



rapoptosis: Renatusu via Apoptosis - Prototyping Using Clothes

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Abstract. To redefine the way artifacts are inexhaustively produced, consumed, and discarded, the authors define a new form of death for “things” and propose a system in which artifacts circulate and transform themselves in our society. This system is inspired by the characteristics of organisms, such as self-death and regeneration, in nature. We redefine the death of artifacts as the time when their intrinsic existence value ceases to exist in the relationship between the object and the user, rather than when it ceases to function (self-death: apoptosis), and we propose a method to allow artifacts to judge their intrinsic existence value themselves and survive by having them change users autonomously (rebirth: renatusu). We propose to call this system “rapoptosis” (renatusu via apoptosis). In this paper, we report the results of the rapoptosis prototyping using clothes and investigate the current general methods, timing, and potential requirements of methods to dispose of clothes.

Keywords: Self-death · Apoptosis · Artifacts · Sustainability · Intrinsic existence value

1 Introduction

Artificial objects have been inexhaustively produced, consumed, and discarded throughout history. Thus, when developing items in this context, the manner of retiring the item, or its “death,” has received little consideration. Meanwhile, infrastructure development on the Internet that enables easy trading and sharing between individuals has progressed recently. Thus, not only when an item is no longer usable, but also when it is no longer being used, options other than disposal are being considered increasingly. However, the entity that decides the timing and method of releasing things remains a person.

On the other hand, in nature, not only life but also the manner of death is programmed carefully. For example, apoptosis is the self-death of programmed cells in multicellular organisms. Even though the cell still functions, it purposefully self-destructs for the greater good of the entire life form. We were impressed

with the autonomous and altruistic nature of death in the apoptosis process and wished to extend appropriately to the existence of items, specifically, the timing of the death of these items when their existence ceases to have value to the user. Additionally, we define the method of death as movement to other users in society, in much the same manner in which cells that have killed themselves via apoptosis are absorbed by the surrounding cells and regenerated within the individual. In summary, if an object judges that its existence ceases to have value to its user, it can leave on its own (apoptosis) after its estimation of value is confirmed by the user. Then, they arrange their transfer to another place/user, effectively being regenerated in the society (renatusu). We define autonomous and sustainable regeneration as a new form of the death of things, which we term “rapoptosis” (renatusu via apoptosis, Fig. 1).



Fig. 1. The concept of rapoptosis.

The literature commonly recognizes artifacts as having their value determined when they are produced; however, based on recent share economies and blockchain technologies, the value of things changes constantly depending on the user and context. From these contexts, the mechanism by which things themselves change their own places and owners to increase their value in society is similar to biological phenomena, such as metamorphosis. Metamorphosis occurs when organisms change greatly to achieve an optimum form, lifestyle, and/or place for survival in their development process. Although rapoptosis does not change the shape of the object itself, it acts to actively increase its inherent value. In other words, rapoptosis is an example of applying the mechanism of circulation and transformation of an ecosystem consisting of self-death and regeneration of life. It also can be positioned as a new artificial life system that can be integrated into daily life by utilizing the recent social/information infrastructure.

2 Design Guideline of rapoptosis

rapoptosis shows the way that objects themselves are autonomous and sustainable. Figure 2 schematically shows the process required for this prototyping system. Specifically, the system operates by progressing through the following steps.

1. The item judges its existential value in relation to its user.
2. The item checks its existential value with its user.
3. If this value has ceased to exist, the item removes itself from the user in the real world.
4. The item performs the action of seeking new users on social networking or internet services (SNS/WEB).
5. The item performs the action of moving to a new place in the real world.

In this way, rapoptosis is thought to be realized as a mechanism that spans both the real and information worlds. Because the potential existence value of things is decided within the relationship with the user, it is desirable to finally calculate from plural parameters. By using the existing SNS/WEB platform, one can communicate in a natural and easy-to-see manner in a more natural way by displaying the intention to users and searching for new users. On the other hand, as the objects perform the real-world removal and direct the movement, we expect that the objects themselves will convey their intention to leave to the user intelligibly. In this paper, as a first prototype to embody rapoptosis, we focused on clothes.

