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CONTENT

DESIGN AND IMPLEMENTATION OF AN INTEGRATED MANAGEMENT SYSTEM BASED ON OPEN SOURCE TECHNOLOGY IN A GEO-INDUSTRIAL TOURIST DESTINATION

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ABSTRACT

The paper concerns the design and implementation of an integrated management system in the geosite of the Gianna Mine, a mine reconverted into a tourist destination situated in the North-West of the Italian Alps, in the Piedmont Region.

The system is based on a wireless network system, called Scatol8®, which provides information to the TIQMS (Territorial Integrated Quality Management System). These tools have been developed by a research unit within the Commodity Science Area of the Department of Management, thanks to the participation in the multidisciplinary research project "PROGEOPiemonte". The project aims at enhancing the quality of the tourist package in order to improve tourism in the area based on geo resources as well as the industrial heritage.

Scatol8® is a remote sensing network of environmental, landscape and management variables based on open-source technology (hardware and software) that consists of a central and peripheral units connected in a network. Numerous sensors are inserted in the peripheral units, which transmit the data to the central one and, thanks to a server, to the Internet. The sensors and peripheral units can change in type and numbers depending on customers' requirements; thus, it is possible to create a real-time monitoring of each measured variable as well as to evaluate their performance over time.

To set up the Scatol8® wireless network in the Gianna mine geosite, some critical points (due to the microclimate and the morphology of the gallery in terms of low temperature, high humidity rate and wireless communication) have been faced and overcome. In the end, the complete network has been designed and partially implemented, identifying steps for the complete implementation, which is expected on June 2015.

Data can be input for the territorial system. TIQMS is a methodology that allows the user to analyse a region by many points of view, regarding quality, landscape, environmental, occupational health and safety, and social accountability aspects.

All these features are managed because of the European Landscape Convention adopted by Italy and the following international standards: ISO 9001:2008, ISO 14001:2004, OHSAS 18001:2007 and SA800:2008. All these standards require the assessment of some specific indicators that can be evaluated thanks to the information supplied by Scatol8®.

Keywords: *Mining site, tourism, remote sensing network, integrated system*

INTRODUCTION

The paper aims at presenting some provisional results and the methodology adopted for implementing a management tool in a mining site, situated in the North-West of the Italian Alps, currently converted into a tourist destination.

This action represents one of the goals of the three-year research project "PROactive management of GEOlogical heritage in the Piemonte region: innovative methods and functional guidelines for promoting geodiversity knowledge and supporting geoconservation activities (PROGEO-Piemonte)" started on March 1st, 2012 and funded by the Compagnia di San Paolo di Torino.

The PROGEO project consists of several actions, all of them focused on the valorisation of the georesources in the Piemonte region, in North-West Italy, and, in particular (Ferrero, et al., 2012):

- *Review and improvements of the regional geosite inventory;*
- *Assessment of the main thematic areas of the Piemonte geodiversity;*
- *Specialised analysis on related critical issues of Earth Sciences knowledge;*
- *The Monviso massif (MM) and the Cottian Alps (CA) as symbols of the Alpine chain;*
- *Experiments on visual representation of geological environments and processes;*
- *Development of geodiversity action plans including educational impacts;*
- *Promotion of "geodiversity economics".*

In this general context, a specific activity has been devoted to enhance the role of an ex-talcum mining site, converted into a geotourist destination in the mid-'90 and actually visited and seen by about 14,000 people a years (in most cases, students).

Although the most recent definition of geotourism is supposed to be especially related to "a form of natural area tourism that specifically focuses on geology and landscape" (Newsome & Dowling, 2010), several authors highlight the positive role of the mining site in enhancing tourism in old European mining Regions (Rybár, 2006). It is, for example, the case of Poland and Germany (WóJtowicz, Strachowka, & Strzyź, 2011).

In the last few years, an intense literature focused on tourism in ex-mining sites has been produced. Some authors

(Pretes, 2002) (Cole, 2010) underline the importance of the involvement of the local community in the conversion of these sites into tourist destinations and the possible economic benefits and opportunities from mining heritage (Edward and Lluedés i Coit, 1996) (Conesa, Schulin, & Nowack, 2008). Furthermore, in several studies and researches, a geosite is considered a vector for an educational experience based on georesources and plays an important role in order to enhance the benefit of the tourist activity (Walliss & Kok, 2014).

If, on the one hand, this is a form of tourism that can entail economic benefits for the local communities, and on the other hand, a tool able to help managers in the management of the mining sites, it may represent a fundamental key for improving the quality of the tourist experience.

DATA AND METHODS

The methodology adopted for enhancing the ScopriMiniera/ScopriAlpi site as a tourist destination is represented by the integration of two tools: an Integrated Management System and the remote sensing network of environmental variables, called Scatol8®, both of them elaborated within the Commodity Science area of the Department of Management (University of Torino).

