Determination of Air Quality through Remote Image Segmentation

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Project Surya-research.cens.ucla.edu/urbansensing/

Introduction: Using a mobile phone and an air filter, we can remotely measure pollution levels in India

India is one of the top polluters in the world

- **Since last year, India has been one of the top 10 producers of carbon fumes**
  - Most of this carbon is estimated to come from rural homes, where families constantly burn carbon fuel to cook their food
  - However, there has never been an accurate measurement of how much these homes accurately contribute, due to the isolation of these homes from the internet and other communication media
- **Project Surya attempts to utilize mobile devices to measure this unchecked level of carbon pollution over a long distance**

Sending a Scientist abroad is too expensive

- **Easier, and more cost efficient to train the indigenous people to perform a mostly automated process**
  - With the technological advances that exist today, many remote devices, including mobile phones, have the capability to connect to the internet even in normal 'dead zones,' by utilizing cell towers
  - Allows for the transfer of images and data over long distances
- **Connects with the indigenous people, and gets them involved with what's actually happening**
  - More likely to change their pollution habits if they are the ones collecting the data

Problem Description: How to create an efficient system to collect and manage the remote data

The system has to meet certain requirements:

- **All of the different parts of the system (database, server, and mobile) have to be fully integrateable**
  - The image gathering and sending code for all three platforms must be in sync and on a specific schedule
- **The server and database both have to have built in file management and organizational code**
  - Although the system is built to be mostly automatic, scientists should still be able to easily find and access all the raw data
  - The image segmentation code must also be able to quickly find the images slogged from the online database

However, it also has some freedom.

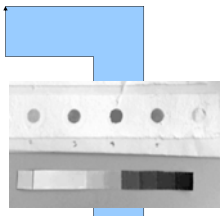
- **Since the project is going to be taken place over a long time period anyway, speed of analysis is not an important factor**
  - This allows us to focus on the actual quality of analysis: we can choose a script on its results rather than on how much time it takes to run.

Proposed Solution: A combination of an online database and a dedicated server

We use a combination of Python, PHP and MySQL to manage the uploading and receiving of images

Mobiile Phone

The User first takes a picture with the cell phone, and then runs a Python program that sends it to SensorBase, an online CENS information database



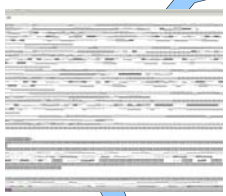
SensorBase takes the images with MySQL, records the time each image was received, and then stores the data into the database

SensorBase

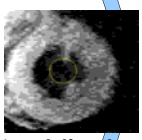
Next, we run a PHP script on a dedicated server that slogs the images uploaded to Sensorbase within the last three hours, and sorts them based on the time the picture was taken

Dedicated Server

The dedicated server then converts the images to a Grayscale PGM format for analysis before running the Image Segmentation and Color Matching Python code



An Image in PGM Grayscale format



An image halfway through the segmentation process

The final air data is then saved in a .txt file which is stored on the server

Finally, using Python we send the final data back to the mobile phone, in the form of an SMS to inform the original sender of their air quality.