Joint Resource Allocation and Trajectory Optimization for Multi-UAV-Assisted Multi-Access Mobile Edge Computing

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Abstract

Unmanned aerial vehicle (UAV)-assisted mobile edge computing (MEC) has been considered as a promising approach to offering extensive coverage and massive computing capacities for Internet of Things (IoT). In this letter, we propose a novel multi-UAV-assisted multi-access MEC model by allowing each IoT user to offload tasks bits to multiple MEC servers deployed at UAVs simultaneously for parallel computing, which can effectively reduce the energy consumption of users and UAVs. The weighted sum energy consumption of UAVs and users is minimized by jointly optimizing the bit allocation, transmit power, CPU frequency, bandwidth allocation and UAVs' trajectories. Due to the non-convexity of the formulated problem, it is decomposed into two subproblems and a joint resource allocation and trajectory design algorithm is proposed by alternative optimization. Simulation results show that our proposed algorithm with multiple radio access outperforms the fixed trajectory, fixed bandwidth allocation and the single access schemes.

Keywords: *Multi-UAV, Edge Computing, IoT, Resource and Trajectory*

1. Introduction

Nowadays mobile edge computing (MEC) has been commonly agreed as a promising technology to help the resource-limited Internet of Things (IoT) users to deal with the computation-intensive and latency-critical tasks [1]. However, in remote regions or disaster areas, it is difficult to provide MEC services for IoT users by infrastructure-based MEC systems. Fortunately, thanks to the easy deployment and flexible movement of unmanned aerial vehicles (UAVs), UAV-assisted MEC can provide ubiquitous communication and computing supports for IoT users. More importantly, as UAVs are operated and move at a high altitude, IoT users are enabled to establish Line-of-Sight (LoS) communication links with UAVs, which can greatly improve the channel gains and thus reduce the offloading energy consumption of users. Driven by the above-mentioned advantages, multi-UAVassisted MEC systems have drawn extensive research attentions. For example, in [2]–[4], the energy consumption minimization problem is investigated by jointly considering the radio and computation resource allocation and multiple UAVs' mobility. Additionally, a computation efficiency maximization problem is formulated in [5] for a multi-UAV assisted MEC system.

2. Literature survey

"Computation-efficient offloading and trajectory scheduling for multi-UAV assisted mobile edge computing," by **Author** J. Zhang et al

The emergence of mobile edge computing (MEC) and unmanned aerial vehicles (UAVs) is of great significance for the prospective development of Internet of Things (IoT). The additional computation capability and extensive network coverage provide energy-limited smart mobile devices (SMDs) with more opportunities to experience diverse intelligent applications. In this paper, a computation efficiency maximization problem is formulated in a multi-UAV assisted MEC system, where both computation bits and energy consumption are considered. Based on the partial computation offloading mode, user association, allocation of central processing unit (CPU) cycle frequency, power and spectrum resources, as well as trajectory scheduling of UAVs are jointly optimized. Due to the non-convexity of the problem and the coupling among variables, we propose an iterative optimization algorithm with double-loop structure to find the optimal solution. Simulation results demonstrate that the proposed algorithm can obtain higher computation efficiency than baseline schemes while guaranteeing the quality of computation service.

"Joint deployment and task scheduling optimization for large-scale mobile users in multi-UAV-enabled mobile edge computing," Y. Wang et al.,

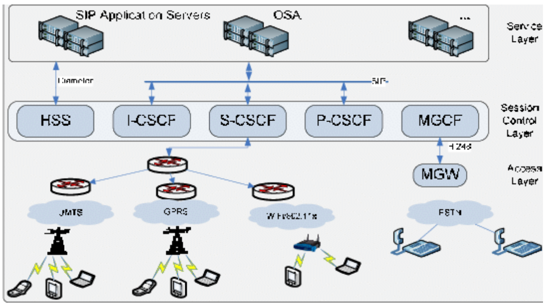
This article establishes a new multiunmanned aerial vehicle (multi-UAV)-enabled mobile edge computing (MEC) system, where a number of unmanned aerial vehicles (UAVs) are deployed as flying edge clouds for large-scale mobile users. In this system, we need to optimize the deployment of UAVs, by considering their number and locations. At the same time, to provide good services for all mobile users, it is necessary to optimize task scheduling. Specifically, for each mobile user, we need to determine whether its task is executed locally or on a UAV (i.e., offloading decision), and how many resources should be allocated (i.e., resource allocation). This article presents a two-layer optimization method for jointly optimizing the deployment of UAVs and task scheduling, with the aim of minimizing system energy consumption

