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 symptom onset. By monitoring these factors in real-time instead of relying on patient documentation, patterns in symptoms can 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 asthma acerbations and to display them on a map.

Motivation:

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

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; rechargeable
- Optimally reusable
- Accurate GPS coordinates : within 20 ft
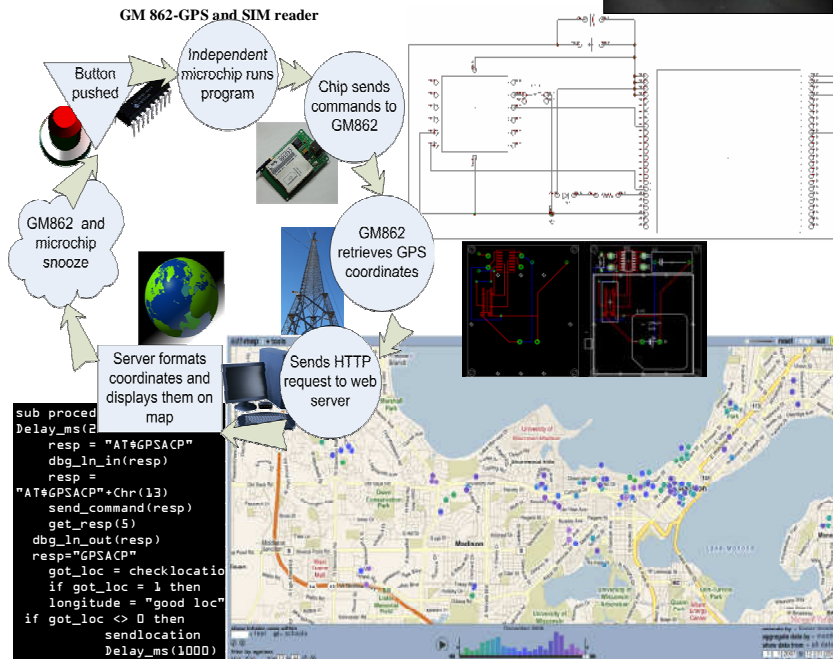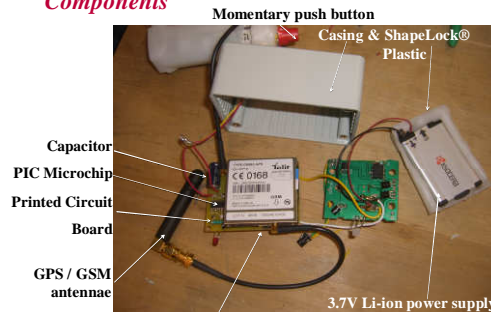- Cost less than $300 per unit

Project Schedule

SEMESTER 1: PROOF OF CONCEPT

SEMESTER 2: FABRICATION
- Learned Eagle CAD Program
- Created Pinouts/Schematics
- Programmed microcontroller
- Ordered PCB's
- Created battery holder and recharge circuit
- Integrated with mapping software

SEMESTER 3: TESTING

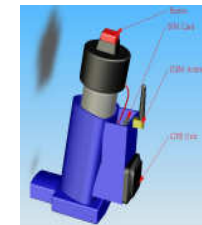## Final Design

Components

- Momentary push button
- Casing & ShapeLock® Plastic
- Capacitor
- PIC Microchip
- Printed Circuit Board
- GPS / GSM antennae
- 3.7V Li-ion power supply

GM 862-GPS and SIM reader

- Button pushed
- Independent microchip runs program
- Chip sends commands to GM862
- GM862 retrieves GPS coordinates
- GM862 and microchip snooze
- Server formats coordinates and displays them on map
- Sends HTTP request to web server

```
sub proced
Delay_ms(2
    resp = "AT$GPSACP"
    dbg_ln_in(resp)
    resp =
"AT$GPSACP"+Chr(13)
    send_command(resp)
    get_resp(5)
    dbg_ln_out(resp)
    resp="GPSACP"
    got_loc = checklocatio
    if got_loc = 1 then
    longitude = "good loc"
if got_loc <> 0 then
        sendlocation
        Delay_ms(1000)
```

Cost of Materials

Item	Cost for four	Cost per prototype
GM862	$ 735.80	$ 183.95
PIC	$ 25.14	$ 6.29
PCB	$ 75.00	$ 18.75
Capacitors	$ 5.20	$ 1.30
Battery	$ 3.96	$ 0.99
Casing	$ 18.86	$ 4.72
Button	$ 4.75	$ 1.19
Molex connector	$ 23.80	$ 5.95
ShapeLock ®	$ 24.95	$ 6.24
SIM cards /service	$ 100.00	$ 25.00

TOTAL PER PROTOTYPE: $ 254.37

Future Work

- **IRB Approval**
- **Testing**
  - Prototypes
  - Clinical
- **Activate GSM locator capability**
- **Add intelligence to microchip program**
- **Mass production**
- **Patent Disclosure**

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

References

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[4] Julius, S. M., Sherman, J. M., & Hendeles, L. (2002). Accuracy of Three Electronic Monitors for Metered-Dose Inhalers. *Chest, 121*(3), 871.

[5] Kulldorff M, Heffernan R, Hartman J, Assunciao R, Mostashari F. (2005). Early Detection of Disease Outbreaks. *PLoS Med, 65*(2), January 29, 2007

Acknowledgments