Local Business Promotion Using Networked Tangible Interaction Devices Connected to a Location-Based Social Network

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Introduction:
The advance of the internet technology and the increasing availability of affordable handheld mobile devices has advanced the World Wide Web into the era of Web 2.0, enabling the one-way information channel of the Web 1.0 to become a two-way interaction. Social networks such as Facebook, Twitter, or LINE, have changed the way people maintain their social connections. Social media also bridges online advertising and online promotion. The availability of affordable handheld mobile devices further extends the flow of digital information by delivering information to consumers while they are away from home or work. The ubiquity of mobile internet devices also enabled location-based social networking (LBSN), which allows on-location sales promotions to be implemented as off-location advertising via consumers' social networks [2]. This paper presents a study that investigates the possibility of integrating off-location advertising and on-location promotion through interactive tangible devices connected to social networks. The concept is to utilize LBSN to induce on-location engagement with on-site customers while also fostering off-location interactions to deliver online advertisements using the social networks of the on-site consumers. The physical device was constructed using a computer-aided design method and digital fabrication technologies. The device was then implemented with the microcontroller that allowed customers to interact with it through their social media applications. A field test was conducted. Three devices were constructed and placed at different locations during a campus promotion event for a duration of 24 days. The objective of the field test was twofold: the first is to test the functionality and durability of the system, as well as the mechanics of the interaction device; the second is to test the efficacy of on-location promotion in tandem with off-location advertising through the interactions with local businesses.

Main Idea:
Location-based social networking (LBSN) refers to advancements in social networking that utilize localization technologies. A LBSN allows users to share their current and visited locations and location-related activities [1]. Those shared location data provide opportunities for local businesses to connect with consumers on the move through the consumers' own social networks. This in turn enables LBSNs to use the internet for the conventional "word of mouth" marketing approaches.

Research has proven that evoking the emotion of surprise can lead to successful long-term word of mouth marketing [3],[5]. Many tangible vending machines utilize the concept of evoking surprise with the unexpected result of purchase. Those types of vending machines are categorized as bulk vending. Various types of devices have been designed for bulking vending. Regardless, they are consisted of following main components: the rewarding objects to be dispend; container holding

rewarding objects; and the mechanic system that release reward object from the container. For the rewarding objects and container, we adopted the gashapon system. Gashapon is a Japanese term that refers to the sound of a capsule cranking out of a machine and dropping into a receptacle. As the gashapon capsule can contain one of the items a customer wishing for, surprise and joy will come when wish granted. If not, customer may continue to shop.

Our prototype adopted the gashapon capsule as the object container to hold rewards. As the gashapon capsule has a standardized form and dimensions, this facilitates easy refills and presents a broad array of possible uses. The formal configuration of the container accommodates the gashapon capsule and makes the dispensation process visually compelling and joyful. To dispense the gashapon capsule, we utilize the location-based social networking via check-in as the input to signal the device to dispense a gashapon capsule.

Prototype Design:
The human-computer interaction (HCI) system of the prototype design consists of two-way communication. At the physical location near the interaction device, the customer sends a signal to a virtual address on the internet. Upon receipt of the customer's signal, a response signal is sent to the interaction device to release a gashapon capsule with a coupon inside. The tangible interaction design was employed to make the physical device that interacts with the social network. This transaction is possible because of recent advances in free and open-source software and the open-source microcontrollers operating on that software [4].

The prototype was first constructed by stacking layers of customized laser-cut medium-density fiberboard. A pilot study of this prototype was conducted by placing the prototype at a local coffee shop for one week during a two-week anniversary sales promotion. However, during the pilot study, the stronger-than-expected influence of the weather impaired comparison of the weekly sales totals with and without the interaction device. Thus, the pilot study failed to evaluate the effect of the on-location prototype. It was also observed that the medium-density fiberboard was heavy and could not be used outdoors [6].

