Impact of AI enabled Robots in the field of Industrial Revolution- Analytical survey

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Abstract—*In the modern industries, there is no doubt about declining global competitiveness in the manufacturing sector for instance and amount of value-added production has been shrinking to the point where nearly in the past 20 years. There is tendency that some sectors count on overseas production for lower operation costs with the help of AI enabled Robots technology. However from a viewpoint of maintaining and fortifying global competitiveness of the modern era economy towards the future, enhancing domestic geographical advantage is a challenge that is as crucial as keeping pace with the expansion of overseas market with help of Robotics automation. Robots are back in the limelight once again in recent years as the key to growth across the world including for developed countries.*

Keywords—Robots, technology, automation and Production.

I. INTRODUCTION

Artificial intelligence (AI) Technology required for robots to think and act according to instructions from people or the situation in the surroundings. Since processing capability of computers is advancing exponentially according to the Moore's Law, what can be realized with AI technology has dramatically expanded. However, there are following challenges at present: Although it is possible to provide one answer to one question based on given information, it is difficult to give a natural response based on the analogy of the context of conversation or instruction or by reading between the lines, or respond to unknown situations (machine translation is still developing). Pre-programmed movements can be made, but it is difficult to autonomous change or determines tasks by recognizing task progress or situations in the surrounding, or makes a movement by imitating the craftsmanship. It is necessary to study modularization of AI and software (e.g., thinking system and reflex system in the brain structure) in terms of concentration of research and development resources and improvement of development productivity. These challenges will require advancement and unification of data-driven AI and knowledge representing and reasoning AI (e.g., technology to realize analogy and reading between the lines of unknown conversation through learning to read between the lines from a large amount of conversation data, or to realize autonomic deduction of optimal movement by checking existing knowledge against the current situation), research and development of such technology as brain-like AI (e.g., development of advanced intelligence that imitates information processing in the brain by modularizing AI that imitates the regions of the brain such as a cerebral neocortex model, a hippocampus model, and a basal ganglia model and by combining them). Sensing and recognition technology to import information concerning the situation in the surroundings into robots [1][2].

Thanks to advances in semiconductor technology, sensors themselves are becoming less expensive and smaller, realizing easier utilization in terms of quality as well as quantity. However, there are following challenges: It is difficult to differentiate partially-hidden objects (occlusion) or objects whose outline cannot be cut out. Objects cannot be recognized in specific environments such as backlight and darkness. Images need to be processed faster than the traditional speed at the time of automatic movement in a narrow space. It is difficult to use a sense of smell to identify the location of a human body at disaster sites or pick up necessary sound from noise. It is difficult to identify specific voice when several people are talking simultaneously. It is also difficult to recognize various objects such as soft objects using a sense of touch. It is necessary to recognize surrounding environment according to situations in a flexible manner (even without a map) by unifying multiple data of surrounding environment indoors as well as outdoors[3][4]. In order to recognize someone's will and feelings, it is required to presume by sensing brain waves, blood flow, and pulse in addition to movements and language. These challenges require research and development of environment-learning vision sensor, voice processing and recognition technology under low signal noise ratio, smell sensor, distributed touch sensor system, and sensor fusion system integrating these sensors. Mechanism, actuator, and control technology for robot's devices (e.g., motor, arm) to act externally. The power weight ratio (PWR) of servomotors has now become 5 times greater than that in 20 years ago, realizing an error of a few µm as movement accuracy. However, there are

following challenges: It is difficult to realize both power (output) and dexterity (movement accuracy) with the same size and weight as humans. The current mechanism with high stiffness and actuator with little flexibility are not suitable for flexible movement. Meanwhile, artificial muscle is not suitable for accurate positioning. It is necessary to handle objects that humans use daily, such as objects of complex form or flexible material, without obtaining information in advance. Modularization should be considered for manipulators and hands, instead of exclusive development as needed[5]. These challenges require research and development of servomotors with low-cost and high power weight ratio (PWR), multi-degree-of-freedom actuators imitating the human joint, high-molecular light-weight artificial muscle and a control theory for smooth control of such a highly non-linear system, and general-purpose hand system for bilateral control. OS, middleware, etc. In order to make a robot and robotic system, element technology, parts, and the robot itself need to be integrated using basic software such as OS and middleware. This will enhance compatibility and development productivity.

II. RELATED WORK

These technologies have following challenges: It is currently necessary to have the development and integration environment and tools to concentrate resources on the development of high-level applications for recognition, reasoning, and autonomic control (e.g., simulator to check movement of software without actually creating and using a robot; OS, middleware, and programming language that are easy to use and standardized to some extent) correspond to the future development of element technology. Interface of robots and modules needs to be standardized when robots with different OS communicate with each other, or a new module is implemented on a robot. These challenges will require research and development of simulators simulate working environment, and OS and middleware that can work with simulators, as well as general-purpose OS and middleware that can be used as the standards.

