IMPLEMENTING AN ALERT SYSTEM FOR WATER FLOODS TAKING INTO ACCOUNT SUSTAINABLE DEVELOPMENT

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The technological level of our society helps us to ensure a certain safety which has to be increased by accepting in the future the importance of the sustainable development. The authors have adapted the existing international water flood alert system at the Romanian's environment and water flood risks. The GPS mobile monitorising system special designed by the authors in order to prevent future flooding is being described from the technical components point of view. This paper also presents an automated monitoring data transmission system, which is optimized by the authors. Its design model is being described by the authors based on their passed experience with such systems.

Nivelul tehnologic al societății noastre ne ajută să asigurăm o anumită siguranță, ce trebuie să fie mărită de acceptarea într-un viitor apropiat al importanței dezvoltării durabile. Autorii au adaptat sistemul international de alertă al inundațiilor la mediul român şi la riscurilor de inundații existente pe teritoriul nostru. Sistemul mobil GPS de monitorizare special realizat de autori pentru a preveni viitoarele inundații este descris din punct de vedere al componentelor tehnice. Această lucrarea prezintă şi un sistem automat de monitorizare a transmisiei datelor, ce este optimizat de autori. Modelul lui de realizare este descris de autori pe baza experienței lor anterioare cu astfel de sisteme.

Keywords: sustainable development, GPS, GPRS-SMS, water flow, SAMTD

Introduction

In 1789, Thomas Jefferson said: "the earth belongs to each of these generations during its course, fully, and in their own right. No generation can contract debts greater than may be paid during the course of its own existence." Now in 2005 dark times have come for Romania and other European countries. We have consumed much more than we can afford, the effects of global warming caused by an extreme level of pollution have triggered a massive weather's change.

Monitoring of Container Door Seals on high water level using a land-based GSM Mobile telephone is now a practical reality. Until recently, expensive

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satellite tracking was the only available solution to monitor assets in remote areas and on the middle of the Oceans. Apart from the high costs, satellite tracking has its own technical restrictions and practical reservations. The GPRS-SMS Gateway Platform has been announced for commercial deployment through a marketing collaboration between TriaGnoSys GmbH of Wessling and MobinTeleCom of Helsinki. The technology is based on research in the Wireless Cabin project. GSM connectivity and Internet access On Land, On Air or On Sea is now a reality.

The turnkey solution offered by MobinTeleCom consists of a Tri Band 900-1800-1900 GSM-GPRS-GPS Telematics Transceiver integrated with a RFID Transponder on the Container Door Seal. Regular heartbeat pulses transmitted by the Transponder, keeps the Telematics Black Box installed within the inside of the water's Container Door, fully informed of the status of the Door Seal. Any breach of security, compromise or tamper of the Door Seal triggers an alarm instantly to the security flood monitoring station on ground, giving co-ordinates, with the date and time of the incident.

TriaGnoSys and MobinTeleCom may offer this turnkey service globally, through a limited network of franchisees, which are expected to satisfy stringent security demands.

The convenience of using ones own GSM mobile or PDA or the Laptop seamlessly in a train or boat or plane, and receive one monthly invoice from ones own Telecom Services Provider is one benefit, says Dr. Axel Jahn the Managing Partner of TriaGnoSys GmbH and Senior Projects Manager of German Aerospace Center. Of course, the ability to have seamless connectivity anywhere, all the time, is an invaluable business tool. The applications and usefulness are limitless [4].

Seamless GSM connectivity, SMS, Email and Internet access when one is traveling by train, or by boat or by plane, is now a new customer-service, a commercial opportunity and a reality, giving both customer satisfaction and an opportunity to create a new revenue stream.

Apart from marine related security applications, MobinTeleCom and TriaGnoSys welcome enquiries from operators of Commercial and Executive Aircraft, Cruise Ships, and Intercity or Transcontinental Fast Trains.

Flood system security applications for remote locations are used by people who are seeking cost-effective seamless GSM communications and Internet access solutions from the GPRS-SMS Gateway Platform in order to be prepared for any flood phenomenon and monitories their house or assets.

This is an example of a system which can be used in the flood preventing process, example presented within Fig. 1.

