Research on Assignment Algorithm of Personalized Intelligent Recommended Computing Based on Group Intelligence Perception

Qian Yang¹, Yan Liang¹,*, Xianzhi Hu²
¹School of Technology, Xi’an Siyuan University, China, 710038
²Division of Informationize Management, Xi’an University of Technology, China, 710048

*Corresponding author e-mail: 21943748@qq.com

Abstract. The development of mobile Internet and intelligent sensors makes our perception and judgment of environmental information more convenient and accurate. This paper introduces the related technical background of group intelligence perception and intelligent recommendation, and makes an image schematic diagram of the basic framework of the two systems. Finally, the task assignment process and basic algorithm of group intelligence perception are described in detail for communication and learning among relevant professionals.

Keywords: Group Intelligence Perception, Intelligent Recommendation, Algorithm

1. Introduction

In recent years, with the rapid growth of the number of mobile intelligent terminals and the significant improvement of the GPS, acceleration sensors, gyroscopes and other built-in sensor functions[1], the perception means of mobile terminals are increasingly abundant and the perception dimension is increasing. The emerging mobile group intelligence perception technology has gradually become an effective way to perceive and collect the surrounding environment information in real time. Different from the traditional static sensor network, a large number of sensor nodes need to be deployed in advance. Mobile group intelligent perception takes the intelligent mobile terminal carried by ordinary users as the basic sensing unit. It uses the sensing, computing, storage and communication functions of mobile terminals to perceive the surrounding environment information anytime and anywhere. Whether it is the breadth and depth of perception, or the cost and speed of construction, mobile group intelligence perception is incomparable to the traditional way of perception, which can complete large-scale and complicated perceptual tasks without significant cost[2, 3]. With the development of mobile group intelligence perception technology, a series of related applications have emerged.
Existing applications can be divided into three categories according to the characteristics of the task, namely, infrastructure applications, environmental applications and social applications. In infrastructure applications, mobile group intelligence perception can be used for traffic congestion monitoring, public transport comfort detection and so on, to achieve the purpose of intelligent city traffic and maintenance of public facilities.

2. Background of group intelligence perception

2.1. Crowdsourcing
Crowdsourcing refers to the open outsourcing of tasks traditionally performed by designated agents to the undefined but large number of ordinary users. Simply put, crowdsourcing uses the power of the public to accomplish tasks that require a few professionals. In more detail, companies or organizers publish some of the outstanding issues on the internet, and then in a way motivate the public to provide ideas and solutions, and then select the best or synthesize the results given by the public to get the answer to the question, and finally feedback to the participants according to a certain scheme.

2.2. Internet of things and mobile sensing networks
Sensor network is a distributed intelligent network system deployed in a specific sensing area. The sensor node has certain perceptual computing power and can interact with other nodes and convergent nodes with wireless sensing. The Internet of things extends the type of Internet connection devices, in addition to standard device. It can also access traditional non-Internet physical devices and daily necessities such as laptops, smartphones, smart bracelets, and so on. The devices connected in the Internet of things are diverse, the communication technology is different, and the information beneficial to human decision and behavior guidance can be obtained by analyzing the large amount of information and data collected by the sensor network and using intelligent computing technology such as data mining. The Internet of things has been fully applied in military and other fields. A group-intelligence network can be regarded as a mobile sensing network connected by various communication technologies, which are held by a large number of ordinary participants. It uses the storage computing and communication capabilities of a single device to perform the "micro-tasks" issued by the platform. After collecting the data to the platform, it acquires complete and large-scale perceptual data by means of data aggregation, filtering, analysis and so on to provide other applications for data information mining and application[4].

2.3. Cloud computing platform
Cloud computing is a shared pool that quickly provides configurable computer system resources and higher-level services through the Internet with minimal management work[5]. Cloud computing relies on resource sharing to achieve consistency and economies of scale, which provides a strong platform basis for complex and huge later data in group intelligence perception analysis. Because the task implementer in group intelligence perception is a large number of ordinary mobile users, the perception ability of holding devices and the behavior habits of carrying out tasks vary greatly, which leads to the redundancy and inconsistency of collecting data, and requires a large number of post-filtering and analytical calculations to realize the complete and accurate sensing map of data in the region. In the large-scale group intelligence perception system, often will form the structure complex, the huge scale perception data. Both structured data and unstructured data are contained in different data structures, as well as GB data levels. These features pose challenges to data storage,
processing and computing. And the cloud computing platform can provide a strong guarantee for the storage, real-time processing and analysis of these large-scale data. On the cloud platform, using the mining technology of big data, we can find the hidden information behind the huge data, and provide an important reference for managers to make decisions.