In this study, the device was completely redesigned to improve durability and mobility. Fig. 1 illustrates the new physical configuration. The device measures approximately 40 cm × 40 cm × 60 cm. It was constructed using the digital fabrication technologies of laser cutting and 3D printing. The main structure was constructed by stacking laser-cut 5 mm translucent acrylic sheets. Circular-cut sheets were stacked to form a receptacle to hold the gashapon capsules prior to dispensing. A main platform supports a spherical jar container that holds the capsules. A 3D printed rolling mechanism was installed at the center of the main platform and was controlled by a servo motor on the side. The servo motor is controlled by a microcontroller with a Wi-Fi connection. The microcontroller used in the prototype is Arduino Yun.
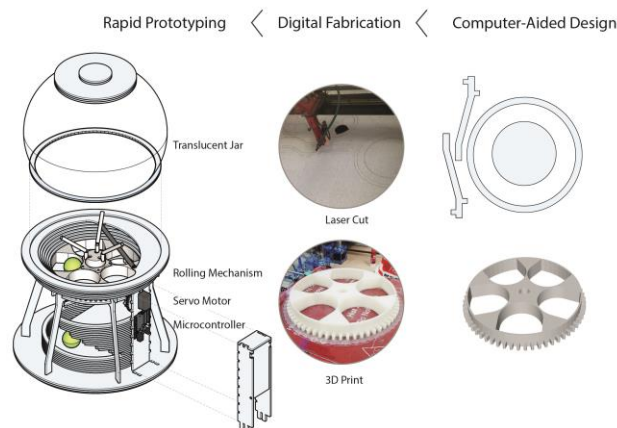

Fig. 1: Design, fabrication, and physical configuration of the tangible interaction device.

Fig. 2 depicts the system framework and the computing algorithms as a flowchart. A web application was installed on the microcontroller. The application was created using Node.js. It can retrieve data from shop's Facebook fan page through the Facebook Graph API. The software system was instructed to read the number of check-ins on the local shop's Facebook fan page once every second. When a customer checks in on the fan page, the adjusted check-in number triggers the servo motor to drive the rolling mechanism to release one gashapon capsule.
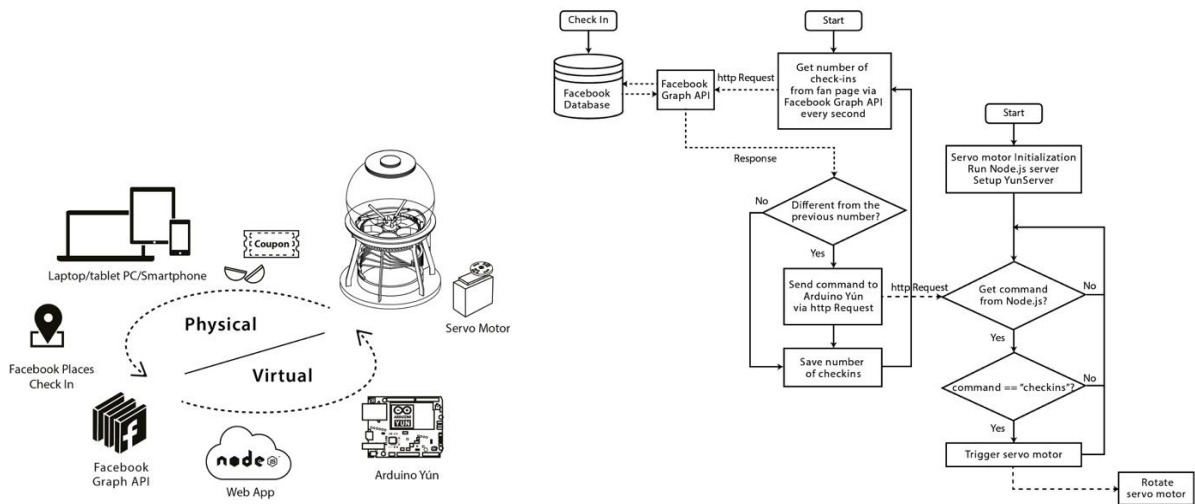

Fig. 2: System framework and flowchart representing the algorithms.

Fig. 3 illustrates the complete marketing strategies for the integration of on-location sales and off-location advertising. By checking in on the shop's Facebook fan page, customers receive a gashapon capsule containing a coupon with one of several different values that can be redeemed for an in-store reward. In exchange, the shop appears in the customer's Facebook feed, wall, etc., along with any additional photos and/or comments posted by the customer. Thus, advertising for the shop and its sales promotions can be rapidly and dynamically disseminated throughout the customer's social network.

Fig. 3: On-site promotion and off-site advertising circle.

