

SYSTEM FOR DOCUMENTS SECURING AND INTELLIGENT MANAGEMENT

George ENCIU^{1,*}, Adrian POPESCU², George CONSTANTIN³, Emilia POPESCU⁴

¹⁾ Prof., PhD, Robots and Production Systems Department, University "Politehnica" of Bucharest, Romania

²⁾ Lecturer, PhD, Robots and Production Systems Department, University "Politehnica" of Bucharest, Romania

³⁾ Prof. PhD, Robots and Production Systems Department, University "Politehnica" of Bucharest, Romania

⁴⁾ Assistant Prof., PhD, Robots and Production Systems Department, University "Politehnica" of Bucharest, Romania

Abstract: *The use of the RFID technology in all engineering-specific areas is no longer a novelty, this technology being employed today for documents securing and management. This paper presents an integrated system of documents securing and management, with the emphasis on its components (intelligent paper, specialized software computer, printer, reading mode, office mini-archive and the storage and management system of the archive-type printed documents) and the TagDoc specialized software application (TagDoc Print, TagDoc Write, TagDoc Card, TagDoc Arch, TagDoc MiniArchive). The general architecture specific to the system is also presented, by highlighting the distinct areas within it: the access module, the documents securing module and the intelligent archive module. At the end of the paper, a use case is presented that points out how to secure a document by showing all the stages needed to secure and print the RFID tagged document, which can be tracked throughout the life cycle of the electronic chip.*

Key words: *RFID, intelligent paper, TagDoc, printer, archive.*

1. INTRODUCTION

The relatively simple structure of an RFID system [1–3] has led to the diversification of the applications in which the radio frequency identification technology can be integrated [4–7].

Therefore, in addition to tracking production, RFID systems are used either to facilitate maintenance [8] or to track and manage official documents in a governmental institution [9] or to track documents in an enterprise [10]. Thus, the use of an innovative electronic system to manage documents confidential tracking leads both to an increase in the overall security level of documents and to an increase in the level of security associated with the persons authorized to manipulate documents. An additional advantage of the solutions proposed, besides providing better control over documents storage and sharing, will be the ability to track the flow of documents between the security areas and the authorized persons who manipulate documents.

2. PRESENTATION OF THE DOCUMENTS SECURING AND MANAGEMENT SYSTEM

2.1. Description of general functionality

The documents securing system allows complete documents securing for their efficient management. The documents to be secured are printed on a special paper that includes a tag (an electronic device). This tag, when printing the sheet, is initialized with certain information. Further on, by reading this information, and because this

tag has a unique manufacturer's code in the world, one can verify the authenticity of the respective sheet. The system allows the correspondence between documents content and their support (physical documents) by defining IDs. These IDs group, into an informational structure, elements about electronic documents (files) and their support. Through these IDs there is a biunivocal correspondence between documents in electronic format and their physical support. This correspondence provides the opportunity for a complete, efficient, and secure management of documents within an organization.

If the document is modified with bad intentions, the electronic sequence of characters will be different from the original sequence and the document is catalogued as a fraud.

The intelligent archive for electronically secured documents is a modern concept that uses as a stored document the electronically secured paper of the Smart Paper type.

The archive allows the access identification to electronically secured documents, for their management and identification of their position in the archive.

2.2. The hardware components specific to the documents securing and management system

The documents securing and management system consists of the following components (Fig. 1):

- intelligent paper;
- specialized software computer;
- printer;
- reading mode;
- office mini-archive;
- secured document tracking system.

* Corresponding author: Splaiul Independentei 313, sector 6, Bucharest, 060042, Romania
Tel.: +4021.402.9168;
E-mail addresses: enciug@yahoo.com (G. Enciu)



Fig. 1. System for securing, identification and management of secured documents.

The general functions for the entire documents securing and management system are as follows:

- create, edit, and print a SmartPaper document;
- identification and authentication of secured documents;
- tracking documents within the same room or in a larger infrastructure;
- storing and archiving for electronically secured documents at each office or archive level.

