

A Field Study on Basic Usage Patterns of Traditional Watch and Smart Phone for Designing Smart Watch

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Abstract. This paper researches towards people who used traditional watches and smart phone at the same time for 8 participants by diary method. Smart watch look same with the traditional watch and the basic mechanism of interaction is same as Smartphone, not taking special characteristics of watch into account. In this research, we extracted basic design elements and framework for designing smart watches based on basic usage patterns derived from a series of systematic user studies.

Keywords: Design thinking · Diary study · User experience · User behavior

1 Introduction

The development of technology is always beyond people's imagination. With the development of IoT (Internet of Things), the wearable device serves as an important entrance and develops a lot in recent years. Although the conceptualized "Google glass" suffers criticism, it does not influence 2013 to be called "the first year of wearable". All kinds of wearable devices emerge like mushrooms after rain, and as the leader who strikes a pose on the stage frequently, the watch is likely to become the greatest technological revolution followed after smart phone [1], and it also turns into the hottest topic in 2014's smart device market. However, there are many reasons resulted in shortage of understanding towards smart watch by users. The smart watch is a wearable device, the experience and functions provided by which shall be blended in human's daily life naturally, the service provided by which shall be more superior to smart phone, and then its value could be reflected. How to design smart watch, and how to make more people to accept, use are the starting points of this paper. By possessing the attributes of watch and smartphone simultaneously, more than simple accessory to smart phone, the smart watch needs to have its specific Identity. Through analogy method, conclusion and extension of partial experience, we believe that by understanding the Basic Pattern of the traditional watch and smart phone daily used by users, valuable reference and basis could be provided for design of smart watch.

2 Related Work

Let's see traditional watch and mobile phone first. From the birth to today, watch has already developed its particular cultural characteristic. The smart phone is the technological product nowadays, and it has changed the world. The types that people use for gaining all sorts of information are no longer traditional and single. People use the screen with the size of palm to connect the world. In the meantime, wearable device will play a crucial role in big data along with the popularization. Next, we will elaborate the basic attribute of each device in each field.

2.1 Understanding the Smart Phone Attributes

In recent years, the mobile phone is no longer a simple communication tool. With the technical progress, mobile network and services like social contact have turned into the indispensable DNA [5] in mobile phone. The user could use mobile phone to get information and do network social contact anywhere, anytime, and the diverse applications (Apps) in it turn into the main entrance for searching information, doing social activities, recreation and study [6]. The smart phone with diversified functions provides services in different fields, impacting different users' usage habits all the time [7]. On account of the smart phone's characteristic "on-the-move", channels for users to get information become more diversified, and the Internet use becomes more fragmented [8]. "Always on" is also one of the most differences between smart phone and computer. The users install various cell phone applications, they are facilitated and their lives have been changed. Nonetheless, trouble of "text message noise" from all kinds of text messages may be caused to users. For instance, when one focuses on work, it comes news feed, then he might be disturbed. The smart phone develops quickly in recent years, with the sell of iphone6, the small screen mobile phone (with the size below 4 inch) died away gradually, and the big screen mobile phone enters into thousands of households. In 2015, the screen size for smart phone will over 5 inch. But like coin has two sides, when users use big screen mobile phone, all kinds of service experience will be further improved, and in the meantime, some troubles will be brought, such as inconvenient operation by one-hand, inconvenient for taking along, etc.

2.2 Understanding the Traditional Watch Attributes

Before the horologe came out, the main usage of desk clock was astronomical observation. After that the geographic transition facilitated invention of navigation clock, and the train departure at fixed time promoted portable pocket watch. The invention of watch derived from a visual concept, making clock with large size convenient to take along and people to know time. Actually behind the watch, in-depth culture and significance exist. With the widespread circumstance of "one person with many watches", the watch pursuing by people is no longer the single timing function, but expansion of functional scope and increase of art taste, via diversified watchcase

types and watch plate designs, as well as a fashionable accessory which reflects individuality and identity. Timing, accessory, status symbol and other functions, making watch succeed its own significance. So what is the attribute to watch? For students in the examination room, it is a tool for timing; for successful people, it stands for carrier of identity and status; for fashionable figures, it is the embellishment of trend.

Designing smart watch and understanding the attributes of traditional watch appear important particularly.

