A Shop Survey and Advertising System Based on Iot

Sung-Bae Kim, Ki-Young Lee,Jeong-Jin Kang, Yong-Soon Im,Sung-Jai Choi, Yeon-Man Jeong

Abstract: More companies are integrating ICT (Information and Communications Technologies) when advertising and O2O (Online to Offline) service market is gradually growing as well. Accordingly, this study aims at identifying the path of existing consumers and to propose a method so that even customers who have a passive attitude can come into contact with advertisements. In addition, there are many cases of using primitive methods such as investigative surveys when researching consumer behavior. Therefore, this study proposes a method to easily investigate stores by using IoT (Internet of Things) technologies when conducting market surveys and aims to use IoT as a tool for store surveys. It is expected that through this, it will improve consumer awareness of advertisements.

Index Terms: O2O Service; Internet Communication Technology; Advertisement; Arduino

I. INTRODUCTION

The most successful business model for ICT (Information and Communications Technologies) business recently is O2O (Online to Offline) and it is gradually growing and accordingly, the boundary of online and offline is disappearing [1]. Typical advertisements in stores are push ads using beacons and video ads using RFID technologies [2]. Also, the databases of customers are some-times used to provide customized marketing to each customer. Some large distributors collect and analyze customer data based on big data to offer coupons and event news through applications installed by customers [3]. In reality, however, collection and analysis of information on the shopping activities of consumers within an offline store is not as precise as online platforms. This has the weakness that it is limited to customers who purchase products at offline stores [4]. Businesses today investigate consumer behavior through direct observations or by using machines. Through this, it identifies the line of vision or routes of consumers, but it has limitations in that it takes a long time between marketing surveys and advertising stages [5,6].

This study proposes a method to offset the aforementioned limita-tions and furthermore, a method for consumers to actually come into contact with advertisements. This is because it is necessary to be systematically aware of where customers stand to look at prod-ucts and which path they take around the store in order to attract not only actual customers but also potential customers to engage in product purchase activities. Also, this study aims at collecting data on how long people look at products within a store and where customers spend the most amount of time in the store using floor sensors [7,8]. By advertising after analyzing data collected through floor sensors, it will be possible to further enhance advertisement awareness effects for customers. Therefore, this study aims at systematically surveying stores by integrating ICT and marketing and proposes a system for developing an advertisement system based on this.

II. RELATED WORKS

A. O2O

The dictionary definition of O2O is a business strategy that com-bines interactive online and offline platforms to create new business models or to expand business or service fields, manage customers and improve marketing efficiency. This concept was first mentioned by Techcrunch based in the US in 2010 and it is currently highly used in China, Japan and Korea. It can be understood as an extended version of Click & Mortar and Hybrid business that appeared in the early stages of the internet age. This study focuses on maximizing synergy effects by organically connecting offline companies online [9].

B. ICT

ICT is a combination of information technology (IT) and communication technology (CT) and it refers to operating hardware devices such as information devices and using software technologies needed for managing information to collect, produce, process, preserve, transmit and utilize information. The ICT paradigm is composed of the contents (C) – platform (P) – network (N) – de-vice (D) value chain and it comprises all providers and users of platforms by digitalizing all types of contents. Apple is a good example that directly offers platform services with a wide-use operating system like IOS while simultaneously providing a device as well [10].

C. Arduino

Arduino is a tool for creating interactive objects that can detect and regulate the physical world and digital devices. This is based on a microcontroller board and it offers various boards, development frameworks and libraries depending on the use through open source computing platforms and software development environments. Arduino is cheaper compared to other microcontroller platforms and it can be operated in various operating systems including Windows, Mac OS and Linux. In addition, the Arduino

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integrated development environment allows drafting and editing of source codes and offers functions to compile and upload codes. The source code is based on C++ language and uses standard library functions of C language. The Arduino hardware is made up of pins so that the sensors operating in connection with the real world can easily be attached and detached. It is operated by executing codes (commands) drafted and uploaded through software development environments[11].

D. Load Cell Module

Load cell is a detection module that can measure physical quantity such as force and load. When the load cell receives force, it generates an electric signal equivalent to that force to send electrical signals to markers, microcontrollers and computer devices, and this is then reinterpreted to show weight in units of lbs, kg, etc. As shown in Figure 1, the surface of the load cell has a strain gauge and when the form changes, the resistance value also changes to measure weight using the change of the electrical signal emitted by the load cell [12]. Load cells use various devices to measure weight and it is divided into various types depending on the load, shape, features from as little as 50g to as much as 3,000 tons. There are up to seven lines for load cells, but three or four lines are commonly used. Lines are comprised of lines for power input and lines for voltage output in proportion to the entered voltage or measured weight.

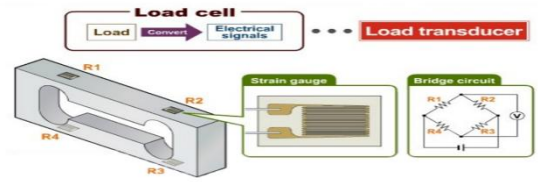

Fig. 1 Principle of Operation of The Strain Gauge Load Cell

III. SYSTEM DESIGN AND IMPLEMENTATION

A. System Design and Implementation

The system blueprint of this study is as shown in Figure 2. It was proposed by mounting load cells and WiFi modules based on UNO R3 board to categorize each function according to the perspective of the store manager and consumers in order to conduct market surveys and manage advertising systems via PC and smartphone applications.The representative module used in this system is the load cell sensor. It aimed at measuring the weight of users (customers) from the perspective of the store manager based on the load cell and to check the number of customers actually moving through this. Furthermore, it was designed to measure the direction of movement by identifying the sequence of the floor in which the load cell is installed to check the location of the subject.In order to display the above-mentioned data in real situations, an Android application was also proposed. Through this, it allows store managers or advertisers to identify the subject's location and the total number of visitors to the store via mobile device using an admin application, and to provide a foundation to use fixed pricing systems for advertising costs in future.The WiFi module makes it possible to see data immediately in android application and it is a module needed to load the values measured by the load cell and to display the advertisement screen entered by the advertiser.

