LOPRICE: MOBILE CROWDSOURCING REQUIREMENTS AND IMPLEMENTATION FOR SOFTWARE AND NON-SOFTWARE PILLAR

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Abstract- The issue of rising prices is not a new phenomenon. There are causes that led to this rise occurs. One of it is the rise in fuel prices. Even though it is just ten cent rise, it affects the increase in the prices of goods. This problem persists despite a decline in fuel prices recently. In addition, a natural disaster is also no less a huge impact on the price hike. For countries that supply agricultural products such as rice, onions, fruits and vegetables had to raise selling prices, particularly in the event of natural disasters such as floods, storms, droughts and etc. There are also traders who simply raise prices at will. This irresponsible attitude gives negative impact on the socioeconomic. The increase in goods prices has directly affected domestic expenditures. For those who live like ordinary workers and lower classes, this increase is undoubtedly pose a burden, particularly with low income. To be able to cope with this, it is good to have a mechanism that is able to do comparison on the prices of items in the market. With this mechanism is expected to assist consumers to catch items with good price and save their budget. In this paper, we analyze the literature of mobile crowdsourcing architecture that can be tailored made to suit the local price watch information solicitation and sharing model, shortly known as LoPrice. LoPrice is an application utilizes crowd that enables in obtaining timely information on the price of items using mobile technology. The discussion starts with the introduction of the crowdsourcing and its applications, followed by an introduction of LoPrice model architecture. Next section, a brief of its four design pillar is presented and detailed elaboration of one of the pillar is presented in the following section before the conclusion is made.

Keywords- Mobile crowdsourcing, Crowdsourcing Architecture Components, Information Sharing Model, Information Solicitation Model

I. INTRODUCTION

Recent years have witnessed the evolution in mobile computing and crowdsourcing where later it introduces the leveraging of mobile crowdsourcing. Crowdsourcing in particular, is becoming one of the emerging new applications and business model in this era of Internet-of-Things which can dramatically change the nature of work of current and future nations. It has been so well adopted and utilized by the global community in wide range of applications and projects in various disciplines where it was widely being used in business and economy. Jeff Howe first invented the term Crowdsourcing in 2006, which was referring to public involvement in distributed problem solving and production process (Howe, 2006). To some degree, Howe was inspired by (Brabham, 2010) who through an extensive research discovered that "under the right circumstances, groups are remarkably intelligent, and are often smarter than the smartest people in them", which is termed as the "wisdom of crowds". Crowdsourcing has been so well adopted and utilized by the global community in wide range of applications and projects (Estellés-Arolas& González-Ladrón-de-Guevara, 2012) as it allows difficult and time-consuming projects to be tackled a bit at a time, and by a large group of individuals, working asynchronously and at their own pace. There are projects that have been successfully applied crowdsourcing in varies range of business or other profit making sectors such as Threadless, InnoCentive, Google MapMaker, Building Maker, and iStockphoto (Brabham, 2010). Nevertheless, the practices of crowdsourcing in other domains have been explored too. It has been used in multiple domains in order to harness the power and wisdom of the crowd such as in business and marketing (Chanal et al. 2008; Whitla, 2009), sociology (Bei Yu et al., 2013; Heinzelman, 2011; Mtsweni, 2014), medicine and health (Rodríguez et al., 2012; Bei Yu et al., 2013; Brabham et al. 2014; HealthMap, 2014), environmental sciences (Glennon, 2010; Gao et al., 2011; P. Fraternali, 2012), as well as research and development (Wang et al., 2011; Callaghan, 2014).
Though being coined only recently, the main idea of crowdsourcing, that is information sharing, is not a new practice. The advances in the information and communication technology (ICT) have become the substance of the development of many applications using mobile. This paper is intended to serve as a review of the architecture of mobile crowdsourcing as a whole specifically for timely local pricewatch information solicitation and sharing model; LoPrice. In the next section of this paper, the researchers explained the LoPrice Model, LoPrice Design Pillars and finally the LoPrice Architecture that focuses on the Software and Non-Software Aspects is elaborated.

