EUROPEAN ACADEMIC RESEARCH
Vol. X, Issue 10/ January 2023

Impact Factor: 3.4546 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Intelligent Transportation System Architecture (ITS)

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Abstract

The purpose of this paper is to treat, explain the way of operation, respectively the connection schemes that should be made within an intelligent system for remote control of vehicles or objects in motion or standing, also describing the role of each component in this architecture, intelligent transport system or similar.

Keywords: GPS, GPRS, MMC, server, architecture, GSM, AVL, FM110, microcontroller

1. ARCHITECTURE OF THE COMMUNICATION MODULE OF THE VEHICLE MONITORING SYSTEM

Figure 1 shows the architecture of a server which is used in intelligent transportation systems, respectively the way such a server is built, how it functions and interacts.

This scheme in this paper will only serve to give us a vision about this server otherwise the essence of the paper is to show only one component of this system or rather to explain only the communication module architecture of a monitoring system or managing a vehicle on the move, a fleet of vehicles or similar.

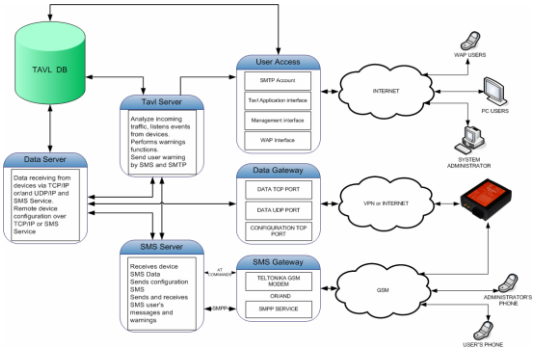

Fig. 1 ***AVL Server Architecture - Triola***

The following describes the architecture and technique of implementing the communication module for vehicle monitoring.

Particular attention has been paid to potential problems regarding the performance of the system by describing the structure and implementation techniques, that enable us to minimize these problems.

Introduction - Vehicle monitoring system is a complex software and communicating system, whose task is to generate periodic or even real-time reports regarding the position (location) of vehicles through the GPS Global Positioning System (GPS), processing, reserving and making these reports available to potential users upon request.

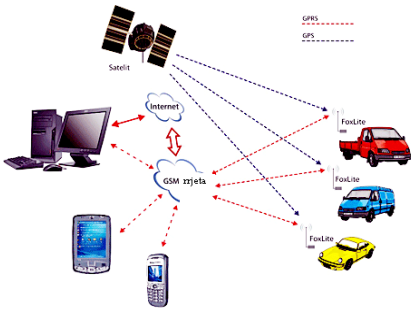

Fig 2. Schematic overview of the operation of an intelligent transport system

In addition to the position (location) of vehicles, this system provides other parameters such as, the speed of movement of vehicles and other occurrences or parameters, which are detectable through the various sensors installed in the vehicles.

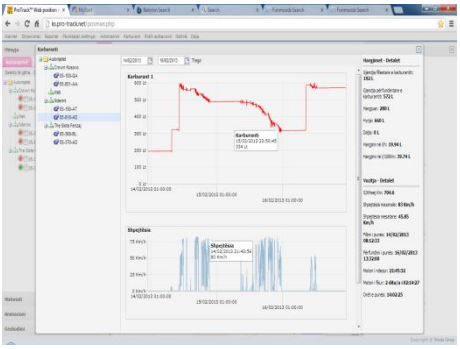

Fig.3 Visual representation of one of the reports provided by ITS

The order of the basic components of this system, from the source of information to the end user, is as follows:

- Positioning device - which is usually mounted on the vehicle and consists of a satellite receiver (GPS receiver) navigator, communicating device and incoming sensors.

- Communication Infrastructure - for transferring data (orders, commands) between the positioning device and the activated communication module (GPRS, SMS) (which we have purchased from the provider).

Communication can be one-way, from vehicle to activated communication module, or two-way.

- Activated Communication module - which receives (accepts) commands-orders-deliveries-notes from the positioning device, which is found in the vehicle and these notes for internal identification of the vehicle and sends them for processing.

- Deliveries Processing module - which interprets and stores deliveries-orders-notes that were acquired or came from the activated communication module.

- Visualization and report generation module - which displays the data about the vehicle by value processed, providing the user with the form or adaptation that he has requested.

There are several ways to integrate or implement the last three modules and this depends on who builds this application and its purpose, but these three modules are usually integrated into a single application.

