Reduce Waste with Giving Approach

An alternative solution to the future sustainability of Singapore

J. S. Sam
School of Computer Science and Engineering
Nanyang Technological University
Singapore

ABSTRACT

Waste has always been a prominent problem to solve with the limited land of Singapore. There has been plenty of existing state-of-the-art solutions that can aid in solving this problem, but it was never enough. An alternative approach is through Giving. In this conference paper, we will be reviewing the proposed Giving solutions in the context of Singapore. In particular, the ideas, the development framework, and the limitation of this solution.

KEYWORDS

Giving, Digital, Donation, Exchange, Software, Waste, Needs, Charity, Sustainability, Future, Technologies.

INTRODUCTION

All around the world, extensive waste is a huge problem. In Singapore, we have approximately 28.8% [1] increase in total waste over the last decade since 2008. Unfortunately, Singapore's waste landfill at 'Semakau Island' has limited space which is estimated to last up to the year 2056 (36 years) if the generated waste trend continues in this manner [2,3]. By then, the waste must be deposited elsewhere which imposes a bigger problem for our future generations. On top of that, a study has shown that Singapore has emerged as the top 5th in solid waste produced rate per kg/capita/day in the world which is about 5 times more than the global average, top 1st in East Asia and Pacific region [4]. Thus, it is important to have an alternative solution to counter this problem.

To understand why this is the problem, we must deal with the main source of the contributor to this problem. Singapore, a country that has gone through rapid urbanization in the past [5]. Studies have shown that country with high urbanization rate and high-income group has the biggest contribution [6]. This is likely due to having higher purchasing power on them. Among the high-income group, which classify as a Singapore Citizen or Singapore Permanent Resident who owned a condominium or landed property, or household monthly income is worth more than SGD$20k. A person who owned a condominium and landed property has been increased from 16.5% to 21.4% between 2010 to 2020 [7]. A person who owned more than SGD$20k household monthly income has risen more than double from 6.6% to 13.9% between 2010 to 2020 [8]. Besides that, the recycling rate in Singapore has been constant, approximately 60%, since 2011 except for 2020 due to COVID-19 that restrict the effort in recycling waste [9]. This has motivated the implementation of various solutions in Singapore today.

There are 3 prominent existing solutions to counter this problem. Firstly, the 3Rs, which are namely Reduce, Reuse, and Recycle [10]. Reduce refer to lower the amount of waste in the product or services. For example, Singapore's one of the fast-food restaurants 'KFC' has discontinued plastic straw used for their soft drinks [11]. Reuse refers to products or services being reuse to minimize waste. For example, Singapore's supermarket 'NTUC FairPrice' has been encouraging the buyer to use recycle bags than plastic bags [12]. Recycle refer to waste being allocated to classify recycle bins, respectively. For example, residents who live in Housing and Development Board (HDB) may likely be able to find recycle bins that deposit plastic, paper-related materials [13]. Secondly, the reverse vending machine initiated in 2019, will give out incentive coupons for every amount of empty plastic drink bottles and aluminum drink cans deposited into them [14]. Thirdly, Singapore's government has imposed an act to keep major commercial companies' waste regulated. This act is known as Environmental Public Health Act (EPHA), it requires a company that includes hotels, malls, industrial premises, convention, and exhibition centers to produce a mandatory waste report annually [15]. Given the 3 solutions above, it is not sufficient as our waste generation continues to grow over time. Thus, the idea of an alternative solution is the Giving approach.

The Giving approach where the user can either donate or exchange the unwanted reusable item(s) to someone who needs them through a digital platform instead of throwing them directly into the trash bins.

MOTIVATION

There are associated problems that are needed to be addressed with this Giving approach.

1.1 Donate

Figure 1: A commonly distributed leaflet from a charity organization in Singapore [16].

In Singapore, the donation of reusable goods is made aware typically through leaflets. The accessibility of such leaflets is bound to HDB most of the time. As condominiums or landed property owners tend to have a layer of security, this has hindered the door-to-door approach in distributing such information to the audience. As mentioned earlier in this conference paper, the contribution is mostly coming from people who owned condominiums or landed property, leaflet may not be accessible to these group of people. As such, potentially reusable wastes cannot give away easily. Apart from that, there has being a surge in scam crime cases in Singapore, an increase of 65.1% between 2019 and 2020 which typically targets vulnerable groups such as the elderly folks [17]. This results in losing public trust willing to donate towards people who needs them.

This donation part of the solution would like to adapt like 'Giving.sg' where donation being made through funding means as it has followed a centralized system, making such information easily accessible island-wide [18]. Thus, people are more aware of such needs.

