RPA Constitution Model for Consumer Service System based on IoT

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***Abstract*— Currently, RPA (Robotic Process Automation) attracts attention for productivity improvement of the business processing. However, there are few examples that applied RPA to consumer service system. It is caused by the fact that there is not common sense about an application development method based on RPA for consumer service system. Therefore, we suggest a basic model of RPA constitution for consumer service system. The feature is that we can add continuity, automation, and usability to consumer service system. We inspect an effectiveness of the basic model of RPA constitution by using consumer service system examples characterized by fusing IoT and AI that we worked on so far.**

Keywords*— *Robotic Process Automation; Constitution Model ; Internet of Things; Artificial Intelligence

I. INTRODUCTION

Business Process Re-engineering in the 1990s and Business Process Modeling in the 2000s have been tested as business process improvement. "New teleworking (mobile working)" started around 2014, which has made few contributions to productivity of white-collar. With the development of IT technology, the effort designed to enhance business performance has been made by using robot or AI technologies. This is generally called "Robotic Process Automation" [1]. Its typical example is to make OCR application software read the order placement and reception slips, automate the subsequent accounting process.

RPA is currently designed to automate data input process by office processing; there are few examples that apply RPA to consumer services. This is caused by the fact that there is not common sense about an application method of RPA for consumer services. Therefore, we suggest a basic model for RPA constitution for consumer services to solve this problem. In this context, a consumer service means a service that provides new value to consumers by IoT or AI. Therefore, RPA for consumer services aims to offer new value to consumers while the existing RPA are intended to enhance business performance.

We have developed several consumer services characterized by integrating IoT and AI. Examples are described below. In SNS (Social Networking Service) Door Phone [2], you can know that you have home delivery service through SNS anywhere you are by implementing IoT for a door phone. SNS Agency Robot [3][4] makes it possible to interactively communicate only by conversation even the elderly cannot use smartphones. Autonomous Algal Bloom Decontamination System enables it to clean an algal bloom automatically by linking a drone with a cleaning robot. This paper suggests a basic model for RPA constitution and evaluates its effectiveness based on examples of consumer services we have developed so far.

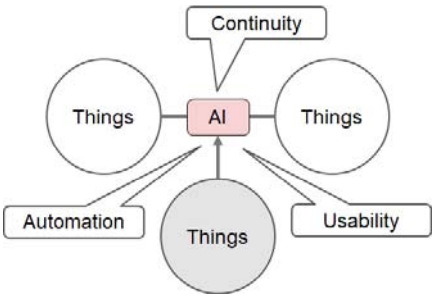

Fig. 1. Basic model for RPA constitution for consumer service system

II. RPA CONSTITUTION MODEL

The popularizations of smartphones make people connect beyond time and place, which make SNS, new consumer services, have gained power. It also brought change to power balance between individuals and corporations. Articles are individually sold, which was used to be an exclusive feature of corporations. With the development of AI, new services which largely improved the usability are provided. For example, you can operate smartphones or home electronics by voice.

Our RPA for consumer services intends to situate on the extension of these consumer services. The difference is the improvement of IoT and AI. The devices are now connected to smartphones or other devices by IoT technologies. However, mere connecting to other devices cannot be called consumer services. What comes important here are "Continuity", "Automation" and "Usability". The essence of RPA is to continue different processes and automate them. In case of consumer services, the viewpoint of usability is also to be added, since the user level of information literacy is not ensured. The characteristic of RPA for consumer services in this paper is that AI supports continuity, automation and usability after connecting several devices by IoT technologies.

