

# Development Children 4.0 concept for information security of school-age children based on wearable technology

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## ABSTRACT

Modern children are growing up with the influence of technology, and their use of wearable devices shows a noticeable increase in their technological skills and a rapidly evolving digital landscape. One of the advantages of sensor technologies is that these smart objects have the ability to transmit information in time, provide availability and communicate in real time. Portable devices enable parents to get real-time information about school-age children's behavior, education, location and physical activities, and in short, to track and monitor their children's behavior. However, as the volume of data obtained through sensors increases, it becomes difficult for parents to analyze this data and requires protection mechanisms using intelligent technologies. Since the information collected in the database through portable devices is sensitive and informative, individuals or companies are interested in using this information for various purposes. The Children 4.0 concept proposed in this study is a comprehensive approach to ensuring the security of information collected in databases (medical information, location information, etc.) through a portable item (bracelet). This approach is offered to ensure the information security of school-age children based on mobile technology while protecting children's personal information.

## 1. Introduction

Industry 4.0 emerged as a phenomenon when technologies, new ideas, concepts, and visions develop. Industry 4.0 is a strategy adopted by the German government in 2011 as part of the "High-Tech Strategic Action Plan 2020" (Yang et al., 2021). Industry 4.0 is characterized by advanced digitalization, and has led to the innovations that connect the physical and virtual worlds together with the integration of industrial production and logistics processes, and the use of the Internet and smart objects (Alcácer et al., 2019; Weyer et al., 2015; Salkin et al., 2018).

In modern environment, stationary and non-stationary objects are equipped with various sensors, software and communication to connect and communicate with the network. Networking in society is not limited to computers, but is created

through various objects and accessories (gadget, wristwatch, bracelet, sensor inserted under the skin, etc.) (Alekperova et al., 2020). As there are no restrictions on the use of these devices, people of all age groups can use them. Equipped with a portable sensor, these devices facilitate access to children by providing convenience, speed or accuracy in acquiring and transmitting information, but pose certain problems for their safety. Some of these problems are described below:

Potential intrusion to the child's privacy. Portable devices collect information about the child, including location data, and transfer it to various databases. The security of those databases and whether or not they have permission to access them are doubtful.

Problem of reliability and accuracy of tracking technology. In some cases, technical failures in mobile devices and inaccuracies in location data lead to potential security risks.

Problem of lack of rules and guidelines. The lack of clear rules and guidelines for the use of portable devices for children raises important concerns about their safety and rights. In order to protect children from potential risks and not to violate their rights, attention should be paid to ethical points in the use of portable devices.

Portable devices have various advantages for children, such as being able to communicate with their parents or other responsible persons in an emergency situation. Global Positioning System (GPS) tracking, "Save Our Souls" (SOS) buttons, and two-way communication provide parents with information about their child's real behavior and allow children to feel more independent. A "smart" school bus equipped with a sensor enables parents and school managers to monitor the movement of the bus (Sojol et al., 2019). The "smart" bag helps students and their parents to manage their school bag according to the school curriculum and to place textbooks and appropriate supplies in the bag. It facilitates the management of the school schedule for children and provides instant notifications to parents through a dedicated mobile application, the design and functionality of a smart school bag (Ajayakumar et al., 2019). In another approach, in the smart school bag, when the student feels a certain danger and mistrust, this mode is activated by pressing the "Panic Button" connected to the school bag and sends GPS coordination data to the student's parent, thus carrying the function of a more useful item in terms of student safety (Anand et al., 2016).

As the use of these technologies increases, it actualizes the importance of creating security measures that eliminate potential risks and promote their safe use. The Children's Online Privacy Protection Act (COPPA), passed by the US government in 1998, provides important protections for many digital marketing and data collection practices and restricts the collection of personal information of individuals or organizations under the age of 13 under United States law. (COPPA – Children's Online Privacy Protection Act, 1998). However, this law was amended in 2013 to respond to emerging problems and practices. The revised law introduces stricter restrictions on the use and storage of such data by presenting new requirements for parental consent before collecting children's personal data. The updates aim to improve children's online privacy and safety in response to evolving technologies and practices. This includes children's behavior and other restrictions.

As the volume of data collected through digital objects increases, it becomes necessary to use big

data technologies to process and store this data. Difficulties arise in making decisions based on data from various systems, hence there is a need for intelligent systems to analyze and derive knowledge from big data.

