Bin Watch

A smarter way of garbage collection

Background

Internet of Things is a principle which revolves around increased machine-to-machine communication and networks of data-gathering sensors.

Smart dustbins which are built on this principle are digital dustbins which collect various data about a dustbin like fill percentage, humidity, temperature etc. This data can be analysed and used to manage waste dumping effectively.

Reap Benefit, a reputed NGO in our society has taken the initiative to place these smart dustbins around us.

What is Bin Watch?

Bin Watch is an application that helps to track the location of smart bins placed in the society and manage them effectively.

This application is currently available on web and iOS platform.

The stakeholders for this application are NGO placing these bins, BBMP collecting and clearing these bins and normal users who want these bins to be placed in their society.

iOS App

- App supports Management and User Mode
  - Management Mode - This is for BBMP Management and Bin Pickers.
  - User Mode - This is for residents.

- Uses the following tools
  - Uses Google maps SDK
  - Uses Crashlytics for troubleshooting
  - Parse SDK for push notifications.

iOS - Management Mode Features

- Dashboard
  - A quick look into fill percentages, Humidity, Temperature levels, Active/Inactive(faulty sensors) Bins
- Analytics
  - Analyse bins date based on fill percentage/temperature and humidity.
  - User can select upto 3 bins at a time.
- Fill Levels
  - Displays the fill percentages of bins in the region.
- Bin Data/Details
  - Predictions for next fill date
  - Bins data(fill %, humidity, temperature) for the week
  - Bins data(fill %, humidity, temperature) for custom time frame.

iOS - Management Mode Features [continued...]

- Bin Locator
    - Displays bins in the region. Bin icon's color gives fair idea on fill percentage.
    - My Location button on maps (Resets map to user's current location).
    - Compass on maps (Resets the map back to default orientation).
    - Option to draw route for picking all Red Bins.
    - Option to draw route for picking all Red/Yellow Bins.
    - Option to select bins on map and draw route to pick the selected bins.
- Data Export
    - Export bins data in a region to PDF, Excel and CVS.
    - Data will be sent to configured Email.
    - User has the option of selecting the format to export.
    - User has the option to change Email ID.

iOS - Management Mode Features [continued...]

- Request for new bin
  - User can put a formal request (Email) to get a new bin at a location.
  - Mail template has the coordinates of the location.
- Reporting an issue
  - User can report any generic issues related to this system and a mail will be send to authorities.
- Settings
  - Option to change coverage radius, Email ID, Export formats

iOS - User Mode Features

- Bin Locator
  - Same functionalities as Management mode
- Push notifications
  - Has capability to receive push notifications. This can be used if Management needs to send messages to residents.
- Messages
  - Displays messages send by Management.
- Route to nearest bin
  - Draws route to nearest bin

iOS - User Mode Features [continued ...]

- Request for bin
  - Same as Management mode
- Report an issue.
  - Same as Management mode
- Report bin not being picked up
  - User has the option of taking a picture of unattended bin, and mailing it to authorities.

Website

http://binwatch-ghci.rhcloud.com/

The website is compatible with any mobile device as well as desktop.

The third party libraries used in front end are :

1. jQuery
2. Bootstrap
3. Google Maps API
4. Font Awesome

Website Screens

The website contains following screens :

- Homepage
  - This screen is an introduction screen to our application.
- Locate Bins
  - This screen locate bins on the app. It also has a search bar to search for locations.
- Bin Detail
  - This screen shows the details about a bin.
- Contact
  - This screen shows the contact details to reach out to Bin Watch team.
- FAQ
  - This screen explains about waste management to users.

Locate Bins - Website

URL : http://binwatch-ghci.rhcloud.com/locate

This screen asks user permission to locate the user. Once the user provides the permission, it makes a server call to locate the smart bins near the user's current location.

The bins are located on the maps and are color coded based on their fill percentage.

There is a search box available where user can type a location to search bins in that particular area. Once the search is done, the searched place is located on the map and a call to server is made to locate the bins near the searched area.

Bin Details - Website

URL : http://binwatch-ghci.rhcloud.com/bin/5627cefb990b1be87d000000

This screen locates the bin on the map and also tells the following details about the bin : last updated time by sensor data, temperature of the bin, humidity of the bin and which kinds of waste it stores.

It also lists out its recent activity and a link to visualize the same over a period of time.