2.3 The Status of Wearable Device

Since the appearance of the first wearable computer [9], up until walking into public views nowadays, the wearable device goes through countless iteration. Now with the big data, cloud computing, data mining and analysis, gradual maturing of internet of things, if pushing the wearable device to a mass market with more fields is needed, the present ecological chain to all kinds of platforms must be combined, thus more convenient and fast service experience could be provided for users.

For the past two years, the wearable device developed rapidly, and the main battlefield for products with public grade was on wrist. The wristband or smart watches released by manufacturers may be called all flowers bloom together. However, the vital point to the user had not been hit. The functions or services provided by them could be realized on mobile phone as well, resulting in reduction of dependence degree by users little by little. Besides defects on function, imperfect aspects showed on service. So the status of smart phone cannot be shook at present. We consider that the orientation to the smart watch of the new generation is not a device that exists solely, but shall act as the “second screen” to the smart phone. Meanwhile, ecological chain with multi-screen linkage shall be added, specific advantage shall be given play, more intimate and smart mobile service shall be provided for users.

3 Diary Study

This paper used diary method [4], which could reflect daily behavioral habit to a person accurately. Basic using forms to smart phones and watches could be known from all kinds of conditions where the participants are in. We need to know the temporal and location context that users use watches and mobile phones, how to use and what are their feelings.

3.1 Study Setup

We prepared experimental requirements and diary format (Fig. 1) by making use of Google docs and Google sheet. Recording the forms from using watches and mobile phones by participants were required. The formats of diary was classified in accordance of the using situations, which included service time, using place, using function and how to use, finally using feelings shall be described and evaluations shall be made. The

Smart Watch					
DATE	TIME	LOCATION	FUNCTIONS	EVALUATION	GRADE
2014-12-23	8: 10	家	戴上手表	从充电器上拿下，电量100%，但是还是有些担心。	4
	8: 20-9: 00	路上	反复看手表，确认时间	10次大概会有一次反应不灵敏，总体还行。	4
	11: 20	教室	收到消息	上课时候，不方便查看手机，手表接到了消息	4
	12: 10	路上	看时间	在阳光下也可以很好显示。	5
	14: 00	教室	收到消息，在手机上弄打开	没听到手机的震动，但是手表及时提醒了消息。5分	5
	14: 25	教室	收到警告	离开手机，超出手表接收范围，发出警告。3分	3
	15:25	路上	收到电话的提醒	周围环境复杂没有感觉到手表的震动，感觉到手机的震动	2
	18: 00	路上	低电量提醒	电池使用的大快	1
	18: 30	家	到家充电	放在电脑旁边，就是一个电子钟，但是放在充电器上就不能接收消息	2
Avg					3.333333333

Fig. 1. Diary sample (by Chinese)

aim was to know the influences from using motivation and functions from the users. We requested participants to record twice a day, one was at noon, recording from get up in the morning to noon; the other was before go to bed in the evening, recording the activities from afternoon to night. In addition, we checked the records every day, and reminded or guided the participants via text message or leaving a message. Due to human has sluggishness, for the sake of getting better data, we provided US\$5 as the survey subsidy for each participant per day.

Device

- Carry mobile phone (provided for oneself) with the version above Android OS 4.3.
- Traditional watch (provided for oneself).
- The smart watch provided is Moto 360 (provided by us). Moto 360 has Android Wear. The reason why adding smart watch in the survey is to let participant try out directly, which is convenient for us to know their usage experience, provide data and reference for designing better smart watch.

Participants. The selected participants must wear traditional watch and use smart phone (Android OS 4.3) at the same time. We found 8 eligible persons, 4 men and 4 ladies with the age distribution 20–32 years old, average age 26.3 and SD 4.06. Their occupations are student, teacher, tour guide, company employee, etc. Because of different occupations and living habits, the using forms to devices like mobile phone and watch are distinct.

