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A system for management of intelligent containers household waste in a city

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Informations	ABSTRACT
Keywords: Management solid waste Arduino RFID *Correspondence : assiaferroum@gmail.com	The economic and technologies development also the increasing population of large urbanization, has a huge increase in the production of solid waste which has become a major threat to both the environment and human health. Despite the development of industrial intelligence and its uses in various fields, the process of waste management still follows traditional methods, which are both expensive and tiring. No the solutions to the problem in line with technologies development a smart containers with indicators to measure the level of waste in them and a communication system based on the technology of internet communication or cellular methods to transfer data to the data bank located in the center of waste management and collection.

1. Introduction

For the past few years, we have noticed that the quality of air and land has deteriorated due to certain parameters, including pollution and the increase in the number of wastes. This is why currently, many countries are looking for alternatives to alleviate this problem. For experts in the field, it is the management and know-how of a branch of the modern economy which considers that whatever the waste produced, it first has an economic value, for this reason it is of paramount value to integrate an automation technology for this problem.

Technology continues to make progress in all sectors, and waste treatment is no exception. The goal of our work is working on the realization of a system capable of controlling the level of rings to improve the collection of waste in a city, for this will create an application capable to:

- Test the level of waste in the bins and send a message to the control post.
- Monitor all processes related to waste management and control the level of bins remotely based on RFID technology.

- Manage material and personal resources.

According to the study we did in the field, several issues were selected :

- Unexpected filling of the tanks before the trucks turn.
- Waste of time caused by unnecessary rounds to empty or not completely plain tanks.
- The long journey that the trucks follow to collect the waste.
- Poor management of staff and professional equipment.

In order to correct the problem, we put a system capable of improving the situation which is summarized in the following points:

- Based on an application that can control and monitor the levels of full bins, we will improve the situation to eliminate several drawbacks.
- The application will control the level of each bin and send data to the administrator who will manage

the human and material resources and the journeys of each truck.

The objective of our work is to develop an application to manage waste by respecting the following points:

- A sensor capable of measuring the level of waste in a bin and sending messages to the administrator.
- A system capable of managing all waste collection operations.
- The application can manage material resources and ensure good management of human resources.

The structure of this paper is as follows:

In the first section, we will talk about waste management, RFID and ARDUINO technology. The second section presents the design phase to detail the proposed system.

The third section is dedicated to show some screens of the system. Finally, the last section presents the implementation of arduino, sensor and wifi card.

2. Background material

2.1. Waste management

The term waste can be defined as any residue from a production, transformation or use process, any substance, material produced or more generally any movable property abandoned or which its holder intends to abandon and which are of a nature to wear damage to human health and the environment [1].

The National Waste Agency was created by Executive Decree No. 02 - 175 of May 20, 2002. Placed under the supervision of the Ministry of Environment and Renewable Energies, it is responsible, as part of a mission to public service subject to inform and popularize the techniques of sorting, collection, transport, treatment, recovery and elimination of waste. It must capitalize on and constitute a documentary background on waste management and ensure its dissemination to local authorities and the business sector. [2]

The missions of the agency:

- Provide assistance to local communities in the field of waste management.
- Process data and information on waste.

- Establish and update a national data bank on waste.
- In terms of sorting, collection, transport, treatment, recovery and elimination of waste, the Agency is responsible for:
- To initiate, carry out or contribute to the carrying out of studies, research and demonstration projects.
- Publish and disseminate scientific and technical information.
- To initiate and contribute to the implementation of awareness and information programs.
- Implement and operate the public system for the recovery and recovery of packaging waste EcoJem. [2]

2.2. National waste management strategy

The waste management policy is part of the National Environmental Strategy (NES), as well as the National Environmental Action and Sustainable Development Plan (PNAE-DD), which took the form of the promulgation of law 01- 19 of 12 December 2001 on the management, control and elimination of waste, dealing with aspects inherent in the management of waste, and the principles of which are:

1. Prevention and reduction of the production and harmfulness of waste at source.
2. The organization of sorting, collection, transport and treatment of waste.
3. The recovery of waste by reuse and recycling.
4. Environmentally sound treatment of waste.
5. Information and awareness of citizens on the risks presented by waste and their impact on health and the environment. [2]

2.3. National cooperation

A framework agreement has been signed between the National Youth Employment Support Agency (ANSEJ), the National Waste Agency (AND) and the National Conservatory of Environmental Training (CNFE) in order to promote micro company in the environmental field.