They are executed locally by users. Denote the task of each user as a positive tuple {Li , Ci}, where Li is the size of task measured in bits, and Ci is the CPU cycles required for computing 1-bit of input data. Without loss of generality, we consider a three-dimensional (3D) Cartesian coordinate system to describe the positions of UAVs and users. It is assumed that user i is fixed at the ground and the location wi = (xi , yi) is known to the UAVs. Similar to [3], [5], [6], it is assumed that each UAV k ∈ K flies at a fixed altitude H > 0. For ease of exposition, the mission period T is discretized into N equal time slots with a slot length δ = T /N, where δ is sufficiently small so that the UAVs' locations can be assumed to be unchanged during each slot. Let N = {1, 2, ..., N} denotes the set of the N time slots. At the n-th time slot, the horizontal location of UAV k is denoted as qk[n] = qk(nδ) = (xk[n], yk[n]). We consider the 3D channel model by taking into account the LoS links and non-Line-ofSight (NLoS) links [8] [9]. The LoS connectivity probability.

3. Proposed System

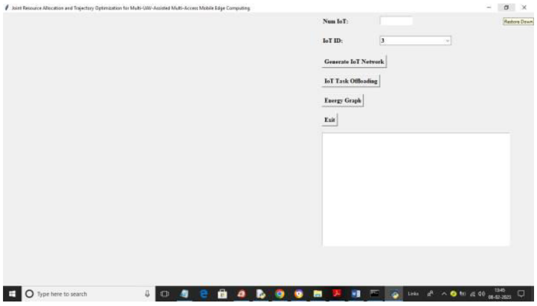
To the best of our knowledge, the potential benefits of multiple radio access in multi-UAV-assisted MEC have not been fully explored in the existing literature. Although the authors in [2] investigate the case where a user can offload task bits to more than one UAV, the performance gain brought by multi-access scheme over the single access scheme has not been shown. Moreover, the bandwidth allocation is not considered. Therefore, in this letter, we focus on minimizing the weighted sum energy consumption of users and UAVs by jointly optimizing the bit allocation, transmit power, CPU frequency, bandwidth allocation and UAVs' trajectories. Due to the non-convexity of the formulated problem, we decompose it into two subproblems. Then, by leveraging the sequential convex approximation (SCA) technique, an alternative optimization algorithm is proposed to solve the formulated problem. Simulation results demonstrates that our proposed algorithm outperforms the fixed trajectory, fixed bandwidth allocation and the single access schemes.

SYSTEM ARCHITECTURE

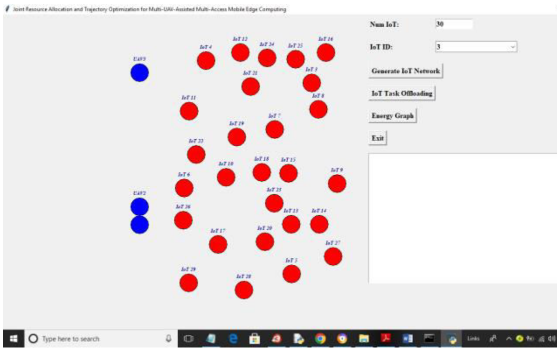


4. Implementation

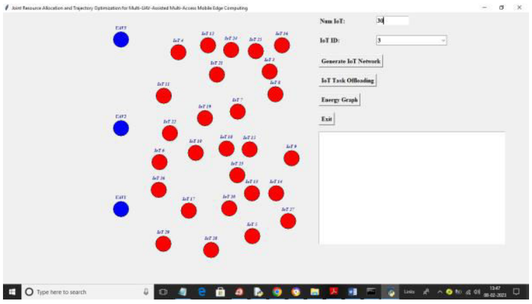
To run project double click on 'run.bat' file to get below screen