It is important and urgent to ensure the information security of school-age children by using portable technologies and to protect their privacy, safety and well-being. This includes complying with legal standards, preventing cyber threats and creating a safe environment for using technology. As wearable technology becomes more and more integrated into everyday life, prioritizing the safety of these devices for children remains a critical challenge.

The proposed Children 4.0 concept envisages ensuring the security of data collected in databases through portable devices. This article explores the technologies used to ensure children's safety in terms of Industry 4.0. The issues of ensuring the security of children's information environment, as well as their personal data, are considered, and the architectural model of the proposed concept of ensuring the information security of school-age children is developed based on the information transmitted through a portable object (bracelet).

## 2. Related works

Devices equipped with sensors monitor and control their users' physical activities and health indicators. They also collect personal data. Applications of sensors include healthcare management systems (Rohmah et al., 2021), transportation (Guerrero-Ibáñez et al., 2018), sports (Hsu et al., 2018), rehabilitation (Fan et al., 2014), remote control (Gupta et al., 2017) and others.

Using sensor-equipped devices makes life and activities easier for people with health-related problems. They assist people with movement or communication problems (such as speech, gesture, and communication recognition devices) to communicate and move so that a person with physical limitations can live a safe lifestyle without the support of others. Regardless of whether such patients are in a hospital, clinic or at home, it is possible to monitor them, observe their physiological parameters, and their health status through remote monitoring systems. Sensor technologies enable more effective analysis of wholesale and retail systems and more effective implementation of sales and service strategies (Hosseini-Motlagh et al., 2022). It is also applied to ensure public and personal safety of police, firemen and military personnel. A more

distinctive feature is the creation of new, effective functions in the entertainment market. Sensors are used for observation, listening, control, situation monitoring, etc. These technologies can share information using the SMS video and audio platform as a communication medium.

The use of sensors is essential to keep children safe, especially to monitor their behavior, attendance and activities at school and elsewhere. Various management systems and methods use sensor technologies to monitor, record, evaluate and transmit information about children's activities to information systems. All of these play an important role in increasing the safety of children by sending real-time information and alerts to parents, teachers and other child-related persons. Ensuring the safety of children at a large public event is a concern for both parents and organizers. The study (Madhuri et al., 2020) proposes the architecture of a digital smart child safety monitoring system designed to enhance children's safety using IoT technology. Here, the geographic location of the child is determined using cloud, mobile and GPS technology.

Parents are always worried about their children, sometimes they are not always able to control their children's school life or the classroom is not fully managed by the teachers. (Gupta et al., 2017) designs a control system for preschool children to write neatly and correctly on the line, etc. Here, the pen acts as the child's writing monitor. The system sends a report on children's writing activity to parents and teachers. In this case, layered computing infrastructure is used.

The use of sensor technologies is important in tracking and detecting crimes such as theft and kidnapping, thus helping to further improve the safety and protection of children. By using sensor technology to monitor children's movements and alert authorities or guardians of any suspicious activity, they can be proactively protected from potential threats. This preventative approach not only helps prevent incidents, but also provides comfort to parents and nurses of children. Correspondingly, through remote monitoring systems, it is possible to follow the patient, observe and evaluate his/her physiological parameters, health status (Angelov et al., 2019). Here, the Wi-Fi module provides communication between the child and the parent through regular SMS using IoT. Child tracking data is transferred to the cloud infrastructure, stored there and automatically activated when necessary (Masud et al., 2023).

Another approach proposes the functions of a portable device with a "pressure switch" to prevent

violence and unethical treatment of women and children. When the child feels the insecurity and bad intentions of the person approaching him/her, he/she presses the button of the device, the sensor sends an SMS, then a call to the parent or guardian, and if the call goes unanswered, the SMS and the call are forwarded to the police. Spatial information is also recorded here (Sunil et al., 2018).

For the safety of children, the system can determine their location, determine the child's body temperature, ambient temperature and heart rate. The presence of an SOS signal on the device for emergencies serves as a warning and assistance to the child (Chowdhury et al., 2019; Cornacchia et al., 2016).

