1 Introduction

There are many aspects to IoT and with that companies are producing various technologies that incorporate sensors to improve the monitoring capabilities of almost any system. Over time these sensor networks would amass large amounts of data that has potential value in many markets.

This essentially creates a network that simply senses and records these sensations in a general way such that data streams can be monitored for live response or stored and later mined for knowledge. Using health-care as a test case, we analyze whether or not cough/sneeze frequency, as measured by several millions of listening devices can pinpoint and predict the initiation, velocity, and vector of a cold or flu pandemic.

2 System Design

The prototype system has two major components. The front-end device that will listen for the cough sounds and the back-end server to receive the data and integrate it into a map.

The following diagram illustrates the overall design if this idea were fully implemented into an area.

The system depicted above is well beyond the scope of this project. The prototype design that will be implemented in this project is going to use a development board with an embedded micro-controller with an attached voice recognition unit and wi-fi networking controller.

The purpose of this device will simply be to record a cough event and relay the time and location information to the server. The prototype will communicate via wi-fi through the internet to a remote server. The incoming data is processed and used in a web-based application that can be used to visualize the data using Google Maps API.

The following diagram illustrates the prototype design for this project.

The micro-controller is an ARM based device attached to a development board from the "mbed" family. Connected to it is the EZ-VR module used for cough detection, it will be trained to recognize very specific cough sounds as it is not yet possible to recognize a "generic cough sound". The attached wifi module will be of the zigbee style and will communicate with the nearest access point.

The back-end will be a virtual server that has been set up to run a simple Mongo database with a simple JavaScript program that creates a page that links to the Google Maps API to generate custom maps and visualize the detected cough events.
3 Related Work

Kansas City has been actively using a microphone array system known as "Spot Shot" for several years. The array is designed to detect the sounds of gun shots and triangulate the location relaying that information to the police to improve emergency response times.

Noise Urban Maps giving sound monitoring in bar areas and centric zones in real time is one of the popular IoT applications.

Waspmote Plug & Sense is a modular solution very easy to configure and deploy. Its sensor nodes integrate more than 70 sensors, adapting to any wireless sensor scenario such as air and noise pollution, irrigation control, livestock tracking, vineyard monitoring, water quality, etc.

The MEMS (MicroElectrical-Mechanical System) microphone is also called a microphone chip or silicon microphone. They have found wide usage in sound based IoT devices. The field is pretty
new currently. But we can expect lot of traction in MEMS based IoT application from the interest they have generated in recent times.

Cough being a common symptom of many respiratory diseases. Detection of cough intensity and frequency can provide clues to the health of person. Apart from humans frequency of cough occurrence in livestock have been studied and used to ascertain the health of the group and prevent spread of diseases among livestock by taking time measure to quarantine unhealthy animals from healthy ones.

Currently there are implementation of cough monitors but they are limited to small geographic location like indoors or big building like hospitals. This is an attempt to aggregate cough data from various locations from a larger geographic region to do analysis of that data.

References of related works are:
CoughLoc: Location-Aware Indoor Acoustic Sensing for Non-Intrusive Cough Detection http://repository.cmu.edu/cgi/viewcontent.cgi?article=1057&context=silicon_valley

4 Status

4.1 Current Work

We are currently working on getting the micro-controller to interfaced with the EZ-VR device and training it to recognize some specific audio files.

From the back-end, the virtual server that will be used to implement the web-based applications is nearly completely implemented. It works at this point, but needs some fine-tuning. We can generate web pages with Google Maps and can generate icons in selected locations.

4.2 Planned Work

We are not able to connect the device to the internet yet because we are awaiting the arrival of the wifi module. So, this is planned work. We also need to finish the programming and integration of the micro-controller and VR unit to complete the cough detector prototype.

Once these have been completed we will try to implement an Android application that will implement the same features as the web application. We simply may not have time to complete the Android features but we hope that we are able to squeeze this aspect into the project as well!