

Internet of Things (IoT) based Waste Management System

Pranav Mhatre¹, Sneha Utekar², Tejali Shinde³

^{1,2,3}Student, Department of Computer Engineering, MGM CET, Navi Mumbai, India

Abstract: Waste management is one of the primary problem that the world faces irrespective of the case of developed or developing country. The key issue in the waste management is that garbage bin at public places gets overflowed well in advanced before the commencement of the next cleaning process. To avoid all such hazardous scenario and maintain public cleanliness and health this work is mounted on a smart garbage system. The main theme of the work is to develop a smart intelligent garbage alert system for proper garbage management. This paper proposes a smart alert system for garbage clearance by giving an alert signal to the municipal web server for instant cleaning of dustbin with a proper verification based on level of garbage filling. The ultrasonic sensor aids this process, which is interface with Arduino UNO to check the level of garbage filled in the dustbin and send alert to the municipal registered mobile number once if garbage is filled. An infrared sensor is attached to dustbin covering 360 degree so that if any waste is found lying on the floor nearby the dustbin it will sense it and the buzzer will ring indicating the person to dump the waste into the bin.

Keywords: Arduiono, Ultrasonic sensor, Infrared sensor, GSM module, Buzzer

1. Introduction

Web search engines have made massive contributions to the web. They make discovery of information on the web quick and easy. However, they are far from optimal. For a given query, a personalized Web search can provide different results for different users or organize results differently to each user, based upon their interests and information needs. Personalized web search differs from generic web search because it returns identical research results to all users for identical queries, independent of varied user interests and information needs. A major deficiency of generic search engines is that they follow the “one size fits all” model and aren’t adaptable to individual users. This is typically shown in cases such as different users have different backgrounds and interests. They may have completely different information needs and goals when providing exactly the same query. For example, a biologist may issue “mouse” to get information about rodents, while programmers may use the same query to find information about computer peripherals. When such a query is issued, generic search engines will return a list of documents on different topics. It takes time for a user to choose which information he/she really wants, and this makes the user feel less satisfied. Queries like “mouse” are usually called ambiguous queries.

Statistics has shown that the vast majority of queries are short and ambiguous. Generic web search usually fails to provide optimal results for ambiguous queries. Users are not static. User information needs may change over time. Indeed, users will have different needs at different times based on current circumstances. For example, a user may use “mouse” to find information about rodents when the user is viewing television news about a plague, but would want to find information about computer mouse products when purchasing a new computer. Generic search engines are unable to distinguish between such cases. Personalized web search is considered a promising solution to these problems, so it can provide different search results based upon the information as per user need. It exploits user information and search context in learning to which sense a query refers. Consider the query “mouse” mentioned above: Personalized web search can disambiguate the query by gathering the following user information. The user is a computer programmer not a biologist and the user has just input a query “keyboard”, but not “biology” or “genome”. Before entering this query, the user had just viewed a web page with many words related to computer mouse, such as computing input device and keyboard. Such irrelevance is largely due to the enormous variety of user contexts and backgrounds as well as the ambiguity of text. Personalized web search (PWS) is a general category of search techniques aiming at providing better search results, which are adjust for individual user needs. As the expenditure, user information has to be collected and analysed to figure out the user intention behind the issued query.

The solutions to PWS can normally be categorized into two types i) Click-Log-Based methods works on repeated query created by the same user it is simple and uncomplicated, this strategy impose bias to clicked pages in the user’s query history. These methods have been indicated to perform consistently and exceptionally well .ii) Profile-Based methods are used for user profiling techniques to enhance the search experience with complex user- interest models. These techniques are effective for all sorts of queries but there are some possibilities of unstable performance under some situations. Although there are some advantages and disadvantages for both types click-log-based PWS techniques. The profile based PWS has signify more efficiency in enhancing the quality of web search freshly, with growing usage of personal and behavior information to

profile its users. The user's unwillingness to reveal their private information during search has become a main obstacle for the wide propagation of PWS. Privacy issues are growing from the insufficiency of protection for such data.