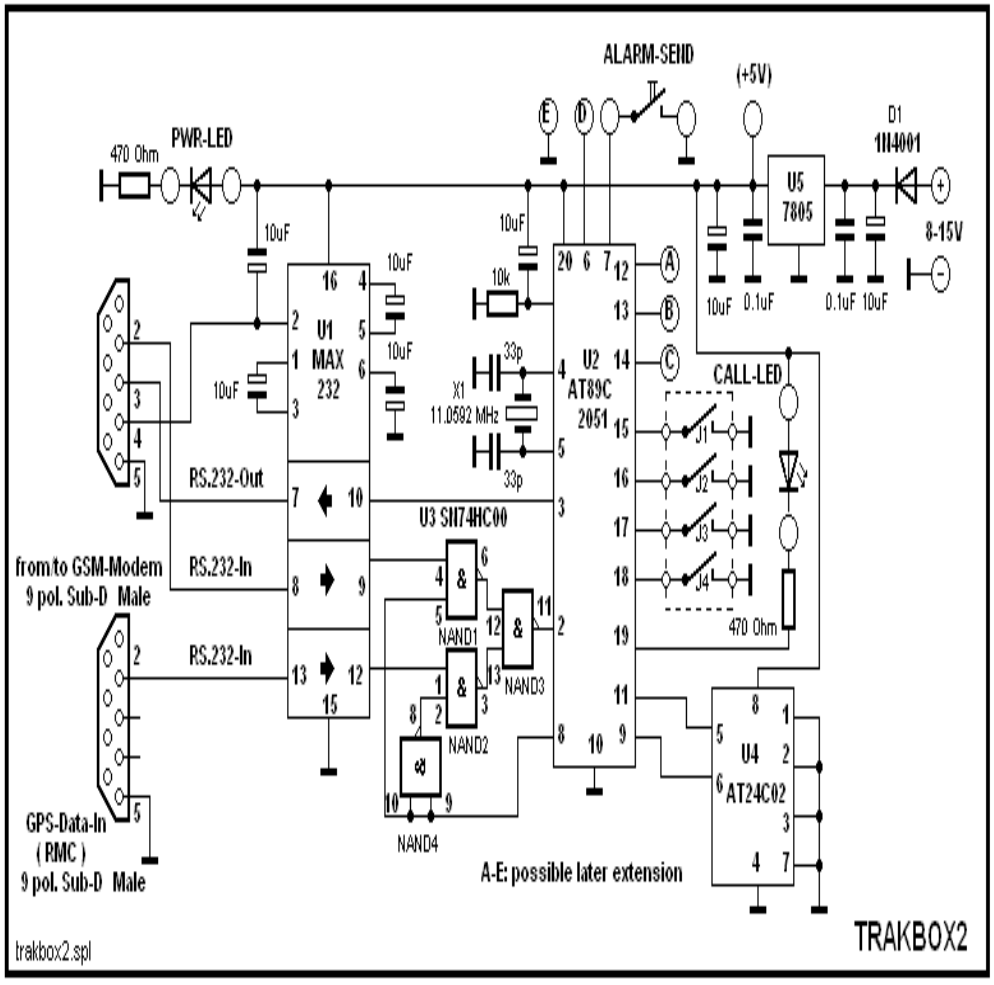

Fig. 1: BlackStar BS-1

BlackStar BS-1 is intended for fixed or mobile objects monitoring and control. When external GPS receiver is connected, the device process and transmits positioning data. This device has the Technical Specifications presented within Table 1.

Table 1

Technical Data

Communication	
GSM	E-GSM 900/DCS 1800 or E-GSM 900/DCS 1800-GPRS Class 10 GSM phase 2/2+ SMS Text mode Output performance: □ Class 4 (2 W) for EGSM 900 □ Class 1 (1 W) for EGSM 1800
Positioning	
GPS receiver	External GPS receiver Interface: RS-232 NMEA 0183 messages: $GPRMC
Interfaces	
Hardware	SIM card holder LED indication Inputs/Outputs: □ Inputs: 3 □ Outputs: 2 Power supply: □ Li Ion Battery □ External power supply 10...35 VDC Power consumption: □ 1 mA in sleep mode □ 120 mA average in operation mode
Phone	Communication protocol based on the open specification
Internet	Compatible with GEOFIX web service
States	
Alarm	Alarm 1: Guard is on and Input 1 is activated Alarm 2: Guard is on and Input 2 is activated Alarm 3: Low power condition
Guard	On/Off

Physical Dimensions	
Dimensions without connectors, W/D/H	80/60/20 mm
Weight	200 g
Firmware	
Version number	2.00.11 Upgradeable via XModem

1. Actual knowledge stage in the areas related to the proposed subject

The problem of water flow monitoring to prevent incidental floods or ecological incidents has become important worldwide since the apparition of major climate changes due mostly to human activities: soil erosion, global warming, melting of the ice caps, etc. Starting from the 80's of the past century, advanced monitoring systems has been implemented to survey river flows having high risk of water floods. The collected data have been organized in data bases, firsts appearing in U.S. and Canada at the beginning of the 90's the importance of the sustainable development being acknowledged.

