A New Feature in Mysejahtera Application to Monitoring the Spread of COVID-19 Using Fog Computing

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***Abstract*— Since the imposition of the Movement Control Order (MCO) by the government of Malaysia on 18th March 2020 due to the COVID-19 pandemic, the Ministry of Health (MOH), in Malaysia introduced an application named "Mysejahtera" to track the infected or suspected cases instead of manual tracking to saving cost and time. However, due to the huge number of users and controlling the spread of the virus we proposed a new framework using Fog Computing (FC) technology, to integrate low power-consumption by adding Identification Generator (IDG), and Risk Detector Fog Computing (RDFC), and improves secure connectivity efficiently. Based on FC concept the mobile users will consider as Internet of Things (IoT) environment, and the central storage is Cloud Computing (CC). This extension ensures the application performance higher than the original version of Mysejahtera application and notifies the users of the affected or suspected cases around.**

Keywords*— *Internet of Things, Fog Computing, Cloud Computing, COVID-19.

I. Introduction

Internet of Things (IoT), comes up now to support tens of billions of devices that have limited resources, such as smartphones which are connected to the network directly around us [1]. In addition, it is leading up affecting all of our life plan by digital transformation spreadly. Particularly the wide deployment in the monitoring of our environment, for example, the monitoring of healthcare and medicine, environment monitoring, city management, requiring data processing, real-time decision making, and information extraction [2], [3]. The increasing number of connected IoT devices to the network and cloud computing generates a huge number of data continuously, while some application work in real-time, and any delay will face a real problem, due to all these challenges cloud computing and the heavy number of data will be impossible follow up and meet the requirements with IoT devices. Fog computing is characterized as a scenario for communication and cooperation with a large number of heterogeneous, ubiquitous, and decentralized devices and the network to perform storing processing, and processing tasks without third-party intervention. Thus, the fog infrastructure not only protects the network's parameters also protects a continuum of cloud-to-the-things, like cloud, at the edge of things in the network. Building blocks of the cloud and the fog that extends the cloud are computing, storing, and network resources according to this trend of fog infrastructure. Thus, latency-sensitive applications may be processed on the edge of the network, while delay-tolerant and computation-intensive resource-hungry applications can take place in the cloud [4]. Figure 1 shows an overview to fog computing environment.

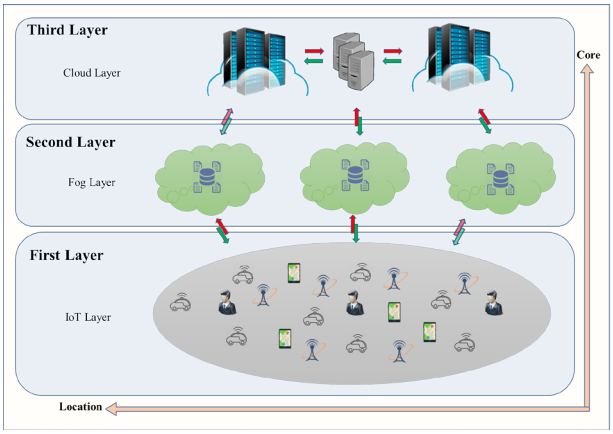

Fig. 1. Cloud computing, fog computing, and Internet of Things environments.

Therefore, IoT environment applied in particular applications and this study proposed to apply a framework to Mysejahtera application. MySejahtera is an application created by the Government of Malaysia to help manage the outbreaks of COVID-19 in the region [5]. It helps people to evaluate themselves and their family for wellness self-assessment. Throughout the COVID-19 epidemic, users can now record their health improvement. Furthermore, MySejahtera helps the Ministry of Health (MOH) to track the health needs of users and take urgent measures to include the appropriate treatments. Mysejahtera is done as collaboration by way of the strategic cooperation between the National Security Council (NSC), MOH, the Malaysian Administrative Modernisation and Management Planning Unit (MAMPU), Malaysian Communications and Multimedia Commission (MCMC), Ministry of Science, Technology and Innovation (MOSTI). Upon the user registration through the registration interface, the

