

# 사물인터넷 기반 웨어러블 디바이스인 활동량측정기의 특성에 대한 탐색연구<sup>☆</sup>

## An Explorative Study on the Features of Activity Trackers as IoT based Wearable Devices

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### 요 약

최근 들어서 정보통신기술 자체뿐만 사물인터넷(IoT)을 활용한 비즈니스가 빠르게 확대되고 있다. 일반적으로 사물인터넷 중에서 웨어러블 디바이스는 고객을 대상으로 활용된 분야 중 가장 선도적인 적용분야로 인식되고 있다. 본 연구는 먼저 웨어러블 디바이스의 대표적 응용분야인 활동량 측정기에 대해서 고객의 니즈를 파악하고, 이를 잘 알려진 마케팅 믹스(제품, 가격, 유통, 촉진)와 연계시킨다. 이를 위해서 대학생들을 대상으로 서베이가 수행되었으며, 활동량 측정기의 현재 및 잠재된 니즈를 밝혔다. 또한 이러한 니즈는 마케팅 믹스에 의해서 분류되었다. 활동량 측정기는 다른 정보통신기기와는 달리 잠재된 욕구가 많았으며, 의료기기적 특성으로 인해 유통채널 등도 온라인, 대리점이 아닌 신뢰성을 보장할 직영점이나 오프라인 매장의 선호도가 크다. 본 연구결과는 일반 사물인터넷으로서 활동량 측정기뿐 아니라 웨어러블 디바이스를 개발하려는 개발자와 경영층에게 디자인요소에 관한 새로운 시사점을 제공할 것이다.

☞ 주제어 : 사물인터넷, 활동량 측정기, 고객 니즈, 웨어러블 디바이스, 분산분석

### ABSTRACT

IoT (Internet of Things) is recently burgeoning as business applications as well as ICT itself. Among the business applications of IoT, wearable devices are recognized as a leading area of customer devices. This research first identifies customer needs of activity trackers (fitness trackers), as one of representative wearable devices, and mapping the identified needs with the well-known marketing model of marketing mix (4 P's: Product, Price, Promotion, and Place). Survey was applied to university students for identifying current and potential needs for activity trackers. The needs were classified by 4 P's, and according to the results, different from other IT devices, activity trackers has more potential needs. Moreover, reliable distribution channels, offline and company owned shops were preferred, rather than online shopping mall by third parties. The results would provide some valuable implications to not only designers of activity trackers but also business management.

☞ keyword : Internet of Things (IoT), Activity Trackers, Customer Needs, Wearable Devices, Variance of Analysis

## 1. Introduction

According to the definition of the Gartner, "Internet of Things(IoT) is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment" [1].

Moreover, coined by Cisco, Internet of Everything(IoE) is also used as integrating people, process, data, and things [2]. Since IoT was introduced around in 1999, diverse application areas have been utilized in the real world. Some examples are in smart cities, smart environment, smart warter, smart metering, security & emergencies, retail, logistics, industrial control, smart agriculture, smart animal farming, domotic & home automation, and eHealth [2]. As smart phone market is getting matured, next generation mobile technology is considered wearable devices in ICT society [3].

The representative wearable devices in the market are glasses, watches, wrist bands, shoes, pendants, clothing, and

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sensors/robots [4]. Abundant research has been conducted on IoT, and provided positive expectation to the application development of IoT. However, some applications were not successful, and the market success of wearable devices should be considered in the perspective of the consumer utilities. That is, the market analysis should be based on NTER(Needs, Technology, Economics, and Regulation) [5]. The marketer E. Jerome McCarthy proposed a 4P's classification(Product, Price, Promotion, and Place) in 1960, which has since been used by marketers throughout the world [6].

Among diverse wearable devices, activity trackers (fitness trackers) as types of wrist bands are used for this research. Activity trackers are getting more introduced in the world, but they are only sprouting in Korea. Different from the spreading of the devices in our lives, the research on activity trackers is insufficient in the world including Korea. The research purpose is to identify consumer needs (the first item of NTER) of activity trackers, and to link the needs to Marketing Mix of 4 P's (Product, Price, Promotion, and Place) of activity trackers, specifically focused on the first 3 items. For this research, survey was conducted to the university students in Korea.

