Renesas RL78 Green Energy
Challenge

CONTEST ENTRY REA10280
ABSTRACT

AIR QUALITY MAPPER

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AIR QUALITY MAPPER

The Air Quality Mapper is a portable device that contains CO2 and CO gas sensors and collects data about concentrations of these contaminating gases in a city, for the purpose of constructing Air Quality Maps ("Smog Maps"). The device can be carried by a walking person and it will collect data along the route followed by the user every day in their way to work or school for example.

Along the gas readings the device also collects global position data from a GPS module for the purpose of constructing accurate concentration maps of the mentioned polluting gases in streets and zones in a city. The device stores all collected data in an SD card and after finishing a route it can be uploaded with the use of a complementary software utility from a PC to a web server, which in time offers a graphical representation of the cumulative collected data with the use of Google Maps. With many people using the device on a daily basis and of course, using different trajectories according to their normal everyday routine, the maps can become more complete and accurate over the time.

The purpose of the Air Quality Maps is to offer information and statistics about the degree of air contamination in residence, work and recreational areas in a city to every individual or organization interested in that information for health, policy, business or other reasons.

INTRODUCTION

The quality of air in cities and public areas has been a deep concern since the past decades, due to the pollution and high contamination indexes that attempts directly to the health of the population. One of the main contaminants and source of the greenhouse effect is the carbon dioxide (CO2) emitted due to the combustion of fossil fuels associated with the use of cars, planes, power plants, factories and other human activities. According to some sources, vehicle exhaust contributes roughly 60 percent of all carbon monoxide (CO) emissions in U.S.A., and up to 95 percent in cities.[1]

Common health problems associated with air pollution include burning eyes and nose, itchy irritated throat, breathing problems, and even death; being the children most susceptible to suffer these health conditions than adults. Air pollution threatens the health of human beings and other living beings on our planet and threatens the health of the planet itself.

For those reasons it is imperative to monitor the quality of air in cities, in order to gain knowledge of the precise contamination indexes present along complete city areas and how that varies in short and long time periods (from one day to another and from one year to the next for example), in order to see which city areas are more polluted than others and what measures could be taken at an individual or organizational level. This kind of data can be valuable for scientists, public authorities, organizations, businesses and the average people in general.

With detailed Air Quality Maps of a city, identifying the most polluted areas the authorities can take

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[1]   http://www.cbsnews.com/2100-500823_162-2126583.html

special policies in order to reduce the contamination index in that area, or decide which areas are more safe for building schools or sports and recreational areas. The businesses can select less contaminated areas for offices and individuals can take informed decisions about where to live or which route is better for them to take to office or school for example.
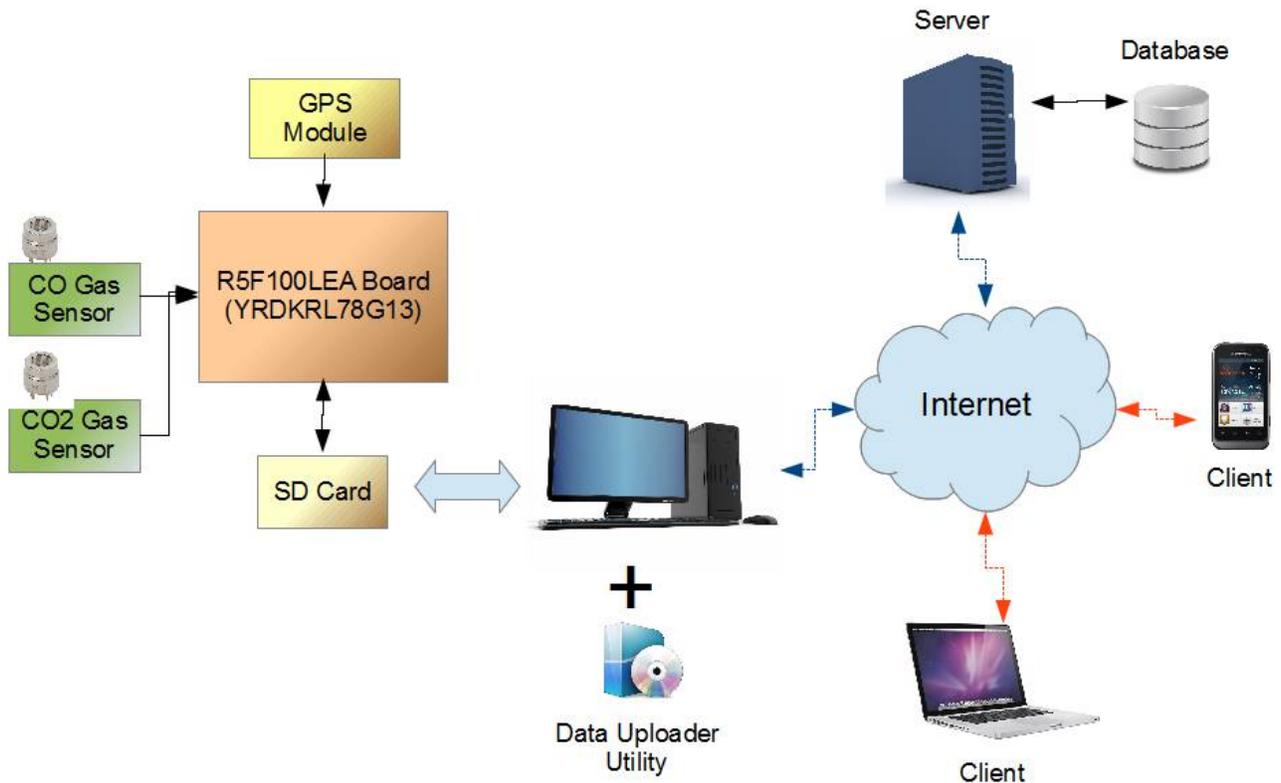
BLOCK DIAGRAM

