Smart Bin - An Odor Oriented Approach to Waste Management

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ABSTRACT

Technology enhanced trash cans have already been subject to research and have become available as market products. How we handle the waste has traditionally been a logistics issue, but it can be approached also in other ways.
The SmartBin perceives the trash as something more than a pile of waste - it is also something smelly!
The emphasis is on improving the indoor environment to ultimately improve the quality of life by detecting odors. The technology enhancing the bin uses sensors which detect gas emissions, mainly the ones occuring in decomposition of organic materials. If any of these values exceed a threshold the SmartBin will react accordingly, supported by state of the art machine learning techniques nope. Any specifics will be listed in the following document. This will range from hardware prototyping to evaluation of the product.

ACM Classification Keywords

H.5.m. Pervasive computing, smart measuring: Miscellaneous

General Terms

Design; Measurement.

INTRODUCTION

Waste management is a constant issue, that is dealt with on the daily by different organisations. According to Eurostat, the countries in europe have had a rather stable production of waste the past decade, while some countries fluctuate towards higher productions of waste other countries produce less. citation needed The above supports the claim that waste management is highly relevant in a post modern society.

However waste management has been traditionally perceived from a logistical point of view. Imagine not the amounts nor the location of the bin being the driving force for picking it up, but rather its smell.

This is the essential feature of our system - the additional parameter, which can be used in conjunction with existing systems or used to produce entirely new experiences centered around the waste bin.

Following this concept, we developed a prototype of a simple system that produces information about smell and trash level, and pairs this information with a specific bin where the device is installed.

The system is specifically designed for private use inside a household, but can be easily adjusted and extended for different usages.

In this paper we describe the system specifications and evaluation, and discuss its potential integration in different scenarios than the one presented.

RELATED WORK

This is not the first paper about Smart Waste Management Systems (WMS). Other researches explored interesting IoT approaches to the problem, mostly in relation to planning garbage collection and/or waste reduction. Different research groups implemented an RFID and weight based approach for a real time automated WMS, with the main focus on bringing down management costs and facilitate automating waste identification [4] [1] (among others). In another study from South Korea, the main approach was to identify food waste in a selected area of Seoul and give citizens incentive to waste less food by fining them based on the amounts of waste they dispose [2]. The infrastructure is similar to other systems, with a centralized server and a host of devices providing data to this server. Then the server provides data for applications such as management utilities or phone apps. In another study, Vincenzo Catania and his colleagues used a Smart-M3 Platform and sensor enhanced bins in Catania, Italy with the main focus on urban planning, smart collection and monitoring of urban solid waste [3]. In this case, the information that was collected was on the location of the trash can, level of fullness, and weight of the waste.

METHODOLOGY

insert this somewhere meaningful..

SYSTEM DESIGN

In this section we describe the overall system characteristics proposed for our approach to waste management.

The system is composed of four main components:

- sensory layer: responsible of producing information, placed directly on the bin.
- communication module: responsible of sending such information.

- data layer (the cloud): this component stores the data and makes it available.
- data consumer (android): this client shows information to the end user on request

Sensory layer

The sensory layer has two sensors and one communication device. The sensors detect the state of the bin. Our approach relies on two kinds of information related to the state of the bin: smell and fill level. For this reason, the sensory part of the system is of key importance, since it enables the information to be perceived and registered by the system. An odor detection sensor is able to capture volatile organic compounds (VOCs) and other gases, typical bioproducts of food decomposition, commonly associated with bad smell. Some examples are Hydrogen Sulphide (H_2S), Ammonia(NH_3), Toluene (CH_3) and others. The smartbin sends the raw values of VOC concentration to the information layer.

The other type of sensor is a ultrasonic distance measurement unit. This is used to get the distance to the bottom of the bin. This type of information is processed in the sensory layer to reflect the amount of thrash filled in the bin.

Communication and Data layer

Having obtained the information is only the first step though, the next one is to make it available.

Our system uses a web service for collecting the data and storing it in a database, making it accessible to potential consumers. The service supports two types of entities. The SmartBins and the contexts. In short a SmartBin represents the hardware instance of a smartbin, this includes information such as location expressed as coordinates, unique identifier, 'calibration' which is the intial air quality level (in "clean" air, a value to which compare later measurements) and meta information about the last associated context. This ensures that status of every bin is readily available without having to traverse the contexts.

The contexts model a snapshot of a bins state at a given time.

The data are sent directly from the bin to the cloud. In our implementation this is done via WiFi, but can ideally be sent in any other way. Our system uses a cloud-based web service for collecting the data and storing it in a database, making it accessible to potential consumers.

Data Consumer

Finally, the information is accessed and presented on an Android application, and made accessible to the users. The client can work in two separate modes: as an android application or simply as an ambient display.

On the android application it is possible to manage multiple bins and get an overview of the last values measured by the system.

The ambient display is much more simple, it just displays a color of a shade from green to red depending on the scent level.

In our system we use an android phone to run in both modes, so pressing on the screen even in ambient display mode will give the user the extra functionality of knowing trash level and emission level.

Ideally the ambient display can be placed in a strategic location inside the house, for example by the door or on the fridge, where people can be reminded of the trash status and act accordingly.

HARDWARE ARCHITECTURE

The Smartbin hardware platform is a simple construction consisting of two sensors, a microprocessor and a wifi communication module. It is embedded into a thrashbin with a lid which is used as a base for both the distance sensor and the gas sensor.

We built the prototype using an Arduino Uno board. As for the sensors we used a Figaro TGS2602 as our gas sensor and a MaxSonar MB1013 ultrasonic rangefinder as our distance sensor. We use a WiFi shield on the Arduino board for wireless communication.

The presentation layer works on Android 4.0 or later.

SOFTWARE ARCHITECTURE

todo to mention: google app engine android stuff, api for graphs, others? arduino code detail?

EVALUATION

The SmartBin system which has been constructed utilizes gas sensors to open up an additional dimension when measuring the state of the environment, in which it has been placed.

This extra dimension provides values of various gas concentrations in the current environment. In short these values will be used in an evaluation of how the current environment is doing in regards to air quality and potential safety hazards for individuals.

The expectation is that these results can be used to produce rather precise predictions about how smelly the air in the given environment is.

People have a notion about what smells, machines need to do these predictions based on values from sensors.

The assumption is that the gas emissions of some chemical reactions, namely the ones where decomposition of organic materials is happening, always produce some specific gasses as a product. It is based on our knowledge of these different gasses and how they smell - we assume that hightened concentrations of some of these gas types result in worse quality air.

System Evaluation

We interviewed a restricted poll of people in regards to usability of our system in a private scenario, and the results are the following: actual findings?

all of the interviewed keep their private trash under the sink in a closed compartment most of the interviewed consistently forget to take out the trash when they should

most of the interviewed think a reminder on the trash status placed on the door would be extremely useful to remember to take the trash out

evrybody think it’s cool

stuff

CONCLUSION

REFERENCES

1. Belal Chowdhury, M. C. Rfid-based real-time smart waste management system.
2. Insung Hong, e. Iot-based smart garbage system for efficient food waste management.
3. Vincenzo Catania, D. An approch for monitoring and smart planning of urban solid waste management using smart-m3 platform.
4. Yann Glouche, P. A smart waste management with self-describing objects.