## 2. Characteristics of Activity Trackers as Wearable Devices

### 2.1 Activity Trackers as Wearable Devices

Wearable devices can be categorized by two distinct areas. The one is healthcare devices, and the other information/entertainment devices. Activity trackers belong to the first area, and its major function is to monitor diverse physical activities such as steps, distance, exercise time, calorie consumption, heart rate, blood pressure, sleep tracking etc. Activity trackers usually communicate users' activity data through the Bluetooth technology with other Bluetooth-enabled devices like smart phone or personal computers, and tracks users' physical activities. Furthermore, activity trackers can compare the activity data among other users of the same user community.

Activity trackers are different from smart watches, which primarily function as smart phones, and in part encompass the functions of digital wallet for small money transfer and healthcare. Activity trackers are the devices dedicated to users' healthcare, which help users to lose weight, increase physical

activities, or simply improve overall health. Nike Fuelband, Jawbone Up, and Fitbit Flex are exemplar activity trackers in the world, and Inlab from Inbody is the only Korean product.

### 2.2 Characteristics of Activity Trackers

Activity Trackers have the following characteristics; (1) style (ankle band, armband, wrist band etc.), (2) cost (under \$40 to above \$200), (3) water safe (splash resistant, water resistant, and water proof), (4) steps, (5) stairs/elevation, (6) swim+cycle, (7) heart rate, (8) heart rate notes, (9) sleep, (10) silent alarm, (11) calories burned, (12) distance, (13) syncing (manual, wireless) (14) data viewing, (15) review [7]. These are comprehensive, and some of the characteristics are used for this research. These characteristics are important to the Product and Price of Marketing Mix explained above.

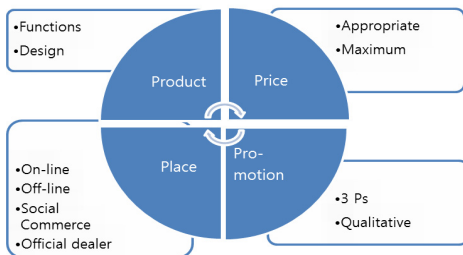
The first of 4P's, product, consists of functions and design. The 9 closed questions are asked for the functions of activity trackers such as ① number of steps, ② activity distance, ③ activity time, ④ consumed calories, ⑤ diet guidance, ⑥ sleeping analysis, ⑦ blood pressure, ⑧ pulse, and ⑨ watch. Further, one open question is provided for the additional functions, which are not mentioned in the questionnaire. The 7 closed questions are related to design such as ① color, ② uniqueness ③ size, ④ operating time after charging, ⑤ wearing comfortness, ⑥ water proof, and ⑦ brand.

The price consists of 2 questions such as ① appropriate price and ② maximum affordable price. The place consist of 1 question on the channel that respondents would intend to purchase in. Moreover, some other questions were asked for completeness of the questionnaire as well as the final demention of 4 P's, promotion. For example, those are the specific brand familiarity on the activity trackers, and the possible purchasing order between smart watches and activity trackers.

## 3. Marketing Mix and Links to Characteristics of Activity Trackers

According to the BusinessDitionary, Marketing Mix can be defined as "A planned mix of the controllable elements of a product's marketing plan commonly termed as 4Ps: product,

price, place, and promotion. These four elements are adjusted until the right combination is found that serves the needs of the product’s customers, while generating optimum income” [8]. Some characteristics above mentioned are used to link with product, price and place of Marketing Mix. The research is to identify functions that the customers (users) need (expect), and acceptable and maximum prices they can pay for activity trackers. Moreover, the research examines the channels that customers (users) want to purchase them in. Diverse functions are applied in activity trackers, but because of the limitations of product itself (e.g. product size and applicable technologies) and economics, relative importance of functions should be identified for activity trackers designers. IoT is recently expanding, and because activity trackers are the relatively new product, ordinary people are not familiar with them. The market seems to moving over introduction stage to growth stage of PLC (Product Life Cycle).