As far as the integrated system is concerned, it is a management system based on the TIQMS - Territorial Integrated Quality Management System - model. TIQMS analyses the management of the site under different perspectives: quality, environmental and landscape, health and safety, and social accountability (Beltramo, Duglio, & Caffa, 2009). All these aspects are taken into account thanks to the adoption and integration of the following international standards: ISO 9001:2008, ISO 14001:2004, OHSAS 18001:2007, SA800:2008 and the European Landscape Convention.

The starting point is the Integrated Preliminary Analysis that studies the operational processes of the organisation's activities and their environmental and health and safety implications paying simultaneously attention to the customer satisfaction. Due to this preliminary analysis, the TIQM system offers a tool and a methodology to implement a set of managerial and operational procedures in order to control and improve the quality of services, the environmental and landscape performances of the organisation and, at the same time, to take care of the employers.

TIQMS was supposed to be implemented *in primis* by the Public Administration as a tool for ruling territorial areas (Beltramo, Vesce, Duglio, & Giardino, 2011). Because of the adaptability of this tool, however, in this specific context the most important elements characterising the TIQMS have been drafted and implemented (see Figure 1).

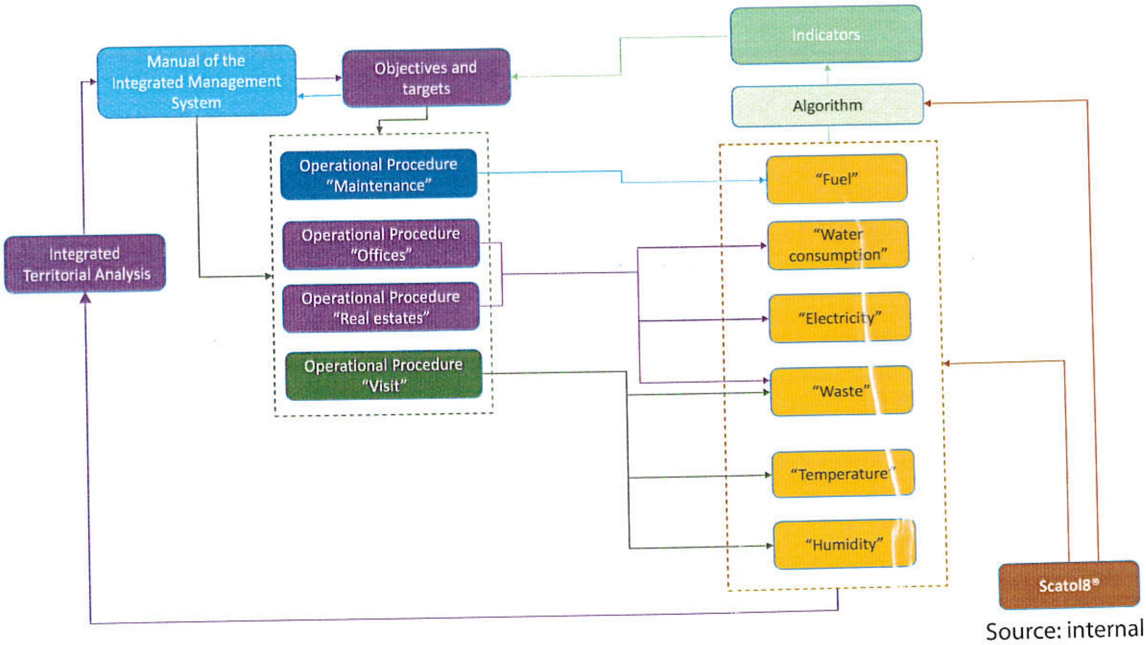

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Figure 1. *The system*

In the first application of the TIQM system to the ScopriMiniera/ScopriAlpi mining site, special attention was paid to the most important elements of the system, in other words the operational aspect of the tourist processes. The research team carried out Integrated Preliminary Analysis in order to identify the core processes related to the tourist package with a special focus on the quality and environmental implications. Thanks to this first step, four Operational Procedures, reported in the following list, were drafted:

1. Visit
2. Real estates
3. Offices
4. Maintenance

From each of them, one or more records on environmental variables derive. These records allow the evaluation of specific indicators, useful for understanding the achievement of the management system targets.

For collecting the environmental data, the TIQM System is integrated with Scatol8®, a remote sensing network of environmental, landscape and management variables entirely based on free and open technologies, with a view of controlling the costs, the openness and ease of access (Beltramo & Margarita, 2012).

Scatol8® consists of a central unit and peripheral (end) nodes, connected in a network. Numerous sensors, able to detect and monitor variables, are connected to the peripheral nodes, which transmit the data to the central unit, connected with a server. The sensors and peripheral units change in type and number depending on the customers' requirements.