Digital devices play an important role in children's lives today, opening up both opportunities and challenges. As children grow, their interests in technology begin to change. They are more focused on mobile devices, computers, tablets and other modern technologies. Modern children's use of digital technologies has begun to change its purpose beyond the usual tradition of using a mouse and keyboard. Interfaces and devices have been replaced by modern forms of interaction such as touchscreens and gesture recognition devices (Aleperova et al., 2020). Technology has already become a part of everyday life for young children. Children feel a significant difference between traditional toys and digital toys. Their first acquaintance with digital devices starts from infancy. Digital devices can provide educational resources, encourage creativity, and facilitate communication. They enhance digital literacy by enhancing the learning experience and introduce children to different perspectives and cultures. On the other hand, excessive or inappropriate use of digital devices can negatively affect children's physical and mental health. It is an important point for parents to be informed about the nature and characteristics of digital toys and portable devices, their useful and useless aspects and the purposes for which the information obtained through these devices can be used. By implementing these strategies, parents and nurses can foster healthy relationships with the digital world by ensuring that children's interactions with digital technologies are both safe and balanced.

### 3. Material and methods

The Internet of Things (IoT) enables the data sharing between physical objects and digital systems, enabling real-time data collection, analysis

and communication by connecting devices and objects to the Internet. This leads to increased efficiency, automation and improved decision-making in areas as diverse as smart cities, agriculture, healthcare and transport.

The IoT aims to create secure, reliable and fully automated smart environments (Ghosh et al., 2020). IoT is a manifestation of digital technologies. These technologies make the surrounding world smarter and more responsive, connecting the digital and physical worlds. Networked computers also show connectivity to things and are classified into two broad categories (Perez et al., 2018; Serpanos et al., 2017):

*Special purpose IoT.* Special-purpose IoT is designed for specific functions or applications. These devices are mainly designed to serve a specific purpose or industry such as healthcare, agriculture, manufacturing or smart homes. Special purpose IoT devices are equipped with sensors, communication and data processing capabilities to collect and transmit data related to specific use cases. They are often optimized for efficiency, reliability and performance within a designated application area. Special purpose IoT devices are playing an important role in enabling automation, data-driven decision making and innovation in various sectors.

*Consumer IoT.* Consumer IoT refers to Internet-connected devices and products designed for individual consumers and used in everyday life. These devices are typically important in improving convenience and efficiency in various aspects of daily life, such as home automation, health and fitness tracking, entertainment, and personal data security. Such devices include smart thermostats, speakers, portable devices, smart home security systems, and they are often controlled via mobile apps or voice assistants. All this allows users to remotely control and communicate with their devices, and data collected through sensors is linked to other devices or cloud services.

*Smart homes.* These homes are residences that use internet-connected devices to enable remote monitoring and control of appliances and systems such as lighting, heating and security. These devices can be controlled via a smartphone or other network-connected device, enabling increased comfort, energy efficiency and security in the house (Bheesetti et al., 2021).

*Mobile IoT.* It enables mobile devices such as smartphones, tablets, and wearable devices to connect to, interact with, and seamlessly

communicate and share data with IoT devices, sensors, and systems (Bheesetti et al., 2021).

*Wearable items.* In recent times, the rapid development of sensor technology and ubiquitous computing has increased significantly. These devices, which are portable, inexpensive, based on sensors and include human activity recognition systems, have become very popular (Degerli et al., 2022).

The history of wearable technology dates back nearly 700 years. This remarkable event was related to the creation of a pair of glasses, which were first created in Italy in 1285 (Laurenti, May 30, 2017).

Wearable technologies belong to the electronic category, as they include a number of devices that are worn on the body and equipped with integrated systems. These devices often incorporate sensors, processors, and connectivity features to collect and process data, provide functionality, and interact with other devices or networks. Examples of wearable technologies include smart phones, smart watches, fitness trackers, glasses, and smart clothing (Degerli et al., 2022). These devices perform various functions such as health monitoring, communication, navigation and entertainment. The integration of electronic components and systems differentiates wearable technology from traditional accessories or clothing items. They are smart electronic devices weared on the human body, as part of a material used in an accessory or clothing. These devices are designed for data transfer, processing and storage. After placing sensors in various devices, they are made portable by being small, compact, and lightweight for people to carry (Degerli et al., 2022). Portable technologies connect the same hardware to multiple devices. These devices can be installed together with different algorithms and visualization tools or can be freely attached to any person (Ometov et al., 2021). These devices are grouped into two categories according to their operation (Muzny et al., 2021):

