

# The Study of Design of Children's Anti-lost Clothing Based upon Ergonomics

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**Abstract.** Children belong to the distinctive group of population who has not yet obtained the complete perceptive ability, or full-fledged adaptability with the lack of self-protection. In recent years, due to the accelerated pace of life, parents' negligence in care for their children triggered a host of family tragedies, therefore provoking increasing emphasis upon the issue of children trafficking and missing children cases on the social media. This paper is to incorporate the latest intelligent tracking technology into the design of preventing lost clothing in accordance with different stages of developmental environment for children in order to reduce the likelihood of loss of a child. As the degree of integration between the technology and art design is on the rise, our attires as the necessities of our daily life are not simply a tool for keeping warm but also serve as a symbol of fashion and style. In the foreseeable future, it is inevitable to integrate ergonomics into the making of clothing with other elements of comfort and humanity.

**Keywords:** Children · Anti-lost · Design · Communication technology

## 1 Introduction

### 1.1 Purpose and Significance

This paper is to combine the human engineering and fashion design to apply in children's anti-lost clothing, in order to explore the needs of parents for children. Through the phased survey, I will statistics data and sum up the anti-lost clothing elements' which be suitable for children with different growth stage, in order to reduce or even eliminate the phenomenon of human-trafficking of children ensure the health of children's lives, and reduce the occurrence of family tragedies.

Children lost are the focus of social news in recent years. Distressed at the same time, we are supposed to focus on the source of the incident occurred to avoid the hidden dangers of children from the fundamental. Safety education for parents and the school is not enough to reduce the rate of lost, meanwhile busy living environment causes parents the negligence of care and feel powerless. Therefore, under such a passive environment, it has important significance to improve the healthy growth of children and the quality of social security by seeking a means of intelligent monitoring and master the children's position.

## 1.2 Research Status

The purpose of this paper is to embed the positioning electronic components into clothing, and through the way of information feedback to remind, inform the parents of children's situation. At present, both domestic and foreign research on smart wear intensified, however, failure to conceal and lack of stealth characterize those corresponding devices, thereby enabling the traffickers to remove them easily when children encounter human trafficking. On the one hand, older adolescents may not favor the shape of the watch: the reluctance to wear it also poses a barrier. With regards to younger children, it is likely to lead to the accidental swallowing of the tiny objects. On the other hand, as to the majority of watches and bracelets with plastic straps and belts, allegedly there is seldom a pleasure for children to wear. But this can be solved via the solution that the device be embedded into clothing to enhance users' experience.

## 2 Survey Results of Children's Actual Situation

### 2.1 Children's Physical Characteristics Overview in Stages

Clothing, as a production of life necessities, its design must follow the "people-oriented" protocol, in the experimental study, we must consider both the objective existence of the data, and to understand the needs of their parents. In this study we randomly collect a questionnaire survey of one hundred cases of 23 to 40 years old children's parents. As the child's development dynamic speed change quickly, we made a segmented survey for parents to adapt to the children in different growth period to make the anti-lost clothes. According to different physiological and psychological characteristics, the fundamental research object can be divided into infancy, early childhood, preschool age, and school age.

**First, Infancy (0 to 1 Year Old).** Baby's early period basic static is sleep stage; this is the most significant children's physical growth and development period. During this period, the baby's functions are also gradually developed, from the 10th to 12th month they learn to walk, or walking upright.

**Second, Early Childhood (1–3 Years Old).** Child's weight and height are developing rapidly in this period. The shape characteristic is a big head, a short neck, a tall, straight body, and an abdominal convex. Children start learning to walk, speak, and have certain ability to imitate, doing simple things and get extreme attention to bold color and activity.

**Third, Preschool Age (4 to 6 Years Old).** The children's physique characteristic of this stage is quite narrow waist, protruding abdomen, shoulders, short limbs, bosom, waist; hip three surrounded degree of the size is not big. Their body grows faster, and surrounded degree increase slowly. The mental and physical development of children in this stage is very speedy. They can easily run and jump, and have certain ability of express languages.

