Development of a Decision Support System for Disassembly of End-of-Life Vehicles

Paulo Torres[1], Julien Juncker[2], Fabio Formiga[3], Nuno Fernandes[4]

Instituto Politecnico of Castelo Branco
paulo.torres@ipcb.pt, julien.juncker@viacesi.fr,
fabio.goncalves@ipcbcampus.pt,nogf@ipcb.pt

Abstract. The disassembly of end-of-life vehicles (ELVs) plays a key role in sustainability. It enables the recycling of materials, the reuse of functioning components and the separation of harmful substances. Major challenges for these companies result from the enormous variety of components to be disassembled and stored, and uncertainty at ELVs' supply and components demand. The accurate knowledge of stocked components is therefore essential for the economic disassembly of ELVs. In this paper, we propose a computer-based decision support system to assist the disassembly of ELVs and improve the effectiveness of decisions made concerning components disassemble and storage.

Keywords: end-of-life vehicles; disassembly; storage

1 Introduction

The recovery of components from end-of-life vehicles (ELVs) is gaining increasing importance due to sustainability concerns and economic reasons (Coates and Rahimifard, 2007; Ferguson and Browne, 2001; Gerrard and Kandlikar, 2007).
Regarding the storage of auto parts, these types of companies therefore have a significant stock of auto parts.
With the objective of managing the stock in an optimized way, we need to find a solution allows the society to have a remote visual to control it.
With a web solution, we can automate all storage process. This work simplifies some of the work of Decision Support System.
We are going to introduce you the role of Decision Support System and the web solution that meets the need of storage process.

2 Decision Support System

The Decision Support System (DSS) should provide users with the necessary information concerning specific decisions. Main areas in decision support include assisting the disassembly and the storage processes. Figure x resume the DSS core activities related with these two processes. The DSS for the disassembly process consists in three main activities:

– D1 (Potential Removable): the system automatically generates a bill-of-materials (BOM) of potential removable components based on the car model, considering legislation requirements.
– D2 (To Remove): the user determines which components should be removed based on the component's status (damage, abnormal wear, etc.), stock availability and potential value (considering market demand, inventory handling costs and selling price).
– D3 (To Store): the user specifies which removed components will be able to store after components' inspection. Non-conforming components, e.g., that were damaged during the removal process, are not included in the list of components to be stored.

The DSS for the storage process consists in three main activities:

– S1 (Product Storage): this requires the user to codify the component and to allocate it to a specific cell in the warehouse. The system automatically generates possible locations, considering product data (e.g., weight, area, equipment requirements, etc.) and space availability in the warehouse.
– S2 (Data retrieval): the system provides information about the product location in warehouse, number of units, inventory value, etc.
– S3 (Product Removal): product may be removed from warehouse on a temporary basis (e.g. for conservation/ maintenance activities) or definitively (e.g., when the product is sold or becomes obsolete).

3   Web solution of stock management

The importance to use web solution to manage your stock is to automate all the action with your inventory. This technology allows the user to see or manipulate remotely materials. This saves time and money.
To meet this need, we can use Database (which stores data with a good structure), and Website (To have an interface to see or manipulate items).
To access remotely to Website and do more complete functionalities, we need to use Webserver like Apache2 and set it up on a server.
Plan a system to store more faster new item in database is essential. For example, RFID sytem where each card contains a specific items. We can imagine a system that when you pass card in RFID reader, We store automatically data in database.
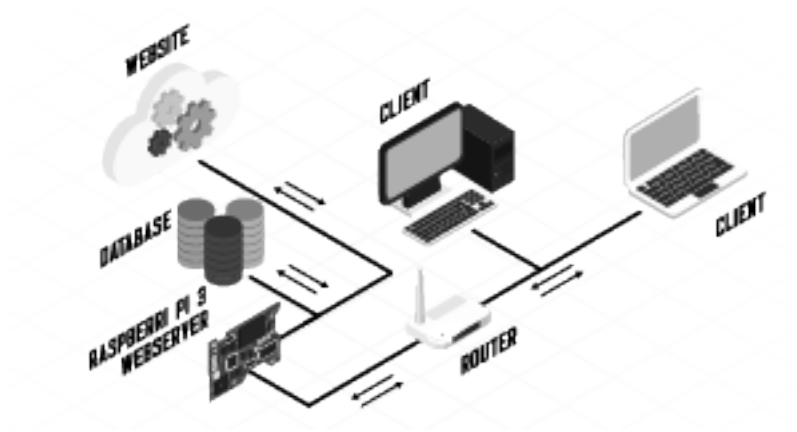
Fig. 1. RDR Web architecture

