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From digital to print: RFID and QR-code integration in Calabria (southern Italy) wood chain logistics

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Introduction

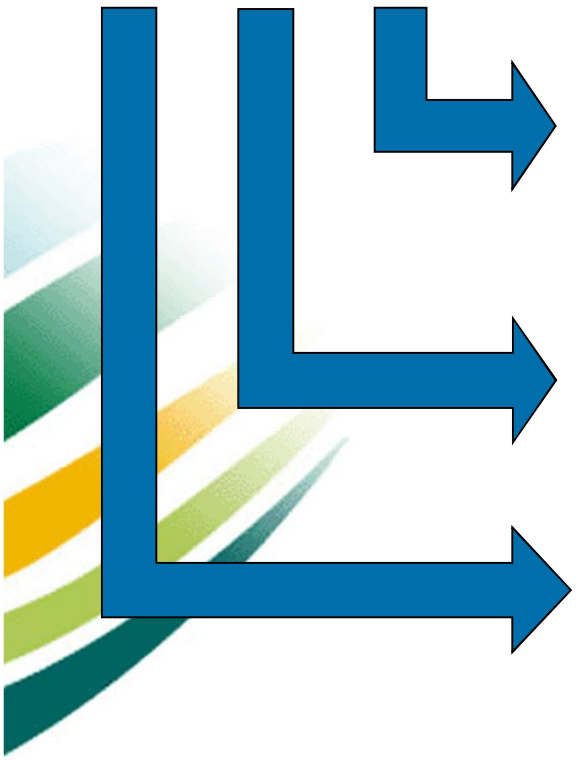
The activity is being developed within the project “Ambi.Tec.Fil.Legno: Tecnologie innovative ad elevata sostenibilità ambientale nella filiera foresta -legno-energia” European PON project.

Improve the forest-wood energy chain in Calabria region (southern Italy)

Improve the wood chain logistic in Calabria throughout the introduction of innovative technologies based on printed or digital tags (RFID)

Introduction

Main applications



Standing trees designated to be cut, the chain of custody and monumental trees in order to:

- Create effective tools for collaboration through the wood supply chain;

- Innovate for improving harvest planning and operations; integrate planning, operations, harvesting and sales;

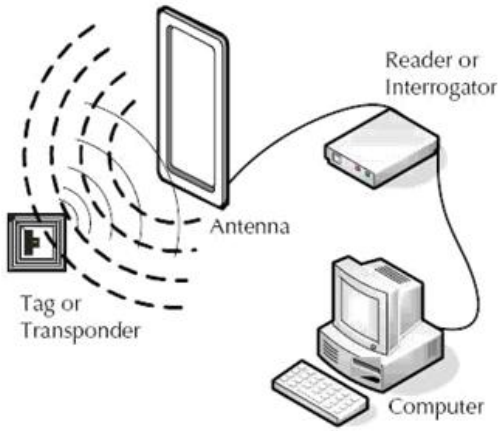
- Fulfil traceability requirements needed in order to obtain product certification and satisfy the consumer demand increasing in terms of product information in an always more competitive multimedia world.

This presentation benefits from participation in the COST action FP-1104 "New possibilities for print media and packaging – combining print with digital".

RFID and QR-code technologies

DIGITAL technologies

A typical *Radio Frequency Identification (RFID)* structure including:
- RFID tag
- antenna (reader)
- database system



PRINTED technologies

Quick Response code (QR-code) is an optical label readable by a device including a camera and decoding software and that carry data about the good to which it is attached (product, URL, link, etc.).

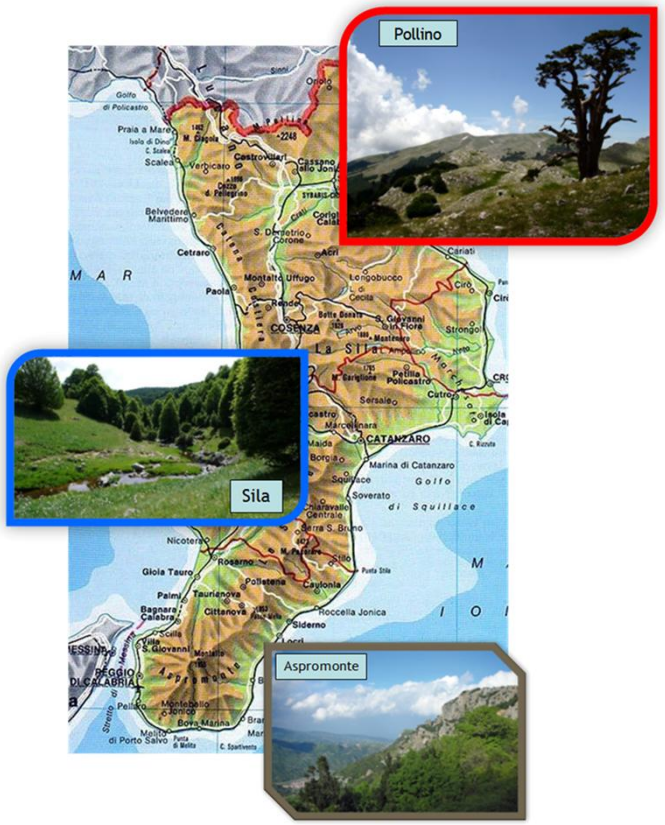
RFID systems have many advantages over the more traditional bar code or the newer QR-code being more resistant to atmospheric agents, carrying more information, being rewritable at several steps along the chain, having a higher information flow speed thus being safer and more cost-effective.

