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SERVICE ROBOT SAFETY STANDARDIZATION IN ISO

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Due to service robots' intrinsic nature of making close contact with humans, the need for securing the safety of the service robot has been increasing. As a result, the first international standard that defines the safety requirements for the service robot, ISO 13482, was published in 2014. Since then, ISO 13482 has been serving as a basis for the robot makers and certification bodies. However, service robot markets have been growing extensively and the technologies have been developed a lot, i.e. the environment around the service robot market has been changed a lot. To comply with these changes, ISO 13482 currently undergoes its revision process. In this article, brief introduction on ISO 13482 is presented and a short report on the progress of the revision is shared.

1. Introduction

Service robots interact closely with humans so its safety is critical and related risk should be reduced to an acceptable level for them to be readily accepted by the market. Therefore, there had been a need for establishing the safety requirements for the service robots agreed by the users and the manufactures. It motivated the establishment of the safety standard for the service robot, and it led to the publication of ISO 13482:2014 - Safety requirements for personal care robots[1], the first international standard establishing the safety requirements for the service robots. ISO 13482 was developed by ISO TC 299 WG 2. Since 2014, ISO 13482 has served as a guideline for the robot design, development, tests, certification by the robot manufactures, certification body and the users in the market.

Since the first publication in 2014, service robot markets have been growing extensively and segmented in various robot types. Each robot type has unique features and particular sources of hazards. However, at the time of first publication of ISO 13482 in 2014, the service robot market was at its very early stage and not many products were available on the market. Hence experiences for the real-world applications of service robots were limited. Therefore, sufficient attention was not paid to such robot type-specific requirements and robot manufacturers had difficulty applying the ISO 13482 at tis best use. Moreover, the requirements in ISO 13482:2014 did not fully reflect the limits of the reality of the robot technology and robot parts market, which are essential for the implementation of the safety requirements. As a result, ISO 13482:2014 currently undergoes its revision process. In this article, brief introduction of ISO 13482 and the revision activities in ISO TC 299 WG 2 is presented.

2. ISO 13482:2014

ISO 13482:2014 specifies the safety requirements for service robots used in personal and professional/commercial applications. The standard basically applies the philosophy of ISO

12100 specifically to the service robots, i.e., the risk assessments—hazard identification, risk estimation, risk evaluation and risk reduction—are required for the service robot use conditions. Mobile servant robots(MSR), person carrier robots(PCR), and physical assistant robots(PAR) were identified as three major robot types of service robots. Around forty hazards originate from their use were identified. To name a few, hazards related to charging battery, power failure or shutdown, robot star-up and restart of regular operation, robot shape, emission, electromagnetic interference, robot motion, mechanical instability, instability during travel, instability in case of collision, collision with safety-related objects, etc.

ISO 13482 includes the additional information on the functional safety for safety-related control systems used as protective measures. For the seven major control functions—emergency stop, protective stop, limits to workspace, safety-related speed/force control, hazardous collision avoidance, stability control, the required performance level(PLr) are suggested as in the Fig.1.

Safety functions of personal care robots	Type of robot							
	Mobile servant robot		Physical assistant robot				Person carrier robot	
	Type 1.1	Type 1.2	Type 2.1	Type 2.2	Type 2.3	Type 2.4	Type 3.1	Type 3.2
6.2.2.2 Emergency stop	d (no low risk option)		c	d	c	d	d	d
6.2.2.3 Protective stop	b	d	b	d	b	c	c	e
6.3 Limits to workspace (incl. forbidden area avoidance 6.5.3)	b[1]	d	b	d	a	d	N/A	e
6.4 Safety-related speed control	b	d	b	b	b	d	c	e
6.7 Safety-related force control	b	d	b[3]	e[4]	a	b[5]	N/A	N/A
6.5.2.1, 6.5.2.2 Hazardous collision avoidance	b	d	N/A	N/A	b	d	N/A	e[6]
6.6, 6.7 Stability control (incl. overload protection)	b	d[2]	N/A	c	b	d[2]	b[7]	d[2]

Figure 1. Required performance levels for selected service robot types.

3. Revision of ISO 13482

Since its publication, ISO 13482 has served as a basis for the robot design and certification. However, there has been big changes around the service robot markets—the technical completeness of the service robot has been improved a lot due to the progress of the related technology, diverse robot types have been put into the real-world market, and competitions between robot makers have been set which requires technical completeness with low cost. To cope with these changes, ISO 13482 faces the revision.

The revision started in 2021 and the main theme of the revision is the market-relevance. ISO TC 299 WG 2 established a principle that the revision should reflect the current market only, not considering the non-existing yet to come robot types. From this perspective, the detailed classification of specific robot types is being identified and discussion on which robot types are to be included in the revised version is being made.

In terms of the structure of the revised standard, the committee are determined to separate the safety requirements that are common to various robot types and that are specific to each robot types as general safety requirements and particular safety requirements. In the particular safety requirements, additional safety requirements originate from the particular robot features are to be addressed.

Currently, the criteria by which robot type can be classified are being discussed as a major issue. In the latest e-meeting of WG 2 in April 2022, the ‘function’ was suggested as a key criterion.

By which, mobile robots, stationary robot and wearable robots were proposed as the current robot classification.
The revision is being processed by three subtask groups that are to establish the initial draft for three specific robot types—MSR, PCR, PAR. At the moment, initial drafts from three subtask groups are collected and it will be soon spread for the committee members for their comments. Regarding the person carrier robots(PCR), as most of the PCRs on the market are human piloted and completely lacks the autonomy, the committee temporarily determined not to consider PCR in the revised version.

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1. ISO 13482: 2014 - Safety requirements for personal care robots