Process and Data Collection. The survey period for each participant is two weeks and divided into 2 phases (Fig. 2). The first phase is one week. Every day the participants needed to record their usage conditions towards traditional watches and mobile phones,

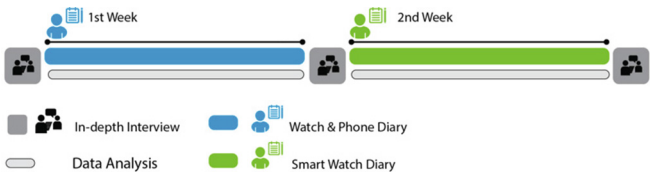


Fig. 2. The data collection process

as per the diary form provided by us. The second phase is one week, too. The volunteers would be requested to wear Moto360 smart watches and record their everyday usage conditions. Before the diary survey, we made an in-depth visit, which was for knowing the basic conditions from the surveyed objects on using watches and mobile phones. After the first week closes, we made a second in-depth interview, of which the content would be set in line with the record conditions from the participants in the first week. After the users recorded the usage conditions for one week, we made the third in-depth visit, of which the content was about smart watch. During using smart watch in the second week, except writing using feelings, the score evaluation shall be filled, which was, from 1–5 (1-totally dissatisfied, 2-not too satisfied, 3-general, 4-satisfied, 5-very satisfied). Because of the participants have not used smart watch before, and it is a new device, this research is used for knowing the subjective feelings from the participants.

4 Finding and Discussion

During the data collection process for eight weeks, we get 976 records in total, 122 records for each participants on average (Min: 61, Max: 172, SD: 36.4). During the whole process, users recorded their usage conditions on mobile phone and watch every day indeed. At the first interview, we found there were 6 persons use watch for more than 5 years, some of them used watch for more than 10 years, which held 75 %; there were 2 persons who started to use watch from last year. Every person used smart phone for more than 4 years.

4.1 A Traditional Watch Usage Pattern

Through first week's research, there are 264 usage diaries collected in total, 33 diaries per person on average. All the participants wore watches with round watch plate. During the 1st in-depth interview, all of them said that they started to look at watch from childhood. The people surrounded were wearing watches with round watch plates. So they felt they got used to look at watch of this type. Secondly, It is observed that the first demand to watch is decoration, that is, the watch should have nature of jewelry. During the in-depth interview, there were 5 persons put forward high demand on appearance. Meanwhile, they said that the styles of watches were various, and there were a lot of choices, so they would not buy at will, and they mainly focused on the appearance. There were 3 participants said that they had many watches, and they would select which to wear according to the occasions. All of 8 participants wore traditional watches with pointers. Compared with watches of digital display, they got used to look at pointers so that efficiency on obtaining time information would be higher. On the condition that the watch was not lost or not damaged, they would not consider changing watch. In the meantime, participants did not have requirements on whether to add functions to the watches they wore, such as alarm clock, second chronograph, etc. They felt that adding these functions appeared cumbersome, and would not be used. The watch was ok by just showing time. The participants' behaviors on wearing

Table 1. Distribution of diary entries

Location	Entries	% diary entries
Indoor	186 (at home 95)	69.4 %
Outdoor	78	30.6 %

watches were constant. When they were out, they would wear their watches naturally. If they forgot, they would feel slightly uncomfortable even they had mobile phones to look at time.

Among the records collected, we divide the situations of using watch into indoor and outdoor, see Table 1. For the indoor, it includes by walk, in transit, etc., which belong to situation under the unfixed surroundings. For the outdoor, it includes at home, classroom, café, etc. which belong to situation under the fixed surroundings. Among the 186 diaries, 95 diaries are made at home, which occupies 35 % of all the watch records. If using watch at home, the 100 % condition is taking off the watch, and then placing at a comparatively fixed place, for the sake of searching, and when going out, it could be found quickly and wore. 3 participants said that his watch was metal watchband, which could be erected on the table, and when at work or home, the watch could be used as clock. Because metal watchband will hinder work, especially when one uses laptop, the laptop or the watchband may be scratched. However, influence will not be brought to work for the participants who use leather watchband. There are 91 records not taken at home, for example, under the circumstances of working for a long time at café or library, the participants would take off watches as per condition. There are 7 such diaries, which occupies 2.6 % of the watch records.

To sum, users care more about the appearance and wearing feeling to watch. If a lady wears a cumbersome metal watch, she will be prominent in secular eyes. Therefore the watch shall be worn by right person in appropriate occasion. And due to wearing watch for one day, the comfortable sensation is extremely important, so don't let the wrist feel pressure.

