Societal Immunizing System: A New Approach to "Never Again" Function of Fatal Situations in Everyday Lives*

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Abstract— **The biological immune systems of organisms provide a function of "never again" of diseases by responding to new sources of risk that arise in everyday life by dealing with both the diversity and specificity of diseases. In this paper, the author describes the concept of a societal immunization system in which the biological function of an immune system protecting from pathogens is reproduced informatic and robotic and applied to protect from the risk of fatal accidents in the living environment. To proceed with the system concept empirically, the author focuses on unintentional childhood accidents, the second most frequent cause of child fatalities. This paper reports a developing system for demonstrating proof of concept through implementing the societal immune system that completes from the creation of knowledge on fatal situations to integration with fatal situations recognition technology. Fundamental evaluations were conducted with a dummy child in a living laboratory environment, and the feasibility of the developed system was evaluated through tests among children of two years and five years in an actual home.**

I. Introduction

In the era of a 100-year lifespan that has now arrived, a society of healthy diversity is set as an essential element in a world of sustainable development goals in which human beings changing mental and physical functions can secure their safety, grow in good health, and engage in society actively [1]. However, because of the lack of organic integration between on-site practitioners and organizations possessing big data, there is a negative cycle where accidents repeat, and practitioners or managers who happen to be nearby may be penalized. This problem stems from the inherent limits on human capacities to transform accidents that occur in individual environments into knowledge and transfer it to other sites.

In the human body, the immune system provides skilled responses to an endless stream of new risks that emerge in daily life [2]. In the realm of artificial intelligence (AI), similarly, new technologies for recognizing multiple environments and interlinkage of distinct data sets have emerged. They are leading to the development of means for effective coordination between AI and humans. This interlinkage may bring the possibility of achieving in a field of safety a function equivalent to the "never again" function of biological immunization, in which data on the situations of many accidents at distinct organizations are collected, their commonalities are identified and deeply interpreted, and an effective response is mounted.

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Maintaining safe environments for children poses particular difficulties. Children are intrinsically engaged in a developmental process of constant and substantial change in mental and physical capacities. Achieving designs appropriate from the perspective of child safety is not easy. As new products and services for children disseminate throughout daily life, new relationships arise between them and the child, simultaneously bringing new possibilities of accidents. Despite the many preventive measures that have been attempted, accidents in the living environment have remained the primary cause of child fatality in Japan [3] and other countries, and a new approach is essential.

In this report, the author summarizes the technological challenges in service and product design that supports a society of healthy diversity and technologies to overcome such obstacles. As a new approach to the challenges, the author proposes the concept of a societal immunization system, in which the practical function of an immune system protecting from pathogens is reproduced as a dynamic distributed risk management function based on informatics and robotics and applied to injury prevention in the living environment.

II. Technological Challenges for Accident Prevention at Sites in Daily Life

The technical requirements for dealing with accidents can be categorized as follows.

- **The difficulty of constructing real-world causal models:** Domestic and overseas databases are commonly compiled on circumstances of past accidents. The problem is that the data on past accidents consist of information on results but are not linked to information on causal behavior and are therefore not conducive to causal modeling.
- **The difficulty of coping with various situations:** The construction of a new methodology that can simultaneously accommodate both diversity and specificity of accidental situations, in other words, cope with what may be regarded as an infinity of variety of the real world, is necessary.
- **The difficulty of Poisson distribution behavior:** The scope of accident management is generally limited to the individual facility under the management of responsible personnel. It leads to a Poisson distribution behavior problem where even an event where nearly 100% of the occurrences may statistically appear to occur seldom when each of the facilities is under different management.