(Fig. 1) Link between Theoretical Background and Research Framework

## 4. Research Method

### 4.1 Sample and Survey

#### 4.1.1 Respondent Characteristics

For this research, the survey was conducted to the university students who use smart phones. Activity trackers are relatively new product in Korea (seem to be in the introduction stage of the PLC), and university students are proper sample to this research, because they should be the first potential purchaser, and smart phones are the representative comparable devices of activity trackers. Each question on functions and design of the survey is asked by Likert Scale of 7 from the least importance, 1 to most importance, 7.

#### 4.1.2 Descriptive Statistics of Functions and Design Characteristics

The demographic characteristics of the sample are as follows. The survey was conducted through on-line. Total of 105 students are participated. All of the respondents are complete and used for statistical analysis (N=105) by SPSS. Among 105 respondents, while 56 are male, 49 are female.

(Table 1) Descriptive Statistics of the Sample

Features	Stat. average	Std. Dev.	Male(56) Average	Fem(49) Average
Steps	4.05	1.53	4.14	3.94
Distance	4.77	1.37	4.84	4.69
Act-Time	4.56	1.53	4.39	4.76
Calories	5.20	1.33	5.20	5.20
Diet	4.20	1.51	4.14	4.27
Sleep	4.48	1.61	4.36	4.61
Blood-P	4.46	1.45	4.39	4.53
Pulse	4.29	1.46	4.20	4.36
Watch	4.14	1.54	4.30	3.96
Colors	4.56	1.56	4.71	4.39
Unique	4.16	1.53	4.50	3.78
Size	5.05	1.27	5.00	5.10
Work-Time	5.38	1.16	5.38	5.39
Wear-Com	5.43	1.17	5.54	5.31
Water-Prof	4.95	1.40	4.93	4.98
Brand	3.62	1.50	3.70	3.53

The first nine items are related to functions, and the rest seven items are design factors. Based on the statistics above, wearing comfortness (5.43) is the most important factor of design considerations, while calorie measurement (5.20) among functions of activity trackers.

## 5. Research Analysis

### 5.1 Product: Design and Functions by Gender

The importance of functions and design are identified as shown in Table 1. In order to identify whether significant difference exists by gender. ANOVA and MANOVA were

applied by SPSS. Statistical analyses, specifically ANOVA, were conducted to identify the difference by gender on each of functions and design. Before the ANOVA, Levene's tests were conducted for homogeneity of variance. All of the function and design were homogeneous in variance at the significance level of 0.05. As shown in Table 2, most of the function and design, except uniqueness, were not different between male and female at the significance level of 0.05. Only uniqueness showed difference by gender at the significance level of 0.05. Different from the initial expectation male respondents think uniqueness more important than the female (average 4.50 vs 3.78). It might imply that activity tracker designers should consider its unique shape for male activity trackers.

(Table 2) Functions and Design Difference by Gender

Stat. Features	F	Sig. prob.
Steps	0.464	0.497
Distance	0.290	0.589
Act-Time	1.480	0.226
Calories	0.001	0.977
Diet	0.171	0.680
Sleep	0.652	0.421
Blood-P	0.235	0.629
Pulse	0.447	0.505
Watch	1.310	0.255
Colors	1.143	0.287
Unique	6.182	0.015
Size	0.168	0.682
Work-Time	0.003	0.955
Wear-Com	1.011	0.317
Water-Prof	0.035	0.853
Brand	0.319	0.573

Further, statistical analysis by MANOVA was conducted to identify difference in a total manner rather than the individual function and design between two groups, male and female. Pillai-Trace, Wilk's Lamda, Hotelling Traces, & Roy's Largest Characteristics Roor statistics showed that the difference was exit at the significance level of 0.05. Individually, each feature (function and design) except uniqueness has no significant difference, but in the total manner, the difference has been identified. It might imply that gender should be considered in the delopment process of activity trackers.

