THE RESEARCH ON THE DESIGN OF OUTDOOR SPORTS MONITORING FUNCTION CYCLING JERSEYS

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ABSTRACT

I n recent years，Smart clothing has gradually become the focus of design research. This article is in view of the people's sport-related physical fitness reaction when riding. It puts forward the current common problems on the design of intelligent outdoor sports cycling jerseys. And it further discusses the design of cycling jerseys of real-time monitoring function in order to reflect the physiological characteristics of sports health and the psychological characteristics of human comfort. With that, the study will start from the perspective of fashion design to solve the key problems in the process of design. Designing clothing modeling structure is based on the core principle of fashion. Choosing the fabrics of cycling jerseys is based on the required principle of comfort. Realize monitoring function of outdoor sports cycling jerseys by sensing technology as the key. Design the Arduino as electronic prototype platform. Thereby, monitor micro climate changes of temperature and humidity under the clothing. Finally, this kind of outdoor sports monitoring function cycling jerseys is a combination of sensing devices and clothing. It not only has the function of monitoring but also has the aesthetic properties of clothing design. At the same time, it meets human body structure performance. It provides reference for the design of outdoor sports smart clothing.

Key words： *Intelligent Monitoring；Fashion Design；Temperature ；Humidity；Heart Rate*

Introduction

"The rapid fusion of fashion and technology will let stylists more dependent on the Cisco Systems, rather than Chanel."Forbes pointed out in the special edition of the development of future fashion. Science and technology and clothing in the most period of history have relatively independent development venation. Since the 20th century, due to the evolution of social productivity improvement and economic system, also their own developing logic，making close relations between two of them. Science and technology integrate in clothing gradually. In this day of globalization，the innovation of science and technology is leading a new revolution of fashion design in the future——Smart Clothing. Since the last century，people began to explore the future of clothing with a vision of the future and the yarn for future life. Smart clothing arose at the historic moment. The rapid development of high-tech and the Mobile Internet technology which is becoming mature prompted the combination of science and technology and clothing. People began to march to smart wear. They hope that the smart wear can change the future.

"Low carbon，Green health" is nothing new rhetoric. Practice the concept of environmental protection and go outdoors. Riding bike conforms the trend of the times. Cycling movement in many countries are developing like a raging fire. It is not only beneficial to people's physical and mental health，at the same time，is also an integrated reflection of fashion, low carbon environmental protection and fitness. The advent of smart wearable makes people pay more attention to their own health. "Healthy cycling, Science cycling"is the slogan that riding enthusiasts practice low-carbon environmental protection and healthy life. Thus，the combination of technology and fashion has far-reaching significance to the further research on the design of riding wear.

1   The development of outdoor sports in smart clothing
1.1 The research status at home and abroad

The original smart clothing is not wearable intelligent textiles in the modern sense. It was regarded as a kind of equipment or tools to use. The focus on the design of clothing was to realize the function of "smart". Entering the new century，clothing and accessories with intelligence，environmental protection, science, knowledge, creation, discovery, enjoyment and quick as application orientation，using new thinking mode and high-tech means and creating a new world of smart clothing.

The requirements of outdoor sport for clothing are relatively high. It is necessary to do security work and implement health monitoring. Nike, Adidas and other famous brands have been marching toward the wearable technology market. Adidas supernova Bra, Under Arm ourE39T T-shirt, Nike + sport shoes and other new sports products all that can track the data through the sensor and upload to the website or import personal mobile phones for data analysis. Up to this day, smart clothing is not only limited to "Intelligent clothes", more and more wearable device also joined the ranks of the intelligent clothing. For example，Qualcomm Toq, Samsung Galaxy Gear, Pebble and Apple's new Apple Watch all that have the function of monitor. The field for the application of the intelligent clothing opens up a new land.

