead to hospital visits

Current Devices:

- Currently there are no competing products on the market

Design Criteria

- Must meet FDA standards for use
- Secure attachment for peripherals
- Withstand normal wear
  - Waterproof, does not damage on impact, etc
- Wireless with battery power is ideal
- Optimally reusable
- Accuracy of GPS location, date, and time should be as accurate as possible
- Cost less than $300 per unit

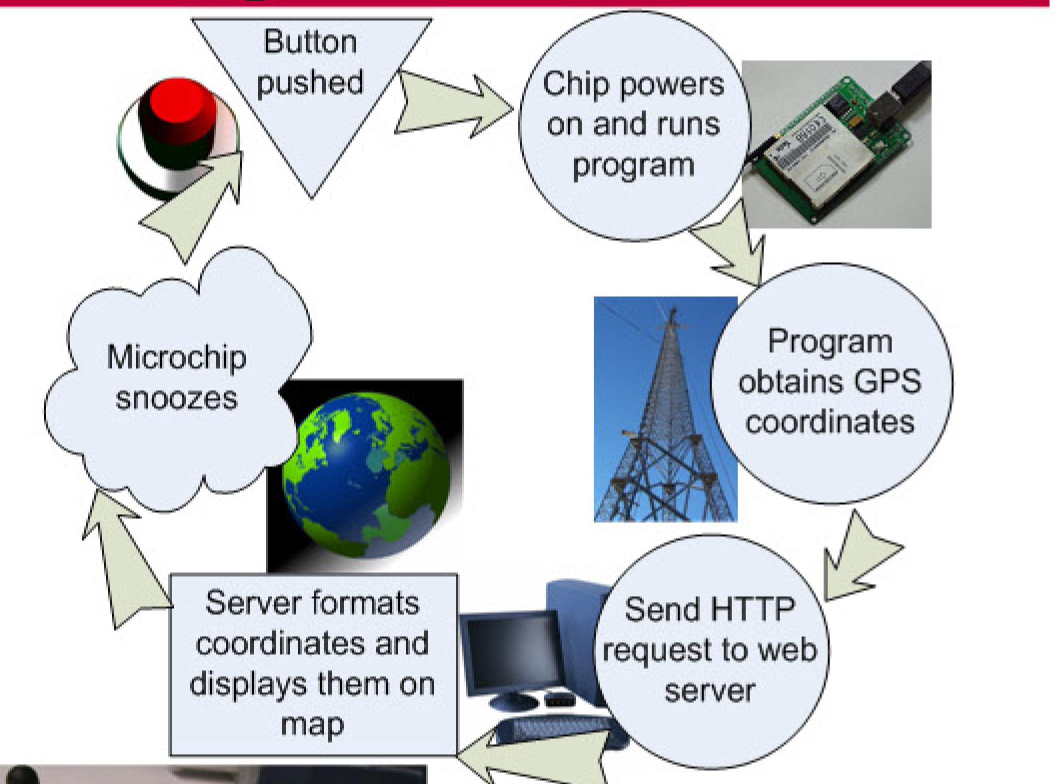
Cost of Materials

GM862-PCS kit	$289.50
Prepaid SIM card	$36.91
Total Cost	$326.41

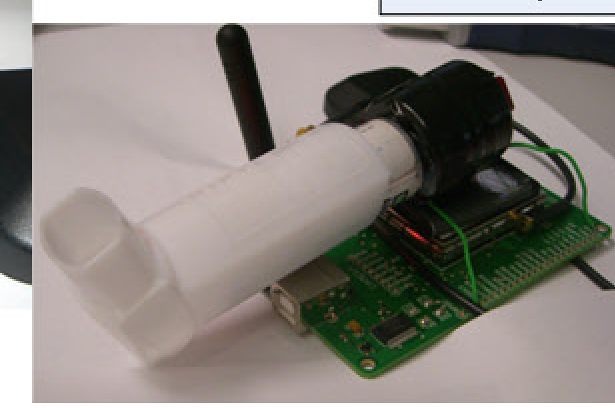
Final Design

Components

- Momentary push button
- GM 862-GPS microchip and SIM card reader
- 3.7V lithium-ion power supply
- Web space on the college of engineering server
- GPS and GSM antennae
- Laptop for programming



