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Mobile Edge Computing-Based Real-Time English Translation With 5G-Driven Network Support

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ABSTRACT

Real-time English translation (RET) requires high network bandwidth and low network delay to provide better quality experience, and even needs the support of massive connection to provide more services. For the three metrics, the traditional strategies make it difficult to realize RET well. With the fast development of mobile edge computing (MEC) and 5G networking, the guarantee of three metrics has become very possible. Therefore, this paper studies MEC-based RET with 5G-driven network support, called 5GMR. On one hand, 5G-driven network has the natural properties to support high bandwidth, low delay, and massive connection. On the other hand, MEC is used to offload the complex tasks related to the computation of English sentences into the edge server for the efficient computation, which not only saves energy consumption of mobile device but also decreases the whole network delay. In terms of the task scheduling in MEC, genetic algorithm (GA) is adopted to address it. The experimental results demonstrate that the proposed 5GMR is feasible and efficient.

KEYWORDS

5G Network, English Translation, Genetic Algorithm, Mobile Edge Computing

1. INTRODUCTION

English Translation System (ETS) (Zhang, 2020) has attracted much attention from the global research communities, such as Google, Kingsoft and Youdao because it can provide the convenience for all kinds of people. However, with the development of network media, more and more people want to obtain the online (rather than offline) translation services and require to provide the real-time translation results, which causes that the traditional ETSs cannot satisfy the requirements of users well. As a result, Real-time English Translation (RET) rises in response to the proper time and condition. As we know, RET, especially the simultaneous interpretation is regarded as an important assistance for the real-time communication among different regions and countries, and it requires high network bandwidth and low network delay to provide better quality of experience, and even requires the support of massive connection to provide more network infrastructure services. Especially, at the time of the outbreak of COVID-19 (Barouki et al., 2021), RET has being faced greater needs and challenges because almost all of multinational enterprises and important international conferences are very inclined to hold meetings through the Internet. In this case, the large-scale cross domain communication scenario is essential. If there is no the guarantee of RET, everything with respect to the related meetings is empty talk. Therefore, the research on RET is considerably significant.

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To achieve RET, three essential metrics, i.e., high bandwidth, low delay and massive connection should be guaranteed. In terms of high bandwidth, it can support the mass data transmission so as to more concurrent translation requests can be satisfied; In terms of low delay, it makes sure that the users obtain the translation results as quickly as possible, reflecting the instantaneity; In terms of massive connection, it can provide the ability to connect more translation devices so that more users can be served. Regarding the above three metrics, the current strategies are difficult to realize RET well. Under such situation, 5G-driven network (Jain et al., 2020) (Navarro-Ortiz et al., 2020) is at the right time because it has the natural properties to support high bandwidth, low delay and massive connection. However, it is insufficiently powerful for RET only depending on 5G-driven network irrespective of the computation optimization of English translation tasks. In fact, with the fast development of mobile Internet (Kamilaris & Pitsillides, 2016), almost all users use mobile devices (e.g., smartphone) with translation software(s) to do the English translation tasks. Nevertheless, the computation resources and storage resources are very limited, which cannot support the efficient computation on the English translation tasks and thus has the important influence on network delay. With the usage of mobile devices and the limitation of computation resources and storage resources consideration, Mobile Edge Computing (MEC) (Elazhary, 2018) framework has been accepted as a nice candidate solution.

Different from the traditional cloud computing with some limitations (Esch, 2014), such as serious bandwidth load, low response speed and bad security privacy, MEC is deployed at the network edge with a number of mobile devices, with some remarkable advantages (Abbas et al., 2018). For example, it completes information computation and information storage at both mobile devices and edge servers, and thus network delay can be decreased greatly; it does not upload the information to the cloud center so as to guarantee the security and privacy. Using MEC into RET, the complex and redundant computation tasks on English translation can be offloaded into the edge server(s) for the efficient computation. In such way, the whole network delay can be reduced at the same time the energy consumption of mobile device can be saved. To sum up, 5G and MEC have made the guarantee of three metrics become very possible and deployable.

Given the above statements, the major contributions are summarized as follows. At first, a system framework with MEC and 5G network is presented. Then, Genetic Algorithm (GA)-based task scheduling scheme is proposed in MEC scenario. Finally, the simulation experiments are performed based on 10,0000 English translation tasks.

The rest of this paper is organized as follows. Section 2 reviews the related work. Section 3 presents the system framework of RET. Section 4 gives the detailed design on MEC. Section 5 reports the experiment results. Section 6 concludes this paper.

2. RELATED WORK

There have been some proposals on English translation. For example, in (Rahnemoon et al., 2017), the authors investigated and analyzed the thematic structure of English news and their Persian translated version exploiting both descriptive and quantitative approaches, where the extracted data was analyzed by adopting the neural network classification manner. In (Fu et al., 2018), a reliable English-Chinese machine translation system based on artificial intelligence was built, which improved the credibility and accuracy of machine translation. In (Singh et al., 2019), it translated the source language into target language with the help of sentence structure for source language (English sentence) and corresponding reordering rules for target language by using a deep neural network, where the fuzzy matching between the input sentence and the sample sentence in the database was done with cosine similarity. In (Yang & Fan, 2020), the authors used the help of computer aided-translation software memoQ to do auxiliary translation, which reduced translator's burden and improved accuracy and efficiency. In (Vyas et al., 2020), the authors considered the real-time English audio as an input and translated English into Indian language, in which an open source initiative for neural sequence modeling was