We can divide web structure in two parts, Front End and Back End.
The Front End is like the client side, he can interact with it. Generally, we use three langages:

- HTML: It's for the structure of webpage
- CSS: It's for the style of webpage
- JS: It's for developing client interaction

The Back End is like how things work. Usually, we have "business logic" and request for data. In our case, we use PHP langage.
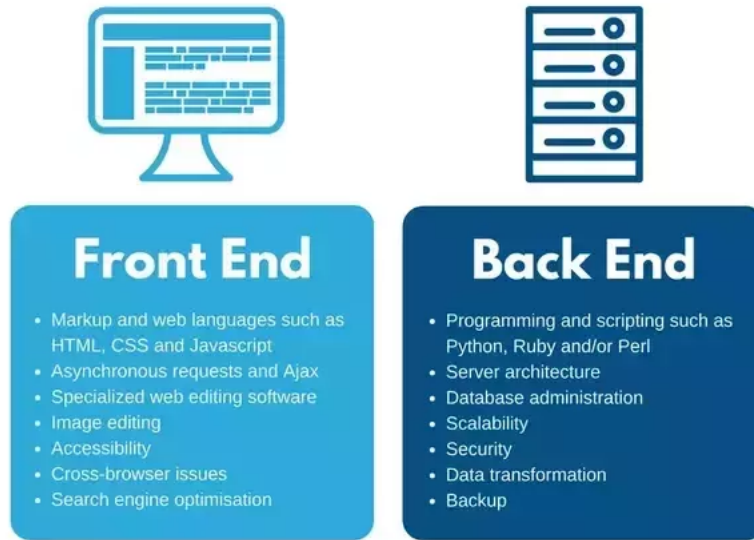
Fig. 2. RDR webpage structure

To explain quickly the webpage structure, we have PHP language on webserver. This language allows you to develop dynamic webpage through HTTP server.

When the client request the server with specific url and port, it will be on PHP page, she will do specific actions. If she need, she take data on database and render webpages to client through HTML langage. If client need to interact with website, we develop Javascript (and JQuery) script. With this langages, the client can do some actions in Front side.
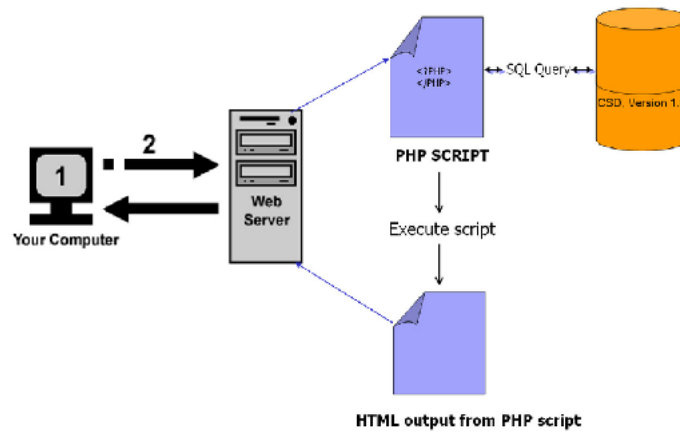
Fig. 3. RDR webpage structure

3.1   Website

The need that we can find for the use of a website is to have a remote view to data stored in database. We can manipulate this.
The website that we will present permit to user:

– Have a quick visual about the items.
– Have the possibility to manipulate it.
– Have an authentification system on website for more security

For access quickly to specific information that we want, we have planned a filtering and search system.
The manipulation of items can be editing, adding, removing items.
The authentification system permit to give specific rights to each user groups. For example, default client cannot manipulate items directly. For each modification, we need a confirmation of administrator.

Fig. 4. RDR Homepage with explanation

- 1. Object part: We can add an object, confirm client modification request in 'notification', associate RFID to item and edit column in table.
- 2. Authentification part: We can see connected user and disconnect this current user.
- 3. Table view: We can see all information about items and edit of remove it.
- 4. Fitering part: We can filter table with specific year, quantity or brand. Also, we can filter in a time interval or quantity.
- 5. Searchbar: We can search specific item.

3.2   RFID sytem

For adding new components in database, it will be so long to add element one by one with the website. So, we found a faster method uses RFID.
The goal is to associate each RFID card to specific item.
For do that, we need to have programming card like ESP8266. With this card, you have WIFI communication and it we allows you to programming RFID reader.
   You can read RFID card and with WIFI signal and specific HTTP protocol. The webserver understand this request and process it.

Fig. 5. RDR RFID system architecture