2.3. Software components specific to the documents securing and management system

The software applications specific to the TagDOC system for the documents securing and management, accomplished under the main author's guidance, are as follows: TagDoc Print, TagDoc Write, TagDoc Card, TagDoc Arch, TagDoc MiniArchive.

TagDOC Print – allows documents to be secured at the same time as printing them. The securing method is a step-by-step one. To secure a document at the same time as printing it the sheets with an integrated electronic component and the printer within the system must be used (Fig. 2).

For securing, a number of sheets with an electronic component equal to or lower than the number of pages in the document can be used. For example, if not all the pages in the document need to be secured, but only the important pages, then, a number of sheets with an electronic component equal to the number of pages in the document to be secured will be used for securing. Each electronic component sheet is programmed with the key text previously selected from the page.

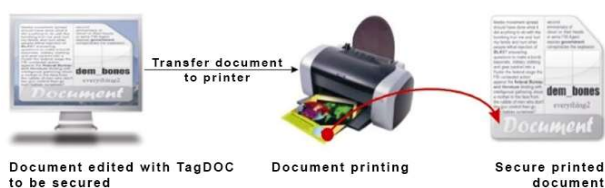


Fig. 2. The information flow for securing and printing a document.

TagDOC Write is used to secure documents already printed on paper. The documents securing method consists in transmitting a quantity of encrypted information (keywords selected from the content of the document) to the memory of an electronic component later attached to a document already printed on paper.

TagDoc Card is an application that allows to create access cards for the persons who are to handle secured documents in the secured archive. The access cards can be programmed to allow access only to specific areas of the archive within certain time slots and to have limited validity. The TagDoc Card application allows the administrator to later modify the data originally programmed on the access card.

TagDoc Arch is used to identify the access to the electronically secured documents, in order to manage them and to identify the position in the archive (Fig. 3). The functions of the archive are as follows:

- entering data for documents from a profile, by associating the photo;
- creating a file by associating chip;
- creating a portfolio with the chip allocation function;
- associating for a document of a physical file, by pointing out the file-portfolio couple;
- viewing the documents entered;
- authorizing a person to manipulate a physical document and see the existence of the document;
- associating a person with a portfolio, file, or document.

TagDoc MiniArchive is employed to identify documents after they have been secured. It is used together with the reading module or the office mini-archive.

3. THE ARCHITECTURE OF THE DOCUMENTS INTEGRATED MANAGEMENT SYSTEM

The documents integrated management system consists of the following modules: the access module, TagDoc Print / Write module, intelligent archive module and communication module.

Figure 3 presents the general structure of the documents securing and management system, and Figs. 4–7 show the modules in its compenence and list the main functional features.

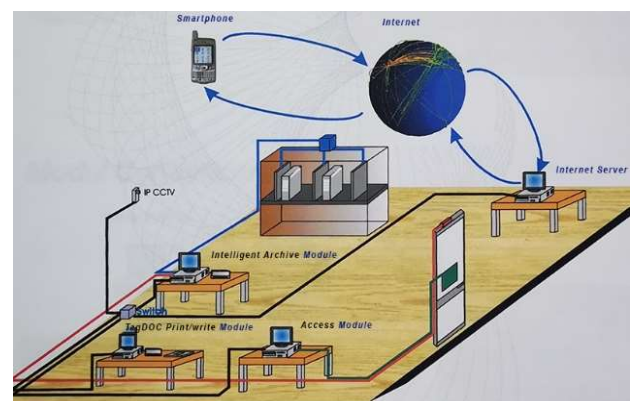


Fig. 3. The general structure of the documents integrated securing and management system.

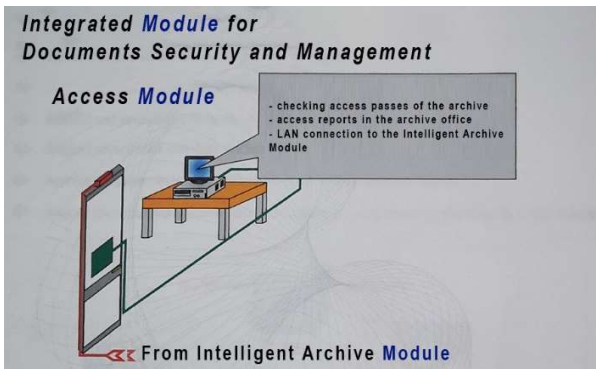


Fig. 4. Intelligent archive access module.