Together with the progress of I.T. technology such data bases have been recorded in electronic format on various servers connected to Internet. Most interesting cases from the point of view of similarity are those related to monitoring hilly or mountain river flows, where hazards can occur within an hour. For example, in U.S. there is a Natural Resource Conservation Service within the Department of Agriculture which is specialized in monitoring water volume in different hydrograph areas, especially in mountainous Colorado, Washington or Montana. On this Internet site, data are refreshed daily or weekly [1].

Such achievements are not enough in natural disasters due to the quickness of weather phenomena and slowly response of local authority. This is why private initiatives or at state level have developed automated telemetry systems that can be posted on the Internet in the shortest time [5]. Such systems are implemented, for example, by ORSANCO - Ohio River Valley Water Sanitation Commission with the so-called Project Overview. Such advanced systems can process real-time data, transmitting new information every hour.

Now, all European countries, including Romania, have on line data about main water flows, especially navigable ones. Such data are monitored in hybrid half-automated systems and data are refreshed daily, which can be considered a

large interval of time in case of sudden freshet or biohazard pollutions. In all the countries, catastrophic floods occur on small rivers, away of highly monitored areas.

A forward step can be considered the mathematical model of water flows and the prediction of future flow capacity as it is studied, for example, by the Japanese researchers of Kyoto University [4].

In the same time, Finns researchers from Helsinki University of Technology have proposed an integrated system of Assimilation for Remote Sensing Data to Physical Models in Environmental Monitoring and Forecasting (ASSIMENVI) [2].

In Canada, country with a high hydrographic potential, there are also extended concerns in static and dynamic mathematic modeling of river flows. Operational models based on the IBM's MPSX software packet have been developed by the Toronto University [3].

The concern of different Universities in this field of research has attracted also important firms to become partners in manufacturing complex monitoring equipment for water parameters. This is the case of NORTEK USA or Sutron Corporation who have developed integrated measurement sensors for water quality parameters (water volume, flow speed, various chemical agents concentration, pH, salinity, temperature, etc.), sensors having telemetric capabilities to transmit data. Most recent systems that start to be installed in U.S. consist in series of sensors placed on river flows, transmitting data every 15 minutes, data that are satellite passed to the Internet. It is notable that in 2008, Colorado river area will have a density of 243 sensors for an estimated area of 40.000 km2 [2].

In Europe already exists the so called EFFS European Future Freshet System, to which also I.N.M.H. has participated. The main result is a prototype prognosis system for freshet that anticipate freshet 4 to 10 days in advance, on Mureş hydrograph area, based on the same principles as EFFS [4]. It is important that the system doesn't have a warning role, but a prognosis one, which is different. On the other hand, the evolution in developing unified signal integrated sensors with remote capabilities, through infrared ports or using microwaves has allowed new types of applications in a wider range. Such examples are often seen in Formula One races, mobile communications using telemetry applications provided by Connex and Orange, remote command and control of mining and oil extraction equipments. All these examples assure optimal premises for the proposed research: to place on a mountain river a string of sensors having telemetric capabilities used for warning in case of freshet or environmental pollution.

Despite all this, practical implementation of integrated monitoring systems for water flows which allow a good time response is not usually seen on

mountain rivers not even in the most advanced countries. The special situation of Romania, vast erosion of her soil, massive disappearance of her forests impose installation of modern warning systems which can help saving human lives, material goods and avoid dramatic situations as the ones this year.

2. Potential contribution to the scientific knowledge development and original/innovative aspects of the research

The present situation of Romania concerning the risks of sudden massive floods is probably unique worldwide. There are many causes to explain this: social, material or climate causes. Our project doesn't deal with these aspects. The reality has proven that are many areas, intensely inhabited, on the mountain or hilly valleys where the risk of sudden freshets is increased. Also, economic agents that are polluting some areas still exist, not only through industrial chemical products but also through different improper working methods: clogging, dams, sand excavations. All these aspects required the realization of a monitoring system of water parameters and quality with rapid response time to allow the pre-warning of local authorities and zone population. Such automated monitoring data transmission system (**SAMTD**) can be installed in highly risking flood areas and can serve the local communities situated downstream.