1. *Those that work independently and act as a central connector for other devices and/or data.* These include devices such as smartphones or tablets that can connect to other devices via Bluetooth or Wi-Fi to access or share information. These devices often have their own operating systems and can run various programs;

2. *Those for recording specific actions or analysis of measurement results.* Equipped with portable modern sensors and data processing capabilities designed to record specific movements or analyze

measurement results. These devices can monitor various parameters such as track steps taken, distance traveled, calories burned, heart rate, sleep patterns, etc. They often offer real-time feedback and insights into the user's performance, allowing them to better track and analyze their health and fitness activities. Furthermore, some wearables may include features such as GPS tracking, training modes, goal setting, and data synchronization with mobile apps for a comprehensive user experience.

These technologies can share information using SMS video, audio platform as a communication medium. Sensors can play an important role in the detection of crimes against children by providing valuable information and increasing surveillance capabilities, consequently some crimes are considered more convenient to be tracked and detected in time. Obtaining location data is a useful tool in ensuring the safety of children from threats such as kidnapping, abduction or disappearance by criminals, and below are some of them (Jin et al., 2024; Tsakanikas et al., 2018):

**Video Control.** Sensors such as cameras and motion detectors can be strategically placed in public spaces, schools or childcare facilities to monitor and record activities. These sensors can provide evidence that can help investigate crimes against children by identifying suspicious behavior or potential threats.

**Location Tracking.** Wearable sensors or GPS-enabled devices can be used to track the location of children, especially in cases of child abduction or disappearance. This technology can be useful to law enforcement agencies in quickly locating missing children.

**Internet monitoring.** Sensors can be used to monitor online activities and detect potential cyber-bullying, child-inappropriate content. By analyzing online behavior and content, it can help identify and prevent malicious activity.

**Environmental monitoring.** Sensors can be used to detect hazardous conditions or substances in environments where children spend time, such as schools or playgrounds. For example, sensors can be useful in providing a safer environment for children by detecting the presence of harmful chemicals or pollutants.

The rapid development in sensor technology and the widespread use of ubiquitous computing have indeed led to significant developments in wearable devices with human activity recognition systems. Sensor technology plays an important role in increasing children's information security

by providing monitoring and detection capabilities. For example, sensors can be used to track a child's location, monitor their online activity, or detect unauthorized access to devices or sensitive data. By using sensor technology, parents and caregivers can better protect children from potential online threats and keep them safe in the digital world. The growing popularity of sensor-based wearable devices among users, their benefits and problems have become the target of scientific research and require the development of new approaches.

### 3. Children 4.0 conceptual model development

All parents are interested in getting timely information about their children. Although childhood is divided into different categories, the term "child" refers to persons who have not yet reached the age of 18 (Law of the Republic of Azerbaijan "On protection of children from harmful information", 2018; Ojagverdiyeva, 2022). While children are studying at school, their behavior, psychological state, attitude towards others, successes or weaknesses in various subjects are entered into the databases of the educational institution (Alekerova et al., 2020). The information obtained through the sensor placed on the child's body, bag, hat, shoes, or the watch, bracelet and other digital devices attached to their arm, is accepted by the parent, teacher, etc. These data contain information about the children's location, time, illness, psychological condition, etc. Parties, especially parents, use this information to make certain decisions about their children. But after a while, the volume of this data grows. As the volume of obtained data increases, it becomes difficult for the parent or specific persons to process this data. At this time, there is a need for intelligent systems that process the data transferred or collected between the child and the parent, and process large volumes of data to make decisions based on the data, which have the following characteristics (Ojagverdiyeva, 2022):

- to analyze;
- to monitor;
- to store data in the cloud;
- to assess the threat;
- to make decision;
- to predict;
- to inform the relevant individuals, etc.

There are many benefits to using portable devices to collect and store personal data about children, including:

*Importance in the privacy and security of children's information.* Because these devices have data collection capabilities, they can help track children's health, location, and activities. It is possible to monitor and track various physiological signs of the child (heart rate, breathing, body temperature, blood pressure, etc.) through portable devices. By conducting analyzes on the basis of these collected data, it is possible to make an early detection, prognosis of any serious concern in the child's health or to evaluate the general health of the child. It is considered convenient for following their sports activities, monitoring or evaluating their recovery process after an injury. These devices are equipped with additional sensors to measure sleep patterns, stress level, emotional state and other factors.