4.2 Mobile Phone Usage Pattern

We've collected 427 usable data from smart phone diaries. Through the first time in-depth visit, we learn about that there are 42.3 Apps installed in mobile phone per capita, with the maximum of 146 and minimum 23 Apps. There are 7 APPs used per capita per day, and they would put the Apps of common use on the first page of the display screen. Heavy users of mobile phone exist among these participants. Some of them used more than 7 h and some of them used for no more than 1 h, with the per capita 2–3 per day. Combining with the in-depth interview, we classify the 8 participants into 5 user types. Except the inherent communicating functions to mobile phone, the diversified services constitute different roles the mobile phone played in their hands (Fig. 3).

Main Usage Patterns	"Assistant Manager"	"Lifestyle Hub"	"Society of Friends"	"Access Information"	"Entertainment Center"
Used primarily for	Chatting	Doing	Chatting	Browsing/Search	Doing
Most Frequent Task	Calling and Management Work	Using apps that support the uses lifestyle	Using Social apps to show lifestyle and connecting to people	Using news apps or browsing to pick up information	Using entertainment apps to have games or others
Level of Mobile Interdependency	Low	High	High	Medium	Medium
What Determined Mobile Concern	<ul style="list-style-type: none"> · Security · Battery life 	<ul style="list-style-type: none"> · Network connection · Security 	<ul style="list-style-type: none"> · Network connection · Security · Battery life 	<ul style="list-style-type: none"> · Data plan · Network connection 	<ul style="list-style-type: none"> · Function of device · Data plan · Battery
Description	Just for calling/SMS and Management Work	The smart phone supports the user's activities, with apps selected by the user to improve his life	Lots of society activities, keep track with friends with the device	This is the typical usage pattern to access information and study tool	A variation of the Entertainment usage pattern, to listen music and game

Fig. 3. A taxonomy of smart phone's basic usage pattern

This Figure shows the degrees of dependency from all kinds of users, common task and the fields they cared about. By comprehensive understanding towards them, it means favorable guidance for analyzing following diaries.

We used affinity diagram technique [12] and divided the original data into 10 categories, Call/SMS, social contact, personal management, obtaining information, entertainment, daily information, phone management, daily record, study and else (Table 2).

Most data belong to communication. As the inherent attribute to mobile phone, the communication holds 25.7 %, which is the top one. Secondly is the social behavior.

Table 2. Breakdown of smart phone needs by categories. Examples for each category are from real diary entries.

Category	Diary Example	#of Entries	%of Entries
Call/SMS	Walking on the road, a call came and answers it	110	25.7 %
Social contact	Waiting friends on café, open Facebook...	85	19.9 %
Personal management	Setup alarm for early wake up	56	13.1 %
Obtaining information	Research something on web	41	9.6 %
Entertainment	Break time, have mobile game	39	9.5 %
Daily information	Check weather before leaving home	37	8.6 %
Phone management	Apps need update	30	7.0 %
Daily record	Have funny time, take a picture	15	3.5 %
Study	Improve my English	12	2.8 %
Etc.	Transfer accounts to friends	3	0.7 %
SUM		427	100 %

Many social network sites break away from browser, develop their own service platforms of vertical type, providing convenient service for users. For all the activities of social contact, we divide into Social Connection and Social Avoidance as per the motivation [11]. “I am waiting my friend at café. I have nothing else to do, so I open wechat to check friend circle and chat with my friends.” There are 59 such records, which occupies 69 % of the total social contact category. For unable or would not like to check the information push during work or have class, we call social avoidance, which prevails among the participants. Personal agenda management occupies 13.1 % of the total records. The participants expressed that they would plan and remind what they were going to do by using the schedule management tool on the mobile phone. So the speedy and accurate schedule reminding function appears particularly important. All of the 8 participants had their constant habits when use mobile phone, and they said that, “even though changing new mobile phone, function definitions will be set up as the previous mobile phone. For example, I will download the same apps, and then put the apps which are commonly used by me on the first page, arrange all the apps according to the using frequentness.” Therefore, during using new devices, the interface and information architecture shall keep consistency with the original one, making users grasp quickly and reducing the learning cost.

All of the participants expressed that the smart phone was the crucial personal good, their important information were stored inside, and even the band cards were associated with. In case the mobile phone was lost, that would be more terrible than the wallet was lost, so they all set lot kinds of safeguard measure. Meanwhile, they worried about that the contents might be seen by others when they were using mobile phones. So the security and privacy were most concerned by them. Moreover, we found that these participants mentioned they preferred more about mobile phone with large screen, owing to this kind of mobile phone could provide better experience in terms of work, study, entertainment and others. However, it could be slightly demanding on operating, especially for the ladies with smaller hands. Under some special conditions, e.g. on the crowded bus, the restriction of space is inconvenient for operation with single hand. By this time if the important information or phone call comes, people will be in hurry-scurry. The participants expressed that under special conditions, it would be better there was more faster or convenient query method.