**Fourth, School Age (6 to 12 Years Old).** This is a significant period of motor function and intellectual development. Children gradually moved away from childish

feeling, have the certain imagination and judgment, but has not yet formed independent point of view. Life range from family, kindergarten to the school of and collective. Physical differences in boys and girls become increasingly obvious, there appear to be a circumference difference on the girls' busts and chests, their waists become slimmer than their butts.

## 2.2 Survey Results of Fabrics, Colors, and Styles of Anti-lost Clothing

In addition to distinguish the various stages of children's body characteristic, the investigation content also includes classifications of fabrics, color, and style for parents' aspects. Considering the elements may affect the children's stretching, we also should give full consideration to the placement of positioning components, method of use requirements, and give full solutions to the application.

Through the questionnaire survey, we concluded that the parents' requirements of fabric tend to be: elasticity, comfortable, soft, and without toxic characteristics; of the color tend to: bright, conspicuous, conducive to the development of children's intelligence and creativity; of style, consider more on loose, introduction, and leisure style.

Therefore we concluded that, under the comprehensive consideration for children's delicate skin, and because they are sensitive to external stimulation, prone to infections and skin rash. And thus anti-lost clothes should choose elastic fabric; use its soft and wet absorption, air exchanging, natural cellulose and good warmth retention property. So while using the fabrics, we should give priority to the knitting fabric. Using a soft, elastic and unique knitting fabric with good characteristic wrinkle resistance and resilience. On the one hand, to dress in the process of technology application design, combine the positioning device integrated with the fabric performance; On the other hand, to ensure the rationality of fabrics and clothing garment structure during the design process.

In addition, the bright color can be visible enough to help us quickly find the child in the crowd, but in order to prevent the fabric fade from causing damage to the skin, Plain and elegant color should be chosen in deciding the clothing color, such as light pink, light blue, yellow, etc.

As one of the three elements in design style, style is quite significant in designing clothes, especially in children's clothing design. Not only should we stick on the basic principle of design, but also must do the fundamental basis for the design of children's body and its activities. Thus, in the style design, we must master the clothes' restricting factors for children's activities. At the same time, we should pay close attention to the functional requirements of the clothes in the market and the popular trend of product design, ensure it is attractive both on the function and design development.

Considering the difference of peoples' understanding and requirements on the positioning of functional clothing, the questionnaire provides several different styles of clothing including basic style, casual style sports style and adult style to summarize the parents' preferences. The results show that the casual and sports style popularity rages highest in the survey while the adult style selected proportion is almost zero, basic design is under investigation for identity is much lower than the casual and sports. As shown in Fig. 2, 50 % of respondents chose the casual style, 37 % of respondents

chose the sport style. Figure 1 shows that respondent parents under aged 35, while being active, have a higher level of education, and concern more about the fashion and leisure issues, are affected by the style of leisure and sports deeper. And as the age increasing, the respondents over the age of 35 has lower pursuit for fashion and sports, prefer mature, stable, comfortable and healthy style.

Therefore, we determine the anti-lost clothes to choose light knitted apparel leisure as the basic style.