However, while to read a RFID tag a specific antenna is needed, any QR-code is made to be read with all the smartphone on the market making it preferable for application consumer oriented.

Wood chain logistics in southern Italy (Calabria)

Regional forestry plan (2007-2013) evaluate about 1.4 milion m^3/year the biomass that is possible to harvest without damaging the natural stocks underlining conspicuous financial resources:

- Harvesting rate has been maintained unchanged only in coppices, mainly targeted to fuelwood production.
- At the moment the reduced information flow present is managed by hand writing data on paper. Automatic technologies, such as RFID systems, look increasingly concrete, especially from forest to sawmill.
- These promising technologies can support a unique identification of the primary object (tree), along with management planning information.
- The region own another patrimony represented by the presence of many monumental trees that enrich its territory attracting tourists.



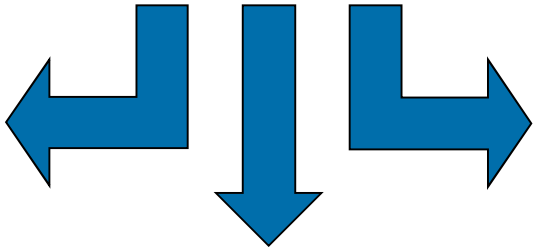
Potential intervention initiatives: 1) chain of custody

Ambi.Tec.Fil.Legno group of research planned three main points of intervention:

1) Chain of custody as many organisms on the base of governments and consumers requirements do certify wooden product on the base of their geographical origins, processing and transport

3 main returns

For the producers:
Added market value, origin and wood quality certification



For the government:
Data gathering for an efficient wood monitoring, harvesting, production and better organize forestry management planning

For the consumers:
Certified wood products (quality and origin)

Potential intervention initiatives:
1) chain of custody

Potential intervention initiatives: 2) Store and manage information

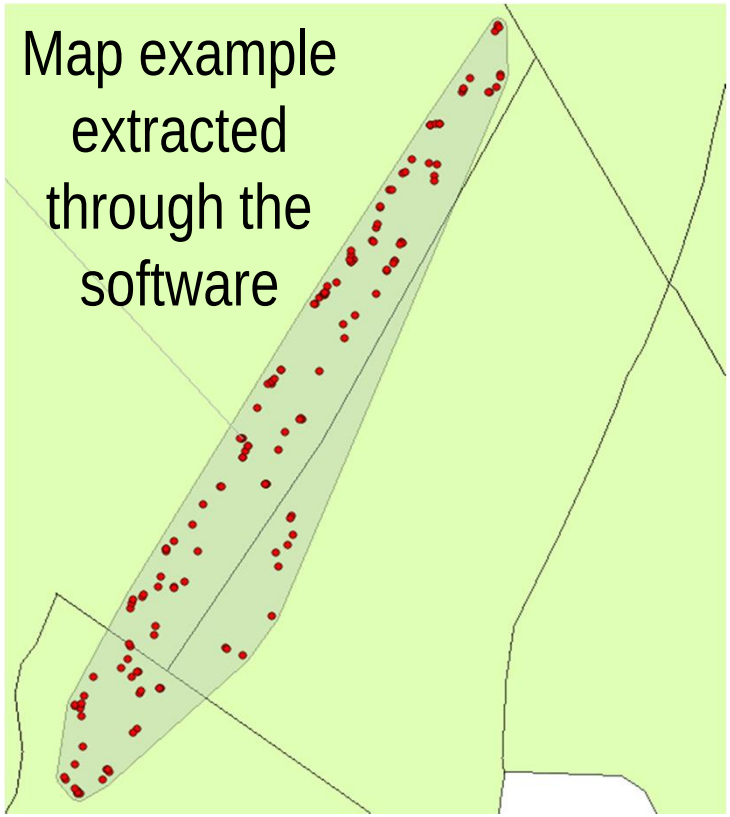
2) RFID-based solutions to store and manage information during monitoring and inventories field surveys

The integration between mobile GIS software and RFID technology allows: direct in-field data validation; fast and secure localization of single trees; improved GPS-based positioning of stands or sample's plots.