The research development of smart clothing is late in our country. Compared with the developed countries，there is little independent innovation research in China. Most of all are about the intelligent technology research in the field of fashion design. The theoretical research in the field of intelligent garment design is not yet mature. It still stays in the initial stage of exploration. Smart clothing has not fully entered the real people's lives. But the research and design of intelligent clothing field represents a development direction of future clothing. Smart clothing will develop and lead the new trend in the future. The research on the theory and application of smart clothing in China needs to catch up with the international advanced level and build intelligent garment design system in conformity with the development trend.

1.2 Put forward and solving problems

Under the background of new era which driven by the high-tech industry development. Smart clothing has become a hot topic in the research field of clothing. The combination of technology and fashion has opened up new prospects for the trend of the world. The present progress of science and technology become a driving force for the further research and the development of smart clothing.

Compared with the design of traditional clothing，the design pattern of smart clothing is not mature. Smart clothing has been always on the basis of functional clothing and electronic clothing which involved in electricity, biology and material science. Its development is not only limited to specialized subject domain. It also has entered the fashion field. What's more，the cross of human factors and multidisciplinary so that it makes smart clothing gradually popular which is in line with the personalized lifestyle and fashion ideas.

It requires intelligent clothing design takes fashion as the core, function as the key, comfort as the requirement and interactivity as identification. It reflects art and science mutually promote with each other in the design. It will use the aesthetic creation of science and technology to rich original costume design concept. The integration of science and technology and fashion design gives us full consideration about fashion modeling, style, aesthetic feeling, structure, craft, materials, body effect, etc. On this basis, it gives the clothing more humanization and intelligent functions so that design smart clothing which do not break vogue. This makes the wearer experience the convenience of technology when they pursuit fashion. Also, they experience the science and technology when obtain the quality of garment.

2   The design of outdoor sports monitoring function cycling jerseys

It is only 200 years since the invention of bike. As a popular traffic tool，it not only has the characteristics of environmental protection, but also is an excellent exercise. With the development of cycling sports，the industry of cycling jerseys which is one of the most potential areas of smart clothing and fabric is in the momentum. It is to cater to the desire to keep health and fitness in the ecological environment. Furthermore，people always hope to pay attention to their own health when doing sports. Therefore，the integration of technology and clothing makes the design of cycling jerseys in the function more humanized，the fabric more low-carbon comfortable，costume structure more popular and the color more natural. With the optimal design of intelligent textiles can improve the riding comfort of clothing in order to bring riders more high-quality riding experience.

2.1 Technical design

Technology is a key element of design in the design of smart clothing. Technology determines the overall smart clothing. It directly affects functions, comfort and interactivities of intelligent clothing. It will also indirectly affect the appearance of clothing. Therefore, the promotion of technology is a double-edged sword. It should not only ensure the intelligent clothing wearable, but also try to hidden electronic devices in the intelligent clothing. This makes that the development of smart clothing will bring great opportunities and challenges to the technical design. Science and technology makes smart clothing overweight.

This research realizes the monitoring function of outdoor cycling jerseys through sensor technology. Choose Arduino as the development platform of electronic prototype. The development and application of various functions can be realized by using Arduino programming language and Arduino development environment. Arduino includes hardware and software. It has low price, supporting mass sensor, controller

and actuator and other equipment, as well as cross platform, rapid development and other important advantages. It is easy to use conveniently and flexibly. It can sense, feedback and affect the environment through a variety of sensors and is the best choice to realize the interaction with the human-clothing-environment.

Based on the characteristics of Arduino，Lilypad Arduino Simple（One of a series of Lilypad Arduino）is adopted in this research considering the performance of clothing. It is designed specifically for wearable electronics and fabric design. It can be sewn in the fabric with the electric sewing thread connecting each block of the PCB plate that corresponding function to achieve a variety of functions. After unplug the battery，you can use a mild detergent to wash in cold water. It can greatly meet the performance of wash and wear of smart clothing.