This application, when the last three modules are integrated into one whole, is suitable for use in cases when it is used for a small number of vehicles (up to 100) and when these vehicles belong to a single company or enterprise.

However, if we provide this monitoring system for use to different companies, which have a large number of vehicles with different parameters and with different requests regarding to them during monitoring, then separating the communication modulebrings the following advantages:

- **Scalability** – which means that by incresing the load for vehicles or for notes we can add parts(to increase the performance of application) to communication module, such as, for example, migrating form a current version of the database to a newer versions, then creating new scripts, incorporating new application requirements etc.
- **Redundand (additions, extras) –** where parts of the communication module can take over the role of the other, if one fails.

The potential disadvantages of this system or of this selection are the additional delays in the distribution(sending) of data and the complexity of configuring the entire system This paper describes the communication module architecture designed to receive data or input from a large number of vehicles, with minimal delays in distribution or deliveries and also acknowledging the possibility of the Redundand effect.

2 GENERAL ARCHITECTURE

2.1 FM 1100 communication module used in AVLTriola (AVLT) application

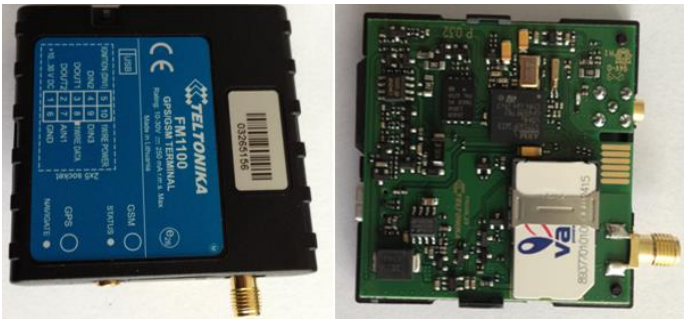

Fig. 4. ***Modulit FM 1100***

The implemented scheme of the device or module for monitoring moving objects would look like in the following figure 5.

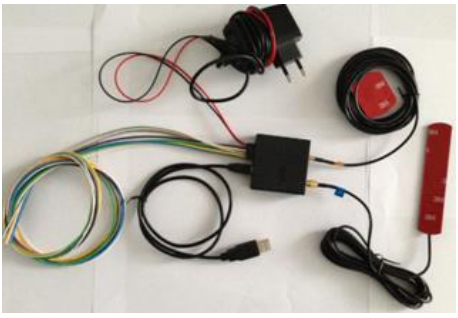

Fig. 5. ***Connection of the GPS receiver, antenna and supply modules***

The main features of the vehicle monitoring device (module) are such that they have a very compact design by incorporating modern electronic components with a high degree of integration, such as:

- GPS FM1100 module
- GSM/GPRS and the communicating link SMS

It is also important to note that this module is designed for active and passive vehicle monitoring.

The hardware architecture of the vehicle monitoring device is shown in the following figure 6.

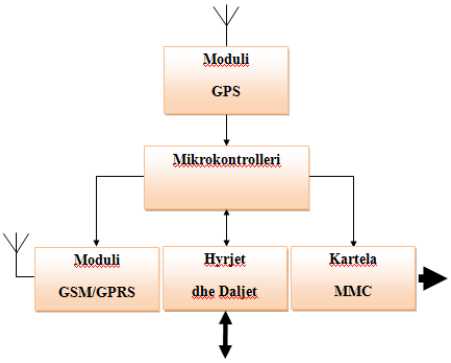

Fig. 6. ***Scheme of FM1100 communication module***

- **GPS Module**

The GPS module consist of an antena that can be temporarily and permanently connected for the purpose of performing or receiving signals from orbiting satellites.

The GPS module has the task of processing the data (notes) that arrive through the antenna or the receiver of the signal, and based on this data, the message is constructed about speed, position, time, etc., fig. 7.

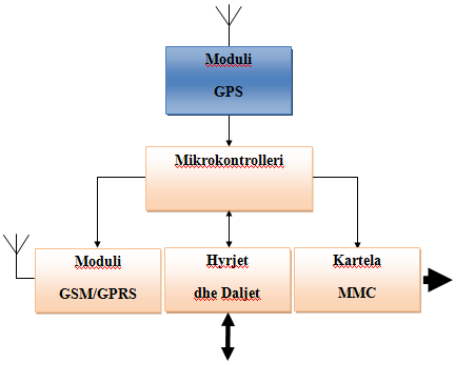

Fig. 7. ***Scheme of GPS module FM1100***

- **GSM/GPRS module**

The GSM / GPRS communication link is required to perform active vehicle monitoring and has the primary task of transmitting coordinates to the GPS center or more specifically transmitting to the control center the vehicle's latitude, longitude, altitude and real time.