A. Objective

UPS provides runtime profiling, which in effect optimizes the personalization utility while respecting user's

B. Privacy requirements

Allows for customization of privacy needs Provides an inexpensive mechanism for the client to decide whether to personalize a query in UPS

2. Literature survey

Before going into the details of our IoT based Smart Garbage Management system, we will review some of the existing system in vogue pertaining to Smart garbage System. In the traditional Garbage Management, the Municipal Corporations are assigned to place big dustbins in the society for the collection of the garbage and waste. Once the bin gets filled, bin gets cleaned by the garbage collector and bin collected are disposed somewhere appropriate. This system got no proper supervision from the corporation for cleaning the bin regularly, which creates dirtiness on the streets and roads and spread diseases. So accordingly some initiative have been proposed in developing IoT Technology for Garbage Management. In one of the research, a sensor (Infrared sensor / proximity sensor) is placed under the dustbin. When the sensor signal reaches to the threshold value, a mail notification (like email, twitter, whatsapp message) will be sent to the respective Municipal / Government authority person. Density of the Dustbin also checked through a GUI (Graphical User Interface) so any of the authenticated people can check the present condition of the dustbin. This would enable the personnel to send the collection vehicle to collect the full garbage bin or dustbin. In this section, work proposed by various authors for the privacy protection in personalized web search is detailed. Previous works on profile-based PWS mainly focus on improving the search utility. The basic idea of these works is to tailor the search results by referring to, often implicitly, a user profile that reveals an individual information goal. Remainder of the section is review of the previous solutions to PWS on two aspects, namely the representation of profiles, and the measure of the effectiveness of personalization. Many profile representations are available in the literature to facilitate different personalization strategies.

sX. Shen, B. Tan, and C. Zhai [2] developed an intelligent client side web search agent (UCAIR) which is a web browser plug-in that acts as a proxy for web search engines. They developed technique for implicit user modelling in information retrieval and presented decision theoretic framework. Search precision over the popular search engine Google by search agent but it is lacking user modelling and is also not adaptive to individual users.

K. Sugiyama, K. Hatano, and M. Yoshikawa [3] proposed many approaches for adapting search results. It considers each user's need for significant information without any user effort. It uses detailed analysis of user's one day search history for achieving user preferences by user profile based on modified collaborative filtering. Disadvantage in this process is that every user needs different information for their query. Therefore, with the different information needs, search result should be adapted to every user.

B. Tan, X. Shen, and C. Zhai [4] introduced methods for mining contextual information from long term search history are statistical language modelling based methods. The major advantage of method is utilizing it for a more precise estimate of query language model. Disadvantage is that, the problem in web search engine occurred is only one size available for all documents to return

3. Architecture

The existing Garbage Management system of Municipal authorities got no technological innovation and relies purely on human being towards collecting the bin regularly. The collection of bin and getting cleaned are supervised by municipal authorities. But there is no record of bin being cleaned or not. Many a times the bin collector do not come regularly which results in garbage overflow and making streets and city unclean with foul smell. So towards this some sort of technological innovation been developed as a prototype by employing IoT technology where Infrared sensor employed in detecting the level of garbage in the bin and accordingly intimate the municipal authorities by email or whatsapp. Also research done in developing low cost embedded system for tracking the level of the garbage bins and a unique ID will be provided for every dustbin in the city so that it is easy to identify which garbage bin is full. In all these research, Infrared type sensor used which can only detect the level of bin based on threshold when garbage in direct line of sight with Infrared sensor. This is a bit of challenge in detecting the level of threshold in the bin. Also placement of sensor under the bin will give a wrong signal as bin is full due to line of sight. Also there is no system for predicting the rate at which garbage getting filled and cleaned from the bin for planning the garbage removal periodically rather than static policy. So accordingly we here have developed.