There are 11 pins in Lilypad Arduino Simple （As shown in Figure 1）——This LilyPad board has 11 pins — the silver petal-like tabs that ring the outside of the board. Each of these pins, with the exception of (+) and (-), can control an attached input or output device. This board is based on the ATmega328V microcontroller. This board has 9 digital IO pins（of which 5 provide PWM output）and add a JST connector. At the same time，it has built-in polymer battery charging circuit.（The specifications as shown in Figure 2，The circuit shown in Figure 3）
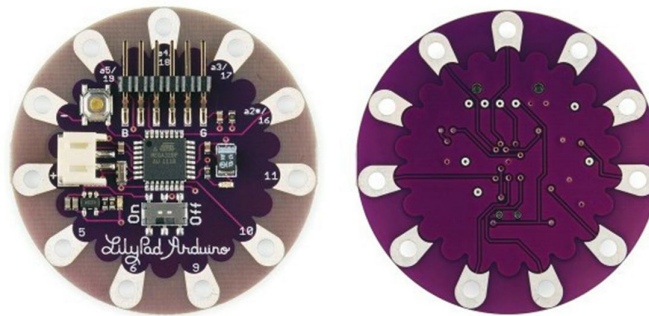

Figure 1 Lilypad Arduino Simple shape firmware structure

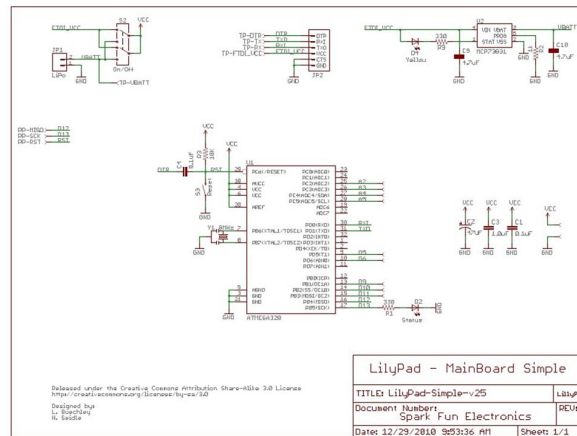| total pins	11
Digital I/O Pins	9
Analog Input Pins	4
PWM pins	5
voltage	DC5V power supply
Microcontroller	ATmega328
Operating Voltage	2.7V-5.5V
Input Voltage	2.7V-5.5V
DC Current per I/O Pin	40mA
Flash Memory	32KB（of which 2 KB used by bootloader）
SRAM	2KB
EEPROM	1KB
Clock Speed	8MHz

Figure 2 Lilypad Arduino Simple Specifications

Figure 3 Lilypad Arduino Simple Circuit diagram

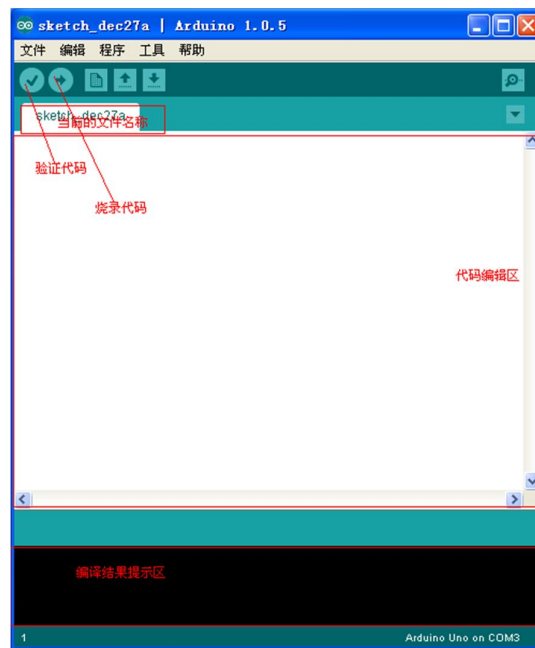Figure 4 Main interface of Arduino

On this basis，design and implement the real-time monitoring function of cycling clothing jerseys. The HR-Wristband is selected as the heart rate measurement module Wristband，which measuring the heart rate through the skin reflex. DHT11 digital temperature and humidity sensor is as integrated temperature and humidity measurement module. Through the computer software Arduino（As shown in Figure 4），the programming code of temperature and humidity monitored that can be uploaded to the Arduino main development board. The written code will be converted into the language that Lilypad Arduino Simple development board can understand to implement operation with development tool.

