DEVELOPING AND IMPLEMENTING A WEB-BASED RECYCLING SYSTEM FOR PROTECTING THE GREEN ENVIRONMENT

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ABSTRACT

Our society suffers a lot from the things that are thrown uselessly; these things may be beneficial to our society. On the other hand, communities suffer a lot of waste especially plastic waste; this has led to environmental pollution and depletion of natural resources. Therefore, this research aims to achieve sustainable development and achieve part of the Saudi Arabia vision 2030. Hence we have distributed a questionnaire to 88 responders, and based on the results of this study, which shows the importance of recycling and its impact on the environment and the extent of community interest in this subject and their supporters, The Let's Recycle site, based on the results of the questionnaire, will improve waste and plastics disposal in an environmentally positive manner.The proposed system was developed using the Unified Modelling Language (UML) and Microsoft Visual Studio2010 programming language.

KEYWORDS

Recycling System, Green Environment, Technology, Software Engineering and Unified Modelling Language.

1. INTRODUCTION

According to Roch man, Browne [1], in the year 2012 alone, it was estimated that about 280 million tons of plastic has been produced worldwide. From that amount, about 130 million tons of the plastics were land filled or recycled. Of the remaining 150 million tons, plastic will find their place in daily lives of human being. Meanwhile, the rest of the plastic fraction find their final way as litters in the oceans or land filled. Consequently, the plastic waste brings serious environmental threat to modern society because it is made up from several toxic chemicals, and therefore plastic pollutes soil, air and water if not properly managed or treated [2, 3]. Accordingly, when most of the available plastic today is made up from non-biodegradable sources, land-filling by using plastic would mean burying the harmful material for over a period until it naturally degrades. In their original condition, any plastic materials would increase the waste volume during land filling. However, their degradation rate and bulky in nature creates environmental risks tremendously. Besides, the plastic waste mass may hinder the ground water movement [4]. Plastic waste may usually in the form of film and hard plastic may contains harmful metal based elements such heavy metal, at which when mixed up with water or rain water can impede soil and receive water. Besides, plastic garbage can impede the rate of percolation and in turns would deteriorate the soil fertility if it is mixed with soil [4]. Moreover, plastic waste which is mostly disposed into surface water, public drain, river or sea water can create imbalance of the water and aquatic life [5].

The idea of recycling began during the First and Second World Wars, when countries suffered from a severe shortage of some basic materials such as rubber, which led to the collection of these waste materials for reuse. After years, recycling became one of the most important methods for waste management; For many years, direct recycling by scrap producers was the basic form of recycling, but by the early 1990s, the focus was on indirect recycling, ie, the manufacture of waste materials to produce other products based on the same raw material as recycling of glass, paper, plastics, aluminum and other materials. Industry experts have found that if recycling programs are taken seriously, they can help reduce the cost of raw materials and operating costs, and improve their image as being guilty for environmental pollution.

After ten years of application of the idea the question about the effectiveness of the process and the best means to get rid of waste has appeared. They have discovered over time that the cost of remanufacturing is high compared to its advantages and returns. The recycled product is usually lower in quality than the primary product used for the first time; also it is not used for the same purposes as the primary product. However, the cost of manufacturing it is higher than the cost of manufacturing the primary product from its raw materials, making the recycling process economically illogical and energy wasting. Where, another method of waste disposal should be sought while at the same time non-renewable raw materials are not wasted. Some ideas have already begun to emerge, such as using crushed glass in waste as an alternative to sand in street paving or trying to use waste to generate clean energy. In the future, many other ideas are expected to get rid of waste piles in a way that conserves the environment and does not waste energy. Green parties have emerged in many parts of the country, and many are aware of environmental awareness and a genuine desire to stop the drain of resources. A generation was emerging that knew new vocabulary such as the Ecological System, Global Warming, the Effect Green House, the ozone hole, recycling use, the ozone hole, recycling.

2. RESEARCH MOTIVATION

Where the statistics indicate the high per capita consumption will reach 1.39kg per person in 2016, indicating the high consumption of plastic materials, paper and other materials, which will increase the cost of burning and burying these materials and increase the environmental pollution resulting from the burning and will corrupt soil as a result of dumping of non-biodegradable materials. This will increase the percentage of desertification and increase the global warming, which led to the extinction and scarcity of many living creatures. Therefore, recycling processes should be taken seriously to reduce environmental problems and provide a less harmful environment for us and for future generations[6]. Table 1 shows the collected household waste per capita in KSA.