*Prevention of interference with children's personal information.* Security measures of access control in the protection of the data collected in these databases limit the access of unauthorized persons to the personal data of children. These databases have strong encryption, which makes it difficult to access the data.

*Using children's personal data for research purposes.* Anonymized data collected from portable devices in databases may be used for research purposes, but it is important to consider both the violation of the child's privacy and the identity of the child when using this data. Such research should aim for valuable insights into children's health, behavior and general development for good purposes.

*Individual service provision.* Based on data collected from wearable devices, recommendations for exercise or nutrition can be made based on the child's health indicators.

In many cases, the personal information that constitutes Big Data can be used by companies, banking systems, various health organizations, and organizations engaged in demographic analysis, as well as some criminal groups. However, the problems related to the security of personal data collected in the systems are inevitable. These problems may include:

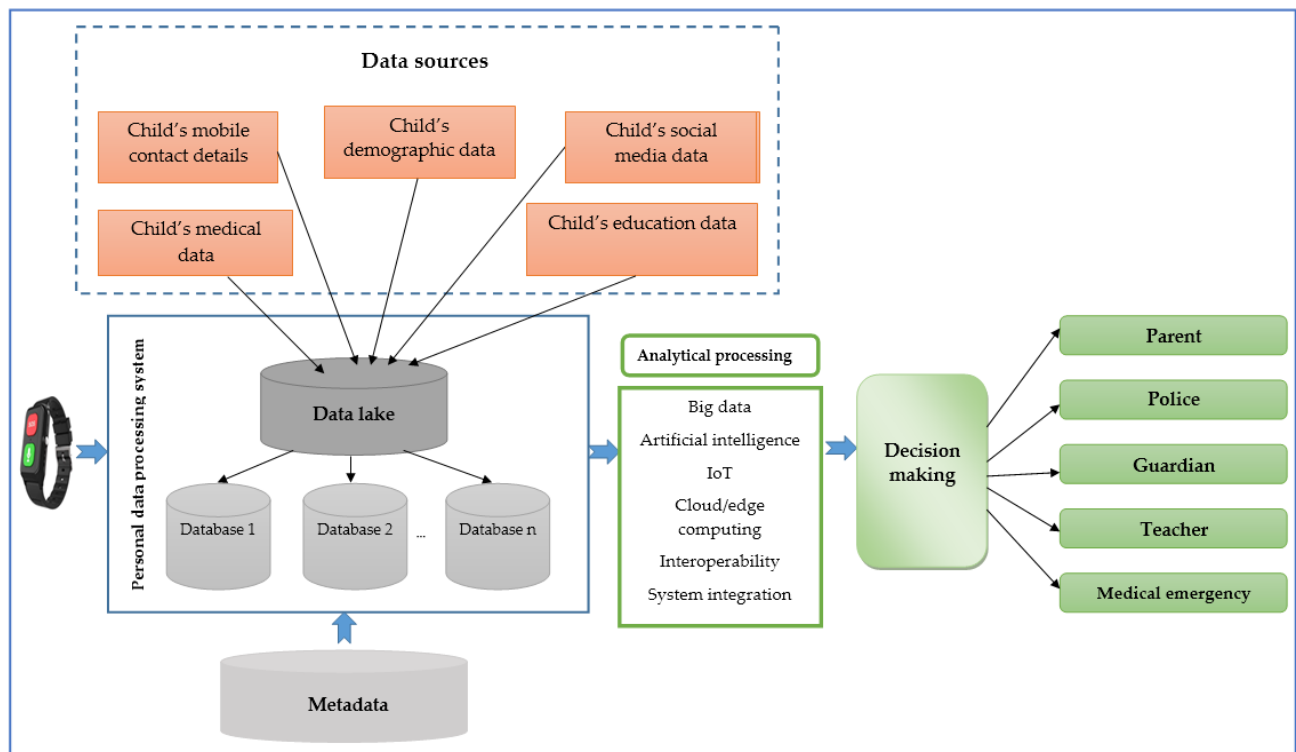
- medical data security of information about the child's personal health;
- security of data transmitted in emergency situations faced by children, as well as in special risky situations;
- data security related to children's location data;
- data security related to children's social relations
- data security related to children's personal data;
- data security for manufacturers and users to prevent unauthorized access or misuse of this data;
- and so forth.