2.2 Fabric design

Cycling sport is different from other sports. It has many features, such as high energy consumption, high sweating and the lower limb exercise and activity range than the upper body. Thus, according to the characteristics of the cycling sports, for cycling jerseys, it should can adapt the body movement in order to stretch and make human body activity light under the condition of satisfy the premise of clothing aesthetic effect. Moreover, it should have other performances such as efficient mechanism of perspiration and moisture permeability, heat preservation, windproof performance , resistant to sunlight and washable performance. Considered from the visual, tactile sensation, temperature characteristics and other feeling aspects,   improve the riding apparel fabrics personality continuously and make the overall more advanced.

With the development of science and technology, all kinds of new high functional fiber fabric emerge as the times require. Functional sportswear fabric is as the first choice that well-deserved. It directly affects the effect the design of apparel. Functional fabric refers to some special properties and special purpose material which mainly through high-tech materials and finishing. The high-tech is the key raw material. Riding clothes should use high-tech wicking material which can rapidly absorb skin moisture and sweat and immediately discharge to the outer evaporation in order to keep the skin dry and comfortable. It has the function of regulating body temperature. The fabric is smooth, soft and elastic. Wear without binding with a high degree of movement comfort.

There are many kinds of fabrics commonly used for cycling jerseys. Different fabric has different functions.（As shown in Figure 5）

Fabric	Function
Activent	Windproof, breathable
Cool Max	Sweat releasing, fast drying
Lycra	Blended with other fiber to increase the elasticity
Fleeces	Keep warm, prevent small wind
GORE-TEX	PTFE, wind-proof and rain-proof
Wind Stopper	Windproof, keep warm, Permeability is general
Windbloe	Windproof
Outlast	attemperation

Figure 5 The analysis of fabrics and function of cycling jerseys

Since the application of this study is to monitor real-time cycling fitness characteristics, it needs sensors as far as possible to close to the body so that the measurement data is more accurate. Therefore, taken together , the fabric Cool Max blended Lycra is best choice. It wears breathable closing to skin. The elasticity is relatively good. In order to meet the riders' higher requirements and improve the safety and comfort when people are riding. It can be embed color material or flexible LED display. It can not only enhance the fashion of apparel, but also serve as a warning.

2.3 Clothing structure design

The study of the structure model is to explore the aesthetic expression of art and science and technology in the design of clothing. By their nature，smart clothing is the embodiment of beauty of technology， beauty of function and beauty of aesthetic in the structure design. It will take the uniqueness of smart clothing materials into account. It will specially design for the overall structure model and local design. It makes beauty as a starting point and the unity between the forms of the structure of smart clothing.

Analyze the size, range of motion, the action of each part of the psychological factors from the angle of human engineering in the design of cycling clothing which are as cycling clothing design points. Because of the fast speed in the process of riding, in order to reduce wind resistance, cycling jerseys used more personal style. To maintain the upper part of the human body forward and arms lean forward, the front piece length is relatively shorter than the bake bodice. The sleeves designed for forward cutting effect. In order to avoid riding up in clothing, hem and cuffs of the clothing should be designed with anti-skid strap. In order not to interfere with cycling motion, pockets generally are designed in the back.（As shown in Figure 6、7）