## 5.2 Price: Appropriate and Maximum

Appropriate price and maximum affordable prices are questioned to the respondents. The result shows in Table 3. Respondents think that the most frequent appropriate price is around 100,000 Korean Won (49%) while it is less than current market price (around 150,000) of Korean product. Current market price is very similar to the most frequent maximum affordable price (150,000, 32%). It implies that price policy would be very limited in the market, because current price is almost near to maximum affordable price. In operations, how to decrease the current price could be an important factor. Xiaomi, Chinese electronic company, already introduced activity tracker in a very competitive price (around 15,000) [9].

(Table 3) Prices: Appropriate and Maximum

(₩: thousand)

Price	Freq.(Appr.)	Ratio	Freq.(Max)	Ratio
50	30	28%	15	14%
100	52	49%	31	29%
150	18	17%	34	32%
200	4	3%	17	16%
250	1	0%	7	6%
300	0	0%	1	0%
Total	105	100%	105	100%

## 5.3 Place: On/Off-line and Dealer Types

One of the research puposes is to identify distribution channels that customers would like to purchase. Analysis results are as shown in Table 4.

(Table 4) Customer Preferred Distribution Channels

Channels	Freq.	Ratio
Trad. Shop. Mall	28	26%
Social Comm.	18	17%
Dealer(off-line)	10	9%
Auth. Dealer(off-line)	36	34%
Auth. Dealer(on-line)	13	12%
Total	105	100%

Customers intend to purchase activity trackers in on/off-line authorized dealers (46%). Only 26% would like to purchase in traditional shopping mall (Aution, Gmarket, 11street etc), and the ratio is much lower than usually expected. It might imply

that they consider activity trackers (medical) health devices, and reliability and authenticity is important than any other household electronics. Marketing management should develop reliable distribution channels different from other household electronics.

### 5.4 Promotion

Activity trackers are new products, and 29% of respondents have never heard about those. The respondents who know about but have never seen are 62%, and only 7% actually considered to purchase. Traditional promotion strategies for electronic product in the matured stage of PLC would not be applicable for activity trackers

(Table 5) Familiarity on Activity Trackers

Familiarity	Freq.	Ratio
Never heard	31	29%
Know but not seen	66	62%
Considered purch.	8	7%
Already using	0	0%
Total	105	100%

Smart watches tend to encompass some functions of activity trackers. Technological convergence among devices has been emphasized. However, convergence in management perspective is also important to product lifecycle management. 40% of respondents have no intention to purchase. Moreover, purchasing order between smart watch and activity trackers is almost indifferent (29% vs 25%). The results might imply that the customers who need a smart watch also intend to purchase an activity tracker and vice versa. In addition to convergence strategies, new promotion strategy like package sale (smart watch plus activity tracker) would be effective.

(Table 6) Purchasing Order b/w S.W. and A.T

Purch. Order	Freq.	Ratio
Smart W. first	31	29%
Activity T. first	27	25%
Smart W. No.	4	3%
Activity T. No.	0	0%
Neither	43	40%
Total	105	100%

## 6. Conclusions and Future Works

The research first introduced the two; the concept of marketing mix of 4P's, and the characteristics of activity trackers as wearable devices, leading application of IoT. Secondly, the linking model between the two was introduced. Finally, through the empirical research the linking model was tested and some implications have been found.

IoT is developing in technologies themselves such as sensors, communication tools, and big data analyses. However, market success of IoT applications is dependent on the needs of users (customers) in diverse business aspects as well as IoT technologies. In other words, technology application to the product and services should be linked and congruent with customer needs. Otherwise the market acceptance is low, and IoT applications would not expect results in business aspects.

The research provides extended perspectives to designers of activity trackers. The research identified potential needs of activity trackers, in traditional marketing models, and differences from other electronic devices are explained. Most respondents are more familiar with smart watches than activity trackers, and they want to purchase those in authentic dealers, design characteristics except uniqueness were not significantly different between male and female. Market acceptable price would be ₩150,000, which is very close to the current market price. According to the results, more than ₩250,000 will be in hard resistance in the market. Further, the explorative study results provide the conceptual model linking between customer needs and characteristics of activity trackers. The success of new product development has diverse aspects, management ones as well as engineering perspectives. The research will be a linkage between the two different perspectives as well as between academic arena and industry ones. The research would be a research ground on wearable devices like smart watch

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