An IoT Based Smart Garbage Management System where ultrasonic sensor attached to top of the Garbage Bin. These sensors would work on sound waves that would detect and monitor automatically the garbage in the bin and trigger alarm when the garbage gets filled in the bin. In addition the rate at which bin getting filled along with the date and time is computed based on the number of times the bin was filled during the day. This will give the analysis report to the municipal corporation towards planning in cleaning the bin which will be available to the Corp. as well as the public on the website for view. This system makes use of the hardware such

Table 1
System requirements

Functional	Admin login by using valid user name & password, admin can view the user details, add contents, providing general key & personalized key to users, admin can recover the attacked contents, Data sharing between Admin to user, user login by using authorized user name & password, User can search contents, user can request general key & personalized 16 key, End user authentication by admin, finding the attackers.
Non- Functional	Admin never monitors the user activities
External interface	LAN, WAN
Performance	Admin login, User login, add contents, view all content details, search contents, providing general key & personalized key, view search history, recover contents, view users, search based on query, request, response, view user details, view attacker details.
Attributes	Privacy protection, personalized web search, utility, risk, profile, profile based personalization, Admin, users.

as Ultrasonic sensor, Arduino Uno, LED, Alarm, and Raspberry pi3 Processor. The system design and architecture of an IoT based Smart Garbage Management system shown in Figure.1. Fig. 2 to 5 give the Data Flow Diagram, Sequence Diagram, Activity Diagram and Use Case Diagram of the IoT Based System.

A. Implementation results and analysis

The complete hardware prototype of IoT based Smart Garbage monitoring system been developed by employing Arduino and Raspberry Pi3 as microcontroller and processing unit respectively. In addition, Ultrasonic Sensor is fitted to every bin and same connected to Arduino microcontroller which would trigger the LED and Alarm once the bin reaches 80%. Also the Arduino unit is connected serially to Pi3 for communication of data for analysis towards predicting the rate at which bin getting filled. Figure 6 shows the complete prototype system developed. The Raspberry Pi3 processor connected to monitor screen. Functional Admin login by using valid user name & password, admin can view the user details, add contents, providing general key & personalized key to users, admin can recover the attacked contents, Data sharing between Admin to user, user login by using authorized user name & password, User can search contents, user can request general key & personalized 16 key, End user authentication by admin, finding the attackers. Non- Functional Admin never monitors the user activities External interface LAN, WAN Performance Admin login, User login, add contents, view all content details, search contents, providing general key & personalized key, view search history, recover contents, view users, search based on query, request, response, view user details, view attacker details. Attributes Privacy protection, personalized web search, utility, risk, profile, profile based personalization, Admin, users.



Fig. 1. IOT Based Smart Garbage

B. System Requirements

The system implemented the web service using Java, Net Beans, SQL Server 2014, and the details of the hardware and software specifications of this system are briefly explained in this section. It required two types of requirements for the implementation of the proposed system first is functional requirements and second non-functional requirements. Below table will briefly describe the software requirements for supporting privacy protection in personalized web search

C. Functional Requirements

Functional Requirement defines a function of a software system and how the system must behave when presented with specific inputs or conditions. All the conditions may occur in system and these may include calculations, data manipulation and processing and other specific functionality. Some conditions are needed to specify the logical input otherwise the system will not function as per its implementation. In this system following are the functional requirements for the admin and the user.

- The Admin has to login by using valid user name and password.
- After login successful he can do some operations such as add contents, view all contents, list all searching history, list ranking of images, list of all personalized search, attacker details, recover contents, list of all user and logout.
- The admin can add n-number of contents. If the admin want to add a new content, then admin will enter a URL, domain, title, description, uses, related images of the particular content, then submit and that data will stored in data base.
- The Admin can view list of all users. Here button, it will display all personalized search details.
- The time delay Generation chart results. This chart shows the time delay by using greedy DP and time delay using greedy IP.
- The user can attack contents, and then user should enter name to attack, and click on attack button.
- The Attributes are Privacy protection, personalized web search, utility, risk, profile, profile based personalization, Admin, users.
- All register users are stored with the details such as

user ID, user name, E mail ID, mobile no, Location, date of birth, address, pin code, general key and personalized key.