Table 1: Per capita waste generation in Saudi Arabia during the period 2010-2016.

Variable	Year						
	2010	2011	2012	2013	2014	2015	2016
Quantity of household waste	11,555	12,048	12,560	13,093	13,646	14,220	15,752
Population (1,000)	27,563	28,376	29,196	29,994	30,770	31,016	31,742
Per capita daily waste generation	1.15	1.16	1.18	1.20	1.21	1.24	1.39

3. PROBLEM STATEMENT

Communities suffer the large amount of waste and this has led to environmental pollution and depletion of natural resources, and the increase in negative phenomena resulting from the use of the wrong methods to get rid of these wastes and the negative consequences on public health and also suffer from plastic waste as it is one of the products manufactured from petrol, Which is used in many industries such as: making cups and dishes, but at the same time it does not decompose easily, it may take millions of years to decompose completely, so it is dangerous to the environment. The negative disposal of these wastes also affects the ozone layer, increasing global warming, increasing the temperature level in general, and burying some of the waste, which leads to soil spoilage, plant death and increases desertification rates[1-7].

Therefore, we have developed a system that promotes the culture of recycling and shows its importance to the environment and society. The system connects individuals who have a quantity of recyclable materials to those who need them such as glass, paper factories and other factories where they get these materials faster and at cheaper prices.

4. PROJECT OBJECTIVES

1. Achieving part of Saudi Arabia Vision 2030 which aims to achieve environmental sustainability.
2. Reducing environmental pollution caused by landfill and burning processes.
3. Minimizing the human damage caused by pollution of ground and surface water and soil pollution that lead to increased desertification and air pollution by smoke burning processes.
4. Provide additional income for the users of the system through the sale of materials that they do not need and presenting important materials to other parties.

5. RELATED WORK

Tadweer is a website and mobile application which collects excess materials from furniture, plastic, paper and other recyclable materials, which are considered as waste materials that can be recycled and sold[8].The money is then donated to serve charitable projects; the project of Tadweer is currently supporting the following:

1. Watering
2. Building mosques
3. A fasting breakfast project

Figure 1: Tadweer interface[8].

Considered Recycling is a global Orientation Since the increased risks of wastes on the environment through decompose waste which leads to leakage of toxins into water sources, whether groundwater or surface and soil pollution are affecting the cycle of food as well as pollution of drinking water and thus risk to the safety of people . From here, the Arab recycling company came as specializing in recycling services [9]. Arab Recycling Company LTD is a company specialized in recycling services and the most important products offered by it are carton - plastic - white paper - light metals[9]. Arab Recycling Company LTD aims to protect nature and human and reduce waste with the opening of new jobs, the most important services are:

1. Collecting waste of Carton, paper, Plastic.
2. Export materials that are acceptable for recycling to our external customers.
3. Collecting raw materials that acceptable for recycling from suppliers and all available resources.

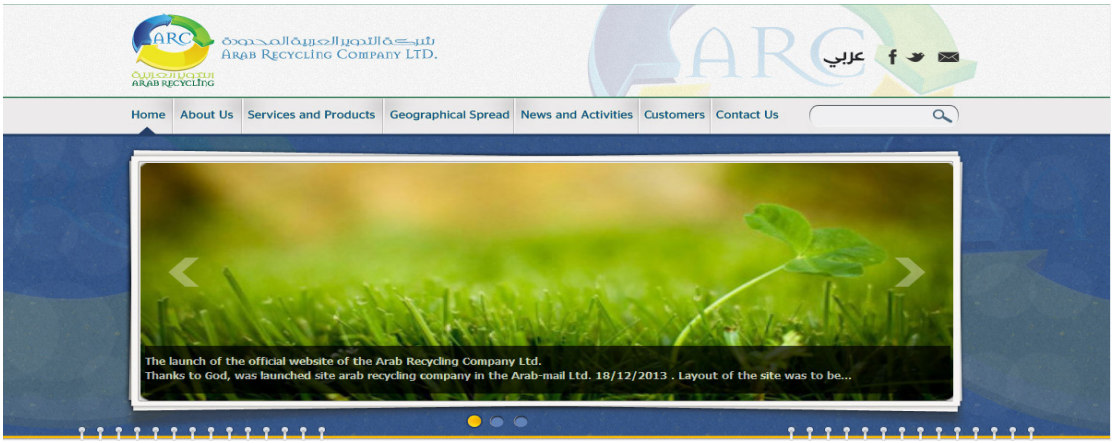


Figure 2: Arab Recycling Company LTD interface [9].