III. OBSERVATION

Security and safety evaluation and standard Technology and techniques are required to create robots and securely and safely diffuse them. These technologies have following challenges at present: The current technique is insufficient in identifying and evaluating the risk of unexpected potential accidents that result from the expansion of the area to utilize robots. It takes time for studies of subjects for safety, etc. (including administrative response). Rules for the protection of personal information collected by robots and personal information collection by robots (e.g., photo taking) are not examined sufficiently. People's acceptance of robots needs to be enhanced through the enhancement of human interface. There is a security risk that commingling of a malicious program may cause malfunctioning of robots or unintended data leak[6][7].

These challenges require techniques for safety evaluation and risk prediction, establishment and standardization of test methods, rules for handling information collected by robots, and examination and research and development of security technology. In addition, technologies converted from broad fields other than the above have following challenges: Light-weight and long-lasting energy source (e.g., battery) will be required. As it is heavy, it requires power to move (if the weight of the frame can be reduced, the size of actuators such as a motor can be reduced, resulting in further weight reduction and a favourable cycle)[8][9].

If the robot itself is heavy or has heavy arms, it is dangerous as it cannot stop immediately and causes a great impact when it runs into something. It is necessary to remotely control robots without distant restriction (radio waves do not reach or cannot be used depending on sites) or autonomously coordinate multiple robots. (e.g., high-speed / ad-hoc network technology, teleoperation /autonomous exploration technology for ocean resources exploration).

It is necessary to make robots to grasp their own present locations and the situation in the surroundings such as the presence of obstacles, through the maintenance of the environment to provide highly accurate location information with the use of satellite positioning and sensors.

Shield mechanism, heat-resistant materials, and corrosive-resistant materials for operations under extreme environments such as in water, high-temperature environment, and toxic environment, need to be converted or improved from those used in other fields. These challenges require research and development of long-life, compact and light-weight battery technology, wireless electricity supply technology, communication technology, and material technology.

Ideal situation of research and development in an early stage, it is necessary to research and develop many element technologies in parallel to technology requiring continuous long-term research and development as well as technology requiring achieving short-term research and development results. In addition, promote competition among different technologies by cooperation and information sharing among different technology through

holding of workshop by research institutions such as NEDO, AIST, and National Institute of Informatics (NII) as needed, and promote inter-technology competition by utilizing the award (competition) system such as challenge programs, and facilitate research and development with the introduction of open innovation. (It is possible to conduct research and development oriented for issue-solving by maintaining the venue for cross-cutting research development and collecting leading researchers depending on fields and contents of research.) [2][4]

Among element technologies for research and development, promote element technologies which should be put into practical use by 2020 and 2025 by using the planning and operation of DARPA project with innovative and non-continuous targets (e.g., targets such as one-digit higher performance, one-digit lower cost). Specifically, program manager (PM) will specify important element technology as the second-generation technology and concentrate investment on the technology [10].

Establish a stage gate midway through research and development so that narrowing down of promising technology and review of implementation structure can be flexibly performed based on PM's judgment. In addition, in order to lead them to practical use quickly, integrally promote the standardization such as environment maintenance and data format, including the review of laws and regulations and social systems along with the review of technology diffusion and business strategy[5][8].

Proactively utilize systems such as the special district system for the verification toward the practical use of new technology. Universities and research institutes are expected to play a large role not only in the field of application but also in basic research.

Universities are particularly expected to promote the systematization of robot technology, which is rapidly developing in collaboration with various fields, as an academic field that will serve as the base of research with an overview and future perspective. The folioing figure 1.1 illustrates the essential components involved in the field of production and Figure 1.2 Shows the impacts.

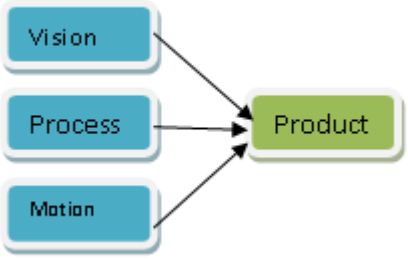

Fig.1.1: Components of AI enabled Robots

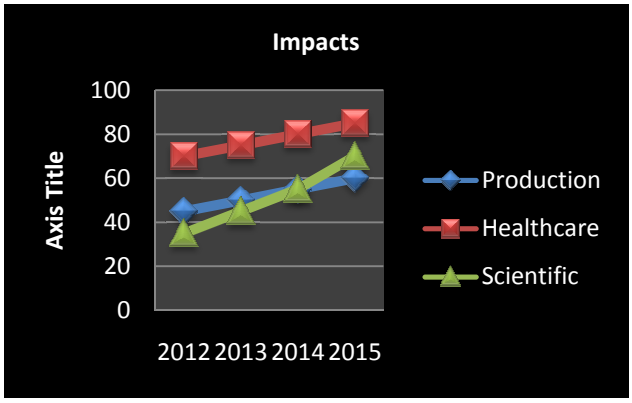

Fig.1.2: Impact analytics

IV. CONCLUSION

The very first change is that robots are shifting themselves from those doing simple routine tasks to "autonomous" ones equipped with self-learning abilities and action initiatives. There is much expectation for further enrichment of robot capacities in line with a great leap in the advancement of AI technology (image, voice recognition, machine learning) including utilization of deep learning in addition to the progress of separate technologies such as sensor technology and higher performance of software and information processing capacity, which altogether will enable a more skilled processing and also extends its hand wide in the industrial production and revolution in the nearby future.

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