Studies have shown that altruistic values and efforts to help others and a sense of goodwill play another important role in encouraging individuals to recycle items [19].

1.2 Exchange

This approach provides a wider option for the user who would like to have something in return. This option also opens an alternative solution for reusability as mentioned in the 3Rs.

In Singapore, security is important, we do not want exchange products to be placed in a location that is classified as a nuisance or creates a disturbance towards the public. One of the similar applications that utilize such an approach is 'Trash Nothing' [20]. It is a multi-platform application where also exchanges reusable products to those who need them. However, after using the application, some flaws do not suit Singapore's interest. The exchange product can place anywhere as long the user agrees with the placement location. This can impose a hazard as the product may be fragile or hazard especially for children who may not be aware of its content, this results in unintentional harm or danger to public safety. Furthermore, some target users may not want to use this application due to reliability issues. Thus, the solution is also here to address such problems.

OBJECTIVES

To achieve the proposed solution through the exploration of a software design, the framework is necessary to evaluate the solution. In this conference paper, we will be evaluating one of the possible solutions with the Giving approach. This solution also explores other features that enhance it as well.

CONCEPTS

In this section, we will illustrate how the 'Donate' and the 'Exchange' work in the system. The diagram consists of the various role of users that interact with the Giving system, within the system it has 2 classify of functions, one is the core function, other is the additional function that helps to enhance the solution.

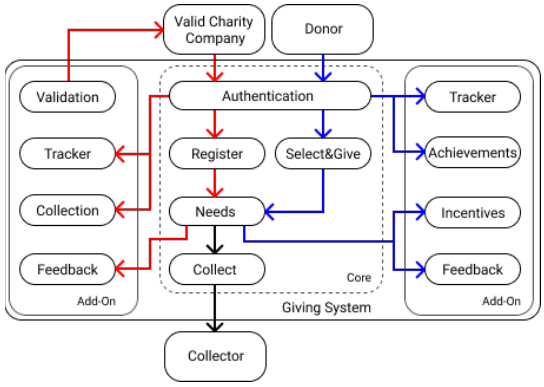

Figure 2: Donate conceptual diagram in Giving solution approach.

To donate an item, the company users must register with a valid company given in the valid company list. Ideally, the list should consist of real-time updates from trustable APIs. In Singapore, we have a 'Charity Portal' website to check if a company holds the license rights to conduct charity works [21]. This is done through a Validation process. The company will register their needs such as their item type, name, quantities into the system. In addition, the company can track their needs to ensure if it is collected. There will also be a set of designated collection points for the company to send their collector to collect their needs item. The company may choose to provide feedback toward the collector and overview feedback of the service to improve the system, Giving's collector efficiency, and performance of the operation.

Once there is an update in the need's list, the donor will receive a notification if their notification service is enabled. The notification received may set towards their interest. For example, person A would like to give away unwanted newspapers. The notification may notify person A if there are any paper-related needs. The donor will select and give the item accordingly, the user is required to place their item outside their corridor or guardhouse if their household is protected by security guards. To ensure reliability, the donor must capture the photo of where they place their item, the item location, name, item type, image, and the donor require detail will be sent to the system donates list. This aids the collector in locating the collection point and item. Afterward, the donor can keep track of their item before able to claim incentives from the system.

The collector will receive a notification or new pinpoint location from the Singapore map from their application. The top few nearest collector will be given the priority to collect and depending on their collection count of the day and their failed attempt to register collection in time, this will ensure collectors are collected in a uniform distributed manner as much as possible. Once a collector successfully sets the new collection point, other collectors will not be able to register. A collector only holds 1 collection point at a time. The collector will have access to such information set up by the administrator of this system.

Lastly, assume there is sponsorship from companies, there will be incentives to encourage the donor to use this donation service.

The incentives such as 'Buy X get free Y', 'Discount X%', etc. Apart from that, to promote the product, there is an achievement for the donor where they can be used to share on social media or being shortlisted to be used on promotional material.

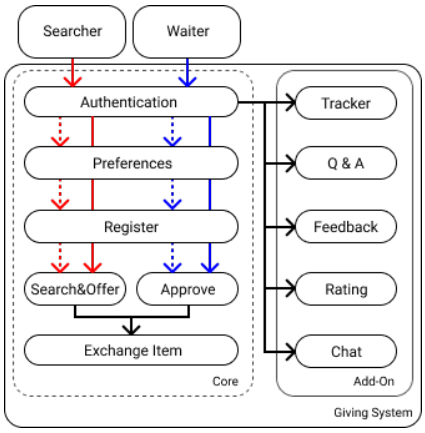

Figure 3: Exchange conceptual diagram in Giving solution approach.