Field Test:
Three devices were constructed and deployed in the field for 24 days. Fig. 4 maps the locations of the interaction devices and the participating local businesses. One device was placed at the plaza near the entrance lobby of the library, which opens onto the campus' central plaza, a high-visibility location. Another device was placed at Curry Place, across the main street leading from the campus to a popular location for food venders that attracts many students during lunch hours. The third device was placed at a tea shop. Although the tea shop is farther from campus, it is close to the student dormitory and is widely known to students. The two shops were selected for two reasons: first, the owners were supportive of novel types of sales promotion and thus willing to support this on-location interaction; second, both shops have their own Facebook fan pages.

Fig. 4: Locations of interaction devices for the promotional events.

Additional shops participated in the promotion to study the various marketing effects of the tested system, including a bubble tea shop located just off campus and an on-campus cafe that provides light food and drinks. The three devices distributed coupons for the participating shops. The study attempted to evaluate the following factors:
- Can the interaction device promote the fan base of a particular local business?
- Can the networked interaction devices drive sales for a local business area as a whole?

Results and Discussions:
Fig. 5 illustrates the total numbers of "checks-in" and "likes" for both "Curry Place" and "Tea Shop" during November 1-24 and December 1-24 without and with interactive devices, respectively. The results show that the interactive on-location promotion using the tangible device dramatically increased the number of check-ins and likes for both businesses.
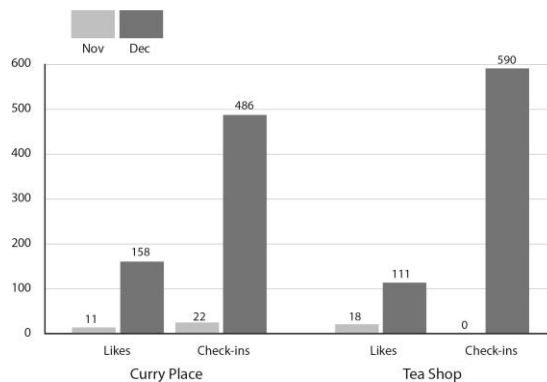

Fig. 5: Total numbers of "checks-in" and "likes" for two participating local shops.

Evaluating the regional contribution of the proposed promotional system to local businesses was difficult because of the variety of the business types and promotions introduced countless known and unknown variables. We recorded the number of coupons distributed by each device and compared these values to the number of redemptions to evaluate the promotional effect. Table 1 illustrates the result and reveals several interesting observations about possible effects of using the proposed tangible on-site interaction systems to promote local business sales.

For the Tea Shop, 12 of 25 (48%) coupons distributed from the campus device were redeemed, while 10 of 163 (6.1%) of the coupons distributed from the device at Curry Place were redeemed, and 66 of 169 (39%) distributed from the device at the Tea Shop were redeemed. Although the campus device had the highest redemption rate, the sample number was relatively low compared to the other two devices. The Curry Place and Tea Shop devices distributed similar numbers of Tea Shop coupons and the redemption rate was much higher for the Tea Shop device. This is reasonable as customers can use the coupons for the shop immediately when they are distributed on-site. We further postulate that on-site customers are more comfortable retaining the coupons for use in future return visits.

When one shop promoted a different business, comparisons of redemption rates for the same promotion distributed from the interaction devices located at different distances discloses that distance might be an influential factor. The coupons for Bubble Tea had a higher redemption rate when distributed from the campus device (13%), which is approximately half the distance of the other two devices, located at Curry Place and Tea Shop (6.3% and 7.1% respectively). This result suggests that coupons are more effective when they promote nearby businesses. This implies that the tangible interactive devices may be useful tools for promoting local area businesses, encouraging a proximity-based alliance between local businesses. Another data collection listed in Table 1 supports this interpretation. Note that the free-topping promotion offered by the Cafe achieved a considerably higher redemption rate of 15.2% when distributed from the campus device located a few meters away from the Cafe as compared to the 2.7% redemption rate realized by the more distant device located at Curry Place.

	NTUT Campus			Curry Place			Tea Shop		
	Distributed	Redeemed	%	Distributed	Redeemed	%	Distributed	Redeemed	%
Curry Place	149	25	16.8	-	-	-	99	10	10.1
Tea Shop	25	12	48.0	163	10	6.1	169	66	39.0
Bubble Tea	100	13	13.0	95	6	6.3	98	7	7.1
Cafe	46	7	15.2	37	1	2.7	-	-	-

Tab. 1: Redemption of the coupons for different business distributed from different devices.

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