Fig. 1 shows a basic model for RPA constitution for consumer services. This basic model indicates the relationship of three things. Two "things" described as white outlined mean IoT devices, shaded "things" offers the function of AI and provides continuity, automation and usability to white

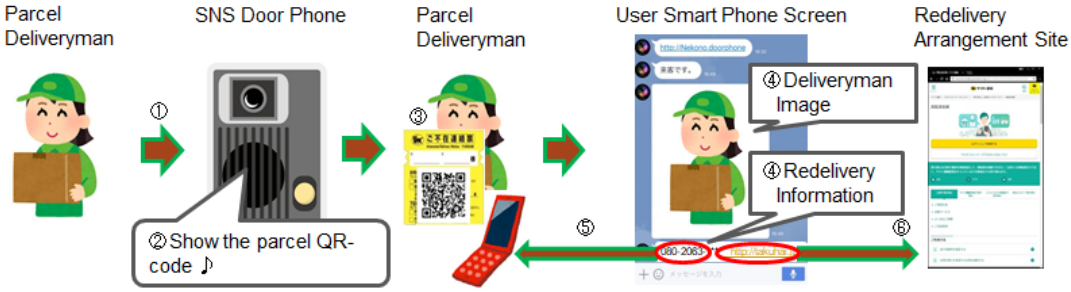

Fig. 2. SNS door phone use case

outlined two “things”. You also can connect more “things” in this basic model, or IoT device itself has ability to offer the function of AI. The point is that AI mediates between “things” and then supports continuity, automation and usability.

III. Examples of Consumer Service System

A. SNS Door Phone

With the widespread of Internet shopping, more people purchase articles by using home delivery service. On the other hand, fewer stay at home in the daytime because of growing trend of nuclear families or two-income families. This causes problems of delivery in absence, which not only needs more workforces for redelivery but also increases time and labor of a receiver. In case of delivery in absence, a receiver notices for the first time when he/she sees home-delivery slip as he/she gets home. For redelivery, it is required to input long parcel number on the slip. If you receive delivery service during a business trip, you know it after you get home and it happens that you miss the redelivery service.

Therefore, we developed SNS Door Phone that informs the delivery service to a receiver in real time by SNS in order to solve the problem of receiver’s side. In this system, the interaction with visitors is supported by AI. Fig. 2 shows a use case of this system. As a parcel deliveryman presses a call button of SNS Door Phone (①), a voice guidance is provided(②). According to the guidance, it is required to show QR code on the slip to the door phone (③). From QR code, the door phone readouts URL which connects the redelivery arrangement Web site and a phone number of the parcel deliveryman. This information is transmitted to the receiver’s smartphone together with face photograph of the deliveryman (④) by SNS. The receiver just taps the deliveryman’s phone number on SNS for redelivery (⑤). Or you can complete the redelivery service just by tapping URL that connects the redelivery arrangement Web site without input of long parcel numbers (⑥).

Fig. 3 and 4 show the hardware and software configuration of this system. The hardware configuration is characterized by the connection of peripheral devices such as a speaker, a camera and a microphone to the Raspberry Pi, a single board computer. On the other hand, the software configuration has a feature of using 2 external APIs. One is LINE Messaging API, which makes it possible to implement IoT for a door phone. LINE is one of the popular SNS services in Japan. The other is IBM Watson Assistant, which makes the interaction in natural language with visitors intelligent.

B. SNS Agency Robot

As Japan’s aging rate increases every year, it is predicted that it continues. Under such situation, many watching services for the elderly are offered. However most of the services are designed to confirm that the elderly are doing well and inform their families, as the services check their situations or detect abnormality by sensors. For example, ZOJIRUSHI offers a service called “MIMAMORI Hotline” [5]. In this service, when the elderly uses an electric water pot, the information is transmitted to his/her families who live apart by e-mail messages. Meanwhile, SNS such as Twitter or LINE became popular among the young. However, hurdles for the elderly in fully using smartphones are still high in order to use SNS. Therefore, we developed SNS Agency Robot which enables the elderly to interactively communicate by Twitter or LINE, even though they are unable to use smartphones [3].

