Mobile Application System for Eco-Accounting

Subjects: Others

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Nowadays, eco-accounting is widely used in sustainable consumption and production. In order to incentivise consumers' sustainable consumption and enhance their environmental awareness, a novel mobile based eco-accounting infrastructure has been developed by this research. It applies the eco-credit values to incentivise the consumer's recycling activities and utilises the eco-cost values to record the consumer's footprint obtained through consumption. The infrastructure consists of four modules: the consumer's eco-account, eco-shopping, eco-recycling and eco-incentives. In order to implement the mobile eco-accounting infrastructure, multiple mobile technologies have been applied to develop the novel functions of the mobile app, including a new QR encryption algorithm, embedded Google maps, advanced Internet-based services and multi-language support.

mobile app | eco-accounting | eco-shopping | recycling | eco-incentive | sustainable consumption | sustainability

1. Introduction

Sustainable consumption is an important agenda in relation to global climate change and the reduction of human beings' impact on the environment. As an instrument to measure sustainable consumption behaviours, eco-accounting is currently attracting great attention. Eco-accounting is used for the generation, analysis and use of financial and related non-financial information in order to effectively solve the problems encountered in the process of sustainable development [1][2]. As a tool to report sustainable impacts, it has been applied in ecological footprint measurements, e.g., water footprint [3][4][5] and carbon footprint [6][7], soil quality assessment [8], ecosystems [9] and energy efficiency [10]. Studies have revealed that eco-accounting is able to calculate environmental impacts from various aspects, however, incorporating lifecycle impact assessment methods into the eco-accounting framework would provide an extended eco-accounting solution from the perspective of products' life cycle. With this solution, the accounting will be able to cover major environmental impact categories through the product's business supply chain and to share the eco-accounting results among stakeholders, which would be one step further to support sustainable development in the circular economy context. Many scholars have applied the conventional eco-accounting merits for major stakeholders of supply chains in various scenarios such as eco-innovation for businesses [11][12][13], and decision making for policy implications [4][6]. However, few studies have accommodated the eco-accounting results for consumers and other stakeholders of the product supply chain.

Some studies proposed the use of eco-accounting results for consumers to participate in the decision-making process of sustainable consumption, e.g., using environmental and health indicators to indicate food nutritional footprint [14], affecting consumers' purchase behaviours by ecolabels indicating product ecological information [15][16][17]. These studies have proven the necessity of interacting with consumers for eco-accounting practices, but they addressed sustainable consumption only and focused on individual consumption phases, which means that the complete view of eco-accounting for the product supply chain is still missing.

With the wide application of mobile technologies, some mobile applications have been developed to provide mobile phone users with the eco-logical information of products and services to encourage their sustainable behaviours in various scenarios, such as estimating the users' greenhouse gas emissions with their paired bank transactions data [18][19]; presenting the product information (e.g., price, expiry date, quality indicators) to consumers while grocery shopping [20]; encouraging car drivers to reduce traffic and its consequent impacts on the environment, climate change and human health [21]; scheduling appointments for solid waste collection in order to reduce environmental burdens mainly linked to the disposal procedures, and then providing eco-feedback information, e.g., energy consumption, for householders [22]. Those mobile applications demonstrate a means of interacting with consumers to encourage sustainable behaviour and have proven to enable efficient sharing and communication with up to date eco-logical information for consumers. However, they address challenges in a sole scenario, for impacts from consumer regular consumption and recycling activities, and lack a systematic solution to accommodate consumers' recording, monitoring and retrieving behaviours for eco-logical impacts. Existing individual mobile applications for eco-accounting deal with only partial aspects of the eco-accounting, without comprehensive functions. For instance, only the functions of eco-recycling and eco-incentive are dealt with in the reGAIN app [23], from which customers cannot obtain products' ecological information, i.e., eco-point value, and eco-account function is also not developed for customers.

