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# Architecture for Epidemiological Data Collection System

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***Abstract*— The spread of the disease in the region need to be known quickly in order to overcome as soon as possible, so it doesn't become a widespread epidemic. Many researcher of epidemiology in Indonesia collect primary data using interview method face-to-face. This method can take its advantage of social cues such as voice, intonation, body language, etc. of the interviewee that can give the interviewer a lot of extra information. This method has several disadvantage such as need a lot of time and cost to collect the data also the risk to the interviewer infected by the disease at the epidemic region infectious disease. We propose an architecture of health IT that using online consultation to give health solution to society and also collect primary data for research of epidemiology. Online consultation based on Android mobile application will reduce the time and also the cost for collecting primary data and avoid the researcher from disease at the infectious disease epidemic region.**

***Keywords*— Epidemiology, method, architecture, online consultation**

## I. INTRODUCTION

The spread of disease is a serious issue in most developing countries. Efficient and effective actions are required to be taken in order to avoid the disease become a widespread epidemic. Common epidemic issue such as supressing Malaria in Indonesia and the recently founded Zika virus in Southern America have become an important issue that require immediate action.

One of the most important factor in avoiding an outbreak is the ability to act pre-emptively and response quickly against an epidemic issue. This actions are possible only when the system has an effective and efficient method to retrieve and process health related data from the community. An efficient system must have the capability to collect the data in real time and able to reach most part of the community while efficient system must be easy and affordable to be implemented.

There are a few available methods to perform health data collection. The mostly used method is to use medical institution spread amongst the community as the main source. By attaching an e-health based system in this institution, public health sector can easily monitor the occurrence of epidemic. [7] and [8] are two research examples that successfully implement a continuous data collection/monitoring of a community health by using an implementation of e-health. This method however has a few weaknesses. Establishing a medical institution requires funds. Thus, a profit driven private institution tends to neglect the poor community and government supported institution will cost a lot of fund. Moreover, this method works only after the epidemic has happened.

The current trend in wearable device gives another option to gather health information from users. This method uses wearable devices as health sensors attached to multiple users. [4] proposed an architecture that uses the health sensors to perform data collection. While this method is currently gaining popularity in digitalized health system [5], it currently has limited capability to detect symptoms. Furthermore, there will be massive of data redundancy since the sensors will also gather information even if there is no epidemic related issue occurred.

In this paper, we propose a new method to perform epidemiology data collection. Our method used a computerized system that allows community to autonomously send data via it's mobile phones. We wrap our data collection application as an Auto diagnostic application. Thus, users will be

motivated to use the application and simultaneously participate in collecting health data.

## II. System Requirements

Based on the motivation stated in the previous section, we concluded a few requirements that have to be satisfied in building the architecture of our system. Since it highly depends on user's initiative to collaborate, it has to encourage them to use the application as a source for alternative diagnosis. Hence, the conclusions made by the application must be accurate and highly reliable. Moreover, to increase the accuracy of the result, the system must have the capability to evaluate the conclusion it has made in previously. This evaluation must be supported by medical staffs and/or doctors as its main source. These personnel must have capability to increase the capability of the software by evaluating its previous conclusion.

The system must also have the capability to construct an information based on the symptoms and location data entered by the user. We decided that it is convenience to have the capability to render a map and point the location of occurred symptoms in an area.

## III. System Architecture

The architecture overview of the proposed systems can be seen in figure 1. The system consists of two main part: AutoDiagnostic and SymMapping. AutoDiagnostic is a mobile phone application responsible to gather data from its user. We build a health consultation application as the front end of the application to encourage the user to contribute in data collection process. This application gives medical advice based on symptoms entered by user. These data are then sent to the server. Attached to the symptoms data is the user's location. To protect the user's privacy, the data sent by the application is anonymous. The application does not send private user's data such as user's name or mobile phone number.

The second part of the system, which is called SymMapping, is responsible to process the data and create an information of occurred symptoms in a certain area. The data is gathered from the AutoDiagnostic's server. These data will be mapped based on their locations. By using a map features provided by Google [6], users can view the distribution of symptoms based on their location.

