



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكرو فيلم

بسم الله الرحمن الرحيم



HANAA ALY



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جامعة عين شمس

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Quality of Service and Privacy in Internet of Things Dedicated to Healthcare

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Abstract

The Internet of Things (IoT) based healthcare systems usually composed of medical and environmental sensors, remote servers, and the network. These systems focus on providing remote monitoring, disease diagnosis, and treatment progress observation. The healthcare systems in IoT domain helps in realizing long-term economical, ubiquitous, and patient centered care systems, that result in improving treatment and patient outcomes. This research contributes to the domain by proposing a Cloud-Fog based architecture that can embrace multiple healthcare scenarios, and able to adapt dynamically with the context and status of the patients. It allows the mobility and physical activity of the patients in the environment through deployment and implementation of an appropriate Received Signal Strength (RSS) based handoff mechanism. It also proposes a mobility-aware task scheduling and allocation approach in cloud-fog computing paradigm, called MobMBAR, with the objective of reducing the total schedule time (makespan). MobMBAR performs dynamic balanced healthcare tasks distribution between the cloud and fog devices. It is a data locality based approach that depends on changing the location where the data is computed to where it actually resides. It takes scheduling decisions considering the priorities of tasks represented in their classifications and maximum response time. To evaluate the performance, we conduct an intensive simulation study with different stationery and mobility scenarios, and compare against other state of art solutions. We measure the performance metrics: makespan, network load, energy consumption, percentage of missed tasks, latency, execution cost, number of handoffs, and resource utilization, and study the effect of varying number of tasks, number of cloud devices, handoff threshold, and percentage of mobile devices on the performance metrics.

The experiments show acceptable results in terms of makespan, miss ratio, cost, latency, and network load. In case of mobility support, it shows that missed tasks ratios doesn't exceed one thousandths percent, and is proven to be 88% lower than state-of-the-art solutions in terms of makespan and 92% lower in terms of energy consumption. This research also includes a realistic simulation case study that uses the layout of an indoor hospital building in Chicago, and it has demonstrated acceptable performance. To authenticate and secure communication between IoT device and gateways, the thesis also proposes a DTLS (Datagram Transport Layer Security) based mobility-enabled authentica-

tion scheme for IoT architecture. It ensures mutual authenticated handoff between mobile IoT devices and visited gateways while saving additional handshakes overhead. The performance of the proposed scheme is evaluated in terms of handshake time, processing time, energy consumption, and memory overhead. The results demonstrate its feasibility for limited resource devices.

Résumé

L'Internet des objets (IoT) pour un système de santé est constitué des capteurs médicaux et environnementaux, des serveurs à distance et le réseau. Ces systèmes se concentrent sur la surveillance à distance, le diagnostic des maladies et l'observation de l'évolution des traitements. Les systèmes de santé du domaine de l'IdO contribuent à la mise en place de systèmes de soins économiques, omniprésents et centrés sur le patient à long terme, qui permettent d'améliorer les traitements et les résultats pour les patients. Cette recherche contribue au domaine en proposant une architecture basée sur le principe du cloud-fog qui peut englober plusieurs scénarios de soins et s'adapter de manière dynamique au contexte et à l'état des patients. Elle permet la mobilité et l'activité physique des patients dans l'environnement grâce au déploiement et à la mise en œuvre d'un mécanisme de transfert approprié basé sur la force du signal reçu (RSS). Il propose également une approche de planification et d'attribution des tâches tenant compte de la mobilité dans le cadre du paradigme de l'informatique dans le fog, appelée MobMBAR, dans le but de minimiser le temps total de planification (makespan). MobMBAR effectue une répartition dynamique et équilibrée des tâches de soins de santé entre les dispositifs de fog et de cloud. Il s'agit d'une approche basée sur la localisation des données qui dépend du changement de l'endroit où les données sont calculées à l'endroit où elles résident réellement. Elle prend des décisions de planification en tenant compte des priorités des tâches représentées dans leurs classifications et du temps de réponse maximum. Pour évaluer les performances, nous menons une étude de simulation intensive avec différents scénarios de papeterie et de mobilité, et nous les comparons à d'autres solutions de pointe. Nous mesurons les paramètres de performance : la capacité de production, la charge du réseau, la consommation d'énergie, le pourcentage de tâches manquées, le temps de latence, le coût d'exécution, le nombre de transferts et l'utilisation des ressources, et nous étudions l'effet d'un nombre variable de tâches, du nombre d'appareils en cloud, du seuil de transfert et du pourcentage d'appareils mobiles sur les paramètres de performance.

Les expériences montrent des résultats acceptables en termes de rendement, de taux d'échec, de coût, de latence et de charge du réseau. Dans le cas de l'assistance à la mobilité, le taux de tâches manquées ne dépasse pas un millième de pourcentage, et il est prouvé qu'il est inférieur de 88 % aux solutions de pointe en termes de durée de vie et de 92 % en termes de consommation d'énergie. Notre recherche comprend également une étude de cas de simulation réaliste qui utilise l'aménagement d'un bâtiment hospitalier intérieur à Chicago, et qui a démontré des performances acceptables. Pour authentifier et sécuriser la communication entre les dispositifs IoT et les passerelles, la thèse propose également un schéma d'authentification mobile basé sur la DTLS (Datagram Transport Layer Security) pour l'architecture IoT. Il garantit un transfert mutuel authentifié entre les dispositifs IdO mobiles et les passerelles visitées tout en évitant des handshakes de main supplémentaires. La performance du système proposé est évaluée en termes de temps de transfert, de temps de traitement, de consommation d'énergie et de mémoire. Les résultats démontrent sa faisabilité pour des dispositifs à ressources limitées.

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List of Publications

International Journals

- RM Abdelmoneem, A Benslimane, E Shaaban, “Mobility-Aware Task Scheduling in Cloud-Fog IoT-Based Healthcare Architectures”, Elsevier Computer Networks Journal, 107348.

International Conferences

- RM Abdelmoneem, E Shaaban, A Benslimane, “A Survey on Multi-Sensor Fusion Techniques in IoT for Healthcare”, 13th IEEE International Conference on Computer Engineering and Systems (ICCES 2018), pp. 157-162.
- RM Abdelmoneem, A Benslimane, E Shaaban, S. Abdelhamid, S. Ghoneim, “A cloud-fog based architecture for IoT applications dedicated to healthcare”, 2019 IEEE International Conference on Communications (ICC 2019), pp. 1-6.
- RM Abdelmoneem, A Benslimane, E Shaaban, “Mobility-Enabled Authentication Scheme for IoT architecture”, accepted in IEEE ICC 2021.

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