II. LOPRICE MODEL

The increase of goods prices has directly affected the domestic expenditures. This is proven by the surveys conducted by number of countries that showed increases in the average monthly household expenditures. Table 1 below revealed the result of survey conducted by the authorities from different countries.

No.	Types of survey conducted		
	Authority Body	*Finding 1*	*Finding 2*
1.	Department of Statistics, Malaysia	RM1953 2004/2005	RM2190 2009/2010
2.	US Bureau of Labor Statistics	USD4142 2011	USD4286 2012
3.	Singapore Consumer Price Index (CPI)	SGD3809 2007/2008	SGD4724 2012/2013

Table 1: Survey Result

Both Malaysia and Singapore performed the survey in every five years but the years of survey conducted were different between these countries. The United States somehow did the survey annually. In Malaysia, the average monthly household expenditure rose 12.1% to RM2, 190 in 2009/10 from RM1, 953 in year 2004/2005 (Department of Statistics Malaysia, 2014). A report on US Bureau of Labor Statistics also showed an increase of 3.36% in the expenditure for the year 2012 US Bureau of Labor Statistics, 2014. In Singapore, a report on Consumer Price Index (CPI) showed an increment of 19.37% in five years from 2007/2008 to 2012/2013 (Singapore Consumer Price Index, 2014). In Malaysia particularly, average monthly household expenditure increased ever since the survey was conducted for the year 1993/1994 until the latest statistics obtained for the year 2009/2010. The cost of most items remains high (this is illustrated in Figure 1 below) and the citizens continue to struggle to support families and themselves. In addition to this, with the Goods and Services Tax (GST) with its fixed rate at 6% implemented with effective from 1 April 2015 by the Government of Malaysia somehow or rather causes the increase of goods and services where some traders took advantage to raise prices so that the tax could be absorbed in the price and borne by the consumers.

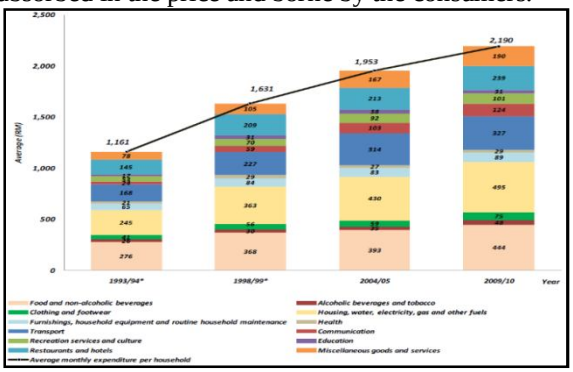


Fig. 1. Average monthly household expenditures by main group of goods and services Malaysia, 1993/94–2009/10 (Department of Statistics Malaysia, 2014).

Fish prices soaring high, price of raw food items rises, rising on houses' rents and petrol gets costlier are some of the factors that impact the domestic expenditures. From the literature study, we can say that the increase of goods are somehow cannot be avoided and it is believed that consumers start being selective in buying items with regards the price. Consider Figure 2 and 3 below; have you ever wonder what to fill in a trolley?

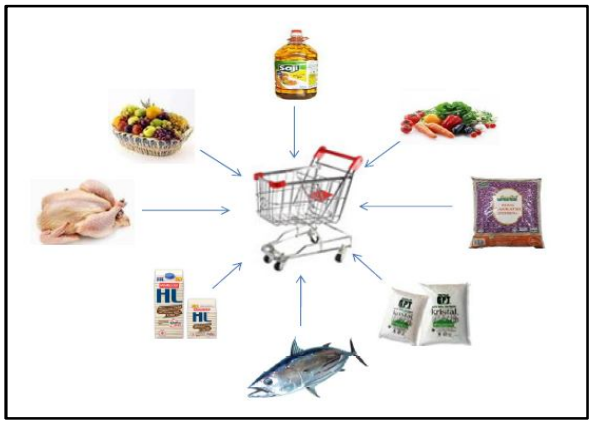


Fig. 2. What to fill in the trolley?