Figure 2.1 System Block Diagram

HOW THE SYSTEM WORKS

The Air Quality Mapper is a portable device that a user can take with her (him) in a daily walking or traveling route, say to work, school or the park for example, and while the user walks her (his) way, the Mapper receives global positioning data from its GPS module, takes readings of the CO_2 and CO concentrations along the way and stores that data in an SD card. Once at home the user removes the SD card from the portable device and inserts it in a PC, and with the aid of a software utility the data is parsed, plotted in a window and uploaded automatically to an online MySQL database. A web page is provided then by the server to visualize all the data in a Google map.

The main hardware component of the system is the YRDKRL78G13 board (referenced in this document as the Mapper Board), although the aforementioned board has been used in this project for prototyping and concept demonstration purposes, a much more compact circuit has been designed (yet not implemented) for a more portable device.

The Mapper Board receives from the GPS Module the global position data (latitude, longitude, hour, date, etc.) every second. Once GPS data has been received, it the proceeds to take readings from the CO_2 and CO sensors and save these along the GPS data to the SD Card.

The CO_2 sensor is able to take reliable readings just once every 150 seconds (by design), but the CO sensor has no such limitation; nevertheless it is possible to specify a reading delay in seconds for the CO_2 sensor too, to avoid cluttering the system with too much data. Both sensors require a preheating time of about 5 minutes also; such delay times are software configurable before compilation.

Once a mapping route has been taken by the user, the SD card must be removed from the Mapper Board and inserted in a PC. A Software Utility written in Python is provided to automatically get the data from the SD card and upload it directly to the online MySQL database server, where the data is stored in a table created in advance. A web page is then served, which in turn retrieves the information from the database and displays all the global positioning points where readings had been taken in a Google map; these points are color-coded in relation to the amount of concentration of CO_2 or CO PPM (Parts Per Million) and clicking in the points it is possible to visualize the exact gas readings in every one of them, among other relevant information.