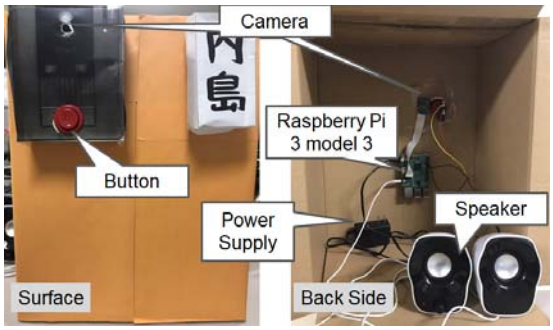

Fig. 3. SNS door phone hardware configuration

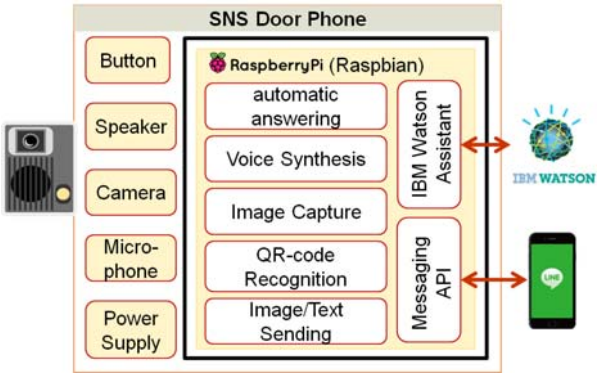

Fig. 4. SNS door phone software configuration

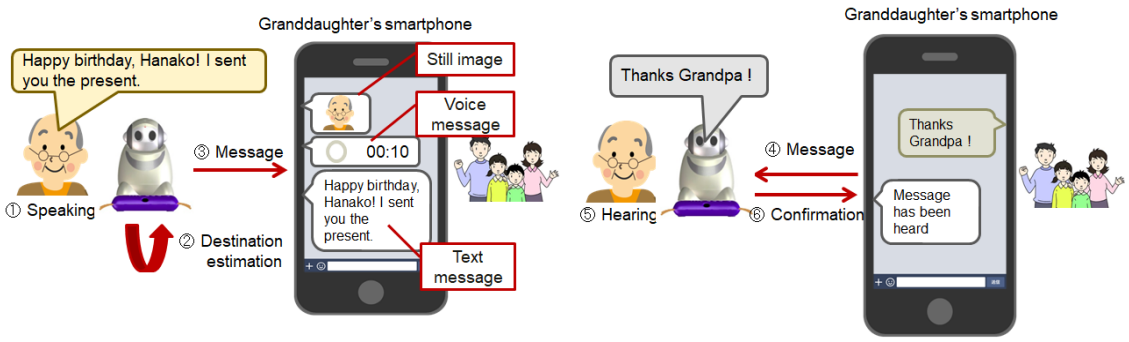

Fig. 5. SNS agency robot use case

(Fig. 5) For example, an elderly speaks to the robot, "Happy birthday, Hanako! I sent you the present" (①). After defining the destination address based on the message contents (②), the still image of the elderly, the voice message, and the text converted by voice recognition are transmitted to a granddaughter's smartphone which installs LINE (③). As the granddaughter answers to LINE, "Thanks Grandpa!"(④), the robot at the elderly informs the message in a voice to him (⑤). The confirmation is also sent back to her (⑥).

Its principle feature is that the appropriate destination address is automatically set depending on its context. Specifically, this is realized by making IBM Watson Natural Language Classifier (NLC) learn the message exchange history with partners. For learning of artificial intelligence, it is required that the correct data is given. In this case, the only person who knows the correct destination address, is the elderly. However, it is impossible to make the elderly input the correct destination address. Therefore, we suggest and implement "message exchange learning type address estimation system" based on the response from the young to the message from the elderly. We use "Google Cloud Plat form" as the voice recognition function which converts the elderly's voice to the text, NEC's "PaPeRo i" as the robot at the elderly's that the face recognition function is mounted on and NEC's "NeoFace KAOATO" as the face recognition for personal identification. The main control function is constructed on "Sakura VPS", a commercial cloud service (Fig. 6). This is the second feature that this system configuration makes the best possible use of external open innovation and commercial cloud service which are inexpensive and highly maintainable.

