Ministry Category : Council of Scientific and Industrial Research (CSIR)
Problem Statement : Anti-pilferage & Anti-adulteration system for fuel road tankers **Problem Code :** #CSIR6
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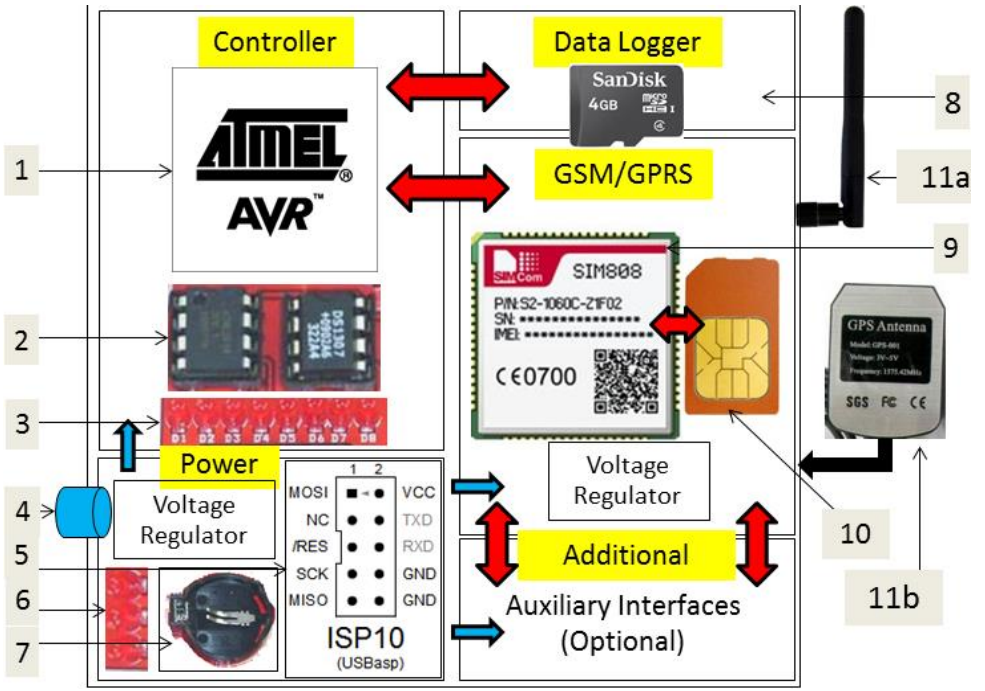
Prototype Description

- The user will be able to track a fleet of vehicles custom-fit with tracking hardware, in real-time, using a Web Browser plugin.
- At the end of a vehicle's journey, a customized report will be generated, describing the route taken, stops made & openings of the drain valve. This will be helpful to any organization to study the on-route behavior while making sure no pilferage/adulteration of fuel takes place.
- It consists of two modules - ***Main Board*** & ***Sensor Extension***.

Main Board consists of 5 segments:

1. Power - Supplies power to the circuitry.
   - It consists of - main & on-board supplies. Main supply would be 12 V, on-board supply would be 3V using CR032 cell (for RTC). In-system programming (ISP) can be done using USBasp.
2. Controller
   - An 8-bit AVRμc controls the operation of GSM/GPRS module & ensures consistent logging of data. Special entries will be made to the data-logger every time the main power is cutoff (indicating stoppage of vehicle). This information is also conveyed to the Server in real-time.
3. Data logger
   - It's a MicroSD card storing travel-time information as 128-bit frames. This consists of real-time co-ordinates (recorded every 5 seconds).
   - Text formatting (using descriptors) will be done for these frames to allow easy interpretation of the records, in case user needs to verify.
4. GSM/GPRS module
   - Currently SIM808 is being used to provide data-communication using GPRS, and GPS tracking using L1 frequency (1575.42 MHz) receiver.
5. Additional module(s) – the **Sensor Extension**
   - 10 pins would be drawn out for adding SPI/USART compatible modules. These will be used to interface compatible sensors for recording the OPEN duration of drain valves/lids.



