Chapter 5

Novel Approach to Anticipate Emerging Infectious Diseases Spreading and Epidemics

ABSTRACT

In recent years, especially in 2014, Africa, as well as the whole world, has faced an Ebola epidemic. The facts have demonstrated the weakness of the global crisis management and limitation of existing diseases prediction, prevention, monitoring, and surveillance systems and policies. From 2015 until today, many studies have been carried out and systems have been implemented to improve the global infectious diseases monitoring. Most proposed monitoring systems consist of using wearable sensors for the remote sensing vital parameter in an individual. These monitoring systems are, however, limited. This chapter proposes a novel infection monitoring and prevention system using a hybrid crowdsensing paradigm to overcome the limitation of existing systems. The proposed system uses large-distance optical sensors (e.g., fiber Bragg grating sensors) for sensing bio-signals in individuals within (ad-hoc) crowds to anticipate any risks of emerging infectious diseases spreading or epidemics.

INTRODUCTION

Infectious diseases can quickly spread to a crowd at a market or supermarket, festivities, dancing clubs, schools, universities, etc. Therefore, it matters to monitor any (ad-hoc) crowds, especially in regions and eventual in season at high-risk for infectious diseases.

The tendency today in diseases surveillance consists of collecting epidemiological data on emerging infectious diseases through social media, wearable sensors systems, or mobile applications and carrying out the analysis by examining the collected epidemiological data. Screening for diseases is one of the oldest traditional diseases surveillance methods. It consists of asking and medically examine a patient or an asymptomatic individual in order to early detect diseases. This method presents certain limitations in early detecting the pathology. In much of cases, diseases are quite late detected and can only be treated than prevented, people do not adhere enough to the screening programs. Additionally, the results of screening for diseases can be wrong or biased.

In the age of information and communication technology, many social web-platforms are used to collect epidemiological data to predict and prevent (infectious emerging) diseases and health conditions. For example, Foodborne Chicago[1] and Flu Near You[2] are social media application used to collect diseases and health condition related data (Christaki, 2015). Though, collecting data through social media applications is limited in its "participatory" and/ or voluntary aspect. Furthermore, they present a geographical surveillance gap due to limitations in communication infrastructures in low- and middle-income countries. To overcome this limitation, mobile phone application is using to collect epidemiological data on infectious diseases, since the mobile phone is widely distributed in these areas (Christaki, 2015). In (Brownstein, Freifeld, Reis, & Mandl, 2008) have discussed the limitations of the internet based diseases surveillance using the example of the Health Map system. The authors summarize the limitations of the HealthMap as follow:

… While Internet-based online media sources are becoming a critical tool for global infectious disease surveillance, important challenges still need to be addressed. Since regions with the least advanced communication infrastructure also tend to carry the greatest infectious disease burden and risk, system development must be aimed at closing the gaps in these critical areas…

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