Proposal and Initial Study for Animal Crowdsourcing

Motohiro Makiguchi[†], Daichi Namikawa[†], Satoshi Nakashima[††],
Taiga Yoshida[†††], Masanori Yokoyama[†] and Yuji Takano[††]

† NTT Service Evolution Laboratories: 1-1 Hikarinooka, Yokosuka-shi, Kanagawa-ken 239-0847
†† NTT Communication Science Laboratories: Morinosatowakamiya, Atsugi, Kanagawa-ken 243-0198
††† NTT Media Intelligence Laboratories: 1-1 Hikarinooka, Yokosuka-shi, Kanagawa-ken 239-0847
makiguchi.motohiro@lab.ntt.co.jp

Abstract

We focus on animals as a resource of processing capability in crowdsourcing and propose an Animal Crowdsourcing (we call it "Animal Cloud", too) that resolves problems with cooperation between computers and human or animals. This paper gives an overview of Animal Crowdsourcing and reports on the interim results of our learning experiments using rats (Long-Evans rats) to verify the feasibility of Animal Crowdsourcing.

Background

The recent growth of networks such as the Internet has led to the continued development of crowdsourcing that asks an unspecified large number of workers to perform a task. A typical crowdsourcing service is the Amazon Mechanical Turk (MTurk) (http://aws.amazon.com/mturk) which involves over 100,000 workers around the world and which enables the processing of mainly micro-tasks inexpensively and within a short time. Existing crowdsourcing methods that use human beings as workers, such as MTurk, have various potential issues involving "continuous guarantee of number of workers or processing time", "optimization of payment design according to the presence of workers", and "preservation of privacy information with workers themselves and within tasks".

We propose a method of crowdsourcing that uses animals as workers, in other words an "Animal Crowdsourcing", as an approach to fundamentally resolving these issues, and we are studying a new system that links together the processing capabilities of a number of animals by a network. An Animal Crowdsourcing is a new approach which expands on the concept of human computation, in which human and animals cooperate with computers with the objective of resolving problems that have each been difficult to solve in the past.

The advantages of an Animal Crowdsourcing are that the use of animals as workers makes it simple to manage the number of workers and the processing time, and that the use of food as payment can simplify the payment design. In addition, it is thought that this will also make it possible to resolve issues raised by tasks relating to privacy, such as image processing that includes people's faces, by ensuring that human workers do not intervene in the processing.

We are conducting our studies of Animal Crowdsourcing from the viewpoints of feasibility, expandability, and business applicability. First of all, we study feasibility, on the assumption that the Animal Crowdsourcing is applied to image recognition, as an initial usage case.

Application of Animal Crowdsourcing to image recognition

Services that use image recognition technology, like the product image retrieval of Amazon Fire, for example, have recently increased in importance. With service applications using image recognition technology, recognition accuracy is important, and various different research projects into improving accuracy are being conducted in the computer science field (Zhao, Jegou, and Gravier 2013). However, with the current state of image recognition technology, computers alone often cannot obtain sufficient accuracy, due to causes such as deformation of the shape of the recognition target or changes in illumination conditions.

There is a technique of calculating the degree of similarity between an input image and images within a database (DB) and outputting information on the image that has the highest degree of similarity, as one approach to image recognition technology by computers. If the subject of that one image does not match the subject of the input image, that is taken to be a recognition failure. On the other hand, the probability that a subject that is the same as that in the input image is included among the top N output candidate

images with the highest degree of similarity improves with each increase in N. In other words, if it could be possible to process a task that picks a single image containing a subject that is the same as that of the input image, from the top N output candidate images having a degree of similarity, this will be directly linked to improvements in image recognition accuracy.

Experiments

We conducted learning experiments using operant boxes (Watanabe. 2013) that focused on rats performing the task of "select an image that matches the input image from among the recognition candidate images" from the previous section, to investigate whether or not animals can do that processing.

The first task is a simplification of: "Decide whether or not the subjects of two images are the same". Two images are presented as one set, with the configuration being such that food is provided if the rat presses the lever when there is an image set of different subjects, but no food is provided even if the rat presses the lever when there is an image set of the same subject. This leads us to expect the development of a learning effect in which the number of lever presses when there is a dissimilar image set is greater than the number of lever presses when there are images of the same subject. We create a task that has four sets with different images in contrast to one set of the same subject, and present the image sets to the rats at the rate of 12 tasks a day (for approximately one hour). The experiments focused on four rats and were performed in an environment and by experimenters that had obtained the authorization of an ethics committee relating to animal experiments.
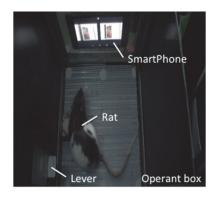

Figure 1. The Operant box

Results

The correct-response rates of same-subject decisions in the learning tasks up to the 15th day are shown in Figure 2. Since the same-subject image sets (correct answers) are one in five sets, the correct-response rate for random answers is 0.2. From this figure, we see that correct-response rate rises with increasing number of days, indicating the potential of task learning in an Animal Crowdsourcing.
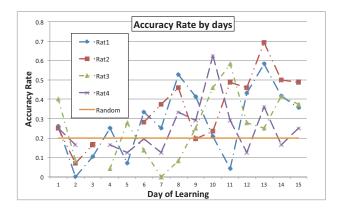

Figure 2. Correct-response Rate of learning tasks up to the 15th day

The multi-agent simulation indicates transitions in the number of workers and the majority vote correct-response rate, calculated from task design with the same conditions as these experiments. The simulation shows that, if workers have an average correct-response rate of 0.4, taking the majority vote with 49 workers will increase the correct-response rate to 0.98, enabling a rough estimate of the number of workers necessary for implementing an Animal Crowdsourcing.

Conclusions

This paper has proposed the concept of Animal Crowdsourcing and has reported on our interim progress into learning experiments related to image recognition tasks. An Animal Crowdsourcing does not just have advantages to the human beings using the system, it is also thought to have advantages to the animals employed as workers in it. It is connected to the creation of new relationships between human society and animals, by improving the quality of life of pets left alone at home by introducing task processing as part of their games, for instance. In the future, we will follow-up our studies with investigations from the viewpoints of feasibility, expandability, and business applicability.

References

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