Study on the Development of Smart Jewelry in the IoT Environment

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Abstract

IoT is the network technology and the environment that things can connect with network, interact with each other, collect and share information by wired or wireless. Now the development of science and technology provides more possibilities for jewelry. This paper summarized the concept of smart jewelry and the related theories. Through the analysis of current situation of the development of smart jewelry, this paper predicted that in the IOT environment smart jewelry will develop rapidly and more intelligently. In the future, smart jewelry will occupy a larger market share in the jewelry market.

Keywords: IoT; Smart Jewelry

1 INTRODUCTION

Internet of Things (IoT) is an essential research domain nowadays. There are many applications for wireless sensor networks in military and civil applications [1]. IoT is an emerging concept of the network which allows any object in the real world is connected together at anytime and anywhere through the integration of object identification, interaction, and information sensing technologies [2, 3]. New intelligent products emerge in IoT era. The most outstanding technical characteristic of intelligent products is "integration" which includes integration between functions, function and network, function and service and so on. Google Glasses, Samsung Galaxy Gear and other latest wearable display equipment has been marketed since 2014. The release of Apple Watch shows that the wearable intelligent equipment has been improved further. Jewelry becomes the main future direction of wearable technology and it develops rapidly in 2015. Therefore, the development of smart jewelry, which is compound and multifunctional, is based on the fashionable exterior design in current market and integrates modern intelligent technology as well as cognizes the sensor-based situation, what's more, it adds the intelligent function and design by these measures, jewelry will become more fashionable and its value and brand will be advanced. Jewelry industry will welcome its innovation. Smart jewelry industry is a new type of market. The content of Chapter 2 illustrates the concept of smart jewelry and related theories. Chapter 3 is mainly about the main characters of smart jewelry, key technologies of development and the future market outlook. The last chapter comes to a conclusion and future research direction prediction.

2 CORRELATION RESEARCH

2.1 Concept of Smart Jewelry

The concept of smart jewelry first appeared in 2012. The concept is "The multifunctional (besides adornment) equipment which can communicate with wearer." The concept of smart jewelry is shown in FIG. 1.

The traditional jewelry industry can be divided into Fine Jewelry, Bridge Jewelry and Fashion Jewelry. Smart jewelry is a functionally new concept. It is based on current jewelry types and integrated with IT technology. The installment of colored LED, sensor and communication devices leads to many changes on jewelry and enables the close communication between jewelry and wearer. The intelligent reactions such as temperature and standby state

can also become possible. As shown in TABLE 1, smart jewelry can be defined as wearable equipment with strong fashion sense which applies to daily life and health, integrates IT and BT technology, and provides additional functions.
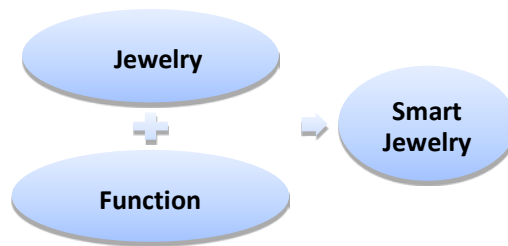

FIG.1 THE COMPOSITION OF SMART JEWELRY

TABLE 1 JEWELRY INDUSTRY TYPES

Jewelry Industry	
Fine Jewelry	Gold, diamond, ruby and other high-end jewelry made by real precious stone.
Bridge Jewelry	Gold (mainly including 12k, 10k, 14k and silver), agate, ivory and other jewelry with lower price. It is between fine jewelry and fashion jewelry.
Fashion Jewelry	Made by iron, copper and other cheap materials and only focus on fashion.
Smart Jewelry	Wearable equipment with strong fashion sense which applies to daily life and health, integrates IT and BT technology, and provides additional functions.

2.2 Sensor Technology and Wireless Communication Technology

To realize the multifunction of smart jewelry, the combination of sensor technology, wireless communication technology and the microprocessor is the key technology of smart jewelry's research and development. Sensor is a transducer whose purpose is to sense some characteristic of its environments. It detects events or changes in quantities and provides a corresponding output, generally as an electrical or optical signal [6]. Sensor can sense the physical, chemical or biological changes of light, temperature, humidity, pressure, sound, natural gas and so on. Therefore, the classification of sensor is various. It can be classified according to sense ability, function, signal transform, material, application and field. It can be seen in TABLE 2.

TABLE 2 CLASSIFICATION OF SENSOR

Pattern	Sensor Classification
Composition	Basic sensor, assembled sensor, applied sensor
Monitor signal	Analog sensor, digital sensor, fundamental frequency sensor, matrix 2 sensor
Sense Ability	Spatial quantity, mechanical quantity, the second law of quantity, electronics quantity, engineering quantity, chemistry quantity ,time, tactus and so on
Transform Pattern	Mechanics, thermodynamics, electronics, magnetic force, electron, optics, electrochemistry, catalysis chemistry, enzymology, microbiology and so on
Material	Semiconductor sensor, ceramics sensor, metal sensor, macromolecule sensor, enzyme sensor, microbiology sensor
Application	Calculation and measurement, perception, inspection, control
Feld	Industry, civil ,medical ,space detect, military

Typical wireless communication technology consists of Bluetooth, Zigbee, UWB, NFC and so on. These belong to Wireless Communication Technology which is available under the wireless condition. You can choose the needed one according to different function requires. Now both Bluetooth and NFC two kinds of wireless communication technology are the most widely used in the smart jewelry.