Fig. 3. Household spending trends

Consumers will try to get cheapest price offered on different stores by comparing prices of items before getting the items. Traditionally, the comparison was done by going to each store, where it was time consuming and taxing. It also could be done by browsing weekly promotional brochures where it was sent to your house mailbox. This way, the promotional items might be differing from one store to another which resulting in difficulty to do comparison of desired items. Recently, with the advancement of ICT, many applications with regards to crowdsourcing in comparing the prices of items have been developed; both web-based and mobile applications. At least 9 applications were included in our review in which 7 were used by people outside Malaysia and only 2 were developed to help Malaysian. The two applications are 1pengguna (KPDNKK, 2014) and Yellavia (Yellavia, 2014) which both were web-based applications. Our experience in Yellavia was that, the information was outdated at least by 1 year or more. 1pengguna, on the other hand is a portal developed by the government of Malaysia to provide price information of 105 consumer product details. This portal utilizes their 'agents'; special members appointed by the government to supply those information. The

information of the price especially should be updated after 2pm every day. However, there is no mechanism to verify this. Based on our experience using the application, it was found out that the information displayed was based on the current date read from the system and furthermore the prices of items were only available for a very limited number of areas.

To address all problems above, (Aris, H and Md. Din. M., 2014) in their study proposed the use of mobile crowdsourcing in the solicitation of information on prices of items through the development of the LoPrice Model. The Model architecture was introduced as illustrated in Figure 4 where it utilizes the crowd in providing the price information of items which objectively to enable timely comparison items prices to be made between different stores.

At a glance, this model is actually used by the crowd in this context it is referring to the users, and for the benefit of the crowd (users) itself. Users share item price, category, location and validity period of prices using their mobile devices with data plan. The information is posted to the application with web 3.0 features. It is expected that it would be a big challenge on the server side to process the information provided. This model shall put all processing tasks on the shoulder of a powerful centralized server that resides in the network while the end user devices just provides a graphical display and avenue for user input. Processed data then can be shared with users upon request. At the moment, the researcher just focus on centralized processing server rather than distributed processing server.

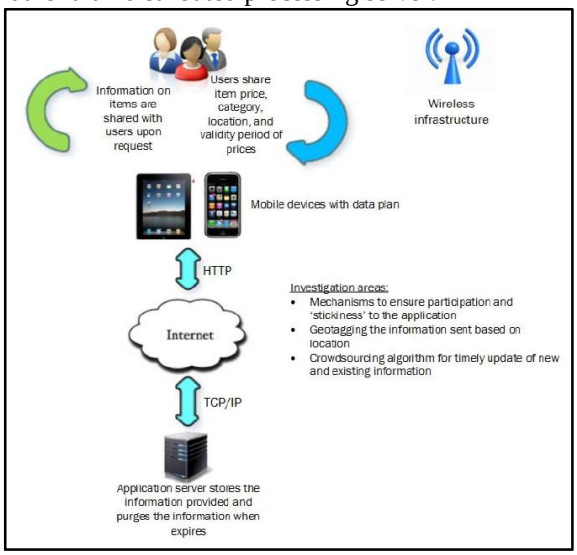


Fig. 4. The overview of the LoPrice Model

According to Estellés-Arolas& González-Ladrón-de-Guevara in their study in 2012, there are some characteristics of crowdsourcing applications may have such as:

1. Clearly defined crowd
2. Clear goal
3. Recompense received by crowd
4. Clear crowdsourcer
5. Crowdsourcer compensation
6. Online assignment
7. Open call
8. Uses internet

This is supported by study conducted by (Ali et al., 2012), where they presented the above characteristics in a form of steps in crowdsourcing. This is as per illustrated in Figure 5 below. With regards to LoPrice model, it has all characteristics or steps except the "Crowdsourcer" and "Compensation/Reward" as we do not foresee these as a threat since this model is a research in progress and therefore it is not owned by any crowdsourcer. Our concern is more on the architecture and the development components, which will be further elaborated in the following 2 sections.