While portable devices have many advantages in terms of collecting data and providing valuable insights, they also have security concerns. Accordingly, since the personal data collected in the database by these devices is sensitive and confidential, there should be a strict requirement to protect this data. Taking these into account, the proposed Children 4.0 model envisages implementing a number of measures to ensure data security and privacy in protecting data collected about children through a portable device (here, a wristband worn by a child). Figure 1 presents the description of this system.

As mentioned above, the useful aspects of portable devices are quite enough, this model aims to maximize their benefits while protecting children's personal information. Information about the components of this system is given below.

*Children's mobile communication information.* Ensuring the safety of children in the context of mobile communication is very important when there is an increase in the use of mobile devices by young people. This may include information about people in mobile contacts, conversations, etc. It covers risks for children (cyberbullying, privacy concerns, etc.) and their mobile security.

*Children's social media data.* This can include different things depending on the social platform and how the child uses it. General public information may be included, such as public information, direct messages, device information, engagement data, name tracking data, etc. This can include content such as text posts, photos and videos that are shared for everyone to see.



**Fig. 1.** The scheme of Children 4.0 concept

*Children's demographic data.* Children's demographics can be viewed from a global or specific country context. This includes the main indicators: age, socio-economic information, location, gender, family structure, disability status. However, taking into account that the demographic processes going on in the world now lead to children's refugee life, disappearance in wars, etc., the presence of such cases highlights the importance of demographic information about children.

*Information about children's education.* These data include primary education, secondary education, higher education and other related information from the time children are ready for school.

*Child's medical data.* This may include information about a child's health, emergency or suspected abuse.

Data from the above-mentioned sources are stored in the "Personal data processing system". This system combines a data lake with a structured database for specific data analytics purposes. Storing metadata about the data stored here is essential for effective data management and processing.

*Data Lake.* It contains all types of data in its original format: structured tables, images, video recordings, etc. It is a large-scale digital memory that can store data. Here, information about children (name, surname, information from data sources) is collected and stored in a separate database.

*Analytical processing.* Using modern algorithms

and artificial intelligence, the system makes decisions based on the information it collects and helps children stay safe in potentially risky situations. Based on the information entered into the system, the place where the child locates, the people surrounding him/her, the child's body condition and various abnormal conditions. The systems analyze various data and patterns collected through sensor technology to determine when a child is at risk. For example, if the system detects unusual activity, such as when a child is in a potentially dangerous location or experiencing intrusions, it can send alerts to relevant authorities, parents and responsible persons. The digital wristband carried by the child incorporates functions and communication channels to send signals to parents or other responsible entities when the child is in danger by:

- sending text messages to the mobile phone through SMS service;
- providing information about the child's location, status or any pre-defined safety issues with instant notifications;
- by pressing the SOS button, or through internal lights, sounds or vibrations on the device itself.

If the 3 signals sent to the parent by the system are not answered, the real-time communication and warning system is directed to other entities. Equipped with sensors, this device allows immediate intervention to remove the child from a

potentially harmful situation by sending signals to parents and other designated persons when the child is in danger. Portable devices allow children to establish virtual boundaries or safe zones (Zehrunge et al., 2021). These technologies have distinct features including accessibility, portability, multi-functionality and practicality among others. These capabilities are important for the control and safety of children and adolescents in our modern age.

The proposed concept realizes decision-making by analyzing issues in a big data environment, such as analyzing the information about the child, ensuring individual protection of each child, including children of all age groups, etc. Some of the key features of the Children 4.0 model are:

*Data Encryption.* It is the application of strong encryption methods to prevent unauthorized access to data both during transmission and storage.

*Implementation of the Access Control mechanism.* This includes using strong authentication methods, passwords or biometrics, to restrict access to information by specific individuals, and allowing access only to authorized individuals.

*Data minimization.* It helps minimize the amount of data collected to prevent system breaches and reduce the risk of unauthorized access.

*Anonymization and Pseudonymization.* It includes obtaining certain information from the data collected about the child and using anonymization or pseudonymization, i.e., naming the children by any nickname or pseudonym, in order not to easily recognize the child's identity.

