A system for data collection of environmental information

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1 Objective

The work described in this abstract has been developed as a part of the EU funded FOREMMS project (FORest Environmental Monitoring and Management System). The main goal in FOREMMS is to develop and demonstrate an advanced forest environmental and management prototype system.

A continuous monitoring of environmental parameters is required, as well as the handling and analysis of the collected data. Depending on what is required, manual measurement in the field, data from airborne and satellite sensors may be used to ensure the required accuracy and coverage. This will allow making a huge vision of the forest by studying many areas from different countries, just as the European ones.

We are describing the design and implementation of an autonomous system, based on a handheld PC as the field device, for the acquisition of manual measures in the field about the environmental parameters of forests. The application personalize the handheld PC as a system for data collection so that the user can introduce all the manual measurements field data easily and later on send them to the database. Some of the requirement for the developed program are to be intuitive, easy to use and to be able to be customised to the applications requirements such as the language for application usage or enable or disable selectively the input of certain parameters to measure them in the field.

This system should also be useful in other kind of data acquisition applications such as systems for forest fire prevention and monitoring. In addition to the data collection function, the system can be used for calibration of remote sensing devices.

The purpose of the developed application is to take tokens from a forest environment by the handheld PC. We need to personalize the handheld PC as a system for data collection so that the user can introduce all the measurements in the field easily, complete in the laboratory and later on send them to the database (Local or remote).

Data acquisition will be taken from different areas. Each area will be defined as a set of data captured points located by the latitude, longitude and altitude using the GPS system. At every capture point, valuable data are stored and samples will be taken immediately so that they can be analysed in the laboratory to obtain their values.

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The set of data is introduced at field environment (FE), Handheld PC, while the values of the samples parameters are introduced at the laboratory environment (LE), desktop PC.

For all the data we are using two indexes, one is the position (co-ordinates) of the place where the data was obtained (GPS information) and the other is the time (Field PC information) when they were obtained,

The cycle of work with the designed systems can be summarized in the following steps (Figure 1):

1. Application customisation (Setting) in PC.
2. Data synchronization from PC to H/PC.
3. Data acquisition in the field with the H/PC.
4. Data synchronization from H/PC to PC.
5. Data results from the laboratory study.
6. Transferring the complete information to the FOREMMS database.

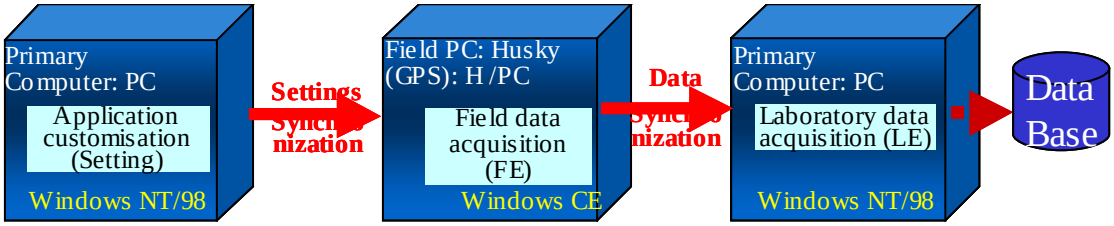


Figure 1 System model

2 System Organization and Functionality

Application users

In the operation of the application two types of users get involved, the “application manager” and the “field user”.

- **Application manager.** He/she determines what kind of information we have to collect in the field experiment, the number of points to measure and the route to be followed. Also he/she will be the responsible of storing the data gathered in the field into the primary computer and sending it to the database.
- **Field user.** He/she will be the user that will introduce the data in the H/PC. This user has not to be an expert and the application must be designed to avoid a previous training on his/her part.

System components

The system components are the following one:

- The **"primary computer" (PC)** can be a desktop system or a laptop; it is the Windows 95/98/NT4-based computer on which it has established a "partnership" with the field PC (Windows CE Device), and also it has been installed software to communicate with the database.
- **Field PC**: The portable Handheld PC (H/PC) is a Husky Field Explorer 21, backing Microsoft Windows CE
- **GPS**: all the field data collected must be associated to a specific geographical co-ordinate, obtained from an integrated GPS receiver
- **Local Database**: all the field data collected must be sent initially to a local database

From the point of view of the system operation three major functions are noted:

Application customisation: From the **PC** it permits the application manager to customise the **Field PC** input in options such as: specify the language for our application usage, specify the number of points and the position where the data must be taken (route of the experiment), initialise specific menus for the forest (tree species,...), enable or disable selectively the input of certain parameters to measure them in the field, that is, field data acquisition only for useful data (disable of parameters that are inappropriate in the context of this field), specify the values of the pull down menus.

Data acquisition: The acquisition of the data from the field includes two steps, the first one is concerning with the data obtained and stored directly in the field and the second one based on the parameters obtained in the laboratory analysis of the samples collected in the field.

- **Data field.** The values of the enabled parameters to be measured in the field are obtained and stored in the Field PC. These values are indexed by position and date. Once the GPS co-ordinates validate the predefined location of the measurement point, it activates the option of input data. The different application windows will show the whole data set obtained. In that way the user will be able to verify the data introduced or go back to change the data.
- **Laboratory data.** For those parameters whose value must be evaluated in the laboratory, the necessary samples are obtained. Once evaluated those values will be stored using the PC.

Synchronisation: With this function we are updating the information stored in both devices, the PC and the **Field PC (Handheld).** Initially it is necessary to connect the Handheld to the PC for its customisation. Once the Field PC has been initialised it will be possible to go to the field to introduce the data for the experiment. At the end of the field data collection, the Field PC is connected again to the PC for storing the data obtained and sends it later to the database.