Technology Stack

 # Hardware

To save space, hardware modules have been referenced in the descriptors list.

 # Software

for hardware programming

Atmel AVR Studio 6
GNU C-Compiler (GCC)
AVRdude (for ISP)

for server deployment

Google Maps Web Services API
Google Maps JavaScript Client API
Apache HTTP Server
Python-Django Framework
Xampp package
Notepad++ Editor

Hardware Descriptors

1. AVR 8-bit microcontroller
2. RTC & EEPROM
3. Status LEDs
4. Input Power (main) – 9V
5. ISP interface
6. Power indicators
7. CR2032 (on-board power-supply)
8. MicroSD card
9. SIM808 module
10. SIM card
11(a,b). GSM, GPS Antenna

Users

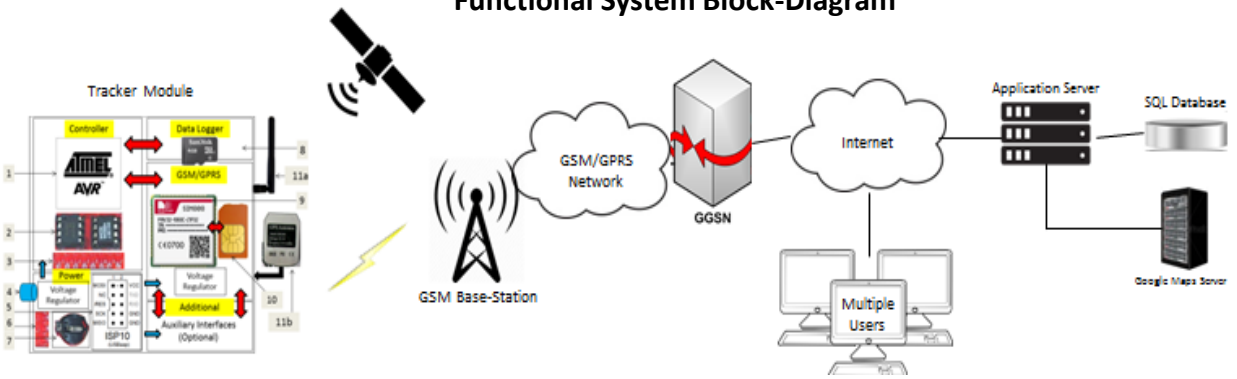
1. Maintenance operators, who will monitor the tanker's movement in real-time.
2. Operators at start/stop points, who ensure loading/unloading of fuel-tanks.
3. Truck-drivers, whose journey will be recorded by the hardware unit.

Use-Case

The travel-route information will be provided to an application server, as described before. The 'additional module(s)' will send alerts if drain valve is opened.

(See the functional-diagram to the side)

Functional System Block-Diagram



The application server will ensure proper delivery of tracking-information to the user, who will see it using his/her browser in real-time.

Dependencies

1. Active HTTP Application Server.
2. Active 2G/3G GSM Service in the area.
3. 'Additional Module(s)' will be decided, based on the mechanism of drain valve operation.

Showstoppers

1. **Google Maps API Pricing (for commercial applications)**
   - Google Maps Web Services API provides a collection of 8 APIs for diverse needs. Especially useful to our solution are the Roads & Distance Matrix APIs.
   - However, for commercial use, they must be licensed.
2. **Improper installation of hardware module**
   - The hardware must be installed in a secure location, where it can be provided with a proper power input. A study of RF behavior near the installation will be helpful to ensure proper system behavior.

Notes

GPS-compatible modules (like SIM808) offer much more functionality than we require for this problem.

Hence, it seems useful to first implement our solution using a SIM808 development board. This allows us to quickly verify our AT-command sentences using an RS232 interface.

Once all the parameters are fixed, a SIM808 SMD-chip will be fixed onto the PCB, and can be programmed only through the microcontroller.

Future Use

Cargo Ship Tracking

Using the OpenCPN stack, interface can be provided for tracking fuel-containers on-board cargo ships.