Store the data directly in each tree facilitates the acceptance test plan allowing a deeper analysis of the discordances between the collected data and the test.

The RFID technology allows also the re-use of the observed data to other research groups for future surveys. The info that will be gathered will be the GPS coordinates, the species, the date of each survey, the diameter at breast height, the tree height using stereovision or clinometer.

ARGOS (F360 srl per SFF/PAT)



Potential intervention initiatives:

3) QR-code technology to enhance the appreciation of monument trees

3) The QR-code technology can be applied to enhance the appreciation of monument trees as high relevant value of Calabria forests.

Age

Species and characteristics

Height, volume…

Historical events

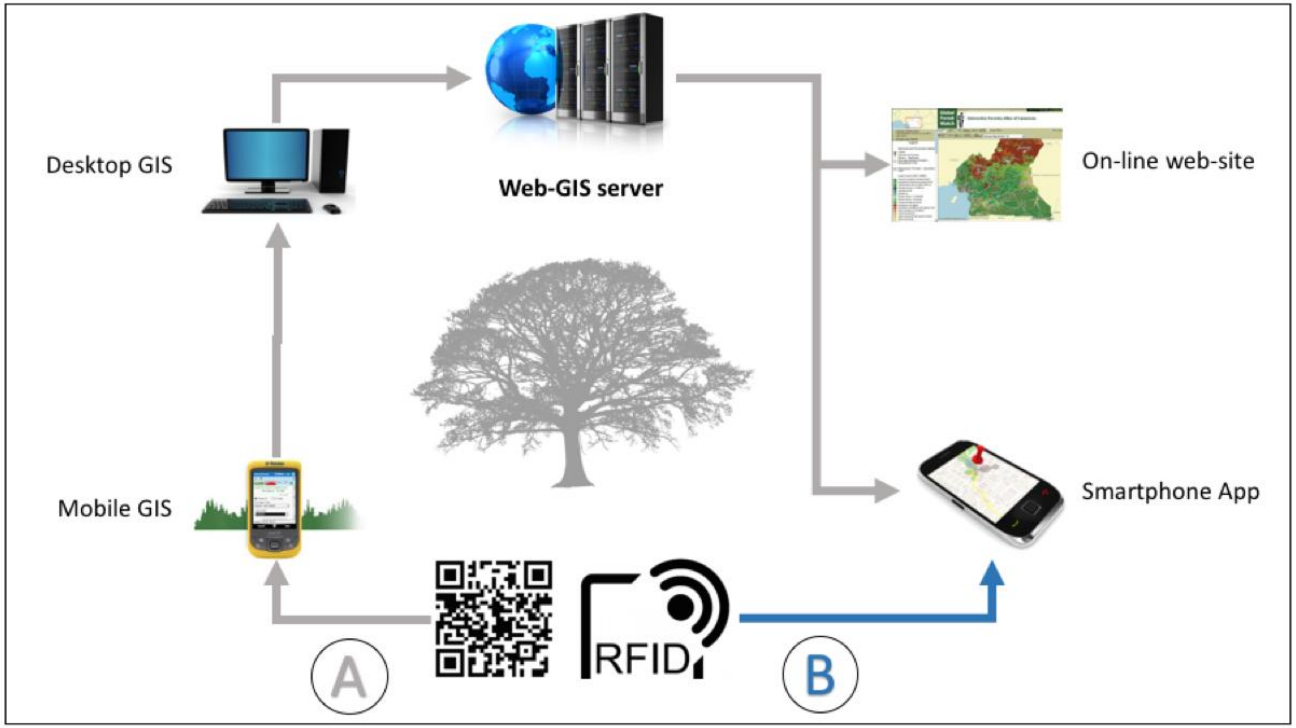
RFID nail tag

QR-code

Potential intervention initiatives:

3) QR-code technology to enhance the appreciation of monument trees

The web-database implemented in a Web-GIS will be consulted using a dedicated App for Iphone and Android systems or from a web-site. The App will suggest the tourist who want to discover the tree in the forest by providing different tours based on geographical information such as roads and paths to reach each single tree, age, height, volume, characteristics of the species, and high quality pictures of the tree during different seasons and years.