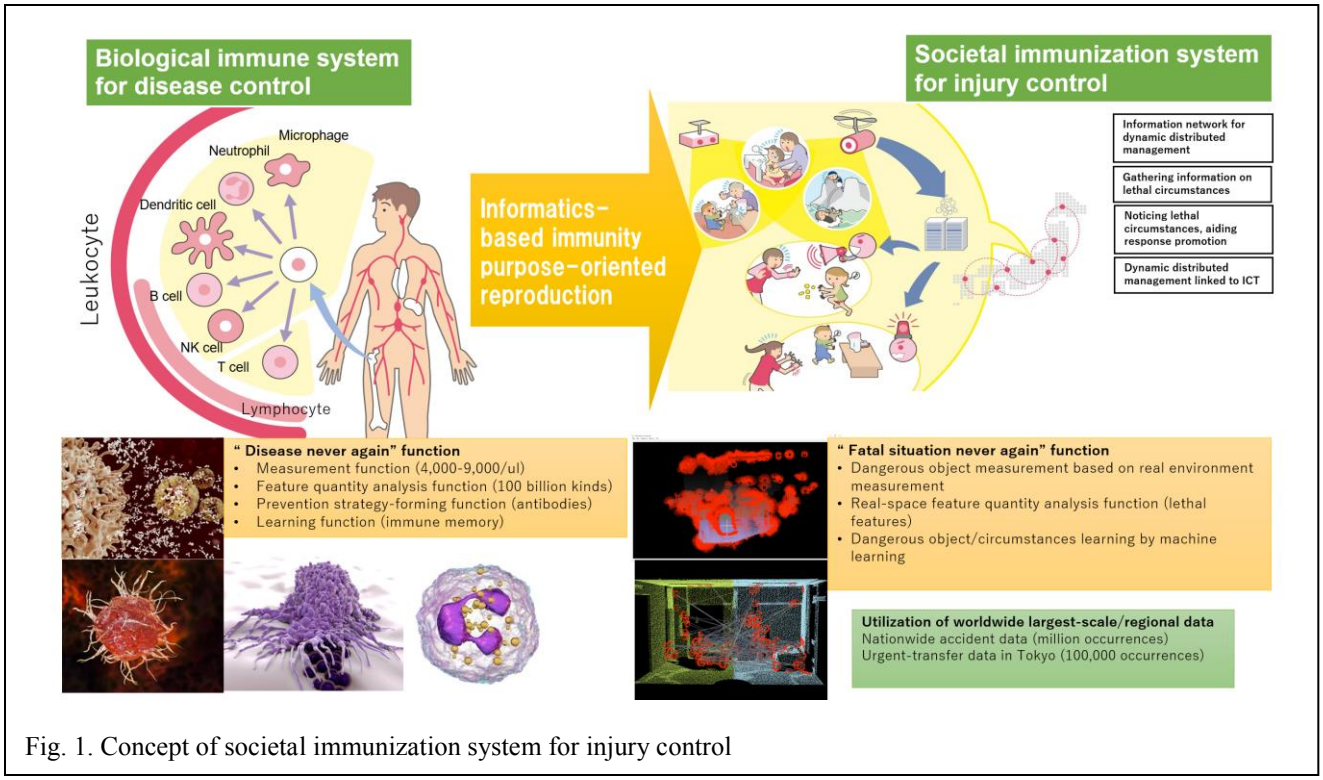

Fig. 1. Concept of societal immunization system for injury control

III. Concept of Societal Immunization System Concept

Figure 1 is a conceptual diagram of the social immunization system for dynamic distributed control of everyday risks, enabling response to real-world diversity, including dynamic changes. The process of "biological" immunity can be interpreted as an information system consisting of the following functions of leukocytes: 1) a function for finding objects (e.g., pathogens) that intrude into the body using ubiquitous sensors placed throughout (several thousand leukocytes exist per microliter), 2) a function for decomposing the objects to peptides and identifying peptide feature quantity (leukocytes are capable of identifying the order of 100 billion types in a text-mining like way), 3) a function of eliminating the objects if they match with a previously defined source of risk, and 4) a function for learning as a new risk in memory if no match exists.

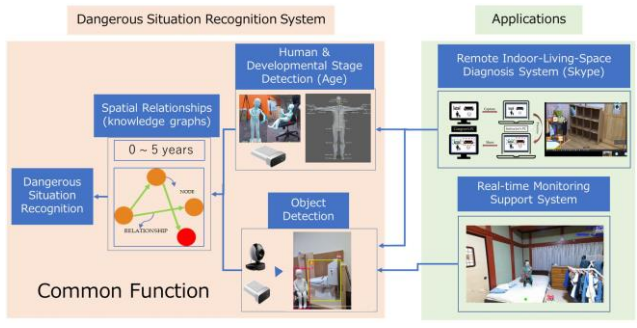

Fig. 2. Ongoing work for demonstrating societal immune system

Suppose we can reproduce a mechanism of an immune system that consists of measurement and recognition functions of the diversity of sources of risk and the specificity to them and systematic learning functions of immune ecosystems from the viewpoint of information engineering and robotics, and apply the reproduced functions to prevention of injury due to accidents, in particular, to control of fatal situations. In that case, a new approach to risk management in the scenes of daily life will be possible.

Figure 2 shows a developing system for demonstrating proof of concept through implementing the societal immune system that completes from the creation of knowledge on fatal situations to integration with fatal situations recognition technology. The author conducted an essential evaluation with a dummy child in a living laboratory environment and evaluated the feasibility of our developed system through tests among children of two years and five years in an actual home.

IV. Summary

In this report, the author has described the current state of challenges confronting risk management in daily environments, the concept of a societal immunization system, in which the biological function of an immune system protecting from pathogens is reproduced and applied to protect from the risk of the fatal accidents in the living environment, together with consideration of the possibility of its achievement based on ongoing efforts.

References

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