3 THE DEVELOPMENT OF SMART JEWELRY

3.1 The Characteristics of Smart Jewelry

The characteristics and significance of smart jewelry follows its basic concept. Fig. 2 shows the classification of its characteristics. Besides its original decorative function, the additional characteristic includes function, interaction, funology, participation and so on.
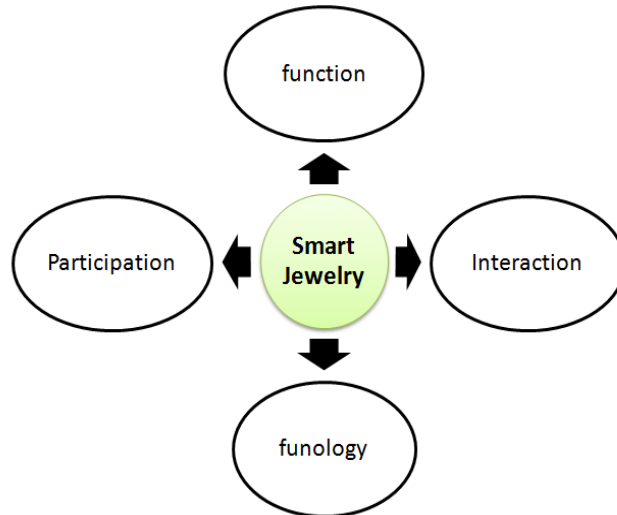

FIG.2 THE CHARACTERISTICS OF SMART JEWELRY

1) Function

Function of smart jewelry can be various. The sensor in smart jewelry can control the brightness of LED, then the temperature sensor will measure the temperature degree and make color adjustment depending on the temperature. Using color sensor can adjust the jewelry's background color so that the jewelry can match with the clothes you wear. Besides decorative function, all these are functions of smart jewelry.

2) Interaction

Design approach of smart jewelry is various. The current smart jewelry focuses on its wearer. Based on interactive design, it enables the interaction between wearer and the product, then the product can make relevant response.

3) Participation

The participation of smart jewelry wearer. Based on the wearer's experience and emotion, the response of product is designed. So it requires wearer to participate from design to usage.

4) Funology

The so called funology is a new trend which is the combination of technology and fun, that is function and fun [5].

3.2 The Classification Based on Constitution

On the basis of various functions and jewelry related IT technologies, the constitution of smart jewelry has three types, such as below.

1) Stand alone Smart Jewelry

The simplest smart jewelry emphasizes color change. It displays multiple colors through diversified combination of monochrome RGB.

2) Smart jewelry based on sensor

Through sensor's sense of surrounding light, temperature, wearer's clothes' color and dangerous situation, the jewelry can make relevant response and change its color or play other functions such as alarm clock.

3) Smart jewelry based on wireless communication

This is the most advanced stage of smart jewelry currently. It is previous to the stage that smart jewelry can communicate with each other. On the basis of wireless communication technology, the interaction occurs between jewelry and other electronic equipment, jewelry and jewelry.

3.3 The Key Technology for Smart Jewelry Development

From the classification mentioned above, we can see that smart jewelry has various and complex requirement for function and technology, the key technologies needed for the development of smart jewelry are as follows,

1) Mini-controller miniaturization technology

Wearer attaches great importance to the size and weight of the normally mentioned jewelry adornment appliance, smart jewelry is no exception. So only the subminiature design of internal mini-controller can satisfy the demand of small and light smart jewelry.

2) Battery technology

The internal LED, sensor port, communication function and mini-controller all need battery to maintain a long-term and stable duration and operation. So the capacity of battery should be large, the weight and size should also overcome the limits.

3) Sensor port technology

Various sensors can be used. It needs the most stable location for current efficiency and the most safe wire connection. So the technology for the sensor's port should be optimized as much as possible.

4) Waterproof and moistureproof technology

Due to the long-term exposition to outside environment, the protection design against water and moisture should be taken into consideration.