To exchange an item, assume the user has registered an account successfully. The exchanger must set their preferences such as the preferred item(s), prefer meeting time, prefer designated location(s), prefer exchange views radius. They are also required to register at least an exchange item in their exchange item's list. The exchanger is classified into 2 types of people, searcher or waiter. The searcher will search for a wanted exchange item then offer them an exchange item. The waiter will approve any offer exchange item from the searcher while waiting. After approval, both the searcher and waiter will meet at the selected designated location. To ensure reliable exchange, there are generated unique quick response (QR) codes that will be displayed, the exchanger will either key or scan their exchanger QR code. Once done, the exchange item will be consider exchanged successfully. Furthermore, they are given feedback such as ratings or remarks about the exchange process. This helps to improve the reliability of the exchanger for future exchanges. In addition, if exchangers have doubts, they may want to chat up with the other exchanger or enquiry about the exchange item via Q & A.

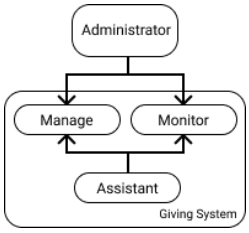

Figure 4: Administrator conceptual diagram in Giving solution approach.

The Giving system will not be complete without an administrator role, they are crucial to ensure the health status of the system is well maintained. This prevents abuse of the Giving system. The administrator manages various other roles of the user include Create, Read, Update, Delete (CRUD) collector users, check for any abnormal behaviors in the system. They also analyze the statistic such as system feedback to decide for the business strategy and the products or the services of the system.

There is also an assistant which can be supervised, unsupervised, or combine AI that assists in either filtering or redundant decision-making process or detection such as object detection for image correctness or abnormal activity log detection, etc. There are many ways to explore in AI field to assist this application which will not be the focus of this conference paper.

TECHNOLOGIES USED

In this solution, we will be experienced with Google software products. The software's and their respective purpose as shown below. The primary language used in this development would be Dart. The framework evaluation will be based on these technologies used.

S/N	Software Name	Purpose
1	Flutter	Front-end
2	Google Cloud Platform (GCP)	APIs
3	Firebase	Back-end as a Service

TERMINOLOGIES

Widget. It refers to a component of the User Interface (UI).

Stateful Widget. It refers to a dynamic component of the UI.

Stateless Widget. It refers to a static component of the UI.

FRAMEWORK

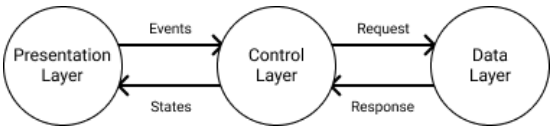

Figure 5: Software layer of the Giving system

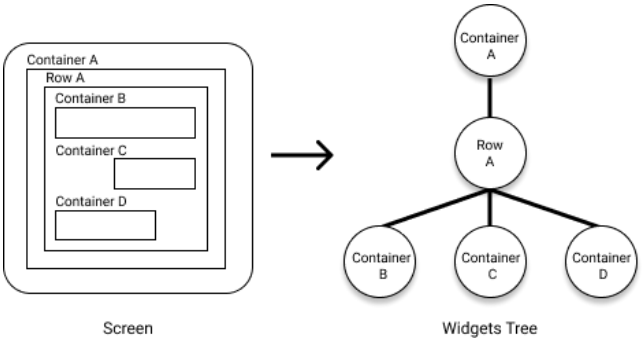

Figure 6: Presentation Layer Conceptual Diagram

The presentation layer compromise widgets. They are represented in a widget tree manner as shown in Figure 6. The widgets are part of the Flutter framework where it describes what the user should view given the current configuration and state. The widgets may trigger an event and return a state where a different state may have a different composition of widgets. The data of the inputs may parse into the events and return the respective output received from the control layer. In addition, the navigation is done with a stack where widgets that represent different pages are stack on top of one another. The stack is a reference with a look-up table that consists of all the various routing names. The initial stack routing name would be '\'.