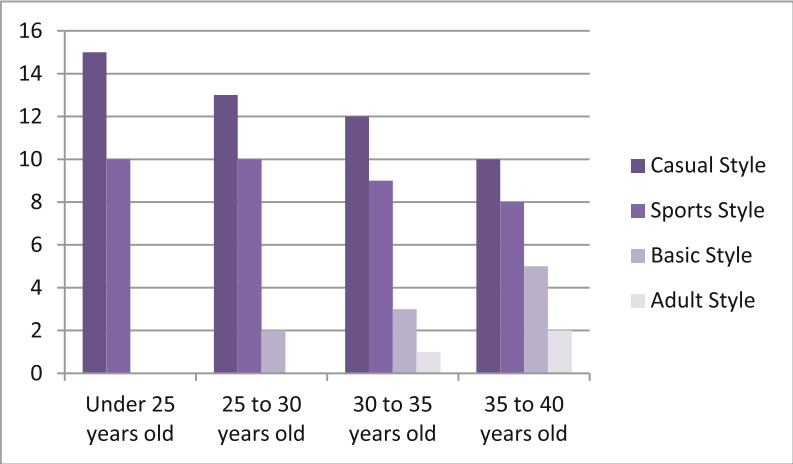


Fig. 1. Parents of different ages on the choice of style

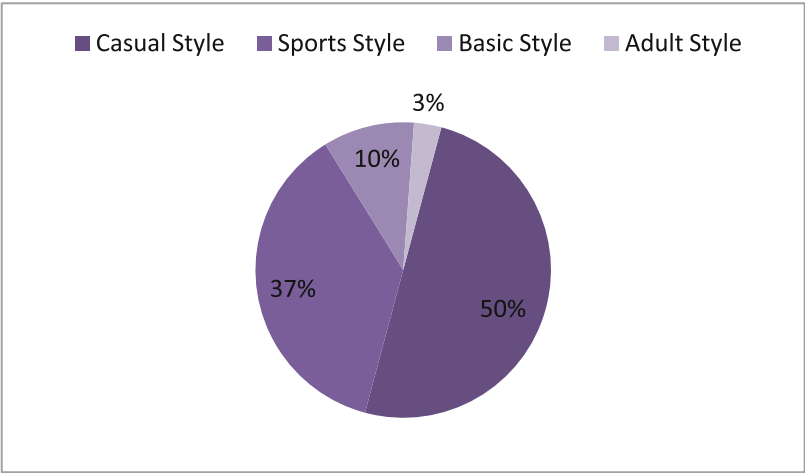
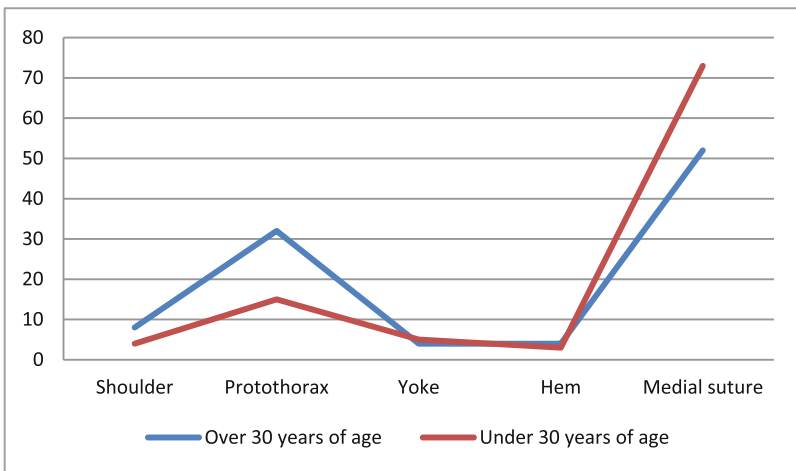


Fig. 2. Style choice of 100 children's parents

### 2.3 The Placement of Tracking Devices

The location design of components is the key point in the whole design of the garment. On the one hand, analysis from the perspective of the visual appearance, due to the limit of the element size and the requirements of physical performance factors in the position of design, size should not be too prominent to avoid combining effects and clothing aesthetics; On the other hand, from the angle of safety comfort analysis, the difference between properties of positioning component and textile fabrics is mainly manifested in the pliability, in design of position, I will fully consider the performance of comfort and safety on clothing, in order to avoid placing on the joint activities of the human body. In view of this, according to the requirements of the overall design, I determine the several different positions, namely Shoulder, Protothorax, Yoke, Hem, Medial suture, and investigate in the market, summarize their acceptance level.