Designed under the perspective of sustainability, Scatol8® is inspired to meet three main criteria:

1. Modularity. The system is constituted from time to time, according to the requirements and specifications of each application.
2. Accessibility and dissemination. Hardware and software are fully based on open technologies and software in view of cost containment, openness and ease of access, even for training purposes. Scatol8® is not only a product, but also an initiative to spread knowledge, which aims to involve young people in the creation of technology (and not only in its use). It is accompanied by information tools on the relationship between observed variables and sustainability and proposals.
3. Environmental compatibility. When possible, all electronic devices are placed in recycled containers, coming mainly from the food and electronic industry, transformed and adapted to their new functions, or in containers made of wood (a renewable resource), or even cardboard.

The sensor network is usually composed by the following blocks (Figure 2):

Sensors

Sensors already included in the platform are resistant to temperature, humidity, water and electric power consumption, wind speed and direction, rain and snow quantity, gas and intrusion detection, air pressure, light, soil moisture, radiation and others.

Node

Despite not been connected to the same sensor, each node shares the same basic construction. The core part has been implemented using the prototyping platform Arduino UNO, which is based on the ATIMEL ATmega328 microcontroller. The second layer of the architecture is the wireless SD shield. It adds one socket for connecting XBees and another one for using a microSd card. This last opportunity is used in case of faults: if the coordinator node is not reachable, data are stored on the node just until the moment when the coordinator availability would come back. The last layer is the groove base shield produced by Seeedstudio. It offers many groove standard connectors for mechanical interfacing with sensors.

Coordinator

The coordinator node is based on the prototyping platform Arduino mega. This microcontroller differs from the one used in the end node (based upon Arduino UNO) because the RAM is not sufficient for the SD, XBee and Ethernet library at the same time. The Ethernet connection and the micro SD functionalities are covered by the Arduino Ethernet Shield, which is based upon the WIZnet W5100 chip. The Arduino XBee shield interface offers a socket for the XBee ZigBee based radio. Data packet transmission between the microcontroller and the radio uses the digital port 0 and 1 of the micro while, on the other hand, GND and VCC pins of the Ethernet shield have been physically connected to the ICSP corresponding on the ArduinoXBee because the first one has not a female ICPS connector ready to use.

ZigBee network

Zigbee is a specification based on the IEEE 802.15.4 standard used to create a personal area network with small and low-power radios.

The most used radios in the Scatol8® network are Digi XBee series2 pro version. It is possible to mix "pro" and "simple" versions because they only differ in the kind of current absorption and covered wireless range (Digi). Despite sometimes a star network topology would be sufficient, we choose to adopt mesh radios (series 2). The reason is that series 1 and 2 cannot speak together and so adopting ZigBee radios from the beginning is the only way to easily switch from star to mesh network topology in case of WSN future expansion.

Server

The data collected by the coordinator are sent to a server through the internet. Using open source technologies you can use Apache as a server, the database engine Mysql and Php for creating dynamic web pages that show collected data.

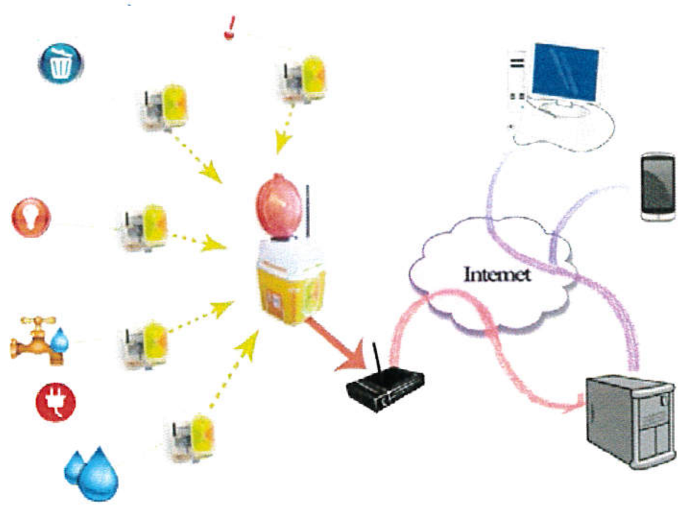

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Figure 2. *Example of Scatol8® network*

Furthermore, the data collected by the coordinator are sent not only to the internet, but also to the TIQM System, thanks to its computerized procedures. The architecture of the computerized structure is reported in Figure 3.