Push button and connections

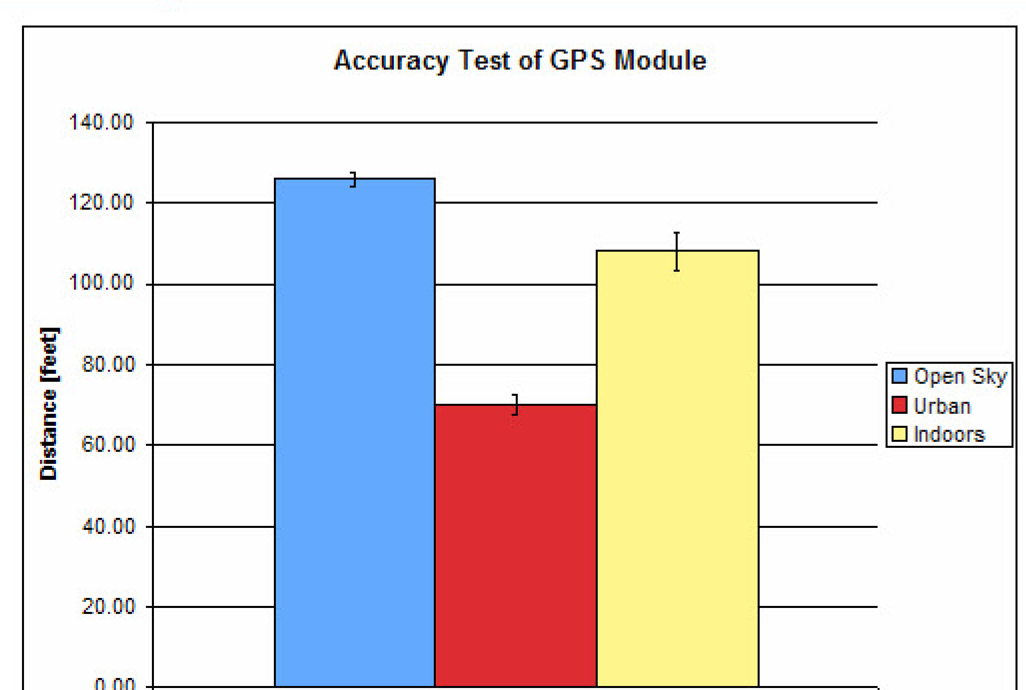


Device size relative to inhaler

Google Map aerial view with inhaler located

Testing: Protocol and Results

- Tested the accuracy of the GPS device in open sky, urban, and indoor places.
- Compared location given by program with location given by Google Maps address
- Calculated the distance from known point in feet
- Standard deviation for:
  - -Open Sky: 1.62
  - -Urban: 2.36
  - -Indoors: 4.80



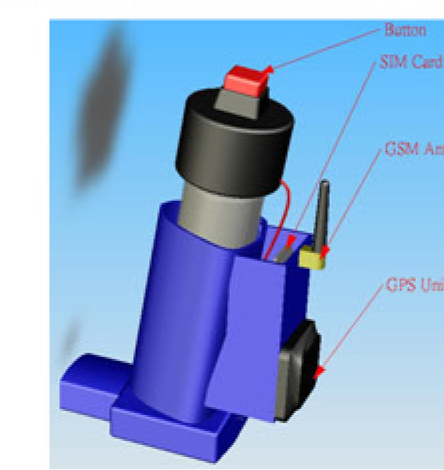
Graph 1: Each bar represents the average value of one geographic location. The distance refers to the difference in location between a fixed location and the output location of the GPS module.

Conclusions

- Testing reinforced the accuracy of the GPS component
  - GSM triangulation has not yet been tested
  - Crucial for urban and indoor environments
- Device serves as proof of concept
  - Easily connects with the web server
  - Accomplished the semester goals
- Further testing is necessary before marketing
  - Power supply and peripheral security
  - Python troubleshooting

Future Work

- Miniaturize design
  - -Work with PCB Express to manufacture 10 devices
  - -One small board with all connections
- New testing techniques
  - -Clinical testing
- Activate GSM locator capability
- Mass production
  - -Research clients
- Real-time mapping system
- Patent Disclosure
  - -Submitted to WARF



Current design goal with all components attached [Schematic made in SolidWorks]

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Acknowledgments

Authors would like to thank Prof. Ken Gentry, Dr. David Van Sickle, and Prof. Willis Tompkins.