The principle of in vitro diagnostic system based on mobile Internet terminal and the implementation of data acquisition subsystem

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Abstract. In Vitro Diagnosis is an important supplementary means for diagnosis and treatment of diseases. Most of the In Vitro Diagnosis on the market is a combination of data acquisition and analysis instrument, of which portability and the cost are restricting factors in its development and promotion. This research routine prepared urine test consumables for laboratory testing by putting the reagents curing on material such as plastic, where Signals can be collected after detection of consumables and urine react. Further more, Signals were sent to the cloud by Mobile phones and other mobile terminals, report would be generated in a instant by using the methods of Image processing, cloud computing, data mining and biological sensing to analysis Routine urine indicators. In Vitro Diagnosis created by this study could generated individual testing results, in accurate, rapid ,convenient way, reducing the costs of testing, and facilitate health survey.

1 Introduction

With the increase of human life expectancy, and health care advancement, disease spectrum and the change of Medical and health service needs, people pay more attention to disease prevention, health maintenance, and improvement the quality of life. In Vitro Diagnosis as the most objective auxiliary diagnosis technology plays more and more important role on improving the medical quality and protecting the public health[1-2]. However, medical examination under traditional hospital is difficult to meet the demand of medical examination for Large stream of people and high frequency, as shown in Fig.1. In present years, a large number of institutions have tried to optimize medical procedures and ease relevant issues that valid data could not be obtained economically and conveniently, and it is subject to existing hospital services. In Vitro Diagnosis with mobile terminal by using biosensing technique and cloud computing as the core can be the most promising technology to replace traditional process of in Vitro Diagnosis. Therefore, this research created a new system to conduct in vitro diagnosis suited to operation procedure of mobile internet, which will facilitate individualized medicine and bring cheap and quality health care to the masses .
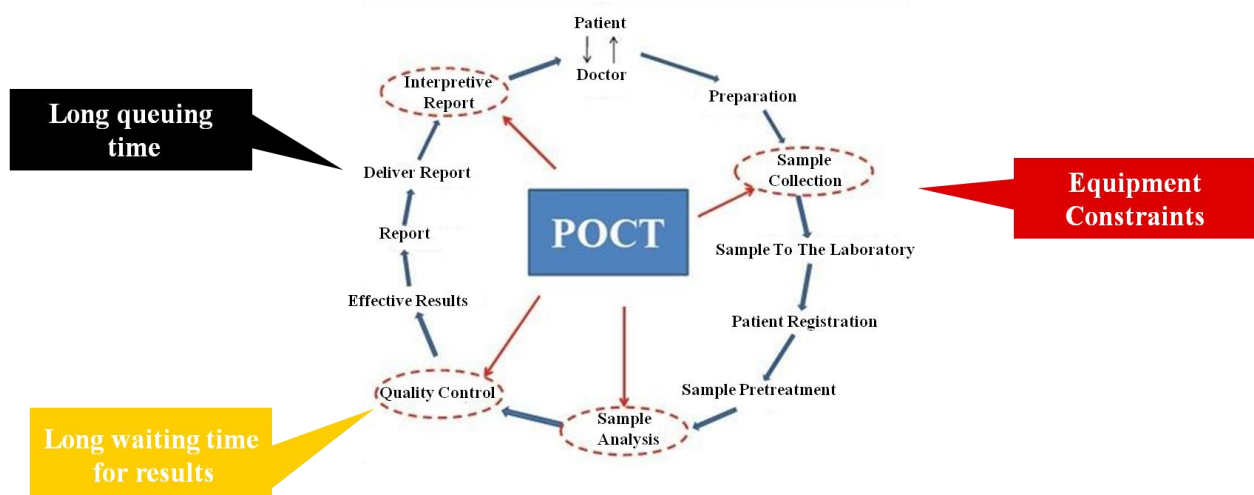