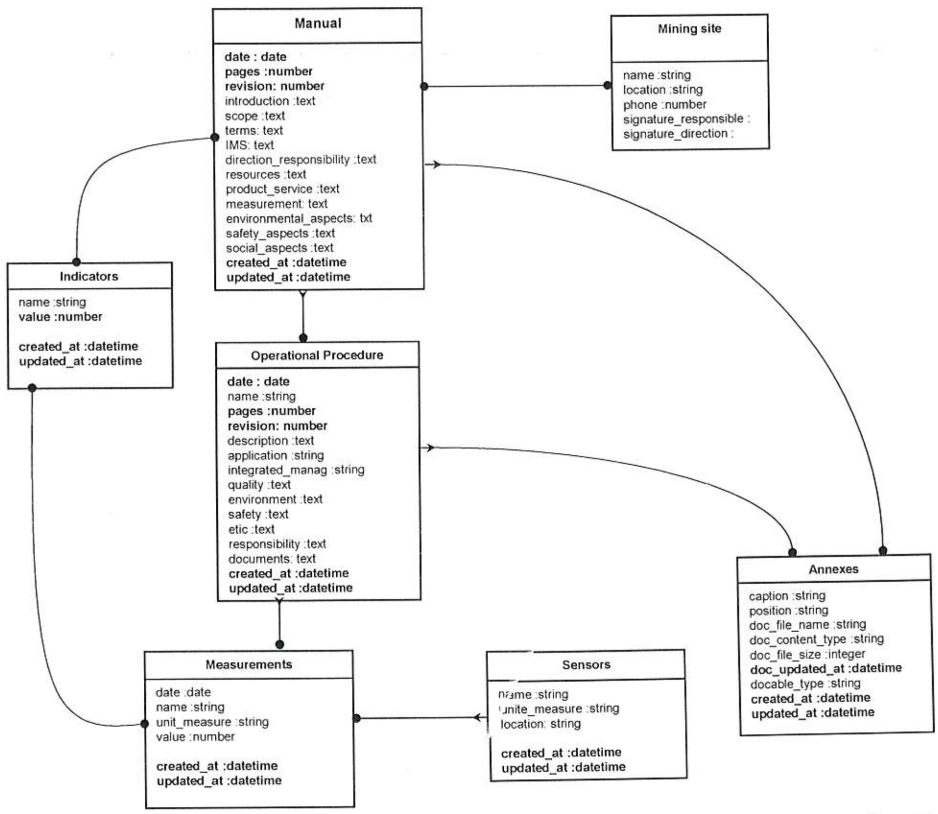

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Figure 3. *First application of the database to TIQM system*

3. RESEARCH FINDINGS

1.1 Project steps

The application of Scatol8® in the particular environment of the mine required many steps.
Because of the complexity of the project, we decided to divide it into 5 parts:

- Hardware safeguard.
- In mine communication.
- Sensors.

- In situ visualization
- Remote data synchronization.

The following two paragraphs show how the first two points have been implemented. The last three steps are currently under development.

1.1.1 Hardware safeguard

1.1.1.1 Problem and solution

Humidity in the mine could be very high. In some areas the relative humidity reaches 95%. Looking at our hardware datasheets it is possible to affirm that humidity over 60% should damage electronics components. Two main kinds of phenomenon can occur: corrosion (De Sanctis) (Ambat) and short circuit (Apiste) (Multisorb) (Seai).

Three solutions satisfy the cost, size and feasibility requirements:

- Protective electronic circuit spray.
- a heating pad to increase the temperature and consequentially to ensure the relative humidity decrease (Robert B. Comizzoli, 1999).
- hygroscopic salt

We have implemented all the solutions at the same time. The chosen heating pad is the SparkFun COM-11288 that is built to work at 5V. As shown in the product video (SparkFun, 2012) it can safely works at 9 or 12 volt increasing a lot the heat production. The use of that heating pad requires a power supply able to assure a 2A current, although the Scatol8® networks usually adopts a current of 0.7A.

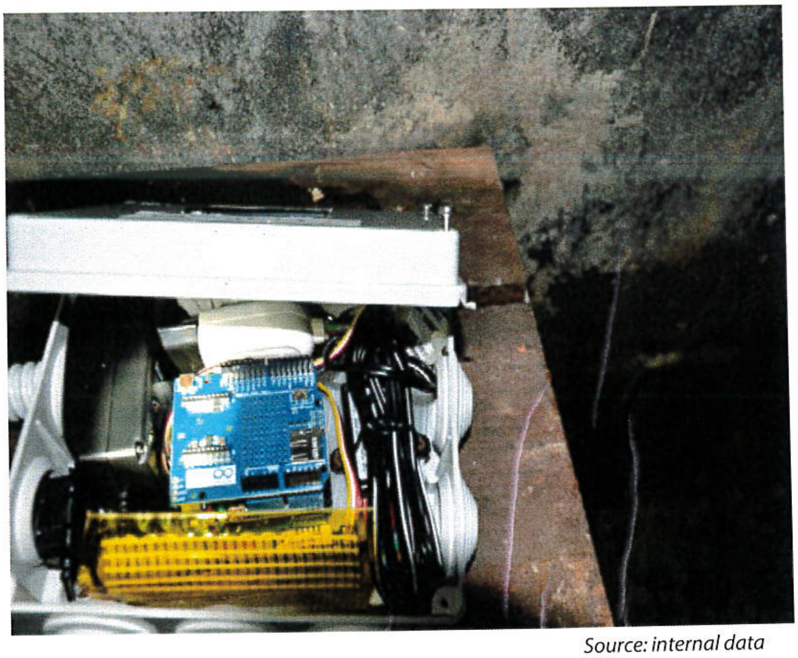

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Figure 4. *The heating pad connected to one node*

Another problem related to the mining environment is electricity flicker that should be caused for example by lightning strike. The presence of a power plant nearby also produces noises on the electric line.