This agreement aims to define a framework for consultation, cooperation and

coordination between the parties, for the upgrading of micro-enterprises in the field of projects related to the environment sector in order to achieve:

- The establishment of a privileged consultation and partnership framework that will promote the creation of activities by young entrepreneurs linked to the environment sector.
- Dissemination of information for the benefit of young entrepreneurs who are interested in events related to project activities in the environment sector.
- Train and support young entrepreneurs during the creation of micro-enterprises.
- Promotion of expertise in this area among young entrepreneurs.

The National Waste Agency is also involved in the following:

- Technical support for companies at various stages of projects related to the environment.
- Provide companies with the necessary information on the technical and scientific levels which allow them to develop their activities in the field of waste management.
- Provide support through their participation in the experience gained.
- Involve these micro-enterprises in seminars and workshops relating to waste management. [2]

2.4. International cooperation

The projects developed with Belgian cooperation are on two levels:

1. Study and expertise fund: in this context, the DNA benefited from an internship by the team in charge of Eco-Jem with FOST+; the Belgian organization approved for the recovery and recovery of household packaging waste. Also, an environmental consultant has been

seconded to the DNA since August 2014.

2. The AGID program: a cooperation project serving local communities for waste management.

AGID (Support for Integrated Waste Management) is a cooperation project between Algeria and the Kingdom of Belgium in the field of waste management. This project will be implemented in three wilayas (Mascara, Mostaganem and Sidi Bel Abbès). The budget allocated for this project is as follows:

- A Belgian donation of € 11,000,000, the implementation of which is entrusted to the Belgian Technical Cooperation,
- Algerian funding of 1,000,000,000 Da, the implementation of which is entrusted to the National Waste Agency.

Supporting local communities is one of AGID's priorities. This support covers all aspects of waste management such as the collection organization, the operation of infrastructures, the technical control of equipment and awareness campaigns. A wide range of instruments will be made available to communities in the intervention area:

- Staff training in managerial, technical and relational tasks;
- The twinning of Algerian actors with their counterparts in Belgium;
- The development of management and monitoring methods as well as the acquisition of tools;
- The development of master plans and integrated waste planning;
- Assistance by specialists (especially for technical landfills).

In a broader context, AGID also aims to develop industries to recover waste and, thus, promote the circular economy. This primarily concerns the recovery of household and similar waste. Selective collections will be organized and sorting centers will be built. On the basis of which, recovery channels will be developed according to the needs and opportunities specific to each wilaya. Actions are also planned for inert waste and special household waste.

The AGID offices will be located at the headquarters of the Regional Environmental Inspectorate in Oran. [2]

2.5. RFID

Radio Frequency Identification is an automatic technology that encodes digital data in an RFID tag (Figure 1) affixed to a product, and allowing a radio wave device to read them remotely. In contrast to barcode technology, which requires that the codes printed on a label pass in direct view in front of an optical reader to allow the reading of the corresponding data, RFID tags can be read without direct line of sight. This ease and speed of reading makes RFID technology particularly suitable for a large number of applications for which the individual reading of each barcode would slow down the process of acquiring information. RFID allows data to be transmitted in real time, without a wired connection or any human intervention. It is ideal for situations that require instant critical data to ensure traceability in a company's supplies. It is also suitable for use in harsh environments [3, 4].



Fig. 1 :RFID tag.

2.6. ARDUINO

The Arduino card is a printed circuit specifically designed to house a microcontroller and provide access to all of its inputs and outputs. It also includes a few other electronic components that operate or extend the functionality of the microcontroller. A microcontroller is a small computer confined to a single integrated circuit (a chip). It is an excellent way to program and control electronic equipment. There is a wide variety of such microcontroller cards, some of the most used are the Wiring board, the PIC, the Basic Stamp and of course Arduino. You write source code in the Arduino development environment to tell the microcontroller what you want it to do. For example, by writing a single line of code (an instruction), you can flash an LED. If you connect a push button, you can add another line of code

so that the LED lights up when the button is pressed. With other instructions, you can have the LED only flash when the button is pressed. So you can easily make the system behave in a certain way, which would be difficult to do without a microcontroller. Like a desktop computer, Arduino can perform a multitude of functions, but it doesn't do much on its own. It needs something to be connected to at least one of its inputs and / or outputs to be useful. Like a computer keyboard and mouse, these communication channels allow the Arduino to sense and act on real-world objects. Before proceeding, it may be useful to discover the broad outlines of Arduino's history. [5, 6]