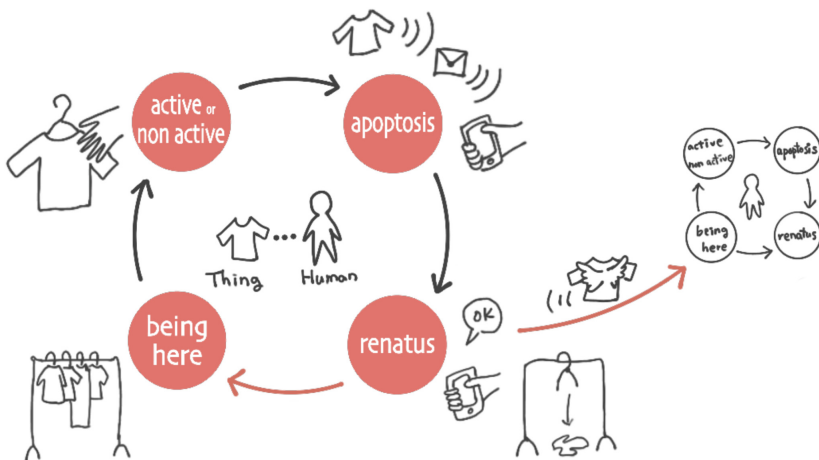


Fig. 2. The process of rapoptosis.

3 User Research on How to Let Go of Clothes

Prior to prototyping rapoptosis for clothes, we surveyed the method and timing of releasing clothes and the present situation on clothing possession by a questionnaire to investigate the potential needs for rapoptosis.

3.1 Method and Time to Let Go of Clothes

To concretely consider the death of the defined object, we used a web questionnaire to survey the methods by which people dispose of clothes. The questions covered the most common method used by each individual (disposal, sell face to face, sell on the internet, give away, or other), the reason for choosing that method, items that sell usually, and estimated timing to let go (i.e., the duration between when the item was purchased and when it was let go). There were 67 subjects (47 males, 20 females) aged from 10 to 30 years old.

For the most common method, in multiple responses, 88.1% answered “disposal,” 43.3% of people said “give to an acquaintance,” and 13.5% said “sell on the internet or face-to-face” (5 people said internet and 4 said face-to-face sales). As a result, about half of the subjects had an experience of giving clothes to acquaintances. The reason provided for this transfer was that the clothes were good and could still be used, so there were many responses indicating that the users wanted the clothing to be reused. Despite being a method that can be reused as well, there are still few people who sold clothes online or face-to-face. This is thought to be a hurdle as a system because a sale is more labor-intensive than a simple transfer. If there were a method to sell items more easily, it is also conceivable that there would be a higher possibility of selecting sale rather than giving away. The most common waste items were T-shirts and socks, the most common sale items were coats and tops, and items were uniformly distributed for transfer.

Regarding the timing of letting go of clothes, the results of three categories (one year or more, less than one year, or immediately) for the period of “when it was bought (purchase time)” and “when it was worn (wearing time)” in Fig. 3. What is distinctive from Fig. 3 is that the percentages of the clothes sold or gave away less than on year from bought are more than 20%. It can be said that the circulation period is brief. From the results in Fig. 4, the percentage of those who wore clothes up to the point just before disposal was high (29.3%), indicating that they were worn until the last minute and expected that it lost its function as cloth.

Finally, as a result of listening to the need for improvement on the method of letting go, common desires included easy recycling, easy-to-understand instructions, a single-step process and instructions as to what to discard. There was an opinion about extra value that “I want to preserve my memories,” and there was a need for a delicate design for the value that emphasizes the rapoptosis system’s construction.

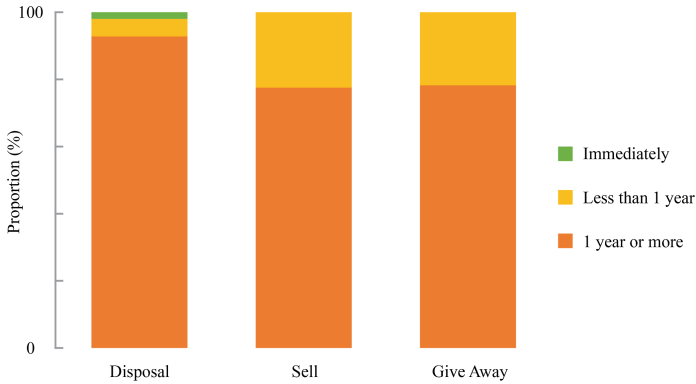


Fig. 3. The length of time from purchase to letting go.

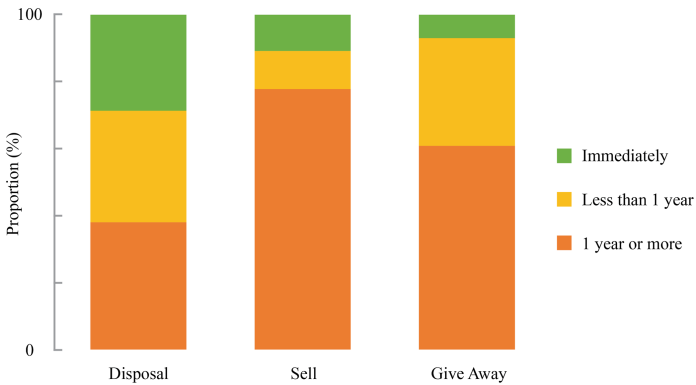


Fig. 4. The length of time from wearing to letting go.