To overcome the shortcomings of the existing mobile applications for eco-accounting, a novel mobile application, CIRC4Life app, has been developed with an eco-accounting infrastructure, which uses eco-cost values to record consumers' footprints resulting from shopping. The app also uses eco-credit values to record and incentivise consumers' recycling activities and provides individual consumers with personal eco-accounts. The CIRC4Life app is an outcome of the CIRC4Life project supported by European Commission's H2020 programme [24] and is based on the experience of the authors' team from the Advanced Design and Manufacturing Engineering Centre (ADMEC) of Nottingham Trent University. The ADMEC has been actively involved in the research in eco-accounting. The myEcoCost project supported by the European Commission FP7 Eco-environment programme [25][26][27], of which the ADMEC is a core member, developed a method to calculate the eco-cost score for products' impact on the environment. The eco-cost scores were calculated based product carbon and material footprints. Based on the eco-cost method, a prototype of eco-accounting infrastructure was developed by Su and Peng [28][29], in which an eco-point method is proposed. With the prototype, a novel eco-accounting infrastructure is further developed by the CIRC4Life project.

2. Overview of the Mobile Application System for Eco-Accounting

2.1. The Eco-Accounting Concepts

The developed mobile application aims to implement the eco-accounting infrastructure proposed in the CIRC4Life project. In order to understand the functions of the mobile application, it is necessary to explain the following key concepts: eco-cost, eco-credit and eco-account.

2.1.1. Eco-Cost

Eco-cost is used to indicate a product's negative impact on the environment. Within the eco-point approach presented in the CIRC4Life project, each product is associated with an eco-cost value that is calculated by using a lifecycle impact assessment method. The higher the eco-cost value is, the more negative environmental impact the product has. The eco-cost value of a product is added to a consumer's eco-account after his/her purchase of the product. The aggregated value of eco-costs reflects the negative environmental impacts generated through the product's life cycles, which help the consumer select more sustainable products.

2.1.2. Eco-Credit

Eco-credit is adopted to credit the consumer's positive behaviour to recycle products, which means consumers can earn the eco-credit value via recycling the end-of-life products. As per how to calculate the eco-credit of a recycled products, the details of this can be found in the CIRC4Life deliverable [25]. Within the mobile application, eco-credit values consist of eco-credits awarded due to recycling, eco-credits spent and eco-credits balance. The eco-credits recycled is the eco-credit value that is obtained by the consumer recycling activities. The eco-credits spent refer to the eco-credit value spent by a consumer in eco-incentive activities, e.g., receiving a discount on purchasing products, redeeming for theatre or cinema tickets, donating eco-credits for tree planting. The eco-credits balance is the balance of the total eco-credits recycled and the total eco-credits spent.

2.1.3. Eco-Account

The eco-account of a consumer is used to record his/her eco-costs and eco-credits related to purchasing and recycling activities. It means that eco-account can enable consumers to record and track their daily eco-footprints on environment. An example of a consumer eco-account page is demonstrated in Table 1.

Table 1. An example of a consumer's eco-account page.

Date	Activities	Eco-Costs	Eco-Credits		
			Recycled	Spent	Balance
01/08/2020	Purchase a tablet	67	0	0	0
08/08/2020	Recycle an iPad	0	74	0	74
16/08/2020	Purchase a lamp with discount using eco-credits	26	0	10	64
20/08/2020	Exchange ticket with eco-credits	0	0	20	44
01/09/2020	Donate eco-credits for tree planting	0	0	10	34

Date	Activities	Eco-Costs	Eco-Credits		
			Recycled	Spent	Balance
	Total	93	74	40	

As Table 1 shows, the eco-cost total reflects the purchased products' accumulated negative impact on the environment, and the eco-credits balance represents consumers' current positive impact on the environment. By using mobile communication technologies, consumers can track their eco-credits, eco-costs and daily eco-footprints through their mobile phones.

2.2. System Architecture

Based on the eco-point approach and the eco-accounting infrastructure developed in Section 2.1, a novel eco-accounting infrastructure using multiple mobile technologies has been implemented, which is shown in Figure 1.