3. Our approach

3.1 System requirements

- We need a system that would be able to monitor the fill level as soon as possible.
- A system that would notify or present this information to affected collection trucks concerned.
- A user-friendly and interactive system.
- A secure and confidential system.
- A system that can provide historical usage reports.

3.2 Functional requirements

These are the basic requirements of the system that it must fulfill to be considered to solve the research problem.

They understand:

- **Adjustment of the filling level:** This allows the system to specify the filling level that it considers as a limit for the collection of waste.
- **Check the status of the tank:** This allows the user to view the filling level at any time via a Web application.
- **Notifications:** This feature will allow the user to be notified each time the filling level is full.
- **Reports:** This functionality allows the system to generate reports when necessary.

3.3 System architecture

The general architecture of the waste monitoring system that we want to achieve, describes the interaction and communication between garbage cans or smart containers distributed in different neighborhoods and buildings in the city. After being registered in a system database, The system administrator browses and retrieves the information processed for monitoring and

collecting waste via a developed web application or platform.

A simplified version of the system architecter is shown in Figure 2.

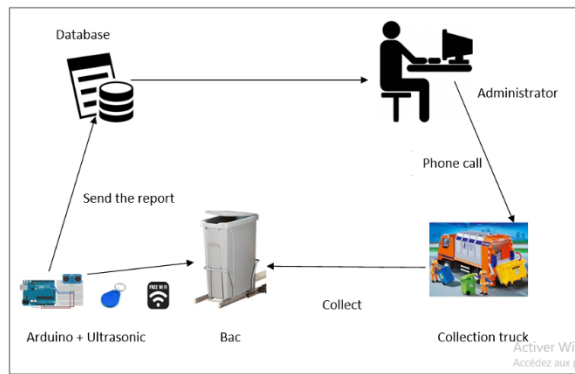


Fig. 2 :The system architecture.

3.4 Building the database

We created a database under the name "garbage-collector", this database contains a set of tables, as is shown in Figure 3.

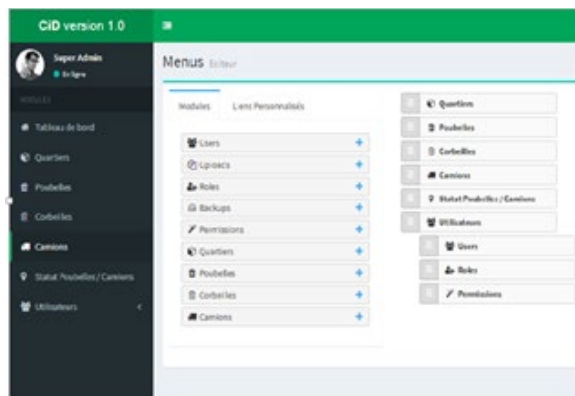


Fig. 3 :The database table.

3.5 Arduino UNO card

The Arduino UNO card (Figure 4) is a programmable ATmega328 microcontroller for operating components (motor, LED, etc.). It has "ports" for example to connect to a computer or to power. The Arduino UNO card is the centerpiece of any electronic circuit for beginners. It has: [7]

- 14 inputs / outputs (6 of which provide the PWM output).
- 6 analog inputs.
- A crystal at 16 MHz.
- A USB connection.
- A power jack.
- An ICSP header.
- A reset function.



Fig. 4 :The Arduino UNO card.

3.6 Ultrasonic distance sensor hc-sr04

The ultrasonic distance sensor HC-SR04 (Figure 5) is an inexpensive device that is very useful for robotics and test equipment projects. This tiny sensor is capable of measuring the distance between itself and the nearest solid object, which is very good information to have if you are trying to avoid entering a wall!