user is required to fill up the 'self-health assessment'. In the next step, the application will classify the user into six categories of classification based on the assessment, and the classification: Low Risk, Casual Contact, Close Contact, Person Under Surveillance (PUS), Suspected Case, and Confirmed Case. Governments are imposing immediate public lockdowns to stop the COVID-19 expansion, causing major economic losses. However, by eliminating widespread lockdowns and more concentrated isolation, we can reduce economic effects. Thus, fog computing in commercial zones can guarantee ongoing economic operations such as shopping centers, buildings, government departments by alerting local residents, while smartphone mobile devices can assist in monitoring the cases that have been contaminated and alleged. Therefore, we proposed this study which is can summarize as follow: Investigate challenges and optimization techniques of fog computing in COVID-19 applications. A new feature proposed IDG, and RDFC. Applying the framework as extension feature to MySejahtera application for reduce the outbreak of COVID-19.

II. Related Works

In this section, we tackled the related proposed frameworks that applied in the field of the healthcare sector and we will focus particularly on COVID-19 applications using fog computing technology. Some studies have concern about the sensors to be as wearable devices and the smart phone consider one of these technologies [6]. The study of Hudaib et. al proposed a model termed as Patient Monitoring System to be a case study.

The implementation method by two steps, the first step is to run the model using cloud computing only, and the second is to run the device based on fog computing technology and evaluate the performance based on standard evaluation measures which are energy consumption, latency, and network usage. This study focuses on the implementation of energy and time latency but there is no consideration for privacy date during the transmission of the data. Smart IoT has gained a lot of coverage, with some important research findings. Sun et, al. [7] proposed summarization of the specifications and problems of data security and privacy protection in IoT applications and propose recommendations for future privacy and security studies.

In order to introduce a privacy management policy and equal motivation to contribute patients to the processing of healthcare data, Tang et, al. suggest privacy protection and benefits focused on different datasets [8]. Another study proposed Fog computing to IoT in order to improve the medical devices based on the concept of the privacy-preserving framework focused on privacy preservation and optimization to provide an accessible privacy security device-oriented [9]. There are several studies used different categories of applications and aspects to enhance the performance to be more efficient and influence such as Artificial Intelligence (AI) Vaishya et al. [10]. Deep Learning (DL),[11]. Deep Transfer Learning (DTL) in the study of [12]. In addition, Machine Learning (ML) [13].

III. Proposed Methodology

This section provides the general framework for the proposed extension method apply to MySejahtera application. The general concept is to enable the application to check in automatically within entering the zone such as school, shopping mall, company and so on. The procedure to check in using the edge device (smart phones) to generates Hash Code (HC) automatically by the Identification Generator (IDG), in the same time the building contains Risk Detector Fog Computing (RDFC) node.

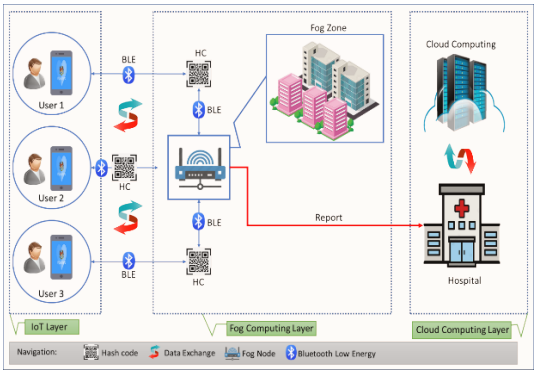

Fig. 2. Proposed framework of fog computing environment.

The smart phone will share the HC with RDFC using the Bluetooth Low Energy (BLE). While the other devices share their HC, each user owned private HC and IDG updated periodically to ensure the privacy for user from hack or detect. RDFC receives the requests from the edge devices and analysis based on the information of HC and if the user low risk the request will be ignored. Casual contact the RDFC notify the other users, and if HC of the user close contact, PUS, suspected case, and confirmed case, RDFC notify the user by message. In addition, the RDFC connected to central cloud CC to store the information and CC is connected to the COVID-19 hospitals, and all the procedure illustrated in Figure 2.