At present, we are developing the function which the robot can detect signs of dementia. For screening of dementia it is required that both "impairment of cognitive function" and "disability of life function" are detected [6]. In order to evaluate "impairment of cognitive function", a doctor usually interviews some questions to the elderly about his age or date of the day. By implementing this function to SNS Agency Robot, we experimentally evaluate the differences from the diagnosis by doctors. On the other hand, "disability of life function" which inhibits the elderly's independence in his daily life is relied upon subjective evaluation by those around the elderly. SNS Agency Robot is able to grasp information of

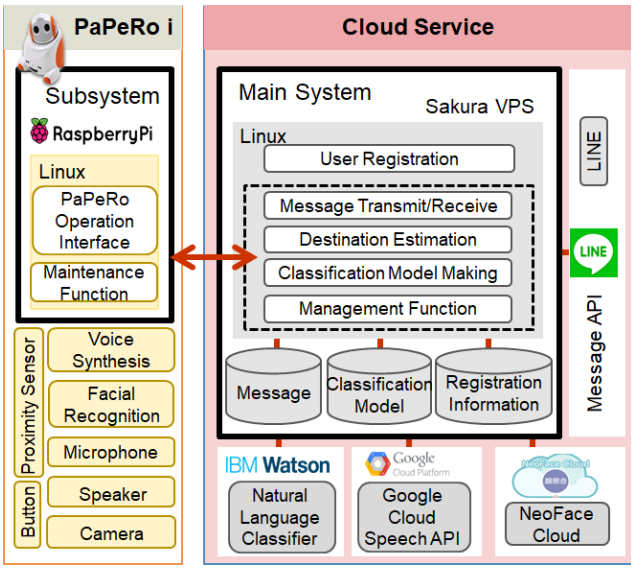

Fig. 6. SNS agency robot software configuration

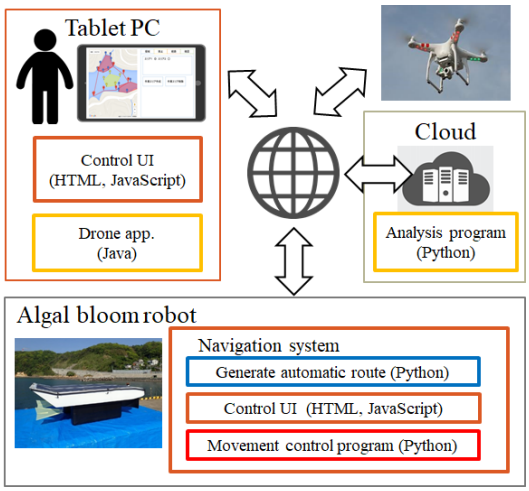

Fig.7.Autonomous algal bloom decontamination system

communication history between the elderly and those around them. By asking some questions to the elderly, Robot itself also acquires information. We are developing the system that evaluates "disability of life function" by using SNS Agency Robot.

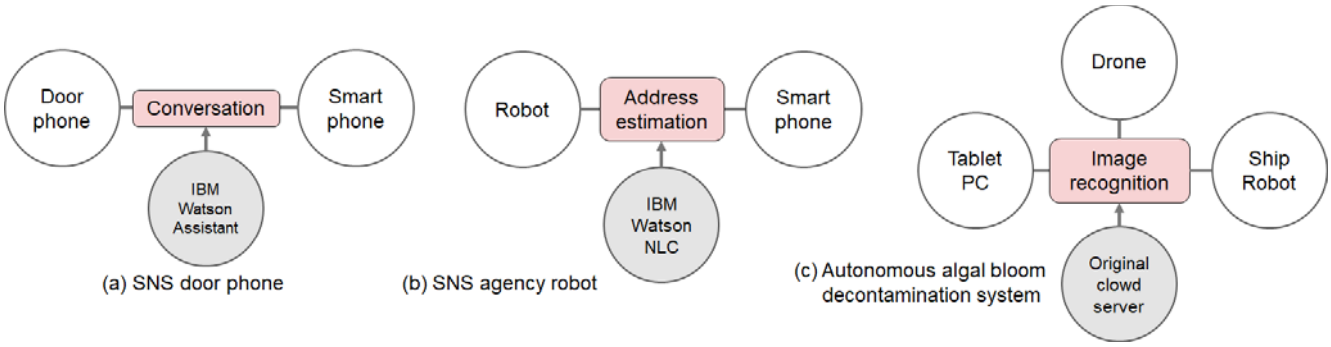

Fig. 8. Embodiments of three examples based on RPA basic model

C. *Autonomous Algal Bloom Decontamination System*

The issue of algal bloom, which brings about environmental deterioration to lakes or reservoirs, is posed by global warming. An alga bloom is accumulation in the population of microalgae or the state that large outbreak of microalgae (mainly planktonic blue-green algae) spreads over the surface of eutrophic water. An algal bloom causes several inconveniences. In human society, it not only prevents use of lakes (for example, fish culture such as carp, freshwater fishery, nearby environment, water-amenity and tourism) but also causes taste and odor of water and health damage to human and animals. It also seriously harms natural environment around lakes.