Figure 6 Effect drawing of cycling jerseys

Figure 7 Garment fashion drawing of cycling jerseys
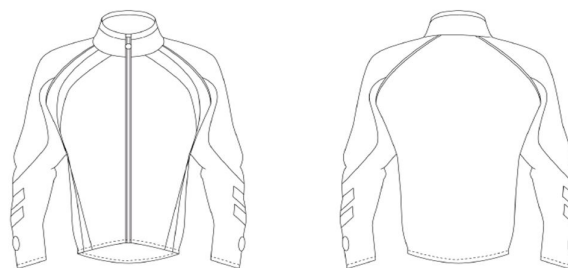
Based on the aesthetics, according to the rule of form beauty, the author thinks effectively solving the key problem of the line trajectory of electronic components in the intelligent garment design can target the distribution of different line in cycling jerseys. The heart rate module used in the technology application can be fixed in cuffs with rubber band or Velcro so that sensor closes to pulse to measure the change of heart rate. Lilypad Arduino Simple（As shown in 2.1）can be sewn in clothing with the electric sewing thread. Since the movement range of upper body in the process of riding is not by much and the back is almost not affected by the influence of cycling activities, the electronic components are sewn close to the cut-off line of jerseys on the back. It not only maintains the appearance of garment, but also ensures the electronic components are not influenced by movement.

2.4 Color design

Under such a system——people-smart clothing-environment，color is a factor to be reckoned with intelligent garment design. It has dual characters. It not only embodies the matching relationship between clothing and human plays a specific role in the technical function, but also plays a role in visual perception in the aesthetic creation design.

Color can interpret emotion connotation. Riders use color to show personality and fashion when riding. Meanwhile，they use color to express the subjective understanding and feelings of beauty which reflects the riders' pursuit of the beauty. Conversely，color can affect people's psychological and emotional and physiological function（As shown in Figure 8）. It can cause people's spiritual and behavior and a series of psychological reactions，endocrine dysfunction and even the activity of the central nervous system.

Hue	Physiology	Psychology
Red	Heart rate is up, elevation of blood pressure，irritability and atigue	Intense，joy, vitality，warmth, excitement, expansion
Orange	Induce appetite, accelerate blood circulation，help restore health and calcium absorption	Lively，exciting, warm，bright, mature，happy
Yellow	Stimulate the nervous and digestive systems, strengthen logical thinking，arouse people's attention	Happy，cheerful, bright，strong, happy，exciting
Green	Good for digestion and balance，calm and relax	Cool，comfortable ，comfortable, balance，vitality
Blue	Reduce pulse，regulate body balance，eliminate tension	Cold，cool，stable ，profound，vast grief and negative feelings
Purple	Mediate muscle, hemostasis，affect the seeing and hearing and smell，the heartbeat is not smooth	Luxurious, mysterious，solemn ，noble, melancholy pain and unease
Black	Depressed，nervous	Horror，depression ，grief，death, perseverance，a sense of decency
White	Steady	Quiet，clean, simple，pure，lofty ，advance and sense of expansion
Grey	Bored	Dull，passive, lifeless，stagnant sense

Figure 8 The influence of color factors on physiological and psychological mood

Except pursuing the requirements of beauty, people need color for function in the design of cycling jerseys. People express the rational content with specific color. Color can be used as interactive identification to express and transfer information. It plays a warning role in order to avoid the collision and target as fast as possible.

Consequently, the bright and eye-catching color will be used for cycling jerseys in this study so that it is more visually attractive. Yellow or orange is main color. Green or blue is as blendent. This color has a strong sense of rhythm and jumping which can enhance the psychological effect of rhythm. Riders can use color to adjust psychological mood when cycling, improve the confidence and determination and enhance the enthusiasm of the movement. And the color of tall lightness has the high degree of recognition. Once an accident taken in the process of movement, it allows peers or rescue personnel to discover quickly. The reasonable use of color can avoid unnecessary danger occurred.

3 Conclusion

Smart clothing is the crystallization of the rising of science and technology. Intelligent garment design is a multidisciplinary subject which involves the main technology of electronic information technology, computer technology，textile technology and 3D printing technology. Because of the limiting of miniaturization and flexibility of electronic components，the covert and wireless of connection technology and the diversification of energy storage，it brings us some troubles and hard problems in design. At present，there is no mature mode of intelligent garment design. In this paper, a typical case study is as the means for outdoor sports monitoring function cycling jerseys through the wireless sensor technology and Arduino to experience the health test preliminary monitoring when people are riding. This indicates that the threshold of the research and development of smart clothing is not high. Meanwhile，it provides the reference to the design of outdoor sports smart clothing.

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