A. *Risk Detector Fog Computing*

Risk Detector Fog Computing (RDFC) is fog nodes located in static zones such as shopping malls, condominiums, restaurants, government departments, and so on. RDFC comprises five principal components which is elaborated in Figure 3, BLE is responsible to receive the HC route requests from the user and HC route reply from RDFC. Next HC reader to decryption the code and transfer the data to task manager. The Task manager is responsible to queue the request from the HC reader to deliver for the next step. RDFC determine the HC information if the user low risk or high risk, and if high-risk status was found the RDFC will send a request to the task manager following the process and generate a new HC to receive by the users warning them a high-risk case around without any information appear of the victim and this information will be assigned to the storage for 14 days only. The check-in will be auto, and the procedure occurs when the users entered the geographical zone of the fog node. In addition, the fog node connected directly to the hospital, and if any high-risk cases reported a notification will send to add for record and all this information will be assigned to the central cloud and will be deleted by the admin only.

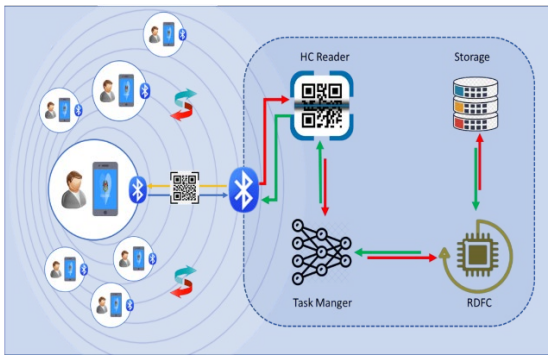

Fig. 3. Risk detector fog computing RDFC.

B. Identification Generator

The term edge devices mean all the IoT devices such as smartphones, smart homes, smart cars, smart cities, smart traffic, and so on. In this study, the consideration of smartphones and particularly is to develop an existing application using the state-of-art and the latest technology which is fog computing. Identification Generator (IDG) a proposed feature applies for MySejahtera application to enhance the performance of the application in cost and privacy perspectives. IDG is a part of the mobile unit collaboration with other features to guarantee secure connectivity. In addition, the mobile unit comprises five principal features. Smartphones, MySejahtera application, IDG generator, privacy block, BLE. The user is required to register with MySejahtera application and provide all the required information. Next, IDG generate the hash code and attach the required information that need by the fog node to determine the status of the user. Privacy block is required to encrypt the data of user and also responsible to change the HC periodically. Next the technology of BLE responsible to forward the HC with nearest zone of fog node to check in automatically. Moreover, Figure 4 shows the procedure of IDG generator.

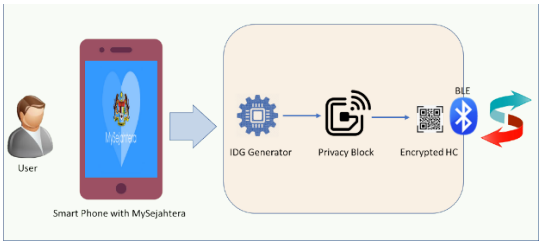

Fig. 4. Identification generator IDG.

C. Proposed Simulation Environment

There are several existing methods can be used to implementation the fog computing model and test the model stimulatingly and achieving the results by simulation to discover any errors or limitation can be appear before implement in the real world this can be decrease the cost and safe time. An examples for this methods MATLAB [14], Python, Java, Amazon Web Service (AWS), and so on. In this study we proposed to use AWS because it provides high accessibility towards the implementation and the required components for implementation can be easily adjustable.

AWS is a division of Amazon offering on-demand cloud computing services and Application Programming Interface (API) to customers, governments, and businesses. These cloud computing web services include a range of simple conceptual, technical architecture, and application-specific key components and tools. Amazon provides several categories of services such as Elastic Cloud Computing (EC2), which is one of them that encourages people to be using the internet as a distributed machine cluster that is always accessible. Digital computer AWS's version is based on certain features of a real machine, like Processing Graphics Units (GPU), Central Processing Unit (CPU), RAM, hard disk, and storage. Networking, including pre-loaded software applications, e.g. web servers, databases, and Customer Interaction Management (CRM). The proposed environment based on services that provides by AWS cloud to implement the fog computing model.