Inside I.N.M.H. there are recent studies over the main flood risking areas: the so called hazard areas. Also, detection via satellite of different climate phenomena is used. The aim of this research project is not to become the substitute for all this, but to offer an engineering product designed to decrease the impact over territory. Until now, in our opinion, no such modern systems have been fully implemented on Romanian rivers, even if that has been tried [2].

The originality of this system consists of:

a. study of field data transmission possibilities using radio waves or GSM services;
b. elaboration of specialized software to integrate the elements of the system and to perform data analysis;
c. the implementation of warning and monitoring system;
d. tests regarding the improvement of system performances.

The present situation in Romania requires the realization of an automated monitoring and data transmission system (SAMTD) needed for warning and surveillance in floods or incidental pollutions for mountain and hilly rivers.

To build this SAMTD, this project has chosen a **simple and effective system**, which can be easily implemented on the field. The system has the following components:

a. autonomous measurement points having sensors for water level, temperature and speed (optional can be added other parameters). To

achieve this, **Remote Terminal Unit** (RTU) measurement stations will be acquired, working on radio channels, 70cm bandwidth (450MHz) or using GSM infrastructure through GPRS packet;

b. data acquisition point. In accordance with data transmission type can be structured with two modules: a central unit and a radio modem. The central unit must have his own memory incorporated and the connection with radio modem must be performed via RS485 serial port;

c. central communication server (gateway) for data recording and monitor report generating.

Table 2 presents the scientific and also the **managerial and administrative objectives which ca be obtained, only by accomplishing the associated activities.**

SAMTD stages *Table 2*

1. Scientific objectives	**Associated activities**
1.1. Design and optimisation of automated monitoring data transmission system SAMTD	1. Analysis of monitoring and data transmission possibilities
	2. SAMTD design and integration of components
1.2. Experimental model of SAMTD	1. Signal conditioning for compatibility of SAMTD
	2. Study of new technologies used to remote transmissions
	3. Implementation of transmission chain
1.3. SAMTD tests and optimisations	1. Laboratory tests and performances report
	2. Optimization of SAMTD to increase performances
2. Managerial and administrative objectives	**Associated activities**
2.1. System positioning study and possible purchaser finding	1. SAMTD presentation to local authorities
	2. Practical simulations of system qualities
2.2. SAMTD equipments acquisition	1. Realisation of conditions of contract
	2. Organization of equipment auctions
2.3. Practical implementation of SAMTD	1. Topology characteristics of chosen area
	2. Real condition test of SAMTD
2.4. Integration of SAMTD in local infrastructure	1. Study of data transmission local area infrastructure
	2. Compatibility of system with other local monitoring equipments
2.5. Results presentation and dissemination	1. Web design of a related Internet site
	2. Meetings and discussions in territory for further system development
	3. SAMTD promotion to future spreading in territory

Conclusions

Starting with previous concerns about remote data transmission during our PhD research, the idea of automated monitoring data transmission system has appeared. Such system can have multiple uses, warning and monitoring hazardous situations. Due to modern proposed solution, the telemetry data transmission system SAMTD can be considered as a **new approach** in this research field of studying hydrograph river flow: impact ways, control and rehabilitation methods which are an anterior thematic area of the environment research domain.

The complexion of such **SCADA** system presents obvious advantages from its simplicity point of view and also from the point of acquisition costs and management. Systems based on radio transmission in 70 cm bandwidth have the advantage of being **independent** from human operators: installation can be performed anywhere there is a possibility of communication with central station. The system is easy to install and maintenance costs are low. Telemetry systems based on GSM services have the advantage of easy installation anywhere there is signal covered by the national GSM network. Intermediate re-transmission stations are not required, which means cost reductions. Data transmission is performed via GPRS network and then via Internet to a central server, from where data can be read by any SCADA program.

Our team, the authors, has experience in implementing data transmission system using radio channels which works in 450MHz bandwidth (430-470MHz) because we used such systems in other several researches.

The possibility of using two different data transmission ways radio channels or GPRS, reduce the inherent risks of research, being used as alternative solutions capable of substituting one with another.

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