System functionality

In this section we will survey the software developed specifically to support the functionality defined by the application (FOREMMS) requirements.

From the point of view of the user, we consider four work modes: settings, field data, lab. data and database. In order to make an easier management and avoid errors, only the fields (parameters) belonging to that mode will be activated.

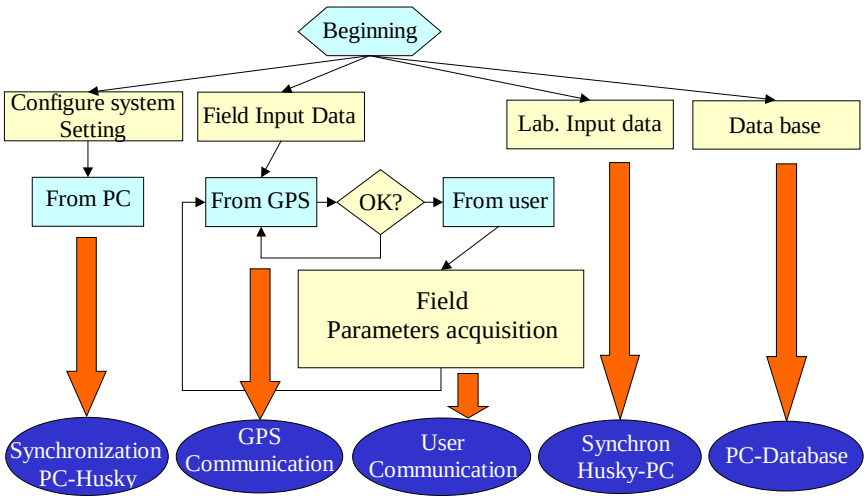


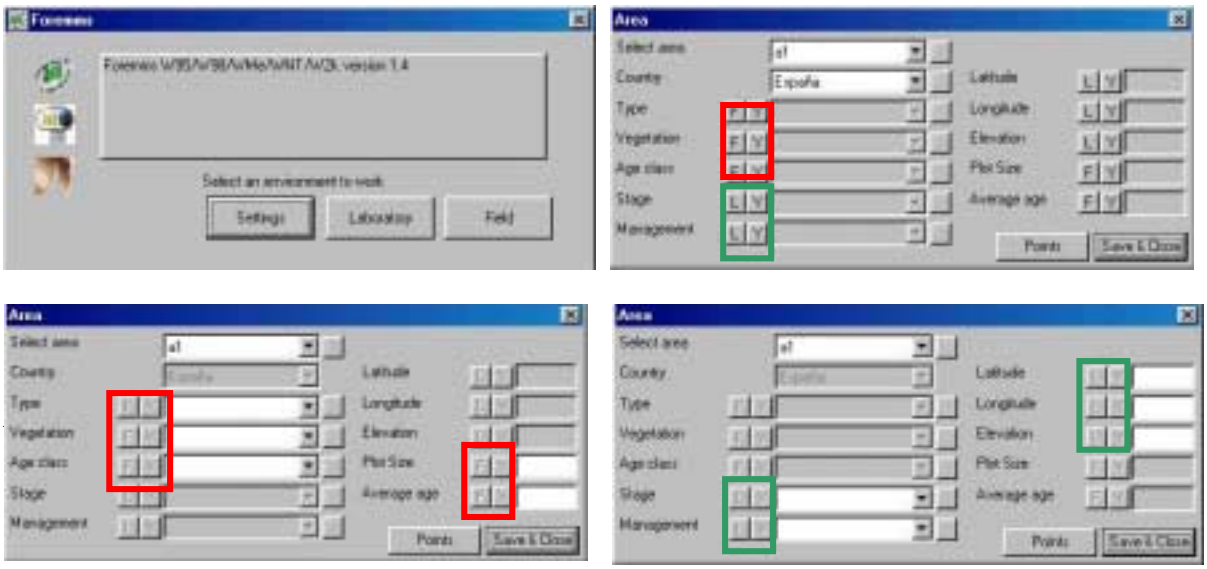
Figure 2 Functionality of the system

Figure 2 shows the four different functions the systems is implementing. For each one of them the basic operation is shown, the component involved and the communication action involved in it.

Figure 3 is showing four different screens following the user cycle. Screen A shows the mail screen where the basic operation to be carried out is selected. In screen B the setting function allows to define general information (e.g. Select area and country) and specify for the different parameters its precedence (Field –**F** - or Lab. –**L**-).

Figure 3 C is showing the user the active windows for those parameters values to be obtained in the field (e.g. vegetation, age class, plot size..)

Figure 3 D is showing the active windows for those values to be obtained from the laboratory work on the samples.



C) Field environment (**FE**) (Field user) Field PC

D) Laboratory environment (**LE**) (Lab. user) PC

Figure 3 Application screens of the user cycle

3 Human interface: Design criteria

In the design of the user interface we have taken account the next principles

The interface uses terms and concepts which are familiar to the user, should be appropriately consistent and the user should not be surprised by the system

The interface should incorporate some form of user guidance: the path to follow is prefixed and help is available at all times This will also include some mechanism that allows users to recover from their errors

User inevitably makes mistakes when using a system. To reduce these mistakes the system is based on menus because the navigation through menus avoids the typing mistakes.

To avoid incomplete data entry in the field measurements the journey button of the application must be pressed. The system has been initialised enabling the parameters to be measured, but in case of some of these parameters were unable to be obtained, the system will provide some specific escape protocol.

To avoid reduced sizes of letters in the Field PC (Handheld), when the menu interface need to structure large menus it uses scrolling menus or hierarchical menus.

The interface has “help” facilities. These provide different levels of help and advice.

User interface is on windows, iconic representations of entities, pull-down or pop-up menus and pointing devices.

4 Bibliography

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