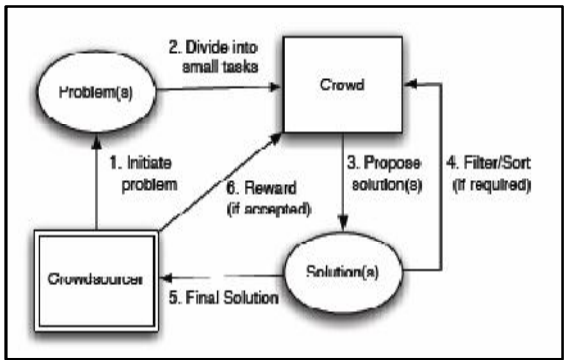


Fig. 5. The overview of main steps in crowdsourcing

III. LOPRICE DESIGN PILLAR

Based on our literature study, we outline below the main components of LoPrice Model should possibly focused during the development phase. We call it as LoPrice Design Pillars as shown in Figure 6. This design pillars comprise of eight (8) important pillars that are grouped together under four main design components such as System Architecture, Algorithm, Database Design and GUI Design. Every design components has two (2) pillars in contributing to the generating or the development of LoPrice Model.

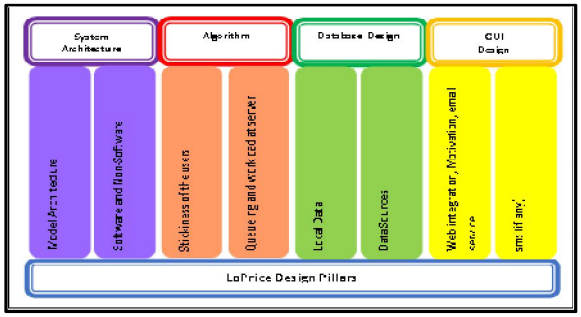


Fig. 6. The LoPrice Design Pillars

3.1. System Architecture

System architecture is the heart of LoPrice Model where it shows the structure of the LoPrice Model. This component comprises of model architecture pillar and software and non-software pillar. In this paper, our focus is on the second pillar of System

Architecture component. This will be explained in detail in section 4 of this paper. The first pillar however has been introduced in (Aris, H. and Md. Din, M., 2014) that had been presented at the 9th International Conference on Software Engineering and Applications recently.

3.2. Algorithm

Algorithm component would be the main challenge for our programmers to think of how to design and implement the algorithm in such a way that users would stick to use and contribute to the success of the LoPrice Model. Good algorithm shall be designed that able to provide a decent queuing and workload balancing at the server side.

3.3. Database Design

Most important, the database should be able to handle big data volume as it is expected that mobile crowdsourcing involves huge amount of data are processed and similar queries are frequently repeated. According to Table 2 above, materialize view is one of the feature of non-software pillar. The purpose of a materialized view is to increase request execution performance. However, this consumes storage space. Further investigation on the crowdsourcing data is needed to get to know the daily statistics of amount of data exchanged/communicating over the network. Issues like data management, query processing, and transaction management should be addressed carefully so that rough idea on the data source capacity and desired design can be drafted.

3.4. GUI Design

This component is all about the user display that plays role in attracting users to continue using the application. This component is actually interrelated to the Software and Non-Software Pillar where it provides detailed designing concern on Human Computing Interaction, Web integration, Motivation of using the application, Email services interface and not to forget the SMS services provided in between SMS centers (SMScs).