A report can also be downloaded in the csv format for the same bin.
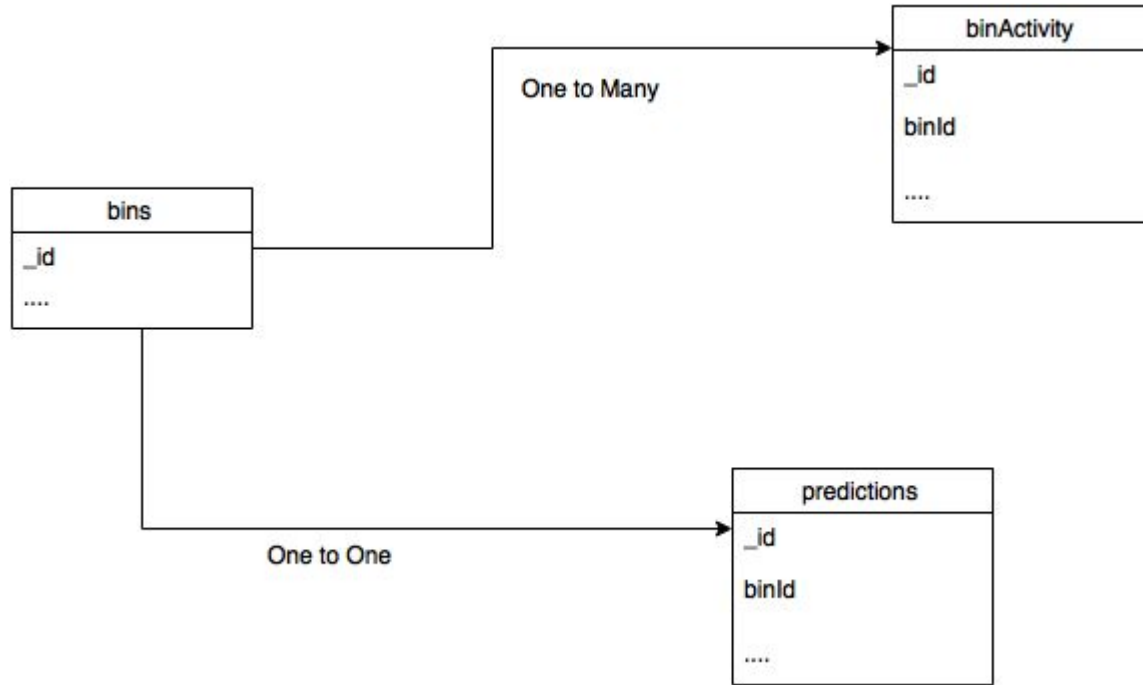
Backend

Repo URL : https://github.com/hkasera/binWatch

The technologies used for backend are :

- Node js
- MongoDB

The website is hosted on Openshift.

Database Schema

bins

_id

....

binActivity

_id

binId

....

One to Many

predictions

_id

binId

....

One to One

Database Schema [continued..]

bins : Stores details of bins

Whenever a bin is placed in the society, an entry in this collection will be created with a unique bin id.
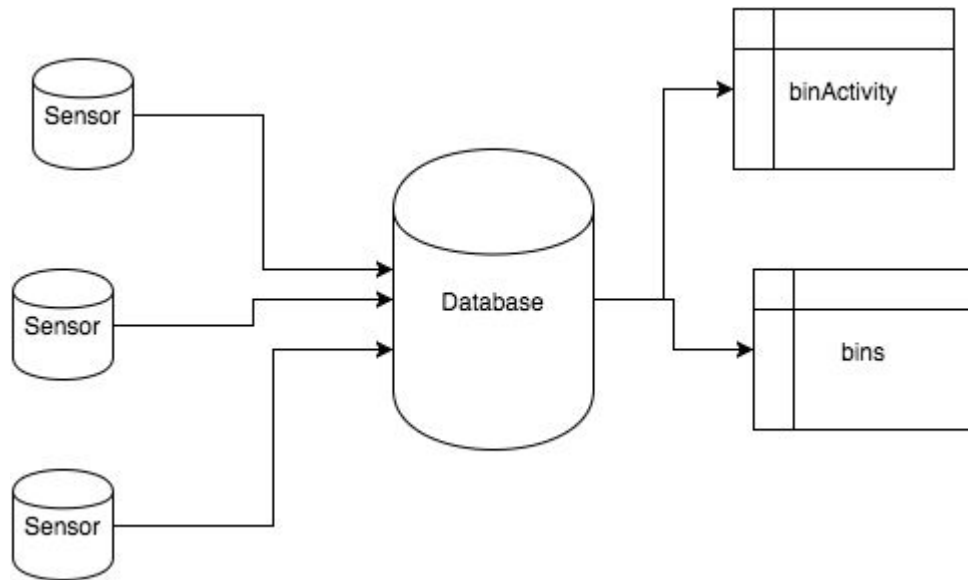
binActivity : Stores sensor data for the bins

Whenever a sensor data is emitted for a particular bin id, an entry is made in this collection with the emitted data attributes of the bin. For every bin id, there will be multiple activity records.

predictions : Stores next predicted fill time of bins

We run a script to determine the next fill date of a bin based on its previous fill values. This can be made as a cron job in future which could run daily at night. For every bin id, there will be only a single prediction record.

Sensor Data

Sensor Data [continued..]

For now we mimic sensor data via an API call.

Every time we insert sensor data, it is updated in two collections, binActivity and bins table.

binActivity collection records all the sensor data for all the bins over a period of time so that it could be used for various analysis and predictions. The bins collection on the other hand always contains the latest sensor data.

Predict Bin Full Time

- Extract 5 (Tunable parameter) recent records for the bin from Database
- Calculate Fill Rates in last 4 (#records -1) slots using formula

  Fill Rate(FR_i)= (Difference between fill levels)/(Difference between Timestamps)

- Calculate Effective Fill Rate(EFR) as weighted sum of above fill rates
- GIve more weights to recent records (we used *W = [1,2,3,4])*

  *EFR = Sum(FR_i * W_i)/ Sum(W_i)*

- Use EFR to calculate timestamp when the bin will be full:

  Timestamp = (100- Current Fill Level)/EFR

Deployment

OpenShift applications activate deployments on every git push on master branch, which makes deployments really simple.

A detailed explanation of the deployment is mentioned in the README file of our repository here.

Team

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Reap Benefit

Reap Benefit is a platform to monitor and implement practical activities and implementation of activities which will have a positive impact on our environment.

These smart bins are placed in our society as an initiative by them. We are very proud of having such a great platform in our society.

http://reapbenefit.org/

Thank you!