3.2 Amount of Clothes Owned

In order to clarify the overall picture of the possession of clothes, we asked to count the total number of clothes they have and the number of clothes they had not worn for more than one year for the three categories of representative tops, bottoms, and coats. We also asked respondents to explain, in a free-response section of the questionnaire, why they do not dispose of infrequently used clothes, despite not wearing them for more than a year.

There were 68 subjects (45 males, 23 females) aged from 10 to 30 years old. As for the total number of clothes, the proportion of clothes not worn more than one year is defined as the percentage of idle assets, and the proportion was examined. As a result, the percentages of the idle assets in each categories were tops (26.0%), bottoms (25.4%), and coats (18.3%). In the case of a coat with a relatively high price for the tops and bottoms, the proportion of idle assets was small.

Table 1. The reasons why users do not wear certain clothes.

Value	Questionnaire answers
Body type	The clothing does not fit my body well
	The clothing is small
Trend	It is not trendy anymore
	There is no place to wear it
	It does not match my current style
	My preferences have changed

Table 2. The reasons why user keep clothes without wearing.

Value	Questionnaire answers
Memories	My feelings for it are still strong
	It has sentimental value because I purchased it at a travel destination
	I received it from someone
	Things that people have chosen or given as gifts.
Prices	Because I paid a high price and bought it
	It was not cheap.
Preferences	It doesn't fit me, but I like the appearance
	I just like this pattern
	I think they're nice clothes.
Indecision	I may use it someday
	Because there is a possibility of wearing it
	I think that I can still wear it

Tables 1 and 2 show free descriptions obtained of answers about why they are not wearing certain clothes and why they do not want to let them go. We also categorised and defined the inherent values. As shown in Table 1, there are many opinions that changes in body type, social trends, and personal preference are important factors, and these value standards have the main influence on the frequency of use. In Table 2, factors such as “memories,” “prices,” “preferences,” and “indecision due to sensitivity” are seen as reasons not to let go, in addition to the items’ original functions as clothes. This indicates how individuals ascribe personal value to their clothes in addition to their original functional value. We defined this as the intrinsic existence value. These intrinsic existence values suggest that the period that one wants to keep the clothing can change, even if the clothing is not worn, because of the intrinsic existence value. In other words, when designing autonomous apoptosis timing, it is necessary to consider these value criteria for each individual. Furthermore, even in the way that things determine their autonomous death, if the intrinsic existence value can be considered, there is a possibility that more efficient and effective separation methods can be produced.

4 Prototyping with Clothes

4.1 System

Although it is desirable to take multiple parameters, for the purposes of the prototype, we considered only the period of unused for designing the time of death. And the condition is set that clothes are always hung on the same hanger. A sensor in each hanger detects whether the clothing is used or not. Eliminating the clothes is realized by actuators in each hanger. The specific structure of the system consists of a hanger-type device (Fig. 5) with shoulders movable by gear control, Arduino Yun Mini for Wi-Fi connection, a power supply, a PC, an external SNS platform (Twitter API), and a smartphone.

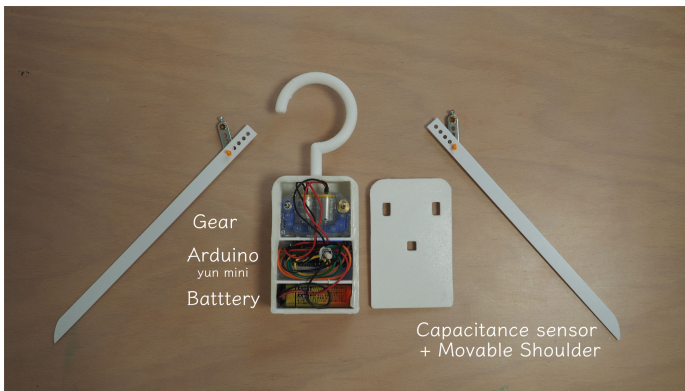


Fig. 5. Overview of hanger device.

The process flow is as follows.

1. The hanger detects when the user tries to put on clothes with a switch and counts the presence, absence, and frequency of use for a certain period.
2. If a clothing item is not used for a certain period, it expresses its intention to leave to the user through Twitter's mention function (Fig. 6).
3. The user reconsiders the existence value of the item and gives or denies permission for the proposed movement (Yes/No) to the hanger, using the reply function.
4. When the user agrees to the movement of the item, the hanger's arms are closed and the item falls to simulate the act of eliminating the clothing item in the real world (Fig. 7).
5. Simultaneously, detailed information associated with that clothing item is released on Twitter along with a hashtag "#forsale" (Fig. 8).
6. When the next user is found, the clothing item is moved to the entrance of the home in an addressed cardboard box (easy to imagine as a new function of a robot vacuum cleaner in home) and is collected by a courier (like a reverse use of the Amazon delivery service).