RecycleNow is the national recycling campaign for England, supported and funded by Government, it helps individuals, businesses and local authorities to reduce waste and recycle more, making better use of resources and helping to tackle climate change[10].

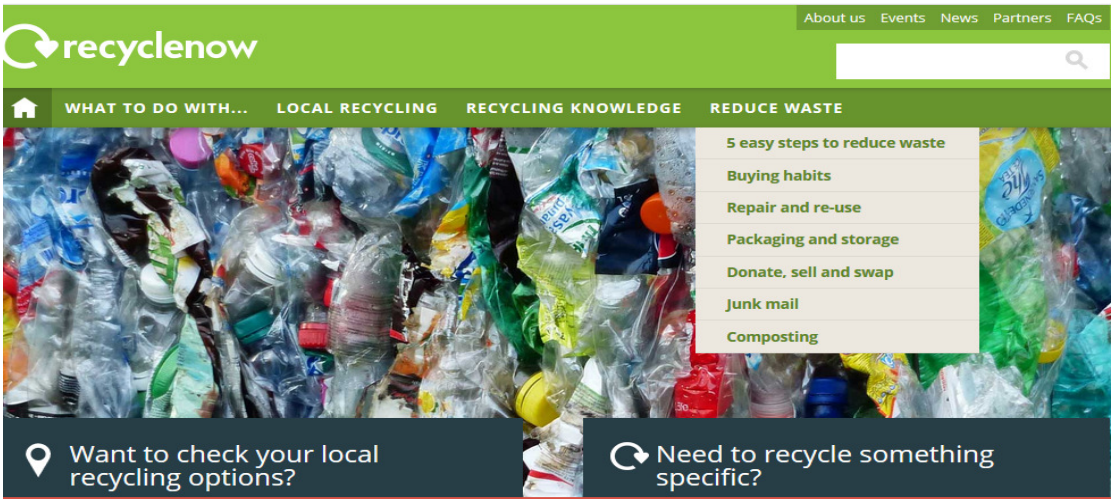


Figure 3: RecycleNow interface [10].

Live Love RecycleApplication, the application helps individuals get rid of some recyclable waste in exchange for certain points and allows them to specify the days and hours they want to get rid of their waste[11].

Figure 4: Live Love Recycle Application interface [11].

The technological revolution influenced everything [12-32], even the methods of complaint management applications for the real world complaint management issues. Today, the use of Artificial Intelligence (AI) algorithms is expansive, particularly in providing solution to challenging problems including patterns recognition and retrieval of information [27, 33-49], image segmentation [12, 13, 23, 50-55], analysis of medical image [56-60], Learning Management System [61-86], nurse rostering problem [87], Healthcare Monitoring system [26, 88], as well as prediction of river flow [89-91]. Accordingly, many researchers have used the Artificial Intelligence as an effective tool for environment protection, sustainability and Smart Recycling[92-95].

6. METHODOLOGY

The process of system analysis aims to study an existing system to entirely design a new system. System analysis is performed to achieve mainly two aims namely:

- To understand the process or the system clearly. This will assist in the new system design.
- System analysis will help to identify the problems in the existing system; therefore this will help to know the inefficiency reasons.

The Unified Modeling Language (UML) is visualization for the system design, it represents graphical notations which help to describe and design software systems, principally software systems constructed utilizing the object-oriented style [96-100]. The UML was utilized mainly to design the proposed system. The Use-Case diagram and the context diagram are addressed below.