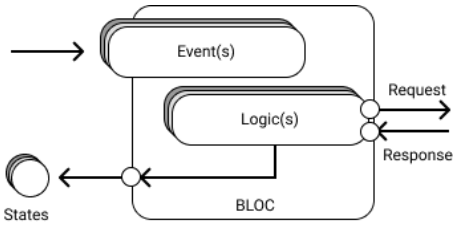

Figure 7: Control Layer Conceptual Diagram

In the control layer, we will be using one of the popular state management in Flutter called Business Logic Component (BLOC). It helps to achieve a separation of concern between UI and Logics. There is no fixed design on how BLOC is classified. In this solution, the BLOC is defined in 3 big clusters, namely, next-action such as 'login' or 'register' where it may interact with navigation, loading data into the screen, and static-action such as verify inputs where it does not interact with navigation.

The process started with event trigger from computer input devise such as keyboard or mouse on the UI component with the event declared properly. The provider of the BLOC will be invoked, it will find the right event and execute its logic within. The logic block may request which fetch the data from the data layer and received the data from response accordingly. The result will decide which states to return to the UI. Each state compromise of different composition of widgets. For instance, when the user's login success, it will show a success screen, when the user's login fails, it will show a fail screen.

The data type flow between Presentation and Control layer is Stream-based which enabled lively updates as the process can be run parallel manner. On the other hand, the data type flow between Control and Data layer is subjective on the data type needs.

In addition, there are more complex features that can be utilized on BLOC such as BLOC-to-BLOC communication, event dependent on other events within the BLOC, BLOC coverage type; Global or Local, Multi-BLOC, etc.

These BLOC features were developed by Felix Angelov, one of Flutter's recommended packages [22].

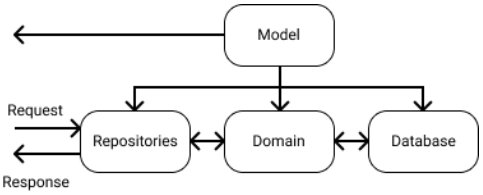

Figure 8: Data Layer Conceptual Diagram

The data layer consists of 4 components. Firstly, model classes which are self-defined objects will be known to all other components include the presentation and logic layer. They are essential for the developer to view or understand the relationship between different data. Secondly, the repositories consist of CRUD methods, it depends on the request from the logic layer and response accordingly. Thirdly, the domain act as the communicator to the type of database involved. In this solution, Firebase's FireStore, Authentication, FireStorage serve as the database in a form of services. For example, a database such as Amazon Web Services SQL server will require a new classified domain in the domain component to communicate with it. This helps to ensure the database is flexible. Lastly, the database is NoSQL, it is designed to provide flexible schemas for the storage and retrieval of data which is more than a typical relational database. In this solution, the database comes with real-time updates from FireStore, it is a document-oriented database where it behaves similarly to how the dictionary object works, it consists of key-value pairs within the document.

LIMITATION

There are no perfect solutions, every solution has its flaws. In this solution, there are several cons. Firstly, the security of the solution is not fully studied in this paper, there were a lot of what-if situations that may lead to potential issues. Secondly, a public sample survey is needed to be conducted to know exactly the real needs of the people from different demographics and enhance ideas that help to create the solution that is more suitable in the Singapore context. However, due to the ongoing pandemic around the world, this part is not supported. Thirdly, some of the features required the government cooperation to produce APIs to get the latest result of the registered company that has the license to do charity work.

CONCLUSION

This solution has indeed provided an alternative solution toward reducing waste in Singapore. A person's trash can make a difference to others as stated in the quote "One man's trash is another man's treasure". In this conference paper, we have seen one of the solutions that help reduce waste through donations or exchange. This solution serves as the first steppingstone of the research. There are more technologies, better and enhance solutions needed to be research to produce the best-optimized solution for the people's needs!

ACKNOWLEDGMENTS

I would like to express my special thanks of gratitude to my supervisor, Dr. O. N. N. Fernando, in support of this conference paper.

REFERENCES

[1]"Solid Waste Management - Total Waste Generated-Data.gov.sg (2000-2016)". [Online]. Available: https://data.gov.sg/dataset/solid-waste-management-total-waste-generated. [Accessed: 25-Apr-2021].

"Waste Recycling Statistic (2016-2018) - NEA Government". [Online]. Available: https://www.nea.gov.sg/docs/default-source/default-document-library/waste-recycling-stats-2016-to-2018.pdf. [Accessed: 25-Apr-2021].

[2]"ENVIRONMENTAL KEY STATISTICS". [Online]. Available: https://www.mse.gov.sg/resources/key-environmental-statistics.pdf. [Accessed: 25-Apr-2021].

[3] "Semakau Landfill information - NEA". [Online]. Available: https://www.nea.gov.sg/our-services/waste-management/3r-programmes-and-resources/waste-management-infrastructure/semakau-landfill. [Accessed: 25-Apr-2021].