Going to the web site prepared for the project any person can get access to the page containing the information of CO_2 and CO concentrations taken in a given reading tour.
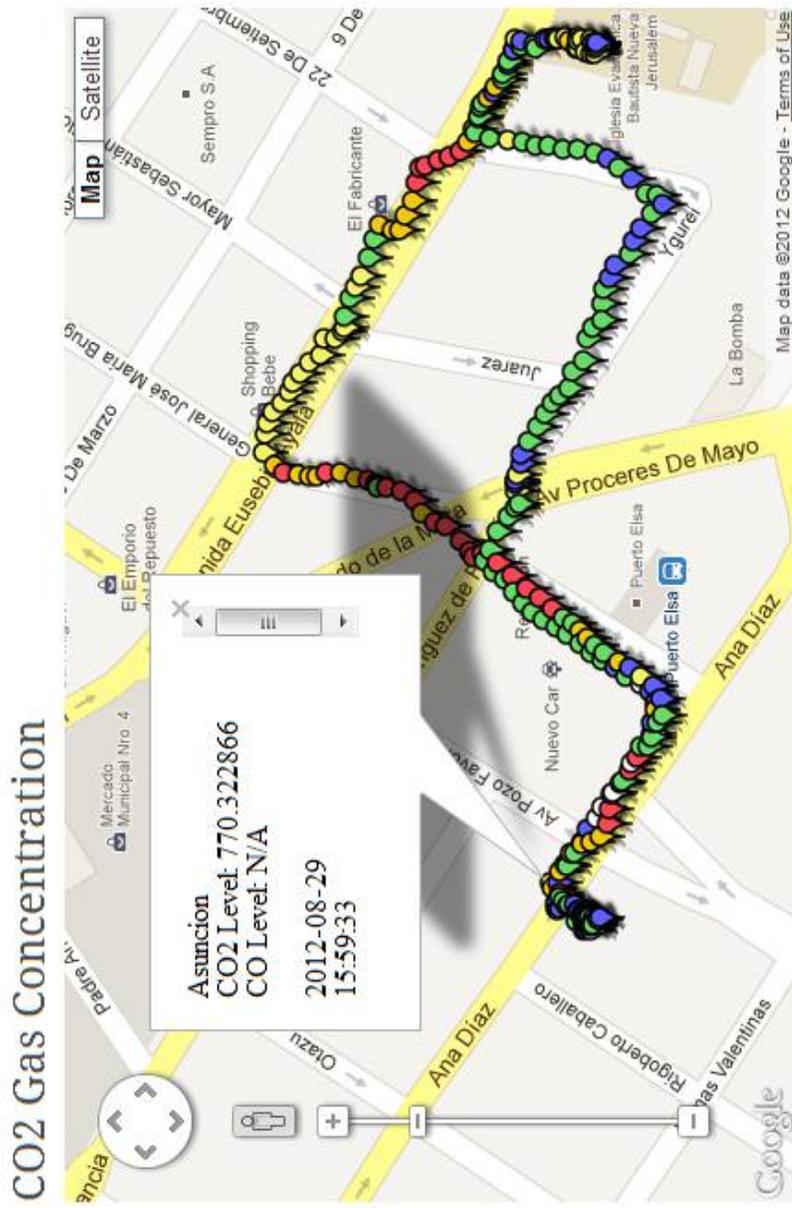
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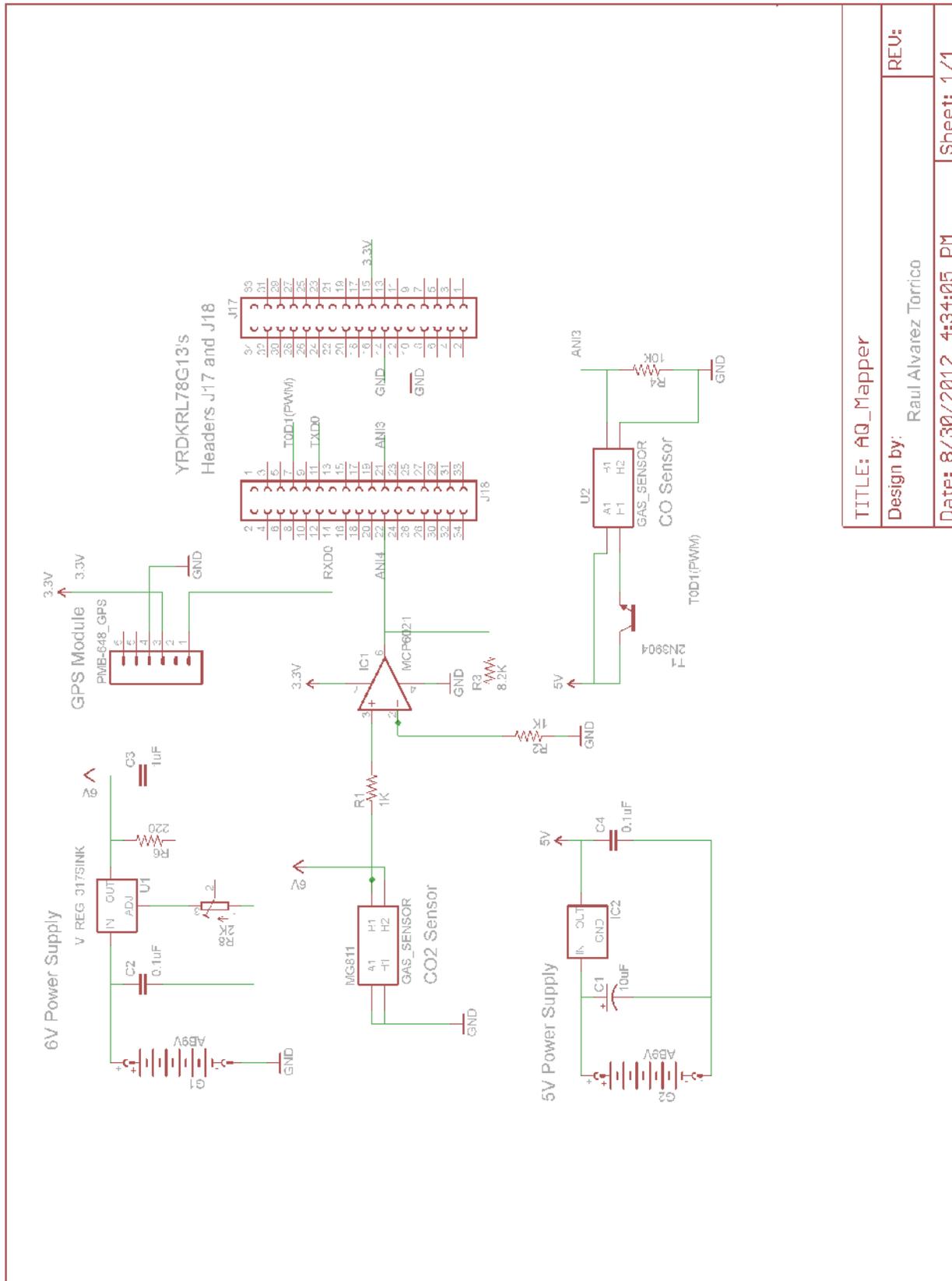
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PICTURE