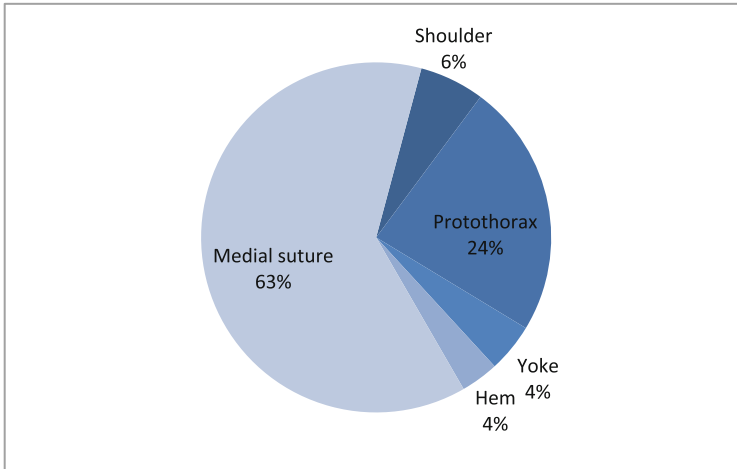
The survey set double options. The research object is divided into two parts as a whole, a part of over the 30 years of age, a part of the under 30 year old. Parents who over 30 years of age have more abundant experience and understanding of children's activities which will give me a greater reference value.



**Fig. 3.** Comparison of parents' choice of placement of components (Color figure online)

By the results of the survey analysis shows (As shown in Figs. 3 and 4), set the element in the protothorax and the medial suture are gain the more recognition. The degree of their preference is 24 % and 63 %. Figure 3 shows that the identity of shoulder position and yoke position is far lower than the protothorax position and the medial suture position, caused by the position of the joint active point, that is, the shoulder end and the back shoulder blade. Under normal circumstances, the greater human joints force, the higher the frequency of the positioning element and the more the human skin friction, to those will bring inconvenience to children's activities and make wearing uncomfortably. At the same time, due to the positioning element friction with the human body for a long time, the combination strength of the component and

the fabric is reduced, and it's easy to cause the location of components defected from clothing, which will destroy use function. From the results of the survey analysis, the element in the position of hem of whole location design choice is insignificant, it means that parents mainly taking into account the appearance of the clothing and the influence factor of human activities. Overall, we should choose the medial suture position to meet the requirements of safety and comfortability.



**Fig. 4.** Total percentage of parent to component position

### 3 Component Condition Analysis of Embedded Elements

#### 3.1 Division of Children's Activity Area

The children's activity areas are divided into safe area, activity area, and detachment area. The safe area is the area in which the child is in the safe state of being accompanied; Activity area is the area for children to walk alone in a small range and play with peers; The detachment area is more than the area of the activity region. Through the communication status of the wireless network node and the information center is in the anti lost module, in order to judge the physical position and the movement tendency of the anti-lost element. When the element is fed back to the center that is about to enter the detachment zone, it will alarm timely, so as to realize the location of the wearer and monitoring, take the initiative to prevent the lost.

#### 3.2 Sound Sensor

This type of sensor is mainly aimed at children in infancy, children in this period have not been developed fully with language ability and Mobility, and crying is one of the main signals of danger. Studies have shown that babies in different time ranges have different crying frequency, such as when the baby is sleepy crying frequency is

approximately 6 kHz, and when the baby is hungry, crying frequency generally reach 15 kHz. After careful research and analysis, the frequency of a baby's cry almost 4 ~ 17 kHz. So according to the different frequency sound, we can use the sound sensor to detect infant safety information which will be processed to send to the network to the guardian alarm. After these, positioning technology to track the location information of the baby can help Guardian find the baby successfully. So distinguish the baby's cry frequency range will appear in two cases: (1) The guardian can manually eliminate the wrong crying alarm information when the baby is around him; (2) The crying information collected by the guardian when the baby goes beyond his supervision range, is determined as the alarm information.