The HC-SR04 can be connected directly to an Arduino or another microcontroller and operates on 5 volts. It can also be used with the Raspberry Pi. However, since the HC-SR04 requires 5 volt logic, you will need two resistors to interface it with the Pi's 3.3 volt GPIO port.

This ultrasonic distance sensor is capable of measuring distances between 2 cm and 400 cm (that's roughly an inch to 13 feet for those who don't "speak" metric). It is a low current device, so it is suitable for battery powered devices. And as a bonus, it even looks cool, like a pair of Wall-E robot eyes for your latest robotic invention!



Fig. 5 :The ultrasonic distance sensor HC-SR04.

4. Some screens

In this section, we present some screens of our intelligent system (Figure 6, Figure 7, Figure 8, Figure 9).

6. Conclusion

The objective of this work is the realization of an intelligent system capable of facilitating the task of management and collection of waste with RFID technology. This realization was carried out in three stages, the first, is the analysis of the needs of our project, the second, is the modeling of the database used, and the third stage is the study of the proposed tools and their capacities. During the realization of this project, we tried to cover the maximum of needs, as well as to increase the efficiency of the functionalities of the applications, all this to facilitate the task for the administrator on the one hand and for the trucks on the other. In addition, this project was an opportunity to acquire assets and technical knowledge of existing software tools in the areas that use arduino. Finally, if we had more time, we could have achieved more functionality at the application level. and add other options and features.

In the future, we hope to insert other types of sensors (gas, weight), make work on the geo-localization MAP and finally, Extend the work on several waste containers.

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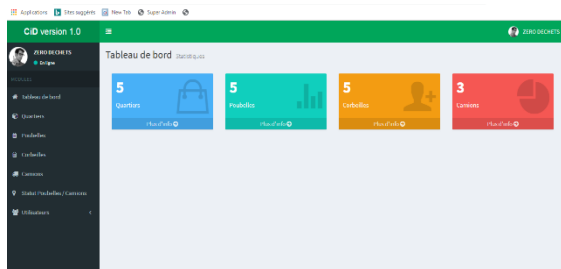


Fig. 6 :The dashboard.

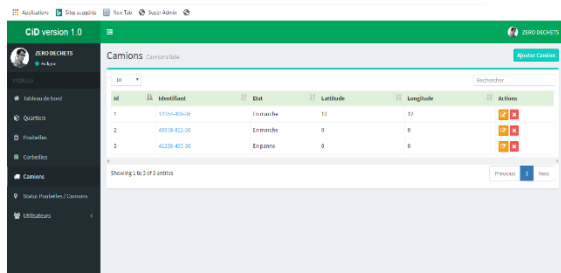


Fig. 7 :The trucks.

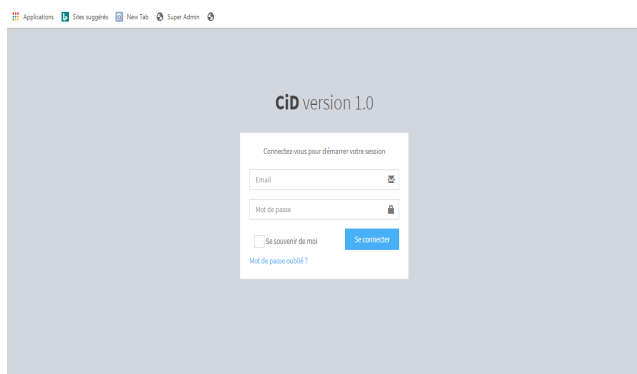


Fig. 8 :Login page.

5. Arduino, sensor and wifi card implémentation

The Figure 9 presents the implementation diagram of Arduino, sensor and wifi card.

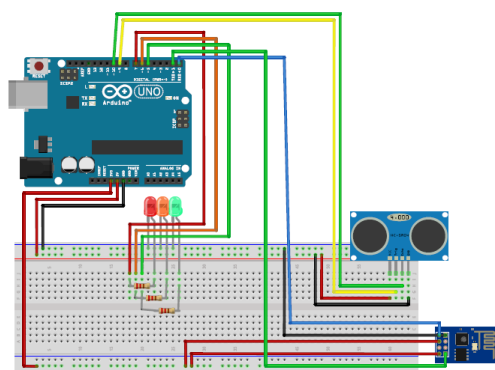


Fig. 9 :The dashboard.