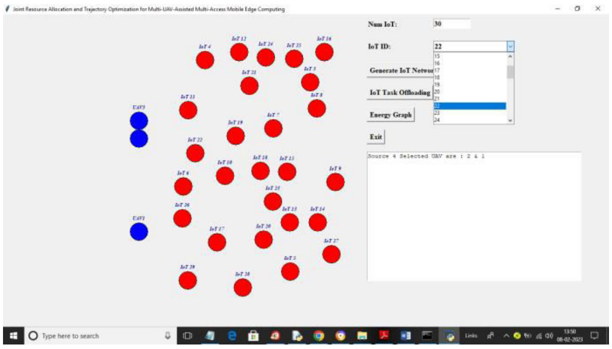
In above screen in first text field enter number of IOT and then press 'Generate IOT Network' button to get below output



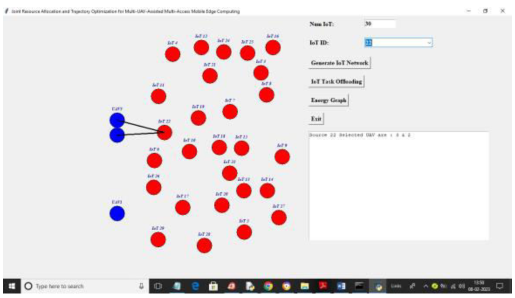
In above screen I entered number of IOT as 30 and after pressing 'Generate IOT Network' we got above output where red colour nodes are the IOT and blue colour nodes are the UAV and we can see UAV are moving which we can see in below screen



In above screen we can see blue UAV are moving and now from drop down box select any IOT ID and press 'IOT Task Offloading' button to offload task and get below output

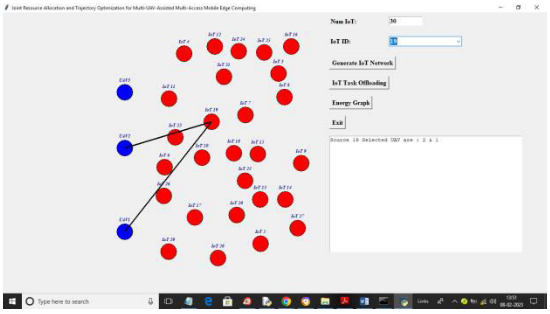


In above screen I selected IOT as 22 and then press 'Offload' button to get below output

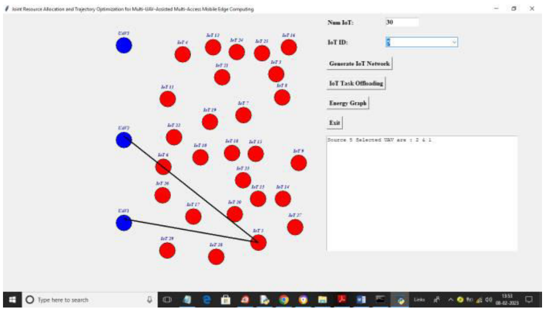


In above screen we can see IOT22 offloading task between two UAV 3 and

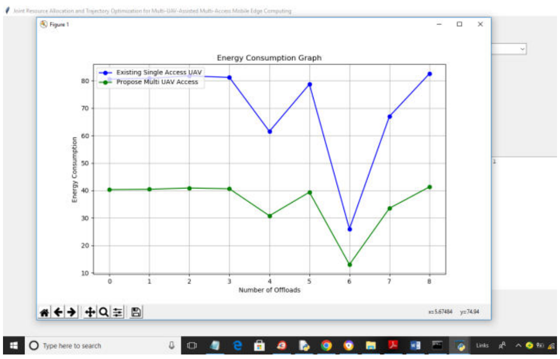
2 and similarly you can select any IOT and offload task to UAV



In above screen we can see another IOT offloading task to multiple UAV and offloading can be known by seeing black connecting line



In above screen we can see IOT 5 is offloading to nearer UAV and now click on 'Energy Consumption Graph' button to get below graph



In above graph x-axis represents number of task offload and y-axis represents energy consumption where blue line represents existing single access UAV energy consumption and green line represents propose multi access UAV energy consumption and in both techniques propose is taking less energy consumption compare to existing.

5. Conclusion

Machine learning approach to predict the Alzheimer disease using machine learning algorithms is successfully implemented and gives greater prediction accuracy results. The model predicts the disease in the patient and also distinguishes between the cognitive impairment. The future work can be done by combining both brain MRI scans and the psychological parameters to predict the disease with higher accuracy using machine learning algorithms. When they are combined, the disease could be predicted with a higher accuracy in the earlier stage itself.

References

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