Economic and technical feasibility

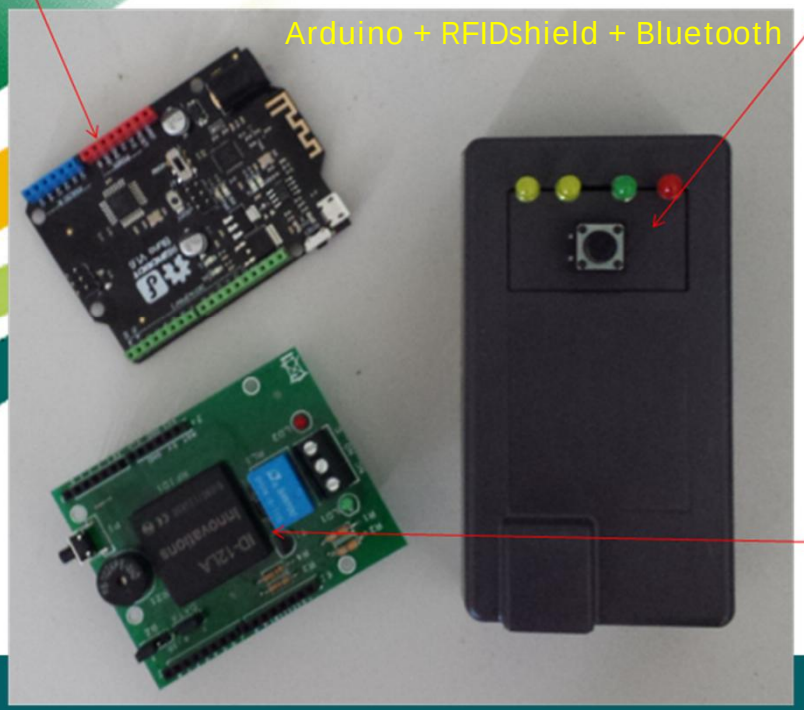
✓ Analysis of the supply chain from forests to mills (Timpe, 2006) revealed that there is a potential to streamline operations and making a more efficient use of the resources by implementing a RFID-based log tracking system in the chain. This system should be an open loop, using inexpensive, passive RFID devices.

✓ On 2006, Timpe calculated, in a concrete example when moving from one tag *per* stack to two tags *per* stack, that the break-even price *per* RFID is halved. Hence, he assumed that the economic feasibility for a passive RFID tag is lower than 0.43 USD. From that time new tags has been developed and patented for specific uses in forestry (Hakli et al., 2010; Björk et al., 2011; Hogg, 2012).

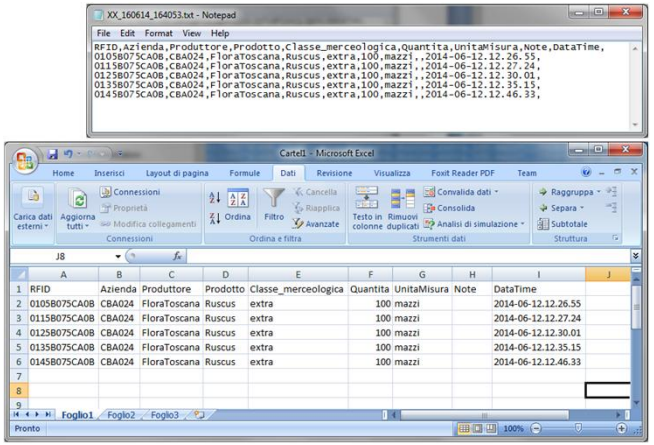
✓ Moreover the implementation of open-source technologies, such as Arduino and 3d printing technologies, in logistics (Menesatti et al., 2014) is opening the market to low-cost sensors and actuators with high reliability simplifying the implementation and the management and allowing an high flexibility in the hardware production. Open source technologies in logistics, for example for antennas, could allow a significant cost reduction from one third, for standard sensors, to two third, for more specific and evolved sensors.

RFiD Open Source Technology developed at CREA-ING
Flor.Id.Ino (Flowers + Arduino)

- A RFiD antenna reads the tag placed on containers;
- The code read is temporarily stored and sent via bluetooth to a smartphone app specifically developed;
- Once the data are stored on the smartphone, the operator adds information relative to the products present in the container.



Backup file managed by the app



Flor.Id.Ino App

1. The application reads the RFiD code from the system “Arduino + Bluetooth + RFIDshield” integrating it on a database, along with the data entered by the user;
2. The database is automatically exported in a text file and immediately available through cloud systems (eg. Dropbox) for integration with other third-party software belonging to the chain;
3. When starting the app there is a text description of the entire system with buttons and start setting.

Dimension of the box containing the RFiD device: 10.5x6x3cm

Costs

The hardware cost of the RFID device include:

- Arduino microcontroller with integrated Bluetooth
- RFiD reader with buzzer and LEDs

For a total value of around 100,00 €

- The system is ready and operational, even if with simplified software interface
- The laboratory tests provided excellent results in terms of effectiveness and efficiency of the measure


THANKS