2.4. Group intelligence system architecture
A typical group intelligence perception system consists of three parts: data requester, cloud platform, and mobile worker. Data requesters typically include companies, individuals, or organizations that submit data requests to the platform that contains detailed descriptions of the data to be acquired, including data types, locations, available time, and quality requirements. The cloud platform collects these requests and divides the requests into micro-tasks according to spatiotemporal characteristics, deployed on the task interest points of the perceived region. Mobile workers generally hold smart devices embedded with a large number of sensors. Mobile workers can network with sensing platforms through existing infrastructure such as mobile cellular networks or short-range wireless communication protocols. As shown in figure 1, we present the basic architecture of the group intelligence sensing system.

![Figure 1. Structure of group intelligence system.](image)

3. Personalized intelligent recommendation technology
Personalized recommendation system needs to fully understand the needs of users and collect their personal information and behavior records, mainly contains the following 6 functional modules, figure 2 is the basic main module diagram of personalized recommendation system.
3.1. Content-based personalized recommendation services
Content-based filtering is a common information filtering method, which is widely used in email filtering system. The content mainly has the text information composition, through the natural language processing carries on the filter to the information, through the construction model reflects the similarity degree between the item content, mainly uses the method to have the indexing, the word frequency statistics weighting and so on. Content-based filtering is also often used to calculate the similarity between user features and project resources.

3.2. Personalized recommendation services based on collaborative filtering
Co-filtration recommendation is one of the recommended technologies received by research institutions. It is different from content-based filtering recommendation technology, collaborative filtering does not need to understand the content of the project information itself, but through the similarity of users, find a set of users most similar to the specified user group, through the analysis of similar users' preference project information, predict a set of project information for users accords with their preference.

4. Task assignment in group intelligence perception
Mobile group intelligent sensing system is to achieve efficient resource allocation, using intelligent devices held by ordinary users available in the sensing area to provide more efficient services to users such as companies, individuals or organizations. Moving a participant to a point of interest to perform a perceived task brings overhead on distance, energy, computation, and transmission. To compensate for these overhead platforms, there is a need for incentives to attract enough users to participate in perceived tasks. The data submitted by the participants are processed, analyzed and even mined, which can provide the corresponding service to the data requester, thus realizing certain value, and the platform can get feedback from the data requester. Figure 3 shows the group-intelligence computing task assignment process.
5. Research on task assignment algorithm in group intelligence perception

5.1. Accurate algorithm
In precise algorithms, there are branch-bounding methods and Lagrange duality. Branch bound method is generally used to solve integer programming problems\cite{6}. The core idea is to search the solution space tree of the problem according to the breadth-first strategy until the optimal solution is obtained. Lagrange duality introduces the Lagrange operator and transforms the original problem into its dual problem. This takes advantage of the characteristics that duality of any form of the original problem is a convex optimization problem, which transforms the original problem which is not easy to calculate the result into its dual problem. Finally, optimizing this dual problem can get the next or even the optimal solution of the original problem.

5.2. Approximate algorithm
Because most of the optimization problems of group-intelligence task assignment are NP complete problems, it is difficult for us to get its optimal solution in polynomial time, and some methods that can get approximate optimal solution in polynomial time can meet the requirements of the system well. This algorithm to return the approximate optimal solution is called the approximate algorithm. Because most optimization problems can be regulated as several NP complete problems, we mainly define the NP complete problem set coverage problem in group intelligence perception.

5.3. Heuristic algorithm
Heuristic algorithm is to calculate a feasible solution for each instance of the combinatorial optimization problem to be solved under acceptable spatiotemporal complexity. The approximation between the feasible solution and the optimal solution is not estimated. Common heuristic algorithms include genetic algorithm, particle swarm optimization algorithm and simulated annealing algorithm. In this paper we mainly introduce the genetic algorithm used later. Genetic algorithm is a computational model of biological evolution process that simulates the natural selection and genetic mechanism of Darwin's biological evolution theory, and is a method to search for optimal solutions through natural evolution process\cite{7}. Genetic algorithms refer to the feasible solution of the optimization problem as population, each individual in the population contains a gene, and each
feasible solution of the optimization problem is converted into a gene by some coding method. The fitness function transformed by the optimized target can calculate the fitness of each individual, and then the individual's genes are selected, crossed, and mutated into the genes of the next generation population through three operations, so that the cycle is iterative to the set number of times, and the individuals with the highest fitness that appear in them are selected as the optimal solution output.

6. Conclusion
Mobile group intelligence perception is a new technology emerging in recent years, which has the advantages of traditional static sensor networks. With the help of ubiquitous mobile intelligent terminal, this technology is the embodiment of intelligence group in the field of mobile data perception. Research in related fields includes task release, task assignment, data collection, and result feedback. Among them, task assignment is the key and has received wide attention.

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