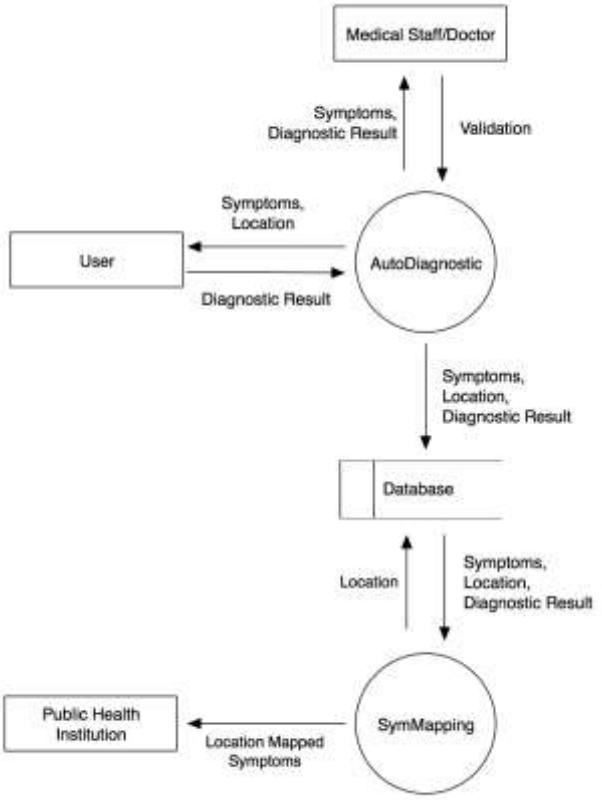


Fig. 1 System Architecture of The Proposed System

## IV. Neural Network Diagnostic Application

As described previously, the system collects data by using a health consultation application called AutoDiagnostic. The purpose of this application is to give its user a medical suggestion based on the symptoms entered by user. To keep the simplicity of the application usability, the application only requires keywords of symptoms as input data. Using these keywords, the application will search for the most possible disease based on the symptoms. The interface design of the application can be found in figure 2.

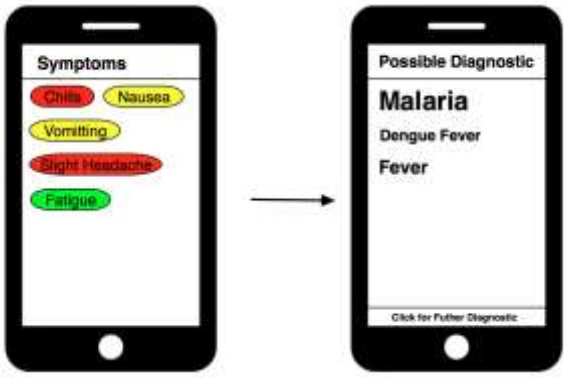


Fig. 2 The Interface Design for AutoDiagnostic

To to retrieve a conclusion of possible diseases based on the symptoms entered by the user, we use neural network model. Neural Networks models is a model in computer science to create an artificial intelligence in a process of decision making. Proposed in 1943 by McCulloch et al. [3], this method uses a simple mathematical modelling the use the combination of parameters and their weights to create rules. These weights are updated by performing a learning process. This process usually contains a predefined set of data

Frequently proven as an effective method, neural network has also been used in many research to create an automated diagnostic application. [1] has developed a system that use neural network to detect pneumonia based on its symptoms. [2] proposed a similar solution to detect lung cancer. Both solution gave a good result on performing automated diagnostic.

Our proposed application shares the same idea; by using a model of neural networks, it will predict the disease based on symptoms entered by the user. Neural network model requires a learning process to increase its ability to create a conclusion. Thus, the system requires medical staffs and doctors to train the system. This learning process is done my mapping the symptoms to any possible disease. This process is done during the application development process. To increase the accuracy of the model, the system will also be evaluated periodically based on the conclusion that has been made.