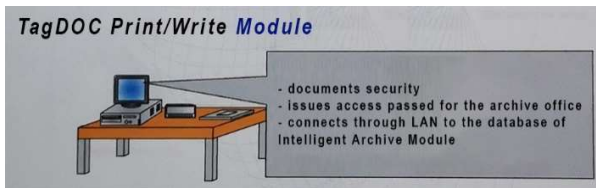


Fig. 5. TagDoc Print/Write Module.

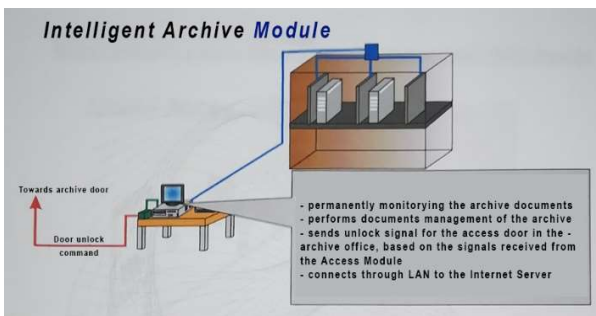


Fig. 6. Intelligent archive module.

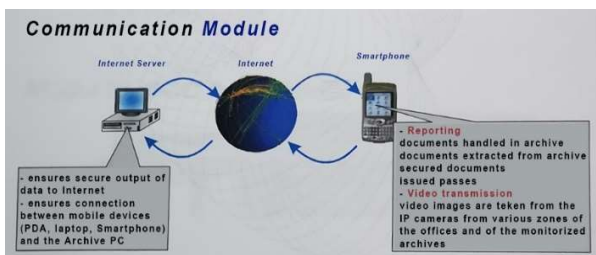


Fig. 7. Communication module.

4. USE CASE

4.1. Presentation of the documents securing application

The main program window (Fig. 8) consists of the following areas: menu bar, toolbar, active document area, current user area.

- The menu bar is the main menu of the program, from which all the functions of the program can be accessed: *System menu* contains the administration functions of the program; *User menu* contains the functions required for managing the program's users; *Document menu* contains functions for working with secured documents; *Reports menu* allows to generate program reports.

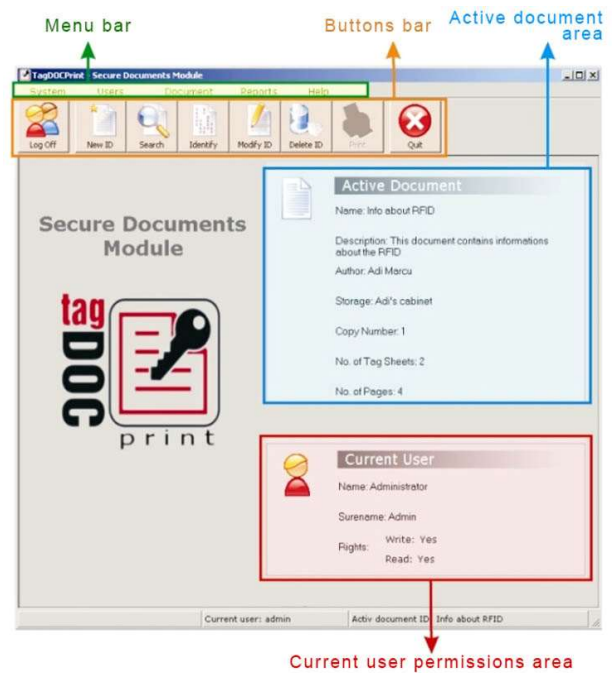


Fig. 8. The main window of the program.