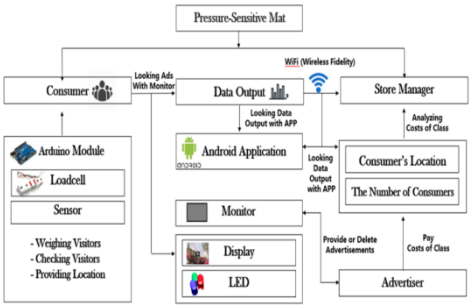

Fig. 2 System Architecture

The system flowchart is as shown in Figure 3. When a user steps on the pressure-sensitive mat on the floor, the load cell sensor attached beneath it will be activated to switch the load into electric signals and to output data. The outputted data can be checked through the admin application for the store manager and by doing so, the advertiser and manager can administer the ads to be placed in the monitor installed within the store.

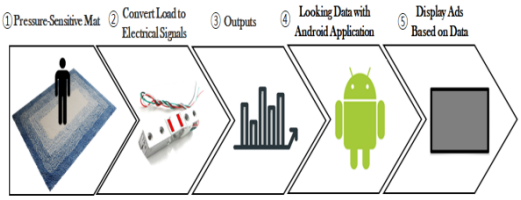

Fig. 3 System Flow

The system flowchart is as shown in Figure 3. When a user steps on the pressure-sensitive mat on the floor, the load cell sensor attached beneath it will be activated to switch the load into electric signals and to output data. The outputted data can be checked through the admin application for the store manager and by doing so, the advertiser and manager can administer the ads to be placed in the monitor installed within the store.

B. System Implementation

The system explained in this study was configured in Windows 10 64 bit operating system and Arduino was configured using a program called Arduino Sketch.This system is comprised of Arduino and load cell and WiFi module and an amp was also used to connect the weight sensor and Arduino UNO board for its configuration.

C. Implementation Results

Fig. 4 System Implementation Results

The configuration results of the system proposed in this study are as shown in Figures 4, 5 and 6. Figure 4 shows the connection with Arduino UNO by soldering the amp and weight sensor, which is the most important aspect of this study. The floor sensor model show in Figure 5 was replaced with yoga mat materials. It should be connected by WiFi in order to be able to check the data using the admin application when the floor sensor model is stepped on.

Fig. 5 Bottom Sensor Model

Figure 6 is a screen for producing the application and it is set up so that the total number of visitors to the store, path of customers, and the real-time location of customers can be checked via mobile phone.

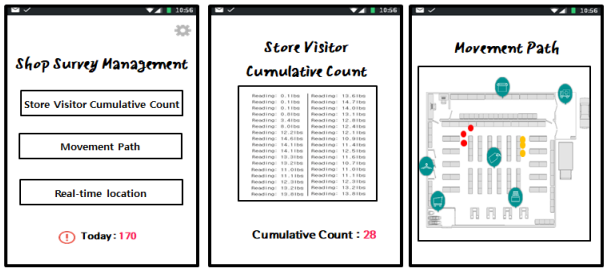

Fig 6 Examples of Manager Application

IV. PERFORMANCE EVALUATION AND RESULTS

The performance evaluation methods for store survey and advertising systems using Arduino are explained in Figures 7 and 9, and the results assessed according to each method are as shown in Figures 8 and 10.

Fig. 7 Performance Evaluation 1

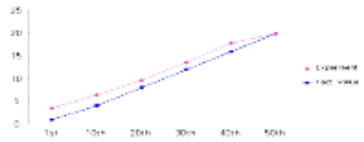

Fig. 8First Result of Performance Evaluation

Figure 7 compares the margin of error of measurements by placing lighter weights at locations that can weigh up to 20 kg and 50 times in order to evaluate whether it can accurately detect the weight of customers. In order to check whether the weight was measured accurately at this time, the fact value was measured using a scale. The actually measured values are as shown in the experiment values of Figure 8. 1 kg was measured for the 1st to 9th time, 4 kg from the 10th to 19th time, 8 kg from the 20th to 29th time, 12 kg from the 30th to 39th time, 16 kg from the 40th to 49th time, and 20 kg at the 50th time. Results showed that error was bigger when the weight was lighter and that the margin of error decreased when the weight increased.

Figure 9 aims at evaluating whether the sensors installed on different floors were checked with the movement of customers. Evaluations were made by moving 10 times from left to right and 10 times from right to left and the results are as shown in Figure 10.

Fig. 9 Performance Evaluation 2

Fig. 10 Second Result of Performance Evaluation 2

As shown in Figure 10, it was accurately counted 8 out of 10 times when moving from the left floor to the right floor, but when moving from the right floor to the left floor, it was counted only 6 out of 10 times, showing a large margin of error.

V. CONCLUSION

This study designed and configured a system to measure customer visitation data using Arduino and load cell sensor modules in order to offer more systemized in-store surveys using the system. Also, the store manager could identify the location in the store preferred by customers and the real-time location of customers, as well as the total number of store visitors easily by the store manager through admin application. Accordingly, it was proposed to systematically change the advertising system. Precise weights could not be turned into data through the performance evaluation of this system and it was concluded that accuracy of data according to the direction of movement could also be ambiguous.

By conducting additional research to construct the database that can manage sales according to the preferred location of customers using this system in future, it is expected that it will be possible to systematically change even the expenses of advertising systems according to product arrangement and flow paths.

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