- Application Programming Interface (API): Is a programming interface that is described as multi-software interfaces. It determines types of calls or queries, how to render them, the communication protocols to use the procedures to be followed, etc. It can also include frameworks to broaden current functionalities to different extents and degrees. API completely customizable, component-specific, or structured to facilitate collaboration on an international standard. API allows strategies to manage by way of knowledge hiding, enabling users to be using the interface without being introduced.
- Lambda: a function that preserves operations that are initialized and ready in two digits within milliseconds to react. Lambda is suitable for the deployment of interactive networks, such as online and smartphone backend, microwave, or synchronous API wireless services.
- Load Balancer: involves the procedure of spreading several tasks across a variety of resources in order to make their production output more effective. Load balancing strategies can increase the responding time for each task, preventing intermittent overloads of computing nodes and making other computing nodes inactive.
- Simple Notification Service (SNS): It was supported as part of AWS 2010 as an alert feature. It offers a low-cost infrastructure, primarily for smartphone phones, for the mass transmission of messages.
- Greengrass: It extends AWS services effortlessly to caching apps so that devices can run on their data locally while also using the cloud to maintain data security in maintenance, monitoring, and storage. Smart devices may use AWS Greengrass to enforce statements based on models to incorporate AWS Lambda functions, synchronize system data, and safely interact with several devices.
- Simple Queue Service (SQS): SQS is a secure channel service to isolate and scale limited utilities, frameworks deployed, and modern applications. SQS removes the confusing and cost-related device loading and attempting to run and lets programmers concentrate on market discrimination. Through SQS, messages among software applications of any scale can be sent, stored,

and received without missing messages and without requiring other resources.

- Elastic Container Service (ECS): ECS is a completely operated platform. Because of their privacy, efficiency, and extensibility, customers such as Duolingo app, Samsung. ECS uses them to operate many sensitive and vital applications.

The proposed scenario in Figure 5 the proposed framework applied for MySejahtera application increase the ability to detecting the positive cases in real-time using AWS service. IDG environment works normally as we mentioned in section B using the interface API to forward the HC, the request of HC pass-through API to Lambda. RDFC work in conjunction with IDG to receive and forward the HC depends on performing Lambda. SNS collaborating with the load balancer to notify the users in the zone of fog computing. In addition, Greengrass is responsible for the collection of data locally from the local fog nodes and store the data to central cloud computing by forwarding the packet to the load balancer to manage the data and arrange it preparing for the next step and avoid any redundant collision or packet lose during the transmissions. SQS is responsible for notifying the COVID-19 laboratories about the existing and reported cases. Lastly, ECS operation is a direct connection with cloud computing to shift the data with reliable shifting. This method is applicable to implement, and it allows the users to check-in automatically during the movement and entering the fog zone. This procedure ensures to decrease the cost since the high demand and register manually. moreover, the framework provides a high level of security to protect the data of the users.

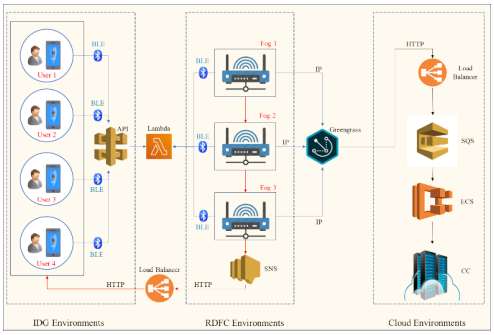

Fig. 5. Proposed scenario for fog computing using AWS cloud.

IV. Conclusion And Future Work

The pandemic of COVID-19 was separated fast, and some countries were taken the action earlier to avoid the high and non-controlled number of affected cases. The technology was attending to contribute a defense using several methodologies. One of these is methodologies is fog computing technology, as it is near the end-user, it can play a very effective contribution to detecting and mentoring the affected cases. This study proposed a framework comprise four main parts. The first part was Mysejahtera application as a main existing feature. The second IDG generator to promote the HC, the third part is RDFC to determine the low-risk and high-risk cases. The fourth part is the central cloud computing to sorting the data. This framework can be implemented and low cost with secure connectivity and also can be applied heuristic algorithms for more high accuracy.

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