6.1. USE CASE DIAGRAM

The Use-Case Model depicts system requirements. Use-case captures the communication between system, users and other stakeholders in order to achieve the intended goal of the system. It shows the interaction between the system and external entities [83, 99, 101, 102]. The Actors are external entities who represent roles. They could be external hardware, human users or other

systems. In this case the actors are the System Administrator, Buyer and Seller. Figure 5 shows the use case diagram for the proposed system.

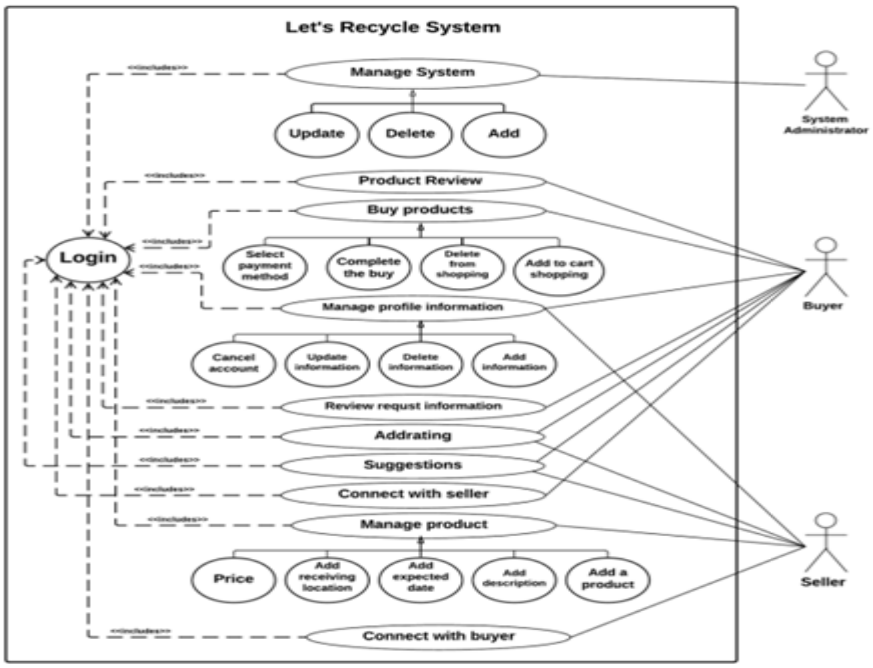


Figure 5: Use Case Diagram of the proposed system

6.2. CONTEXT DIAGRAM

The Context Diagram (CD) is used to establish the boundaries and context of the system to be modeled; where things outside and inside of the system are being modelled, and the relationship of these external entities with the system is also demonstrated. CD sometimes is called a level 0 data-flow diagram, it is drawn in order to clarify and define the boundaries of the software system. It identifies the information flow between the external entities and system [103]. Figure 6 shows the Context Diagram for the proposed system.

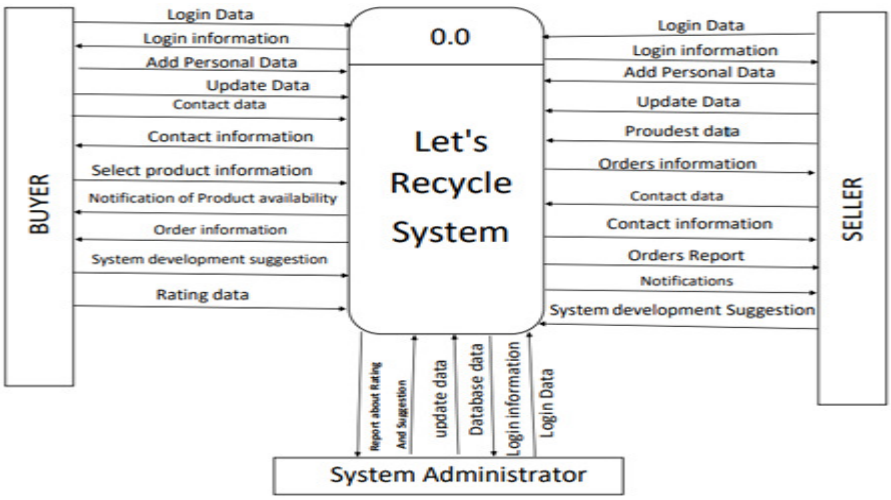


Figure 6: The Context Diagram for the proposed system.