Fig. 6. Screenshot of a cloth’s message to the user (written on screen: the cloth is mentioning the owner, @Sarang_914 and talking “I have not been worn since 15th September 2015. I will go to the next person soon.”).



Fig. 7. Physical interface ceasing to exist.

4.2 Demonstration and Feedback

In this prototype, we implemented each of steps 1, 2, 4 and part of 6 ((Fig. 9). We exhibited our system at a conference and received high praise for the effectiveness and necessity of the concept from the participants and committee [1,2]. They pointed out that this is an opportunity to rethink the relationships between people and things. Furthermore, the method of allowing things to communicate by SNS offered the possibility that people can see things as being alive, which helped to clarify the judgment of existence value. The participants’ opinions indicated that it would be more effective to change the method of separation and to consider a variety of intrinsic existence values that things may have.

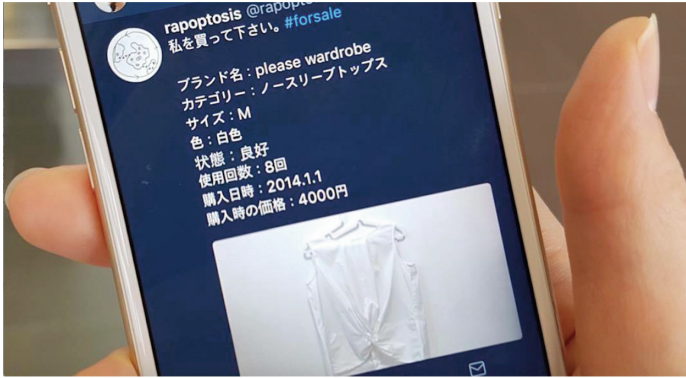


Fig. 8. Screenshot searching for a new owner (written on screen: “Please buy me #for-sale, Brand name: please wardrobe, Category: no sleeve tops, Size: M, Color: White, Status: Good, Number of Uses: 8 times, Date of purchase: 2014/1/1, Price: 4000 yen.”).

5 Related Works

5.1 Robot Considered with Death

In the field of artificial objects, such as the pet robot AIBO, the method and timing for determining death is well discussed in the literature. Users felt emotional connections with artifacts [5] and acknowledged their death in the form of a funeral [3,4]. Experiences with a pet AIBO showed that the artifact value for the object transforms into affection over time, consequently changing the definition of death of the artifact for those people. This should not apply to the types of artifacts for which rapoptosis is proposed, as it is intended for commoditized, utilitarian daily life products, such as clothes, that exist in a different context from pet robots. Based on the feedback from the questionnaires, if rapoptosis could autonomously detect intrinsic existence values, such as “emotional memories” and “personal preference,” the system could teach itself and apply those values as parameters in the object-death determination. We believe that this would hold the possibility to defining new relationships between artifacts and people in the future.

5.2 IoT Device for Context-Aware Consumption

In the field of human interface, context-awareness research, such as providing adequate information or changing environmental conditions by sensing a user’s conditions, are studied [6]. Ubiquitous computing and internet of things (IoT) research based on context awareness are focusing on service related works, such as tracking a user’s SNS or purchase history and trajectory history log to estimate a user’s preferences and provide information that is closer to the user’s needs. Our proposed system, rapoptosis, can be considered a next generation context-awareness system, as it will change the definition of ownership when



Fig. 9. Exhibited rapoptosis at the conference [1].

an artifact itself automatically behaves adequately while actively considering the relations between the user and itself. Recently, Amazon [7] and Google [8] proposed the ideas of promoting a purchasing system based on a user's life-long patterns. Although automatization and customization of the service will be penetrated in the future by using AI technology, systems like rapoptosis, which connects the timing of releasing objects and the social cycle as a comprehensive system, will provide us a novel way to engage with artifacts.

6 Discussion and Conclusion

In this paper, we proposed the concept and method of rapoptosis, in which items themselves judge their intrinsic existence values in relation to their users, and

leave them autonomously, changing users and thereby surviving and extending their lifespan. As a result of prototyping, we were able to confirm the support and potential requirements for the concept of rapoptosis. Future tasks include determining parameters to measure the intrinsic existence value of things in relationship to users and calculating this value. Depending on the type of intrinsic existence value, we would like to further study how to design a method of breaking relationships with users, performing apoptosis, and the implementation of movement in the real world for renatusu.

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