### 3.3 Types and Differences of Communication Technology

In terms of the communications technology, research has been underway to classify and categorize several widely employed technologies for tracking. According to its principle, I will analyze its pros and cons features in the respects of security, interference, involving distance range, relevant methodology and cost as well as the feasibility of embedment into clothing. While considering the problem of the clothing washing, equipment maintenance, and the condition of being fully enclosed or semi-enclosed, we will compare relevant data to select from these types of communications and electronic equipment applicable to each of the four stages of children (Fig. 5).

Bluetooth technology advantage: it is effective in the 2.4 GHz band which is a band that serves industry, technology, medical radio band without application license. Bluetooth technology has a wide range of applications, low power consumption, small size and low cost chip solutions that can be applied to very small devices.

Wireless Fidelity's outstanding advantages to be as follows: First, based on the Bluetooth technology of radio coverage is very small radius of about only about 50 feet, while the Wireless Fidelity coverage radius of up to 300 feet or so. Second, although its data security performance is worse than Bluetooth and transmission quality also needs to be improved, it's really speedy for data transfers.

The main purpose of Infrared communication technology is to replace the cables connecting the wireless data transmission. Its interface can save the cost of download or other information exchanges; Due to the need to transfer information docking, it has strong security. Relatively, its communication distance is short and in the process of communication cannot be moved. Moreover it will be interrupted in case of obstacles.

The advantages of ZigBee could be summarized as: By greatly protocol (less than 1/10 of the Bluetooth), the demand for communication controller can be reduced. ZigBee works in the low rate with 250 KBPS (2.4 GHz), 40 KBPS (915 MHz) and 20 KBPS (868 MHz) of raw data throughput, to meet the demand of low speed data transmission applications. ZigBee has a faster response speed. Only need 15 ms, it can be transferred from sleep to the working state, similarly, Just 30 ms, the node connection can enter the network. It can be argued that the above features are beneficial to further save the electricity.

Category / Condition	Bluetooth	Wireless Fidelity	Infrared	Zigbee
Transmission Speed	1.1Mb/s~2.1Mb/s(Even higher )	Can reach 54mbps.	4Mbps	10 ~ 250kb/ s
Transmission Distance	Generally within 10 meters.	Range of hundreds of feet.	Communication distance is short.	Transmission distance of 10 to 75 meters, after the expansion of up to a few hundred meters, or even thousands of meters
Standby Time	Several weeks	Hours	Longer than others	In a low power standby mode, two section No. 5 battery can support 1 node for 6 ~ 24 months or even longer.
Security	Can encrypt	Exist security risks	It has strong security.	Provides a three level security model.

**Fig. 5.** Comparison of the performance of Bluetooth, Wireless Fidelity, Infrared and ZigBee

ZigBee and Bluetooth are both used in the 2.4 GHz band, which relatively has weak ability through the wall. The difference is that ZigBee uses DSSS spread spectrum, while Bluetooth using FHSS spread spectrum. It depends on product positioning in the market to use DSSS or FHSS, because they can solve the transmission capacity and characteristics of the wireless local area network, which including the anti-interference ability, using distance range, broad frequency the size of the small and transmit data. DSSS technology is suitable for fixed environment or application of higher transmission quality requirements, therefore, wireless plant, wireless hospital and online communities, mostly using DSSS wireless technology products. While FHSS is mostly used in fast moving endpoint, such as mobile phone, the wireless transmission technology of using FHSS spread-spectrum technology.



## 4 Conclusion

Since to master and realize intelligent technology has a time limited, and my interdisciplinary knowledge structure system is not complete, especially the subject of positioning technology is not comprehensive, resulting in many problems and deficiencies in the research. Mainly embodied in the subject of the relevant professional knowledge structure, and the undetailed test, it is necessary to further improve and perfect the analysis. But I hope that through the investigation of parents and children's needs, as well as the communication technology of the data collection and comparison, we can find a suitable way for children to anti-lost. Also hope that I can do my own part of the strength to combine the clothing design and human engineering to solve the social problem of children lost.

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