- The toolbar is a succession of buttons for accessing the program functions faster. The functions of these buttons are similar to those of the menus with the same name.
- The active document area provides important information about the active document.
- The current user's area displays information about the user who works in the system at a certain point in time: his name and rights.

4.2. Information flow for securing a document

By using the TagDOC Print application, encrypted information (key text) can be transmitted to the electronic component memory. For the study presented in this paper, the securing and management system in Fig. 9 was used.

It is necessary to create a root directory containing all types of documents to be secured using the TagDOC Print system. In this root directory, a directory will be created for each type of document specific to the organization one works for. Each document will have a separate directory within its document type and this directory must have a name specific to each document.



Fig. 9. The documents securing and management system used for the case study.

For each document type, a special file will be created – *Management File* containing the domains with keywords for the respective document type. The keywords are the important words in a page or document that must be especially protected since they are at risk of alteration (falsification). In order to customize domains with keywords for a particular document, the Management File is copied into the document folder and then the file content is changed. The Management file is created within an organization by the person who is empowered to set these things and it has a very important role in the proper use of the TagDOC Print system.

Working with documents in the securing module is done with a single document at a certain point in time. Thus, a single document – the active document – will be accessible in the program. The specific operations in the Document menu will be performed on this document. To select a document as an active document, a document already entered into the system is searched using the Document Search feature (accessible from the Document menu \Rightarrow Document Search) or a document is added into the system (selecting Document \Rightarrow Enter and Create ID). As soon as a document has been selected as an active document, in the program's background window, information about this document can be read in the Active Document area. Document editing, deleting, printing, and securing operations can be performed on the active document *only*.

Adding smart sheets into the system – this is the first step that needs to be done before actually starting to work with secured sheets. At this stage, a set of tag sheets will be added to the system, reading each tag sheet on the reading station by using a special feature of the program (Fig. 10). To add a sheet, the sheet on the reading station is placed and the Add button is clicked. The tag afferent to the code will automatically appear in the tag list.

Entering a document into the system assumes it has been edited in advance. Once the electronic document has been verified and is correct in terms of content, it can be entered into the system.

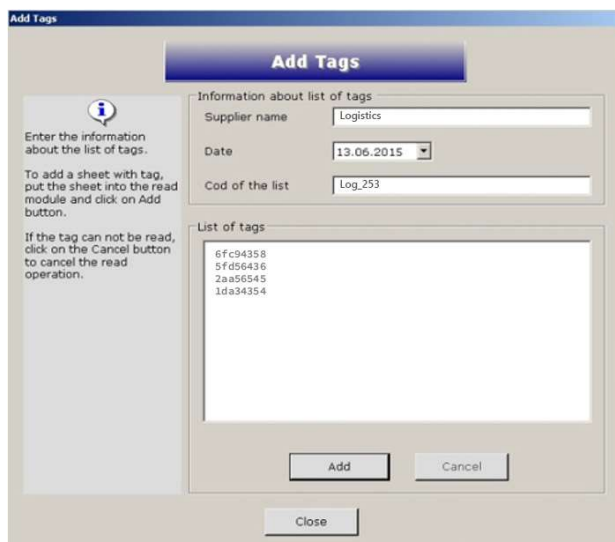


Fig. 10. The program interface that allows intelligent sheets to be added into the system.

It is mandatory for the document to be in a tree structure of documents in the directory corresponding to its document type, along with its afferent Management file.

The user who wants to enter this document into the system must first read the Management File associated with the respective document. According to this file, the pages to be secured will be determined.

Next, the electronic document will be divided into several files corresponding to the secured pages. These files will be saved in the same directory as the full document file.

It is recommended that during the operation of entering the document into the system, to keep the Management File open and follow the instructions in its contents carefully.

To enter a document into the system (Fig. 11), the Document menu \Rightarrow Enter is selected and the ID is created. This menu will open the document Create ID window where information about the document to be secured will be filled in.

In the Management File field, the path of the Management File associated with the document to be secured is entered. This can be done either by typing the path on the hard disk of the file or by clicking on the next button, and then browse the directories on the hard disk until the desired file is located, which is selected by pressing the Open button. Then the Open button is clicked to open the Management File and the data is entered into the system according to this file.