The devices that decontaminate an algal bloom have been developed. However, the site of an algal bloom occurrence momently changes; it is needed to move devices according to its occurrence, which causes a problem of human operation. Therefore, we developed Autonomous Algal Bloom Decontamination System which automatically searches the site and decontaminates an algal bloom by linking a drone and an automotive algal bloom decontamination robot. Fig. 7 shows the overview of this system, whose future is that the system automatically detects the sites and autonomously decontaminates an algal bloom by making the tablet PC link a drone which is an IoT device, an automotive decontamination robot and cloud server. Specifically, the monitoring area of the drone is set in advance on the tablet PC. As the drone automatically flies over the monitoring area on a regular basis or by an instruction of the tablet PC, records the situation of the algal bloom. The drone footage is transmitted to the cloud server with information of photographing point through the tablet PC. The location of the algal bloom is identified by an image recognition using CNN, Convolutional Neural Network. The identified location is transmitted to Autonomous Algal Bloom Decontamination System through the tablet PC, the algal bloom is autonomously decontaminated based on the information.

IV. Model Verification

Fig. 8 shows the embodiments of three examples as described in Chapter 3 which are applied to the basic model on Fig. 1. We confirm Fig. 8 indicates all three examples fall under the basic models. LINE Door Phone enables the fact of "home delivery" and "redelivery arrangement", which has been interrupted to continue and automates "redelivery arrangement". This is also where usability is improved. SNS Agency Robots makes "personal identification" "voice-text conversion" and "message transmission-and-reception" continuous. A sequence of "message transmission-and-reception" itself is automated. We can find improvement in usability in "address designation". "Detection of an algal bloom occurrence site" and "algal bloom decontamination" maintains continuity in Autonomous Algal Bloom Decontamination System, which makes a sequence of "algal bloom decontamination" itself automate. An unnecessary of site visit leads to improvement in usability as it has been necessary for someone to go the site and decontaminate the algal bloom. We confirm that the examples of three consumer services satisfy RPA basic models.

V. Conclusion

In this paper, we proposed the basic model for RPA constitution that continuity, automation and usability are applied to the consumer services by IoT and AI. As the result of evaluating this basic model based on our developed three consumer services, we concluded that our consumer services fall under the model. In future, we define specific architecture as a basis to build consumer services from this basic model by applying the models to other consumer services. We improve productivity of consumer service development by providing platforms based on the architecture.

Acknowledgment

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References

[1] Abderrahmane Leshob, Audrey Bourgouin, Laurent Renard, "Towards a Process Analysis Approach to Adopt Robotic Process Automation," 2018 IEEE 15th International Conference on e-Business Engineering (ICEBE), pp. 46-53, 2018.

[2] Toru Kobayashi, Ryota Nakashima, Rinsuke Uchida,Kenichi Arai, "SNS Door Phone as Robotic Process Automation," 2018 ACM International Conference on Interactive Surfaces and Spaces, pp.25-28 Nov.,2018.

[3] Toru Kobayashi, Taishi Miyazaki, Rinsuke Uchida, Hiroe Tanaka, Kenichi Arai, "Social Media Agency Robot for Elderly People," Journal of Information Processing Vol.26, pp.736-746, Oct. 2018.

[4] Toru KOBAYASHI, Koushin KURIYAMAI, and Kenichi ARAI, "SNS Agency Robot for Elderly People Realizing Rich Media

Communication," 2018 6th IEEE International Conference on Mobile Cloud Computing, Services, and Engineering, Apr. 2018.

[5] ZOJIRUSHI, http://www.mimamori.net/

[6] American Psychiatric Association, "Diagnostic and Statistical Manual of Mental Disorders: Dsm-5," Amer Psychiatric Pub Inc.