6.3. ENTITY RELATIONSHIP (ER) DIAGRAM

The ER Diagram, a kind of flowchart demonstrates the way that entities such as concepts, objects, or people are related within a system to each other. ER Diagrams are commonly utilized to debug or design relational databases in the education and research, business information systems and software engineering [20, 21, 24, 25, 104].

ER diagrams are associated to Data Structure Diagrams (DSDs), which concentrates on the elements relationships within entities rather than the relationships between entities themselves. In addition, ER diagrams are commonly employed along with data flow diagrams (DFDs), which delineate the information flow for systems or processes [20, 21, 24, 25, 104]. Figure 7 shows the ER diagram for the proposed system.

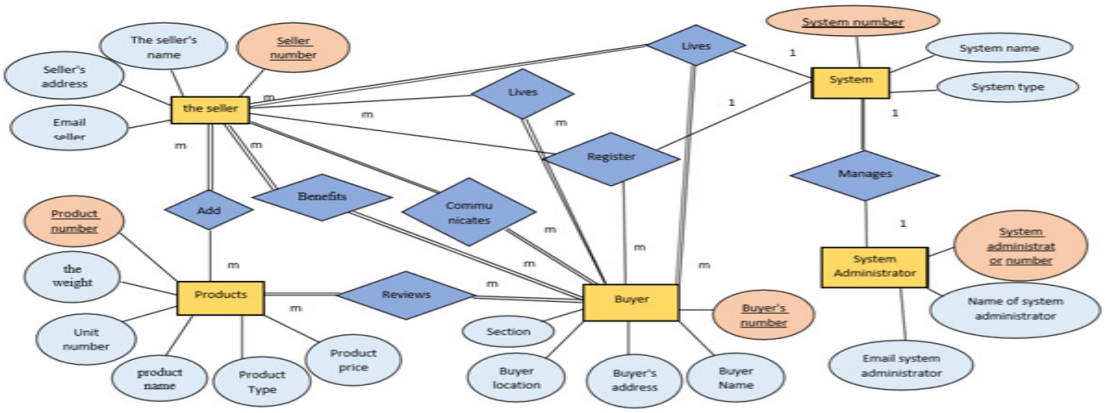


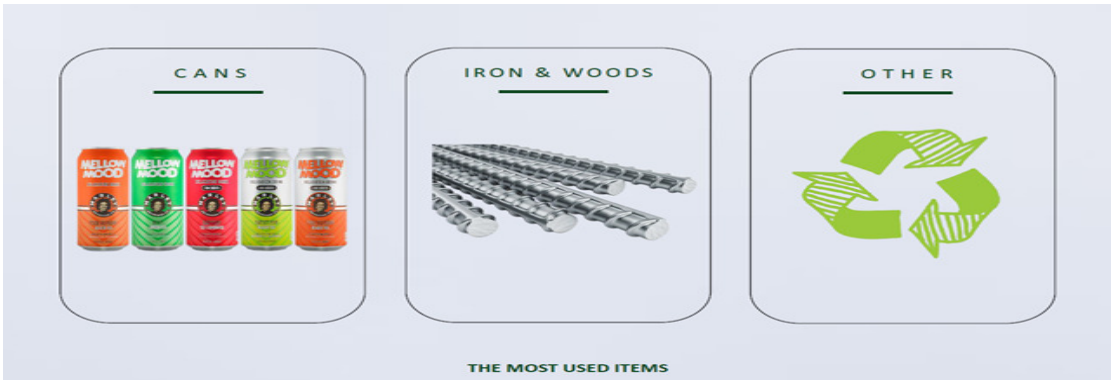
Figure 7: ER diagram for the proposed system.

7. INTERFACE DESIGN

The programming languages utilized in this work is Microsoft Visual Studio2010 programming language. The programming language was chosen relying on the languages features which make them more suitable for this work. In the proposed system, the user starts with the registration in the system; after that the system offers the user a form for login and the user has to enter the information required as shown figure 8. If the information is found correct by the system search in the database, it displays to the user the system homepage and allows the user to make use of the proposed system. However, if it's not valid, the user will be redirected to the login page. Figure 9 and 10 shows the most used items interface and Add new product interface respectively

Figure 8: login interface

(a)



(b)

Figure 9: The most used items interface.

