Building an Automatic and Scalable Tool for Improving Environmental Recycling: ELARA

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Crowdsourcing

What is Crowdsourcing?

- Definition – Crowdsourcing: The concept that large groups of people handle tasks that have traditionally been associated with a specialist or a small group of experts.
- Virtually anyone has the potential to contribute valuable information.
- Numerous crowdsourcing systems are on the world-wide web:
  - Wikipedia
  - Linux, Apache
  - Facebook, LinkedIn, Myspace
  - many, many more...
- Four key challenges crowdsourcing systems face: How to recruit contributors? What are they allowed to do? How to combine their contributions? How to manage abuse?

How this project uses crowdsourcing:

- Hardware and software specifications will be open-source so anyone can build a machine and become part of the system network.
- Any registered user can contribute information about a recyclable or regular garbage item, which will then be stored in the database.
- Database entries are reviewed by trusted registered users who rank other users according to the quality of their entries.
- Users can view their recycling profile and compare it to their city or state's progress + motivation to participate through competitive atmosphere.

The complete System

Overview

Project goal: design and create a system that will help improve environmental recycling.

Motivation: People often mistakenly put recyclable items into the regular garbage bin and vice versa, reducing the amount of items that go back into the recycling stream.

How this project approaches to solve this issue:
- Use other people’s knowledge about recyclable items to help others make the correct choice of where to put their items.
- Small computer at a garbage station draws on this “wisdom of crowds” and acts as a recycling assistant (ELARA machine).

Major tasks of project:
1) conduct a literature search on crowdsourcing
2) design and build a database for information about items and registered users
3) create a web interface for an ELARA machine and the server (simulation)
4) write the basic software application to run on an ELARA machine
5) begin building the system website, begin designing a hardware prototype

Future tasks of project:
1) finish the system website
2) build a hardware prototype of an ELARA machine, create the GUI for the ELARA software application
3) develop a smartphone App to act as a portable ELARA

The ELARA Software

Two parts to the ELARA software:
- server scripts: written in PHP
- client application: written in JAVA

The ELARA software enables and handles a user transaction at a Kiosk

User transaction protocol:
- user indicates her type Guest or enters username if registered
- user scans their item
- user guesses which bin their item belongs in
- user starts next transaction or is finished

In order to prevent many security threats to both the client and the server, there is an underlying security mechanism to protect the system:
- Each ELARA Kiosk has a unique ID number and unique digital signature only known by itself and the server
- A cryptographic hashing algorithm is used on each message that is sent by one side along with the plain message
- The server records certain data for each transaction to track the recycling of a specific user's city/state/etc

The ELARA machine

ELARA stands for “Environmental Liaison And Recycling Assistant”

- Many institutions already have garbage sorting stations where there are separate bins for different kinds of waste.
- An ELARA is an automated tool that is meant to be set up at such an existing garbage station as additional aid to improve waste separation.
- Hardware components of an ELARA:
  - Touchscreen computer as the user interface
  - Barcode scanner to identify the waste items via their unique UPC
  - Optionally waste bins if creating standalone ELARA station
- Every ELARA is going to be connected to the internet so it can retrieve the necessary information about an item from the database on the server.
- Users who wish to build their own ELARA for their institution or organization can construct their machine as they see fit.

The System Website

- The website can be accessed from any device with a browser.
- Built following the MVC architectural pattern used in software engineering: the application data and behavior (model) are managed separately from the user interface (view) and the controller which interfaces the model and the view.
- Any person can view the following pages on the site: registration, log in, about, contacts, view items in database, recycling profile of specific city/state/etc
- Each registered user has her own profile page on the site and a rank according to how much she has recycled.

What can registered users do on the website?

- Average Recyclers: suggest new items for database
- Trusted Heavy Recyclers: suggest new items for database
- register and manage their own ELARA Kiosk(s)
- Trusted Heavy Recyclers: rank other users' database entries
- add suggested items to database
- All users have access to the public pages and can compare their recycling profile to that of any specific category.

The System Website

Fig. 1 Example of waste station (Ferry Building, San Francisco, CA) An ELARA could be installed at a station

Fig. 4 Screenshot of ELARA Project Website

The Diagram Explained:

- 3 different types of client nodes in the network: Home User, Mobile User, and Kiosk
- Home and Mobile Users, and Kiosk connect to system server via the Internet
- Each client type has its own protocol to communicate and exchange data with the server.
- Home Users can only connect to the system through the system website, and the Kiosk acts as the ELARA.
- Mobile Users are the fusion of Home User and Kiosk because they can act as both client types.

The System Website

Fig. 4 Screenshot of ELARA Project Website

References


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