In the Name field, the document standard name is entered. It is recommended to use a standard name for the current document type. Thus, it will be easy to recognize the document later.

In the Description field, a description of the document is entered. It is recommended that this description be customized for each document.

In the Content Author field, the name of the author of the document content is entered that is the name of the person who wrote the document in electronic format.

In the Date field, the date when the document has been added into the system is entered, i.e. the current date.

In the Storage field, the document storage area code is entered.

In the Path field, the document path in electronic format is entered. This can be done either by typing the path from the hard disk of the corresponding file, or by clicking the next button and browsing the folders on the hard disk until the document is located, which will be selected by clicking the Open button.

In the Destination field, the recipients/beneficiaries of the document are entered, these being the persons or organizations to whom the secured documents will be handed over.

In the Total Tag Sheets field, the number of secured sheets in the document is entered.

In the Total pages field, the total number of pages in the document is entered.

In the Copies field, there is specified how many copies of the document are to be printed and secured.

Fig. 11. Graphic window for creating an ID.

The program will allow printing and securing the specified number of copies.

In the Observations field, various comments about the document, observations, etc., can be entered.

After completing all the fields with the required document information, the Add button is clicked to go to the next stage.

Adding information about secured sheets. At this stage it is necessary to enter information about each secured sheet in the document (Figs. 12 and 13). During this process, it is helpful to have the Document Management associated to the document, open to follow exactly the directions in it.

First, the document page path in electronic format will be required. Next, the keywords that need to be written on the tag are selected from the afferent fields. During the selection, the corresponding text will appear in the Text field that will be written in the tag.

To enter other keywords than those in the selected domains, these words are entered in the Keywords field. When selecting key areas and entering keywords, the maximum number of characters available in the tag must not be exceeded.

To go to the next stage, the Add button is click.

Further on, information about the beneficiaries of the document will be requested.

As beneficiaries of documents, both natural persons and legal representatives of organizations can be considered.

Fig. 12. Graphic window for adding a secured Sheet 1.

Fig. 13. Graphic window for adding a secured Sheet 2.

Printing and securing the sheets. Once the document data and secured sheets in the document data have been entered into the program, the sheets will be printed and secured. The Document Printing and Securing window is made up of two areas:

- the top area with the list of the secured sheets in the active document. Here the page number, the path on the hard disk of the file corresponding to the respective page and the keywords to be typed in the tag can be seen;
 - the bottom area with the list of printed copies for the selected sheet from the list above. This area updates automatically during the printing and securing process with the tag code and copy number.
- The securing and printing process of a document consists of several steps. To print a copy of a certain sheet, the steps below are followed:
- select the sheet to secure from the sheet list;
 - insert a tag sheet into the printer and click the *Program* button and wait for the tag's programming included in the sheet;
 - click the Open button and the document will open in the associated application (the application in which it was created).

After finishing printing and securing the copies for a particular page, the next sheet from the sheet list is selected and the securing and printing steps are repeated. Once a document has been printed and secured, it is marked as printed and the printing and securing function is automatically disabled.

Identification of secured and printed documents.

The process of identifying of a document (secured and printed before) is to read the information in the tag included in the sheet and to associate it with the document ID. Thus, it is possible to compare the original information written in the tag (stored in the program) and the current information contained in the tag. Still using this ID, the association between the total support of the document, that the sheet which is being read is part of, and the total content of the document can be made. In this way, the original content of the document can be viewed.

In general, the document identification function is activated by selecting Document menu \Rightarrow Printed Document Identification. The Document Identification

window will automatically open, where the type of identification can be chosen.

In the next stage, the identification sheet is entered in the reading station, and then the Read button is clicked. In that moment the information in the tag is compared to the information in the system, and whether or not they match the program displays a corresponding message.

The window is divided into two areas: Document information and Sheet information. The Document Information area contains all the information related to the entire document: name, description, author, date, storage, copy number, path, etc. and the Sheet Information area contains information about the sheet used for identification: tag code, page number, file path of the page, and keywords included in the tag.