The mine was equipped with many surge protectors to solve the first issue. On the other hand, a noise filter into each node neutralizes small electric noises.

1.1.1.2 Test and results

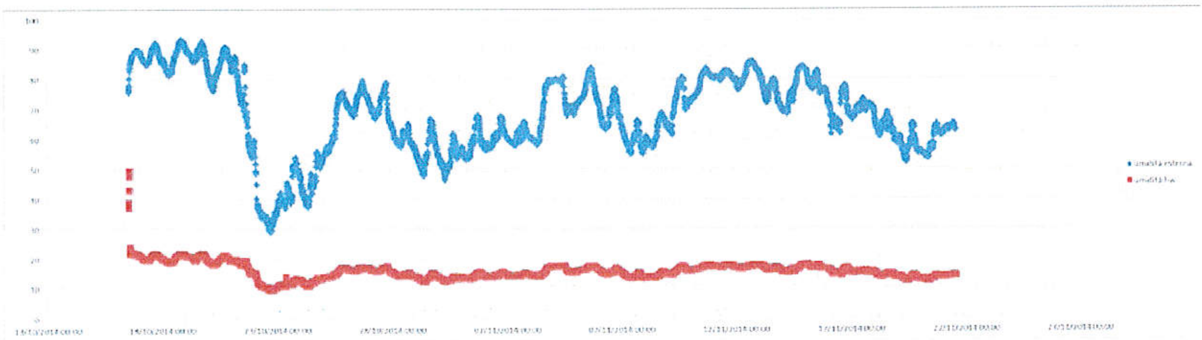
The best way to test our system efficacy against humidity was to sense temperature and humidity inside a node and to compare them to the ones outside it.

We decided to place one node at the beginning of the mine where there is less moisture because of the air exchange with the outside and one node into a small room near the principal corridor because it was one of the most humid places with almost no air exchange with the rest of the mine. Figure 5. The test node map shows where the nodes were placed during the first step of the tests, which lasted from the 16/10/2014 to the 21/11/2014.

Source: internal data

Figure 5. *Test node map*

Figure 6. Node 1 humidity and Figure 7. Node 1 temperature demonstrate that the relative humidity inside the node 1 (the red line) is not only lower compared to the outside (the blue line), but also that the range of values is smaller. The moisture outside the node influences the air inside the box that is not isolated.



Source: internal data

Figure 6. *Node 1 humidity*

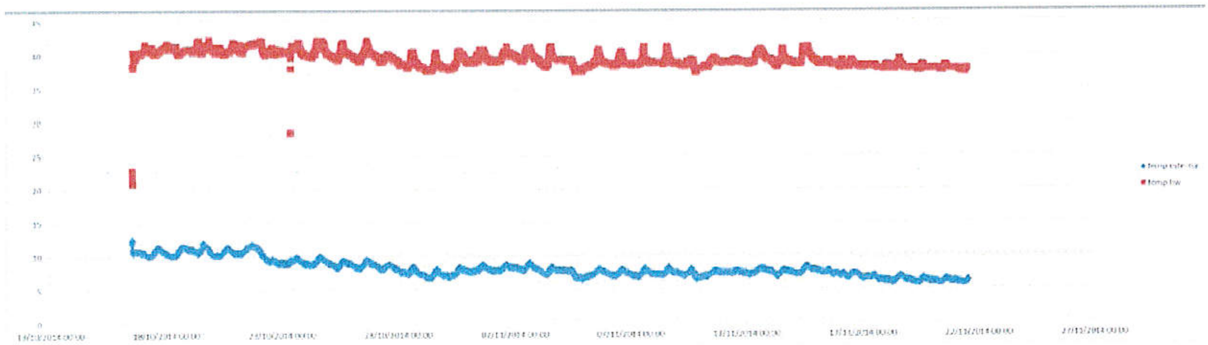


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Figure 7. *Node 1 temperature*

Figure 8. Node 2 Humidity and Figure 9. Node 2 Temperature show the inside and outside temperature and humidity for the node 2. Compared to the node 1 graphs it is possible to notice that the data of node 2 are linear because they are less influenced by the outside mining environment.