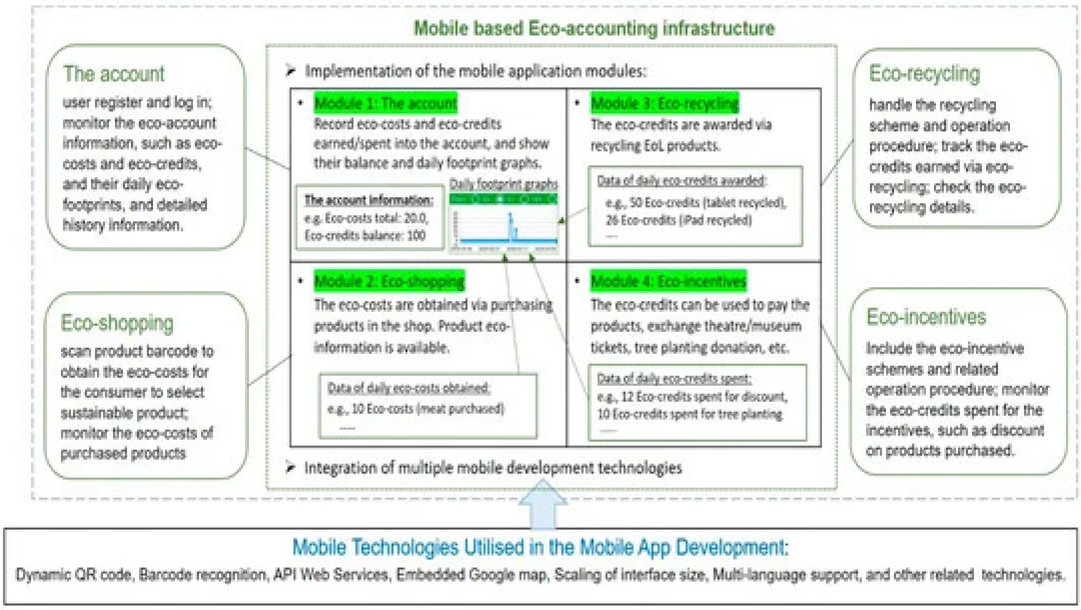

Figure 1. Overall architecture of the mobile application system for eco-accounting.

The mobile based eco-accounting infrastructure consists of four modules: the account, eco-shopping, eco-recycling and eco-incentive, which are detailed in the following sub-sections.

2.2.1. The Account Module

The account module provides four functions: user registration and login, user profile, eco-account information and eco-history detail. The user registration function allows consumers to create their eco-accounts in this system by filling their account name, email address and password. The user login function is used to validate consumers' account ID and ensure that only the registered user can log in the mobile application in order to utilise all the functions. In the user profile function, consumers can edit their personal profiles, change login password and email. The eco-account information function is used to monitor consumers' eco-cost total and eco-credit balance, and to show consumers' daily eco-footprints, which are presented by four ecological charts: eco-credits recycled chart, eco-credits spent chart, eco-credits balance chart and eco-costs chart. The eco-history detail function is designed to retrieve and list the consumers' history activities, e.g., eco-shopping activities, eco-recycling activities and eco-incentive activities.

2.2.2. Eco-Shopping Module

The eco-shopping module is designed for consumers to view the product eco-information when they purchase in stores via scanning the product barcode. It means that consumers can scan products' barcodes with their mobile phone to obtain products' eco-costs retrieved from remote database server to facilitate the selection of sustainable products and monitor the eco-costs of their purchased products.

2.2.3. Eco-Recycling Module

When consumers' products (e.g., tablet, iPad, mobile phone) reach the end-of-life, they can recycle them to obtain the corresponding eco-credits from their recycled products. In the eco-accounting system, the eco-recycling module is used to handle the recycling schemes and operation procedures (such as how to recycle electronic products and how to recycle organic waste), to provide the QR codes of consumers' recycling ID that are utilised to communicate with the intelligent recycling system (namely the intelligent bin) developed by CIRC4Life, and to track consumers' recycling history. Through the above functions, consumers can earn eco-credits via their recycling activities and check all the recycling details with their mobile phones.

2.2.4. Eco-Incentive Module

In order to encourage consumers to recycle and reuse their products, an innovative incentive scheme is developed in the eco-accounting system, and consumers' eco-credits earned via recycling products can be awarded to their eco-account, which are redeemable for shopping discounts and theatre and cinema tickets. Therefore, the eco-incentive module is designed to guide consumers to use eco-incentive scheme with their eco-credits. This module provides functions for consumers to view and check all the history details of their eco-incentive activities.

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