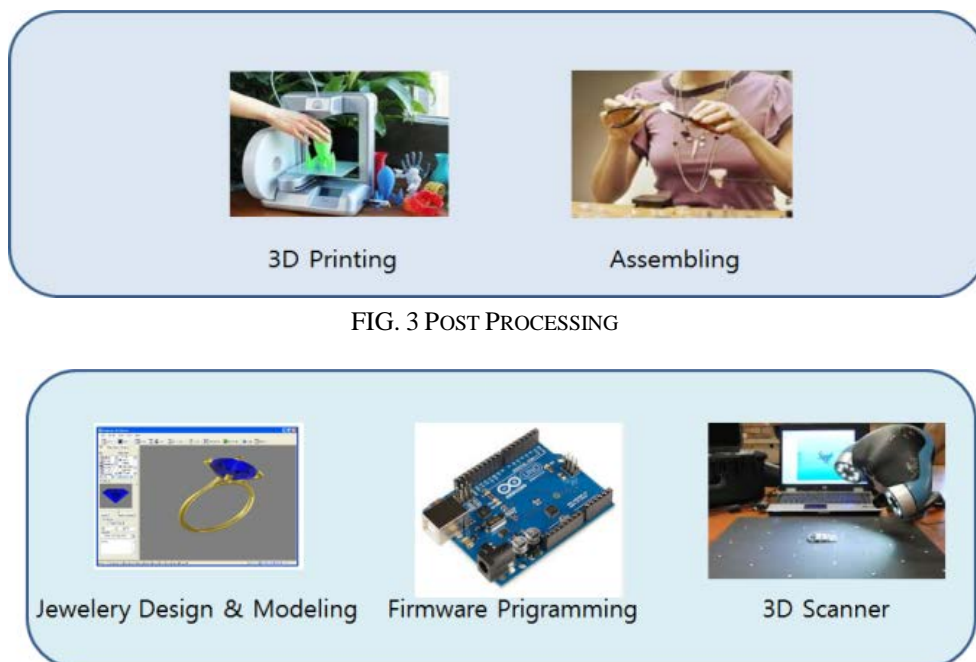### 3.4 Independent Smart Jewelry Production Technology

FIG. 3 POST PROCESSING

FIG. 4 MAIN PROCESSING

All the current materials or new materials can be replaced by brand new processing technology. In addition, the smart jewelry has various sensor ports, communication ports and etc. Diverse jewelry style can be developed in the

future. The 3D printer which aims at the solution of various materials' problem can help us with the design of diverse smart jewelry style. 3D printer has many skills. The skills are different in using available material to build part in different layers.

FIG. 5 SMART JEWELRY PRODUCTS

<http://www.gemfind.com/looking-smart-with-smart-jewelry/>

The picture above illustrates the independent processing technology for smart jewelry through formulation. The 3D scanner in the picture uses the existing 3D pattern to copy or transform the jewelry design. The micro-controller inside the jewelry, with the smart senor can dispose input and output information and can control the core parts of LED. Besides, to ensure accuracy of processing, we recommend SLA (Stereo Lithography) or SLS (Selective laser Sintering) in 3D printer because these two methods have much more accuracy than FDM (Fused Deposition Modelling).

3.5 The Future of Smart Jewelry

In the past few years, with the technologies' spreading, various industry fields' integration and the research help the smart jewelry's commercialized production. The future market position of smart jewelry is shown as follows:
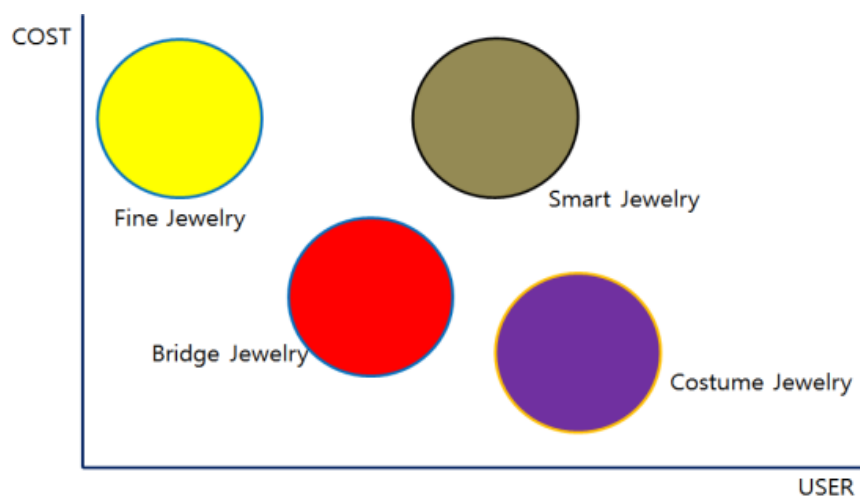

FIG. 6 THE FUTURE OF SMART JEWELRY MARKET POSITION

4 CONCLUSIONS

The theoretical research and development of smart jewelry is in the preliminary stage. This article made a systematic conclusion of smart jewelry's related theory and technology, and it made predicts about its development. In the IoT environment, smart jewelry's development aims at on the basis of sensor's situation cognition, through Bluetooth or

NFC as wireless communication technology, making it possible for the smart jewelry to communicate with telephones and other electronic devices. In the future, the development of sensor, wireless communication and other IT, BT technologies can make smart phone more intelligentized and popularized. Further functions are to be developed. In the view of market, numerous jewelry brands and electronic brands have promoted their smart jewelry products successively. Their products have caught consumers' extensive attention. Smart jewelry market is in the early research stage but it develops rapidly. It predicts that in 2016, the wearable smart market including the smart jewelry will raise an upsurge and sees a rapid development.

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