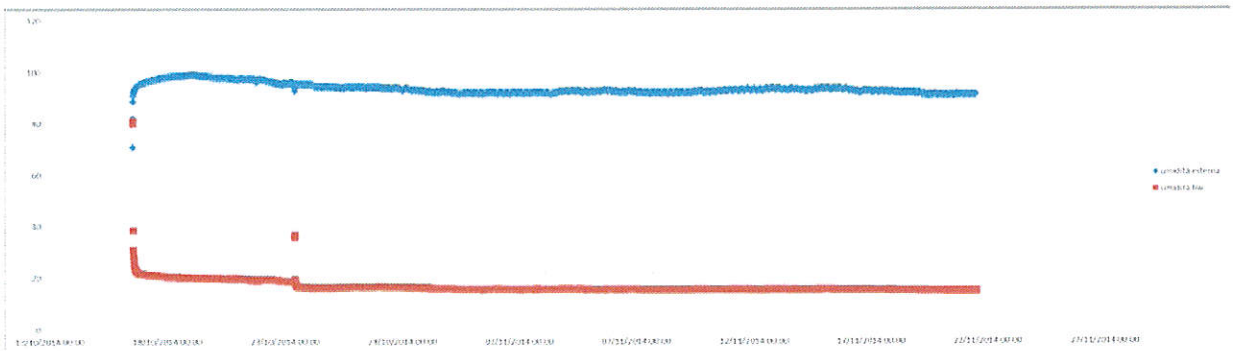

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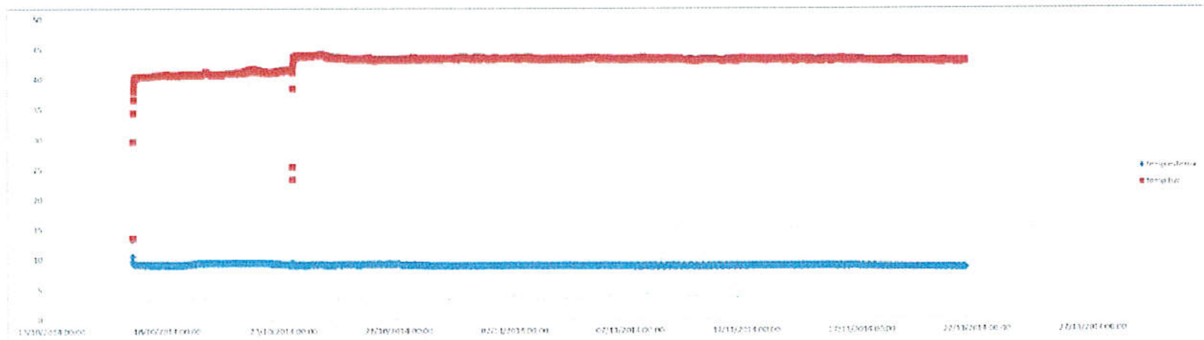
Figure 8. *Node 2 Humidity*

Changing the heat pad voltage has a direct impact on the temperature and the humidity. On the 23/10/2014 the heat pad voltage of node 2 has been increased from 9V to 12V. Due to the box opening you can see some values measured on that date that differ from the average.



Source: internal data

Figure 9. *Node 2 Temperature*

1.1.2 In mine communication

1.1.2.1 Problem and solution

Trying to transmit data between nodes, we have considered three main possible solutions: to use the existing optic fibre line in the mine, to implement a wireless solution and to install a new-cabled line.

We decided not to adopt the optic fibre solution because only a small part of the mine has already been cabled: the price to extend the line is high compared to the other solutions. Another problem is avoiding collision between the existing data and the sensor network ones on the net.

The most critical point of the wireless solution is the number of radio and antennas necessary for transmitting data. This number changes a lot if the antennas are in the same line of sight or if there are some bands.

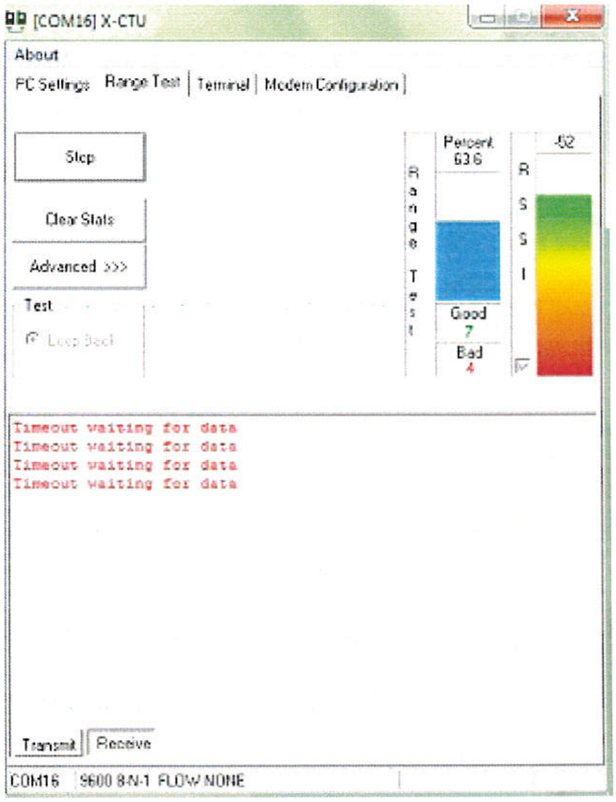
Adopting new-cabled lines increases the costs and needs a longer test time compared to an already tested transmission method like ZigBee.

