Comparative Research on The Application of Positioning Technology to Intelligent Clothing for Preventing Children from Getting Lost

Wang Shi, Wang Qian and Zhang Ning
Dalian Polytechnic University
wangshi@dlpu.edu.cn

Abstract: In view of the increasingly severe problem of lost children, application of emerging technologies to solve the problem has become a major concern in the society in the era of intelligence. In this paper, the application and development of the positioning technology system are analyzed by means of comparative research, so as to give reference to the application and development of positioning technology in future Intelligent clothing for preventing children from getting lost.

1. Research Background
According to incomplete statistics, about 200,000 children get lost in China every year, but only 0.1% of them are recovered, so this problem has to be settled urgently. However, the existing countermeasures such as AMBER Alert merely send information and rely on searching for lost children manually, which can barely be successful; alternatively, applying UVA to searching and achieving facial recognition with camera is too expensive to be adopted on a large scale. By discussing on the application of positioning technology to Intelligent clothing for preventing children from getting lost, this paper attempts to explore a low-cost and high-efficiency method of recovering lost children and help prevent children from getting lost to some extents.

2. Application of Positioning Technology in Intelligent Clothing
GPS and WiFi positioning systems, based on the positioning program of smart phone, can perform outdoor remote monitoring with one server and two mobile devices. For major clothing brands, the currently common way to adopt positioning function to clothing is to interface with the positioning device while connect with third-party devices and making the target clothing functional and intelligent. Taking sports vest as an example, the body’s moisture and heat are adjustable and various physiological health indicators are under surveillance; moreover, its built-in Bluetooth module can be connected with a variety of third-party GPS accessories to perform simple positioning functions. Alternatively, GPS devices are directly placed in the target clothing. The essential is designing external related devices based on clothing modeling, namely, placing the small positioning element in invisible pockets to meet requirements.

The device of Zigbee technology has advantages such as small size, low consumption of power and use in complex environments. However, it can only monitor the subject in a fixed range. Such positioning system is mainly suitable for younger children and children with difficulties in mobility to prevent them from leaving safe areas such as the community, school, etc.; in remote areas without monitoring node, the monitored person will lose his/her track, making the anti-lost device system
3. System Design and Technological Realization

Thanks to the development of social technology and economy, as well as the mobility and convenience of mobile Internet devices, the technology for real-time acquisition of location information and various information about the surrounding environment has become rather matured. Location information services mainly target at locating lost elderly and children, gaining information of personal locations, managing various logistics information, navigation, emergency rescue, intelligent public transportation, intelligent travel, and check-in and attendance. Therefore, applying positioning technology in intelligent clothing is not a rare anti-lost method.

3.1 GPS-based Information Acquisition

At present, smart phones are uniformly equipped with GPS receivers, making it quite convenient to get access to common global positioning information resources based on positioning systems in a real-time manner. The GPS data acquisition module can be installed in the same or multiple wireless communication terminals of one computer. The location information collected by GPS data module is analyzed by a calculator to extract useful information as required, and displayed to the user. The GPS-based information acquisition process is shown in Figure 1.

3.2 WiFi-based Information Acquisition

WiFi is able to locate users. Location-based service is built into various smart phone operating systems in the market, such as Android. When the WiFi service on smart phone is turned on, personal location information and related system information will be uploaded to the server, in which the database of hot spot location is a principal source for smart phone positioning, by scanning nearby hot spots. Based on the information related to the connection of smart phone to the current hot spot and “nearby” information available in the database of hot spot location, the server analyzes and calculates the current location information of the smart device according to the strength of signals of the hot spot and nearby hot spots.

The MAC location of mobile phone can be obtained through tools like Java, etc.. The positioned location is transmitted to the server, and the movement track can be simulated by means of the conversion of MAC address, presenting a clear track of MAC address to the user to trace the object’s movement. This system mainly works with Java language and Android system. Java is the general programming language of Android. TCP and ICMP protocols are involved in the software development, as the system is based on WiFi and GPS. The WiFi-based positioning process is shown in Figure 2.
3.3 Zigbee-based Information Acquisition

Zigbee technology, an emerging short-distance wireless network technology with low power consumption, low data rate, low cost and high reliability, can be used to create a great and effective wireless data transmission network platform. In the context where Zigbee technology is getting increasingly mature and the research on key technologies of wireless sensor networks at home and abroad keeps deepening, some companies are proactive in developing wireless device systems suitable for different environmental conditions. Therefore, it is totally feasible to develop a wireless device specially for preventing lost by actively learning from current theoretical research and actual product solutions.

In joint efforts with Zigbee technology, a wireless sensor network is created to monitor the relative position of children in small areas such as communities and schools, so as to determine the range of their motion. There are three monitored areas: Area A-safety area, Area B-activity area, and Area C-departure area. The alarm will prompt immediately upon their departure from the monitored areas. The physical location and movement trend of the anti-lost module are judged from the communication status of the wireless network node and the central node in each anti-lost module. When the module node is about to enter the departure zone, the alarm will prompt immediately so as to monitor the wearer’s position effectively and prevent him/her from getting lost proactively; at the same time, the infrared sensor is activated to confirm that the module is normally worn to prevent the tracking device from becoming invalid and failing to locate the moving person accurately as a result of the separation of the module from the wearer. The device control process is shown in Figure 3.

![Control Flow Chart of the Device](image)

**Fig.3. Control Flow Chart of the Device**

4. Conclusion

With positioning programs on smartphone serving as the principal channel, GPS and WiFi positioning systems, combined with GPS and WiFi outdoor monitoring, can locate the monitored person precisely. However, there are a lot of shortcomings and defects in the current positioning approach, such as inaccuracy of positioning. At present, the most widely used GPS positioning approach is to obtain the user’s location information by activating GPS, but there are deviations in the location information. The positioning service range of navigation APPs such as Baidu Map and Amap is generally outdoors.
Their positioning is not accurate enough owing to the characteristics of the transmission medium.

Zigbee technology, an emerging short-distance wireless network technology with low power consumption, low data rate, low cost and low complexity, can be used to create a great and effective wireless data transmission network platform featured by low power consumption and low cost in combination with wireless sensor network technology. More importantly, geographic positioning is achievable for Zigbee technology, so the location of the target node is accessible to monitor the moving object dynamically. However, the system needs further development in terms of both software and hardware to improve positioning accuracy, information security, and system stability and practicability. The first two technologies are efficient way to prevent children from getting lost, and the last one is inexpensive to do so. It is admitted that these three technologies all have room for improvement and can be selected according to their characteristics.

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