We divide the using situations into indoor and outdoor. Same as the results from our previous in-depth interview, there were 224 diaries show the participants would take out their mobile phones from bags and pockets indoors and put within their sights, for the convenience of checking information quickly and preventing omission. In the meantime, under the quiet situations indoors, they would set their mobile phones mute or vibrated. There were 49 diaries referred that omission happened even putting by their sides, which explained that more direct ways were needed for reminding, for the sake of omission. On the contrary, under the outdoor situations, the proportion of omission information occupies 81 %. The 8 participants got used to put the mobile phones into pockets and bags. Due to the outdoor environment is complex, the probability of missing picking up rises largely, the using place play vital role to receive information successfully. Sometimes when they received push, the act of “catching a glimpse” holds 47 %, that is to say, if it was not significant information, they would

delay their response. It is observed that more efficient information receiving way could enhance the usage experience.

Finally, the occasion had direct influence to the using behaviors for participants. They hoped there would be more convenient and faster information obtaining way, for the sake of enhancing work and learning efficiency. Secondly, the security for the mobile phone was what they concerned, for ensuring the privacy not disclosed.

4.3 Smart Watch Usage Pattern

Within the first week by using smart watch, we've collected 285 diaries in total (Table 3), with 40 diaries per capita. According to the subjective feelings to evaluate, the average score is 3.5 points with the highest 4.1 points and lowest 3.0 points. The entire using feeling is a little more than "general" grade, which is 3.5 points. During this week, we did not deploy task to participants on intention because we wanted to get natural data. Among the diaries, they worried about the electric quantity most during the first two days, but decrease was shown in the subsequent days. In the using survey towards watch previously, we mentioned that "watch will be taken off naturally when go back home, and put in a place easy to find". While the charger of smart watch happens to be a nice solution, because as long as it is put on the table, it will do quick charge, and show time as an electronic clock. Meanwhile by putting on the table, it has decorative effect. After go back home, about the matter of "take off watch, put somewhere" needs to get solution.

From the diaries, we found that the participants could play smart watches easily, no difficulties were found during using process. So we think easy to play and low learning costs are important. Among the diaries, we find that the main dissatisfaction to wearing watch comes from appearance, the style cannot be chosen, and female participants have thin wrists, so the watches appear prominent. Meanwhile, watch possesses strong feelings of modeling, science and technology, but weak decoration.

"Check time" holds 27.3 % of the diaries. All of the records show that by overturning wrist, the screen will be lightened automatic, so it is natural there is no heterogeneous sense. From the records after using, all people expressed that the times of taking out mobile phones from pockets were obviously cut down, there was no need to

Table 3. A taxonomy of smart watches' basic usage pattern

Category	#of entries	%of entries
Notification	97	25.7 %
Check time	78	19.9 %
Battery management	54	13.1 %
Wear	34	9.6 %
Sync with other device	13	9.5 %
Movement tracking	6	8.6 %
Etc.	4	7.0 %
SUM	285	100 %

worry about miss notification, and information could be viewed even the mobile phones were out of range of visibility. This is because the watch is worn on wrist, which is more efficient than mobile phone reminds. In case of information is pushed to watch, just a glance is needed, and if timely response is not needed, one could ignore it for the moment, the watch saves both time and labor. The smart watch is restricted by the size of the screen, and the voice is the main input pattern. Among the diaries, there were 8 diaries related to voice input (2.8 %), and they expressed that it was inconvenient to speak towards a watch, and people surrounded would feel strange. Moreover, they would feel their privacy was disclosed if the speaking voice was heard by anyone else, so the condition of replying text message by voice was almost indoor behavior. The mobile phone cannot be next to the skin completely, the service provided by the watch could come down to the places where mobile phone could not reach, such as detection of physical condition during doing exercise. The demand of synchronization with mobile phone is not manifested extraordinarily, which accounts for only 4.5 % of the overall records. It was mainly used as “remote control” to mobile phone, controlling music, removing information push, etc. The participants wished more abundant sync to promote the feasibility to the watch.