Once having discovered that the wireless solution was the best, we have tested two kinds of radios (and antennas): the XBee ZigBee that works at 2.4GHz and the XBee 868 that transmits at 868MHz.

1.1.2.2 Test and results

The Digi program X-CTU can be used to test the coverage range of both radios. This utility gives two main pieces of information: the percentage of received packets and the "received signal strength indication". Because the tests showed that the XBee 868 is not the best solution in a mine gallery, we have concentrated our attention on the ZigBee radios. This radio standard has already successfully been used in mining monitoring (Wang, Wang, & Fan, 2013) (Tiantian & Zhanyong, 2011) (Pandit & Rane, 2013).

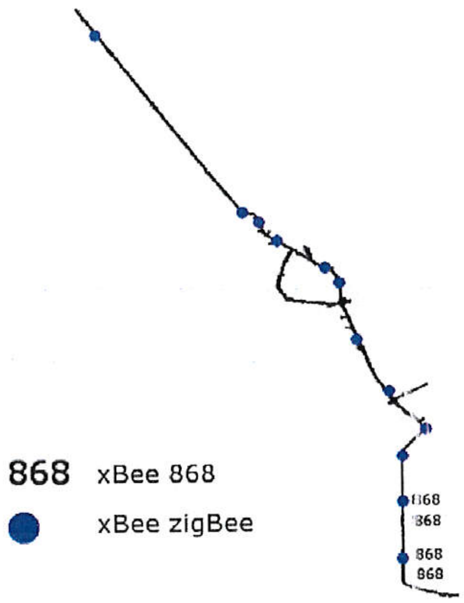
We have started from a side of the mine moving from one point to the next and the last one covered by wireless signal and electric supply. Our objective was to test how many radios should be used to cover the entire mine gallery that is approximatively 5 km long.



Source: www.digi.com

Figure 10. *X-CTU range and RSSI test*

Figure 11. The position of the radios shows the right ZigBee positon so that the mesh net is fully connected. The full XBee 868 position has not been mapped because this radio standard requires too many nodes with respect to the ZigBee to cover the same length. The choice of powering nodes from the electric line despite of using batteries influenced their positions.



Source: internal data

Figure 11. *The position of the radios*

1.1.3 **Next steps**

The following table shows the points of the project that are currently under development.

Table 1. *Next steps*

Sensors	Main parameters of interest are temperature, humidity, radioactivity, earth tremor, water flow.
In situ visualization	Because a part of the mine is a tourist destination, it would be useful to show sensed parameters to the tourists. One solution should be using a single-board computer with a screen at the entrance. This PC must act as a server for the coordinator and must synchronize the data with a remote server if needed.
Remote data transmission	As there is no internet connection in the mine, two hypotheses are possible: connection to a GSM network or making a bridge using xBee 868 or other wireless technologies between the mine and the offices.

Source: internal data

Modularity is one important feature of the Scatol8® networks. Only two nodes were placed for the "Hardware safeguard" test. Once four nodes will be steadily installed the system will not be close allowing the possibility to easily add more nodes to just theoretically cover the entire mine length.

DISCUSSION

Surveys on mining tourism tend to study the trend of visitors, in relation to general data on tourism, within a specified area, and to relate the number of visitors to the natural characters of a destination. Sometimes they refer to marketing strategies and actions, adopted to promote mining sites, by themselves or within a regional tourism supply.

There is a lack of information about management systems, if any, adopted to organize the visit and guarantee environmental and safety conditions, in addition to visitors' satisfaction.

Management systems are ultimately organized information, relevant to significant aspects that are identified and controlled to ensure a sustainable tourism supply.

To implement a management system for a mining site from scratch involves integration of different skills and definition of a detailed program, divided into stages of hardware and software systems design, laboratory tests, in situ tests and, lastly, installation and use. Such a management system is a true "nervous system" of the mine, capable of sending to the managers, in real time, the values of the significant variables. Furthermore, the system must be able to intervene in case of abnormal situations occurring. At this stage, indicators are under discussion and they will be implemented within the integrated management system. For instance, some of them are reported in Table 2.

Table 2. *Indicators*

Area	Theme	Indicator
Environment	Energy	Percentage variation of energy consumption Year (n-1)/year (n)
	Water	Percentage variation of water consumption Year (n-1)/year (n)
	Waste	Per capital waste production (kg/tourist)

Source: internal data

The paper has illustrated the general objectives of the research and activities conducted to date. We believe that the results can be considered encouraging as regards installations performed and the laboratory tests that will lead to the realization of the complete network.

CONCLUSIONS

The paper reported the provisional results of an ongoing project, which has reached approximately half of its actuation program. Its development involves the integration of management methods, related to internationally recognized management system models, and the design and implementation of networks for the monitoring of environmental and management variables. The overall project aims to identify and improve indicators of operational efficiency and effectiveness, thanks to real-time monitoring and integration with an enterprise information system. The results are promising and confirm the ability of open source hardware and software systems to be adapted to the needs of economic organizations, also very peculiar ones, like a mine used for tourism purposes.