- The admin can view the attacker details. If admin clicks on attacker details button, the admin will get attacker information.
- There are n numbers of users are present. User should register before doing some operations. After registration successful he has to login by using authorized user name and password.
- Login successful user will do some operations such as query search, personalized search, attack content details, view comparison graph and logout.
- The user can search query. Before searching any query, the user should request generalization, then proxy server will provide a generalization of profile.
- The user can view the comparison between greedy DP & greedy IL.
- After personalized searching, the greedy IL will be generated. If the user clicks on personalized search

D. Non – functional requirements

Non – Functional requirements, as the name suggests, are those requirements that are not directly concerned with the specific functions delivered by the system. They may relate to emergent system properties such as reliability response time and store occupancy. Alternatively, they may define constraints on the system such as the capability of the Input Output devices and the data representations used in system interfaces. Many non-functional requirements relate to the system as whole rather than to individual system features. This means they are often critical than the individual functional requirements. The following non-functional requirements are worthy of attention. The key non- functional requirements are

E. Security

The system should allow a secured communication between server, Admin and users.

F. Energy Efficiency

The Energy consumed by the Users to receive the File information from the server and admin.

G. Reliability

The system should be reliable and must not degrade the performance of the existing system and should not lead to the hanging of the system.

4. Future Work

Garbage Management is very much important towards having clean and smart society. Traditional Garbage management employing human is not very effective with no proper supervision. Research has been done in employing IoT based technology in monitoring the status of bin towards collecting the garbage once threshold reached. There were

certain drawbacks in the existing IoT based system, which led to the development of IoT, based Smart Garbage Management System employing ultrasonic sensors. So accordingly IOT based Smart Garbage Management System been developed as a prototype where ultrasonic sensor fitted in bin for monitoring the depth of bin and accordingly once threshold reached alarm and LED triggered for cleaning the bin. This information updated in webpage of Cloud. In addition the rate at which bin getting filled is monitored for planning the bin collection dynamically. This information also updated with date, time and rate at which bin getting filled in webpage for municipal authorities for planning the bin collection. The project developed towards smart Garbage Management got lot of scope for future enhancement. One of the enhancement that can be thought about is employing camera sensor for image processing of the cleanliness of the roads and penalizing persons not throwing the garbage properly in the bin. In addition the real time data of the analysis readings and survey on the cloud to be available on the website. Finally GSM module to send the notification to the truck driver of the municipal corporation for the dustbin filled and to be cleaned.

5. Conclusion

Garbage Management is very much important towards having clean and smart society. Traditional Garbage management employing human is not very effective with no proper supervision. Research has been done in employing IoT based technology in monitoring the status of bin towards collecting the garbage once threshold reached. There were certain drawbacks in the existing IoT based system, which led to the development of IoT, based Smart Garbage Management System employing ultrasonic sensors. So accordingly IoT based Smart Garbage Management System been developed as a prototype where ultrasonic sensor fitted in bin for monitoring the depth of bin and accordingly once threshold reached alarm and LED triggered for cleaning the bin. This information updated in webpage of Cloud. In addition the rate at which bin getting filled is monitored for planning the bin collection dynamically. This information also updated with date, time and rate at which bin getting filled in webpage for municipal authorities for planning the bin collection. The project developed towards smart Garbage Management got lot of scope for future enhancement. One of the enhancement that can be thought about is employing camera sensor for image processing of the cleanliness of the roads and penalizing persons not throwing the garbage properly in the bin. In addition the real time data of the analysis readings and survey on the cloud to be available on the website. Finally GSM module to send the notification to the truck driver of the municipal corporation for the dustbin filled and to be cleaned.

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