## V. Location Mapped Symptoms Occurrence

After the collection process is done, the next step is to map these data in an understandable presentation. The objective is too map the symptoms entered by users to their location. This mapping process is done by a web based application called SymMapping. The application uses symptoms and location data retrieved by AutoDiagnostic. The application will then render a map with information of the most common symptoms occurred in a location. Figure 3 shows the interface design of SymMapping.

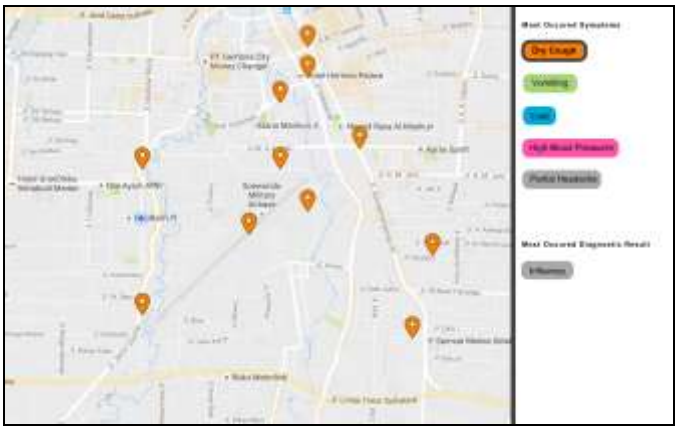

Fig. 3 System Architecture of The Proposed System

By using this information, public health institution may conclude the actions needed to be taken based on the currently reported symptoms. Since the application also provide location information, the action taken can be more specific to a certain location.

## VI. Conclusions

We have proposed a method to collect epidemiology data by using an automatic diagnostic mobile application. By using this application, user may be motivated to voluntarily enter the symptoms data. To increase the capability of the application, we propose the use of neural network model. This model allows the system to be improved in the future by validating the diagnosed result.

These data are then mapped to their location. To render these data, we propose SymMapping to rendering a map with the symptoms occurrence placed on the map. This web based application will be used by public health institution as a source to detect epidemic related issues on a certain location.

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## REFERENCES

[1] Abdullah, A.A., Posdzi, N.M., Nishio, Y., *Preliminary Study of Pneumonia Symptoms Detection Method Using Cellular Neural Network*. International Conference on Electrical, Control, and Computer Engineering 2011 (InECCE), pp. 497-500, 2011

[2] Miah, M.B.A., Yousuf, M.A., *Detection of Lung Cancer from CT Image using Image Processing and Neural Network*. International Conference of Electrical Engineering and Information Communication Technology (ICEEICT), pp. 1-6, 2015

[3] McCulloch, W.S., Pitts, W., *A Logical Calculus of The Ideas Immanent in Nervous Activity*. The Bulletin of Mathematical Bibliophysics, Vol. 5, pp. 115-133, 1943

[4] Jalali, R., Dauda, A., El-Khatib, K., McGregor, C., Surti, C., *An Architecture for Health Data Collection Using off-the-shelf Health Sensors*. IEEE International Symposium on Medical Measurements and Applications (MeMeA), pp. 1-6, 2016

[5] Song, L., Wang, Y., Yang, J., Li, J., *Health Sensing by Wearable Sensors and Mobile Phones: A Survey*. IEEE 16th International Conference on E-Health, Networking, Applications, and Services (Healthcom), pp. 293-297, 2014

[6] Google, (2005) Google Map, Homepage of Google Map Available: https://maps.google.co.id

[7] Ndume, V., Gyekye, Y.N., Lyatu, I., Ko, J., A *Methodology for Data Collection and Interation of e-Health Records: A Case Study of Ifakara Health Institute in Tanzania*. Pan African International Conference on Information Science, Computing, and Telecommunications (PACT), pp. 131-136, 2013

[8] Nita, L., Cretu, M., Hariton, A., *System for Remote Patient Monitoring and Data Collection with Applicability on E-health Applications*. 7th International Symposium on Advanced Topics in Electrical Engineering (ATEE), pp. 1-4, 2011