If one considers the international expansion of the mining tourism, it would be very stimulating to try the application of the model in other situations, to verify its ability to adapt to different territorial, social and economic contexts.

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REFERENCES

4. *Ambat, R. (n.d.). A review of Corrosion and environmental effects on electronics.*
5. *Apiste. (n.d.). Effect of humidity on electronic devices. Retrieved from Apiste: http://www.apiste-global.com/enc/technology_enc/detail/id=1263*
6. *Beltramo, R., & Margarita, S. (2012). The Scatol8® for Sustainability: an update on the remote sensing system of environmental, landscape and management variables. Holistic Marketing Management Journal, 06-18 .*
7. *Beltramo, R., Duglio, S., & Caffa, S. (2009). Il Sistema QIT: uno strumento di "Qualità Integrata Territoriale". Valutazione Ambientale, 16, 75-84.*
8. *Beltramo, R., Vesce, E., Duglio, S., & Giardino, M. (2011). Tool Integrated Management of a geosite: Application of TIQ (Territorial Integrated Quality) for the Progeo-Piemonte Project. VIII Forum Italiano di Scienze della Terra, 4, 112-113.*
9. *Cole. (2010). Exploring the sustainability of mining heritage tourism. Journal of Sustainable Tourism, 6(12), 480-494.*
10. *Conesa, H., Schulin, R., & Nowack, B. (2008). Mining landscape: a cultural tourist opportunity or an environmental problem? The study case of Cartagena-La Unión Mining Disctric (SE Spain). Ecological Economics, 64, 690-700.*
11. *De Sanctis, M. (n.d.). Appunti di corrosione. Retrieved from www1.diccism.unipi.it/De_Sanctis.../Appunti%20di%20corrosione.doc*
12. *Digi. (n.d.). Digi. Retrieved from Digi: http://www.digi.com/pdf/chart_xbee_rf_features.pdf*
13. *Edwards, J.A. & Llurdés i Coit, J,.C. (1996). Mines and Quarries. Indutsrial Heritage Tourism. Annals of Tourism Research, 23(2), 341-363*
14. *Ferrero, E., Giardino, M., Lozar, F., Giordano, E., Belluso, E., & Perotti, L. (2012). Geodiversity action plans for the enhancement of geoheritage in the Piemonte Region (north-western Italy). Annals of Geophysics, 3(55), 487-495.*
15. *Multisorb. (n.d.). Electronics Articles. Retrieved from multisorb: http://www.multisorb.com/media-center/articles/electronics/*
16. *Newsome, D., & Dowling, R. (2010). Setting an agenda for geotourism. In D. R. Newsome D., Geotourism: the tourism of geology and landscape (pp. 4-8). Woodeaton: Oxford, UK: Eds.; Goodfellow Publishers Limited.*
17. *Pandit, V., Rane, U. (2013). Coal Mine Monitoring Usig ARM7 and ZigBee. The International Journal of Emerging Technology and Advanced Engineering, 3.*
18. *Pretes, M. (2002). Touring mines and mining tourists. Annals of Tourism Research, 2(29), 439-455.*
19. *Robert, B., Comizzoli, R. P. (1999). Corrosion and Reliability of Electronic Materials and Devices: Proceedings.*
20. *Rybár, P. (2006). Mining related tourism in Slovakia in connection with the European Network of Mining Regions (ENMR) project. Proceeding of the International Conference GEOTOUR, Košice, Slovakia, 43-46*
21. *Seai. (n.d.). susteinable energy authority of Ireland. Retrieved 02 02, 2015, from http://www.seai.ie/Your_Business/Large_Energy_Users/Special_Initiatives/Special_Working_Groups/Data_Centre_Special_Working_Group_Spinl/Relative%20Humidity%20in%20Data%20Centres.pdf*
22. *SparkFun. (2012). SparkFun 7-27-12 Product Showcase. Retrieved 02 02, 15, from youtube: https://www.youtube.com/watch?v=WdNAQIR5iSI&feature=youtu.be&t=10s*
23. *Tiantian, J., Zhanyong, Y. (2011). Research on Mine Safety Monitoring System Based On WSN. Procedia Engineering, 26, 2146-2151.*
24. *Walliss, J., Kok, K. (2014). New interpretative strategie for geotourism: an exploration of two Australian mining sites. Journal of tourism and cultural change, 1(12), 33-49.*
25. *Wang, J., Wang, F., Fan, Z. (2013). Mine environement monitoring system based on wirless sensor network. Telkomnika, 11(7), 3693-3698.*
26. *WóJtowicz, B., Strachowka, R., & Strzyź, M. (2011). The perspective of the development or tourism in the area of geoparks in Poland. Procedia Social and Behavioral Sciences., 19, 150-157.*