When reading a secured sheet, the following situations can be encountered:

- the sheet could not be read: the tag included could not be read and probably the tag was damaged;
- the sheet which was read is not in the database: the tag code included in the sheet is not recognized by the program. The most likely explanation is the failure to enter the sheet into the system;
- the sheet was not secured (programmed): a situation in which a previously unsecured sheet is probably being tried to be identified.

TagDOCPrint program – the securing mode allows to generate reports, export these reports in PDF format, and send reports by e-mail.

TagDOCPrint program reports are performed according to the system operations. There are the following types of reports:

- ID information;
- Frauds;
- Authenticated documents;
- Modified IDs;
- IDs existing in the system;
- IDs operations;
- Unprinted documents;
- Sheets operations;
- Tag sheets available;
- Tag sheets used;
- User List;
- Client List.

5. CONCLUSIONS

TagDOC Print program is a solution dedicated to securing and printing documents simultaneously. The program also provides content management and document support within an organization. By associating the documents in electronic format and documents support, a complete documents management control is carried out.

The key feature of TagDOC Print is the simultaneous execution of documents securing and printing activities. Using a special sheet, the program ensures the programming of some information in the tag included in

the sheet when printing documents. Subsequent to printing and implicitly securing documents, it is ensured that the document support is identified using the tag code and the tag information. The tag code is written by its manufacturer and is unique in the world as well as impossible to modify. This is a key element in securing and identifying the document.

The TagDOC Print program keeps all information about the document IDs (about electronic documents and their support) in encrypted form. Therefore, all information in the system is encrypted, and unauthorized access to this information is restricted. Still due to securing the information in the system, the identification of the documents and the reading of the information from the special sheet tag can only be done using the TagDOC Print program. All information in the system is stored as a database.

REFERENCES

- [1] K. Dalvinder, S. Jyotsna, *Survey Paper on RFID: Radio Frequency Identification*, International Journal of Computer Trends and Technology, Vol. 39, No. 2, 2016, pp. 72–78.
- [2] A. Popescu, G. Enciu, E. Popescu, I. Tache, *Architecture of the RFID systems used in production systems*, Proceedings in Manufacturing Systems, Vol. 12, Issue 4, 2017, pp. 155–160.
- [3] A.P. Adsul, D. Damame, P. Garde, K. Jore, K. Shah, *Electronic identification system using RFID*, International Journal of Computational Engineering Research, Vol. 5, Issue 5, 2015, pp. 23–27.
- [4] S. Subhashrahul, P. Kumar, *RFID technology & its application for detection of removal of fish plate in rail tracks*, IOSR Journal of Engineering, Vol. 2, Issue 2, 2012, pp. 229–233.
- [5] B. Wang, Z. Cao, Y. Yan, W. Liu and Z. Wang, *Fundamental technology for RFID-based supervisory control of shop floor production system*, Springer-Verlag London Limited, 2011.
- [6] A.V. Barenji, R.V. Barenji and M. Hashemipour, *Structural modeling of a RFID-enabled reconfigurable architecture for a flexible manufacturing system*, 7th IEEE Smart Objects, Systems and Technologies (SmartSysTech), At Erlangen / Nuremberg, Germany, Vol. 7.
- [7] J.M. Sardroud, *Influence of RFID technology on automated management of construction materials and components*, Scientia Iranica, Vol. 19, Issue 3, 2012, pp. 381–392.
- [8] Yu-Cheng Lin, Weng-Fong Cheung, Fu-Cih Siao, *Developing mobile 2D barcode/RFID-based maintenance management system*, Automation in Construction, Vol. 37, January 2014, pp. 110–121.
- [9] RFID technology based solution for classified document management system in government institutions, Romanian National Centre for Research and Development, Grant no. DOBR-BIO4/006/13143/2013.
- [10] T. Bodhuin, M. Tortorella, *Using RFID Technology for Supporting Document Management*, Published in IWRT 2007.