*Regular Safety Audits.* This includes identifying vulnerabilities in the system, conducting regular security audits (reviewing access logs, monitoring system activity, and any weaknesses identified) to verify and ensure compliance with security standards, and promptly remediating system failures.

*Secure connection.* Using secure communication protocols to transfer data between mobile devices and the system helps protect data in transition and prevent interception by unauthorized persons.

*Data breach response plan.* This includes developing a comprehensive plan to prevent a data breach and taking appropriate mitigation measures.

*Compliance with regulations.* Implementation of safeguards tailored to specific requirements may be considered, ensuring compliance with relevant data protection regulations such as the General Data

Protection Regulation (GDPR) or the Children's Online Privacy Protection Act (COPPA).

By implementing these measures, the security and privacy of information collected about children through portable devices can be significantly enhanced. In order to ensure its safety, it is important to conduct assessments based on information obtained from various sensors, determine the level of threats and take measures in accordance with the target of these threats.

In the future, various changes are expected to occur in the field of protecting children and adolescents from negative influences in the environment. Serious changes will be ensued to protect children's safety, their growth, development, physical activities, etc. Based on the specific applications of these devices, as well as their rapid development, flexibility, utility, affordability and efficiency, their function is estimated to be expanded and used more and more.

#### 4. Discussion

The proposed concept realizes decision-making to analyze the information about the child, to ensure individual protection of each child, etc. by examining issues in a big data environment. Since the main goal here is related to the security of data collected in cyber-physical systems, there are a number of limitations in the organization of such systems.

The fact that cyber-physical systems have a wide attack zone can allow hackers to exploit vulnerabilities in their networks to steal or manipulate data. Failure to take strict precautions regarding how data collected in this system is stored, used, and shared may result in the sharing or loss of information. The computing power of the device used must be taken into account here, as mobile devices have limited processing power and poor memory, which can make it difficult to implement security measures (encryption, etc.). The device itself can be physically interfered to gain unauthorized access to such cyber-physical systems or to corrupt the sensitive data contained therein. These limitations mentioned can lead to a compromised cyber-physical system violating the security of a critical infrastructure, data leakage and even potential damage.

Obviously, expansion of the Industry 4.0 environment, the intervention of cyber-physical systems in people's lives has made the coexistence of people with digital technologies inevitable. The



development of digital technologies and widespread use in modeling and simulation allow creating a “digital twin” of a production product, system and process. Digital twins are digital representations of physical or potentially physical objects. Digital twins are primarily used for digital testing, digital modeling, predictive learning, decision making, and various other purposes. A digital twin is a digital representation of a physical object or system (Shao et al., 2019). Digital twins are essential and indispensable for the virtual design and optimization of intelligent manufacturing systems in the Industry 4.0 environment (Leng et al., 2021; Javaid et al., 2019). These technologies have different characteristics as accessibility, portability, multi-functionality, etc. These opportunities can play an important role in ensuring the control and safety of children and adolescents in our modern era. In future studies, various changes are expected to occur in the effective solution of issues in the field of protecting children and adolescents from negative influences in the environment. Industry 5.0, that is, a new era in the field of ensuring the safety of children in the network environment will open up new opportunities in the growth and physical development of children. It will make serious changes to protect safety in their activities. Based on the specific applications of these devices, as well as their rapid development, flexibility, utility, affordability, and efficiency, it can be said that their function will be expanded and used more and more.

## 5. Conclusion

As the Internet develops, new forms of interaction with information technologies begin to emerge. Devices equipped with sensors accelerate the data sharing between individuals and are very important for decision-making. By using sensor technologies, children’s needs can be better understood and addressed, ultimately creating a safer information environment for their development.

The proposed concept was noted to be important in ensuring the safety of children’s personal data and preventing any physical and psychological pressure against them. Here, this model must be constantly evaluated, updated and improved as new challenges arise in the field of dynamic data protection and portable devices.

Portable digital wristband takes into account children’s activities at school, sports, etc. and other

situations. Based on these factors, it was concluded that this proposed approach would help parents and other concerned persons in comprehensive protection of children. However, it is important to have legislative acts and various normative documents related to the safety problems caused by these facilities. As mobile technologies evolve, there is a need to address privacy issues, foster more responsible data protection practices, and develop safe and effective digital experiences for the next generation.

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