[4] K. Silpa, Y. Lisa C., P. Bhada-Tata, and F. V. Woerden." What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050. Urban Development". 2018. [Online]. Available: https://openknowledge.worldbank.org/handle/10986/30317. [Accessed: 25-Apr-2021].

[5] D.R. Richards, A. Law, C.S.Y. Tan, S.F.E.A. Shaikh, L.R. Carrasco, W. Jaung, R.R.Y. Oh, "Rapid urbanization in Singapore causes a shift from local provisioning and regulating to cultural ecosystem services use, Ecosystem Services," 2020. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S2212041620301352?via%3Dihub . [Accessed: 25-Apr-2021].

[6] K. Silpa, Y. Lisa C., P. Bhada-Tata, and F. V. Woerden. "What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050. Urban Development". 2018. [Online]. Available: https://openknowledge.worldbank.org/handle/10986/30317. [Accessed: 25-Apr-2021].

[7] "Key Household Income Trends, 2020". [Online]. Available: https://www.singstat.gov.sg/-/media/files/publications/households/pp-s27.pdf. [Accessed: 25-Apr-2021]..

[8] "Key Household Income Trends, 2020". [Online]. Available: https://www.singstat.gov.sg/-/media/files/publications/households/pp-s27.pdf. [Accessed: 25-Apr-2021].

[9] "Waste Statistics and Overall Recycling Information - NEA". [Online]. Available: https://www.nea.gov.sg/our-services/waste-management/waste-statistics-and-overall-recycling. [Accessed: 25-Apr-2021].

[10] "Mandatory Waste Reporting Information - NEA". [Online]. Available: https://www.nea.gov.sg/our-services/waste-management/mandatory-waste-reporting. [Accessed: 25-Apr-2021].

[11] "KFC Singapore to stop providing plastic caps and straws for drinks – CNA News" 2018. [Online]. Available: https://www.channelnewsasia.com/news/lifestyle/kfc-singapore-plastic-caps-straws-drinks-10442886. [Accessed: 25-Apr-2021].

[12] "FairPrice's No Plastic Bag Initiative – NTUC FairPrice" 2020. [Online]. Available: https://www.fairprice.com.sg/events/in-store/no-plastic-bag. [Accessed: 25-Apr-2021].

[13]] "National Recycling Programme - NEA". [Online]. Available: https://www.nea.gov.sg/our-services/waste-management/3r-programmes-and-resources/national-recycling-programme . [Accessed: 25-Apr-2021].

[14] "Done with your drink ? Dump it in a 'reverse vending machine' and earn grocery vouchers – CNA News". 2019. [Online]. Available : https://www.channelnewsasia.com/news/singapore/vending-machines-recycle-drink-bottle-cans-grocery-vouchers-12051538. [Accessed: 25-Apr-2021].

[15] "Mandatory Waste Reporting Information - NEA". [Online]. Available: https://www.nea.gov.sg/our-services/waste-management/mandatory-waste-reporting. [Accessed: 25-Apr-2021].

[16] "Image representation of a typical leaflets - Reddit". [Online]. Available: https://www.reddit.com/r/singapore/comments/b0mcfb/no_wonder_i_dont_hear_karang_guni_men_honking/. [Accessed: 25-Apr-2021].

[17] "Annual Crime Brief 2020 Infographic". [Online]. Available: https://www.police.gov.sg/media-room/statistics. [Accessed: 25-Apr-2021].

[18] "Main Page of GivingSG". [Online]. Available: https://www.giving.sg/. [Accessed: 25-Apr-2021].

[19] C. Ong, L. Fearnley, and S. B. Chia "The diversity of divestment in Singapore: Junk commodities, charity gifts, and recycling bins. Environment and Planning E: Nature and Space" 2020. [Online]. Available: https://journals.sagepub.com/doi/abs/10.1177/2514848620924564 [Accessed: 25-Apr-2021].

[19] "'Trash Nothing' Mobile Application Download Page". [Online]. Available: https://play.google.com/store/apps/details?hl=en&id=com.trashnothing.app. [Accessed 25-Apr-2021].

"'Trash Nothing' Web Page". [Online]. Available: https://trashnothing.com/beta/. [Accessed 25-Apr-2021].

[21] "Charity Portal – Government controlled charity associated web page". [Online]. Available: https://www.charities.gov.sg/. [Accessed 25-Apr-2021].

[22] "Flutter Package – flutter_bloc developed by Felix Angelov". [Online]. Available: https://pub.dev/packages/flutter_bloc. [Accessed 25-Apr-2021].