There is also the option of configuring the device by sending SMS, for example, by sending an SMS containing **__setparam 1271_21201** (these numbers vary depending on your provider or internet distributor which in our case is Vala) to the number of the card which is found in the GSM / GPRS module the device can be configured

In this case, through this SMS, where the numbers given after the first word are parameters of the network (internet) distributor, we configure the module located in the vehicle from any distance.

Also the standard GSM antenna can be integrated with the GPS antenna.

Communication here is enabled by the GSM modem, SMS services and GPRS.

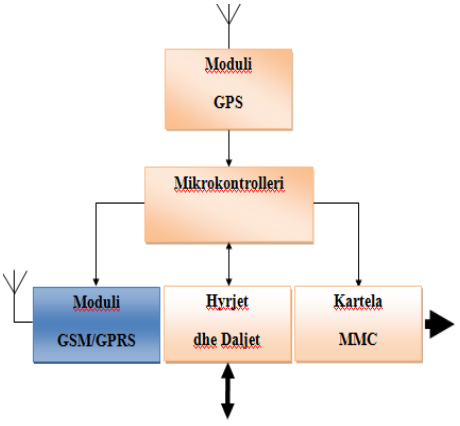

Fig. 8. ***GSM / GPRS module scheme***

- **MMC card**

The MMC card is intended to provide the desired memory for the location of the buffer(memory), while in the case of passive monitoring, which is the result of signals being rejected by the GPS satellite system for various reasons, such as obstacles along the route of the signal from the GPS satelite system to GPS, then the MMC card serves as a medium that is required to transmit the collected data to the moitoring center for lby the designated user at the designated time.

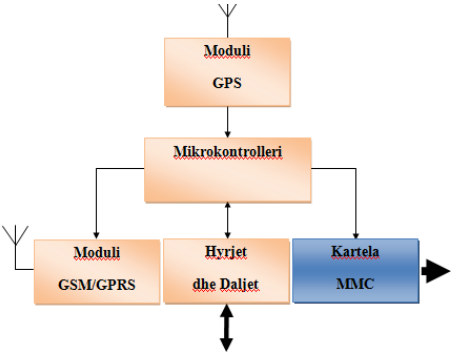

Fig. 9 . ***FM1100 communication module schema – MMC card***

- **Inputs and outputs**

Four discrete inputs enable monitoring the status of the vehicle (engine running / not running, snow cleaner on/ off) etc.

Whereas four relay outputs allow the system to be driven in the vehicle (engine or vehicle lock / snow cleaner steering) etc.

It is also important to note that there is the possibility of expanding (increasing) the number and type of inputs and outputs in an unlimited way.

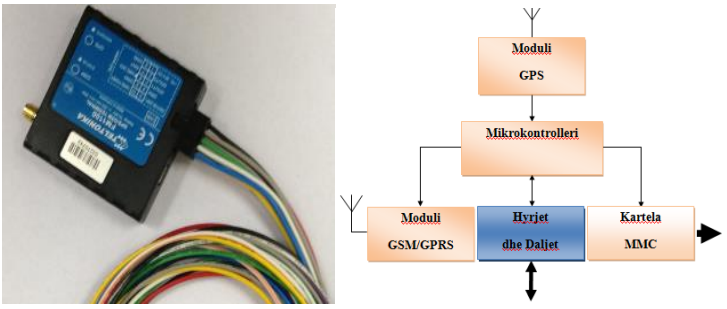

Fig. 10. ***Schema and layout of the FM1100 communication module***

- **Microcontroller**

The microcontroller receives and sends or transmits data, ensures the device's operating logic and enables easy execution of PLC functions. [24]

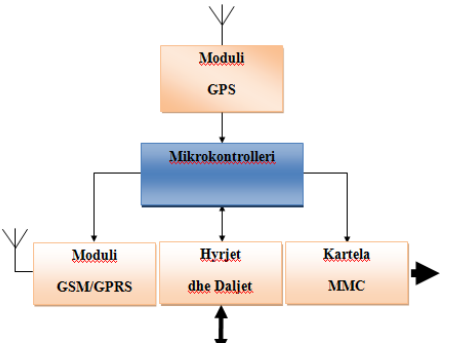

Fig. 11 . ***FM1100 communication module scheme - microcontroller***

The microcontroller connects the subsystems of the monitoring device.

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