IV. SOFTWARE AND NON-SOFTWARE PILLAR

Generally, this section explains all about one of the pillars under system architecture (refer Figure 6). Based on the literature study on mobile computing, it is found that most researchers divide the system architecture to some important components which include hardware and software architecture (Alonso, 2011; Chatzimilioudis et al., 2012; Ali et al. 2012; Hosseini et al., 2014) and LoPrice Model is no excuses. However, since this project has crowd involvement to the success of it, we identified three major aspects that we need to focus on; software, hardware and human interaction. We categorized the hardware and human interaction as Non-Software Pillar. In the end, we come out with our pillar, which is known as Software and Non-Software Pillar; a bit different from existing mobile computing system architecture where most of previous researchers categorized it according to hardware and software requirements/architecture. Detailed explanation on the other three main pillars that are Algorithm, Database and GUI Designs will be elaborated in other avenue, as this research is ongoing until it is complete. Software pillar consists of two sub-pillars that give focus on on-line avenue and development tools. In this project, we aim to have both mobile application and also supports web-based users that are tailored made to suit LoPrice Model. Many aspects need to be given to the development tools but not limited to; front-end platform, back-end platform, security add-on facility and uploader facility. Front-end platform gives focus on the user/client view that is more towards the user interface development. On the other hand, the back-end platform is related to the processing, interaction and aggregation in between user and the application itself. Hardware requirements that is sub-pillar of Non-Software basically includes all related hardware that is possibly needed in developing this mobile crowdsourcing application. It caters both client and server sides, which include development computer, connection, needed (either via wireless or wired connection), mobile client, server and data storage. The minimum features for each of these are explained in the table 2.
Another sub-pillar of Non-Software is human interaction where it gives focus on the facilities and good features of a mobile crowdsourcing application should have to give good experience and view to the mobile client. According to one of the judges in Malaysia Technology Expo (MTE); an international invention and innovation expo which was held on 12 – 14 Feb 2015 at PWTC, he said that a good mobile application should provide two important components of Human Computer Interaction (HCI) that are materialized view and user interface experience (UX). Materialized view generally is a replica of a target master from a single point in time. The master can be either a master table at a master site or a master materialized view at a materialized view site (Oracle, 2014). The main idea of materialized view is mainly to ease network load that leads to a better performance of the application. UX however is related to the human view and experience using the application. Based on some observations and own experience in using mobile applications, we have found that people stick to use the application that is easy to use and user-friendly. It is not too much if we concluded that accessibility feature of the application is the key factor to the success of mobile crowdsourcing. The application should also be incorporated with other features to provide a desired mobile crowdsourcing application like LoPrice.

Table 2 summarizes the minimum requirements of Software and Non-Software aspects for LoPrice Model development. This table would be used as a guideline for the developer to develop LoPrice. Addition to this, any features beneficial to the LoPrice that are not addressed in this paper but are identified during the development may give value added to the application.

Pillar	Aspects/Characteristics		
	Sub-pillar	*Platform/ Facility*	*Features*
Software	On-Line avenue	Mobile Apps	Web 3.0
		Web-based	Web 2.0 and above
	Develop-ment tools	Front-end	UI design tools
			SDK-IDE to access device features
			Cross-platform support
		Back-end	Mobile back-end as a service (MBaaS) user management, push notification, social networking integration
			Mobile app server that acts as middleware between back-end and mobile app
		Security Add-on	Data encryption
		Uploader	Automatic resize the image and converted to a given image format
Non-Software	Hardware	Develop-ment Computer	Minimum of i5 processor with 4Gb RAM
		Connection	To connect a device to the development computer
		Mobile client	User smart devices with Web 3.0 feature as avenue for display and user geo-data input
		Fast server	Powerful processing central server
		Data storage	Able to store big data volume
	Human Interaction	Materialized view	Grab attention / appealing interface
			User could interact with the design for visually pleasing
			Motion feature that giving users additional subconscious information about objects and transformations
		User interface experience (UX)	Accessibility
			Usability
			User authentication

Table 2. Software and Non-Software Pillar

CONCLUSIONS

Price increases cannot be denied and society becomes so selective in their daily expenses. Wisely choosing groceries at low prices to some extent can help manage finances well. Compare prices from one store to the other store is not efficient and taxing. LoPrice; mobile crowdsourcing application is likely could assist consumers in making price comparison of items before leaving their house to shop for their necessities. This paper generally discussed on literature of mobile crowdsourcing architecture particularly for LoPrice. We introduced LoPrice Design Pillars that have four (4) main pillars ideally to be applied in the development process. Every pillar has two (2) sub-pillars to support its main. The four main pillars are system architecture, algorithm, database design and GUI design. We further elaborate one of the sub-pillars of the system architecture pillar that is the Software and Non-Software sub-pillar. This research is still at literature view stage. Probably there are other aspects may not be in the discussion above. However, it could be considered during the development process. Any improvements needed to the LoPrice would be considered from time to time until the project is complete.

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