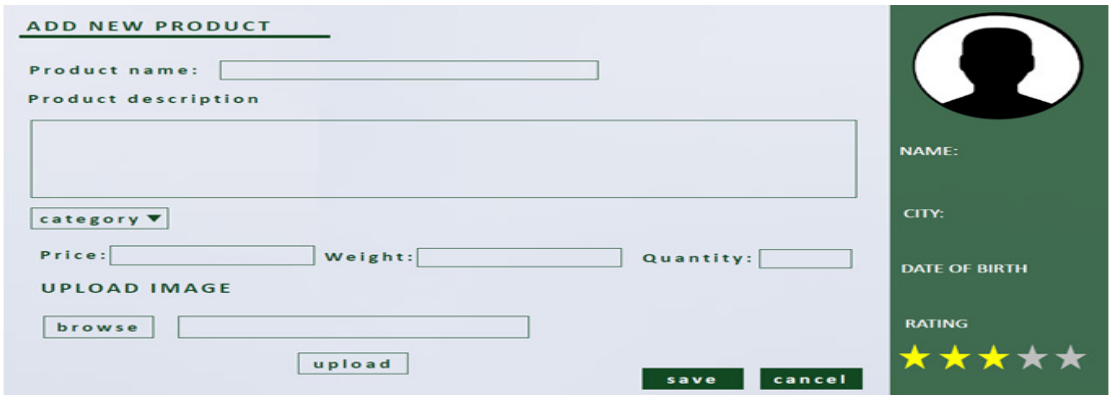


Figure 10: Add new product interface.

8. DISCUSSION

This stage highlights the usability of the proposed system. During this stage, the system is evaluated while user satisfaction is ensured. Test was executed on the proposed system by running it on Mozilla Firefox and Internet Explorer using the local host server. For evaluation purpose, 20 students from College of Applied Studies and Community Service at Imam Abdurrahman Bin Faisal University (IAU) were invited to use the prototype. The students were

first briefed on the prototype's usage and the user interface. Then, the students tested the system, and answered the survey questionnaire consisting of 10 items formulated to gauge the level of user satisfaction. The usability of the proposed system was also determined. The result as well as the level of usability of the system according to the feedback provided by 20 students can be referred in figure11. As can be construed by the result, a significant amount of users agrees that system is practical, useful and fulfil the project's primary objective.

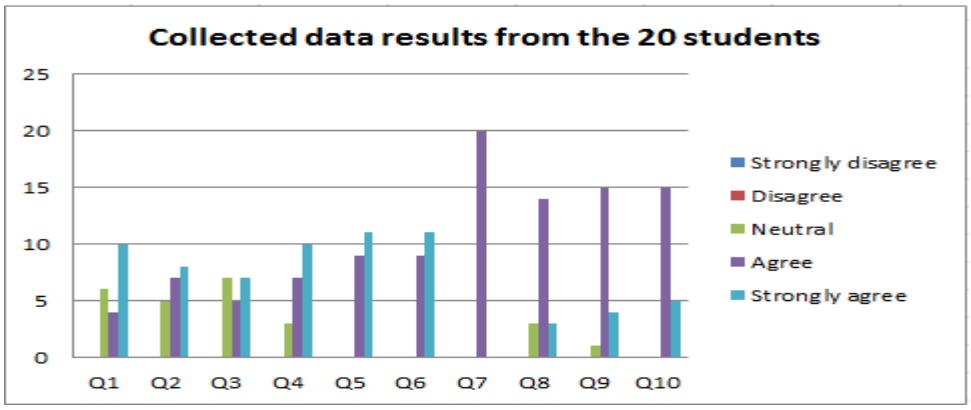


Figure 11: collected data results from the 20 students.

9. CONCLUSION

The results of this study show the importance of recycling and its impact on the environment and the extent of community interest in this issue and their support. We have analyzed the use case, context and ER diagrams. We also designed the pages for the site (Home, Login, Registration, Products, etc.) for Let's Recycle system, this site combines the seller and the buyer through several specifications.The Let's Recycle site, based on the results of the questionnaire, will improve waste and plastics disposal in an environmentally positive manner.The proposed system was developed using the Unified Modeling Language (UML) and Microsoft Visual Studio2010 programming language.

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