4.4 Study Limitations

Firstly, due to restrictions from some conditions, when we collected volunteers, we had not considered users of middle age (above 40 years old). Secondly, However as to the smart watch, it is a new thing. The participants had not formed fixed cognition. In addition, the using process of only 1 week is exploration stage, recording the subjective using feeling. With the increase of using time, the product will generate new experience [10]. The research data at this stage could provide a reference for this pattern of smart watch during using in preliminary stage.

5 Results and Discussion

From the above chapters, we get much enlightenment from the 8 participants, whose daily using behaviors were collected. In this chapter we will elaborate our conclusion.

5.1 Designing Smart Watch

Based on the characteristic to each device, there are differences on the interactive ways and information accesses provided. With the development of mobile network, the information obtained from pc belongs to “*slow interaction*”. From the device size and operational experience, the user could browse information with big space and operate the dimensionality. While the mobile phone has strong mobility, and its service time is fragmented, so it belongs to “*quick interaction*” as well as suits quick receiving and sending information. By the wearable attribute and tiny screen, the “*simple interaction*” to smart watch can reflect its characteristic better. We will design from two layers: experience and function. For the experience layer, the major center lies in person. And for the function layer, the major layer lies in device (Fig. 4).

Experiential Level (People)	Functional Level (Device)	Both (People/Device)
Wearability Sociality Fit to Contextual Visibility High Mobility Continuity	Compatibility Continuity Security	Continuity

Fig. 4.

5.2 Experiential and Functional Level

We will elaborate the experience layer by taking user-centered design as starting point. Firstly is the *wearability*, that is, the watch weight, material and wearing comfort level. Because of the vivo environment needs good physical support, that is to say the carry type shall be according with human engineering and more natural, and then the distance between watch and wearer could be reduced. Secondly is the *sociality* shall conform to present era, viewpoint and culture. The modeling shall not be excessively scientific, or beyond user's scope of cognition. It shall be accepted by social system (for instance, it should not cause many disputes as Google Glass). Its appearance shall be accepted by the public, so that the viewers and users could feel comfortable and not consider it is heterogeneous. In general, that's "make device blend in us, rather than we blend in device". *High mobility* refers to not separating with one's body under any occasion and fitting with body's height, as well as possessing more mobility compared with other mobile devices. Thirdly is the *continuity*. Due to the date is generated from human behaviors, whether the collected data is continuous and accurate will impact the users. Fourthly is *security*. In data era, one device includes all privacy to a user, so enhancing the security could promote using confidence to user. Fifthly, *fit to contextual*, this includes using appropriate functions in appropriate occasion, such as reminding weather, traffic condition when going out, pushing news when on a bus, schedule reminding during work, quick viewing information, etc. The better the combination between function and occasion, the better will the experience. Finally is *visibility*. The favorable visual experience could impact user to use the device, especially with minimum screen, the reasonable information architecture and visual metaphor could boost information reception efficiency.

The good hardware support is the basis to promote functionality, so the smart watch shall have *compatibility* with other devices, for the convenience of quick synchronization between user and device. Not only the hardware compatibility is important, but also the software compatibility is important, and it becomes an entrance for interactive service. The *continuity* is the different from experience layer. Whether the received data is complete or not, the network is unable to connect or hardware factors like insufficient power could have impact on data reception. When it comes down to money or information with high privacy, the *security* will become crucial. So the services related to security functions shall be more perfect, such as fingerprint encryption and others.

6 Conclusion

We did diary survey towards 8 participants when they used smart phone and traditional watch for two weeks in this paper. Through in-depth visit and diary record, we know the using patterns towards smart phone and traditional watch from these participants. By applying analogy and analyzing via thought of concluding and expanding partial experience, finally we get human experience and device functions, which are *wearability, sociality, high mobility, continuity, security, fit to contextual, visibility and compatibility*. We hope this conclusion could provide reference for designing smart watch, meanwhile could provide design thought for other products. Through this survey, we get the guidance frame for designing smart watch. In the subsequent study, we will discuss the interactive mode for smart watch. It is predicted that in 2015, with the apple watch appearing on the market, the smart watch will come with force and enter into our life. In the meantime, it will join in ecological system of smart phone, tablet PC and computer, providing more convenient life for us.

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