Figure 1 .Traditional in vitro diagnostic process

2 Method

A Medical detection or diagnosis system based on mobile Internet terminal is generally made up of five elements, user physiological data acquisition，data preprocessing, data transmission, data analysis and assisted diagnosis, and the result communicating to the user, as shown in figure 2. At present, the popularity of smartphone is increasing, and it is ideally suited to front-end data collecting and processing, as well as the information communicating and archiving, considering its ever increasing processor power, sensor communication interface, and strong ability of wireless communication.
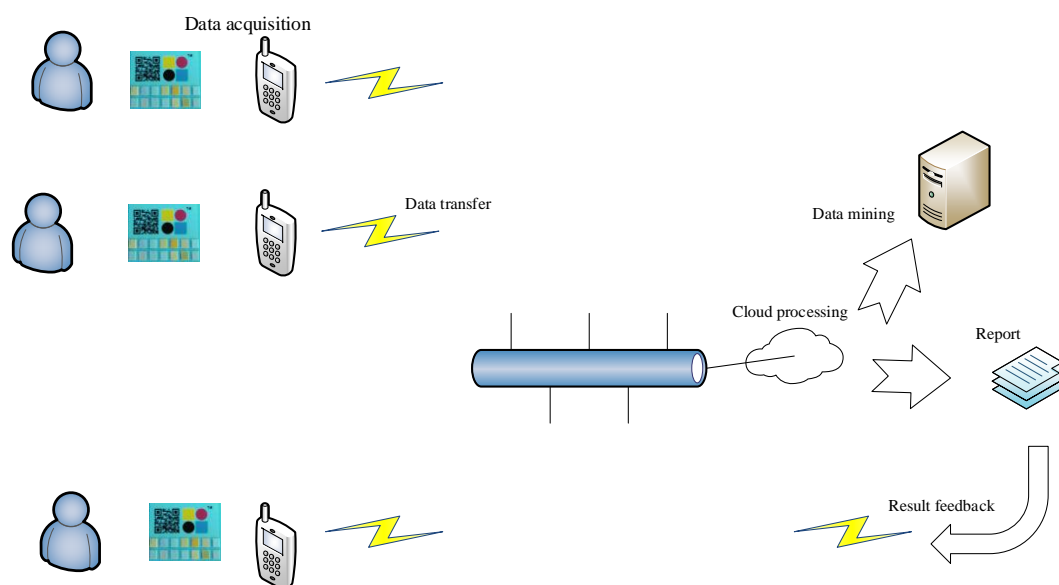

Figure 2. Medical diagnosis system based on mobile Internet terminal diagram

Routine urine analysis is a basic item of physiological indexes, and therefore we focused on routine urine analysis the development of a complete mobile Internet diagnosis system.

2.1 data collection

The convenience and accuracy of data acquisition is directly related to the effectiveness and efficiency of the whole system. Design a method to get the user's accurate physiological index data easily and on the cheap is one of the technical difficulties that need to be solved in vitro diagnostic system. Generally, data acquisition can be divided into two categories: dry chemistry and wet chemical sensor. Dry chemical is flake-like dried in vitro diagnostic reagents and then attached to the plastic support, packed for preservation[3]. Wet chemical is usually tube-like and its core is a tiny tube containing in vitro diagnostic reagents[4]. It will produce light absorption, absorption peak shifts, scattering/refractive index change, producing voltage/current, producing fluorescent glow/enzymatic/quantum dot light emitting and such a physical change after the sample contacting with the reagents[5]. A biological sensing technology will be proposed to solve the problem of in vitro data acquisition in this system, in short，a sensor contacts with in vitro sample, then produce chemical reaction and reaction intensity is translated into physical signals so it can be captured by mobile phones and other mobile terminals. As shown in figure 3, is a urine routine index detector that be designed with biological sensing technology.

Figure 3. A urine routine index detector

As shown above, the bottom 2 lines block of color are curing dry diagnostic reagents, 2D barcode can record information such as manufacturer, batch number, channel, the expiration day. Others are the standard reference colors which can be used to determinate the light environment. An Independently developed real-time color image processing tools can convert image data into in vitro urine test data; Using available commercial cloud services, PHP web development tools and MySQL database to accomplish data transmission, storage and management.

2.2 The data preprocessing and information transmission

The data preprocessing include improving the SNR(signal-to-noise ratio) of data, reducing noise to improve the efficiency of subsequent processing. High resolution camera is smart phone standard peripheral equipment that comes with image processing procedures which can be used to get high quality images. So the results of routine urine sensors would be scanned into images with a mobile phone camera, in this way, not only the process is convenient and quick, but also can ensure the follow-up image algorithm and processing carry out on good image.

The transmission of signals is a necessary bridge to link the user terminals and the big data processing server; We using Wifi network and 3 g / 4 g mobile network as information interaction highway in this system that densely cover our live increasingly .

2.3 Diagnose

Data analysis and prediction is a key part in the process of diagnosis, in addition, the mining capacity of implicit information in large data is also important to Advance system[6].The system prediction model is responsible for big data analysis and set up in the cloud server, and it's main analysis processing as follows: image analysis, signal extraction, the reaction environment analysis, database comparison and generate test report. So, the user can submit images in any of the front-end (such as WeChat public number, APP, camera, image upload) meanwhile get the test report   by PHP image analysis system on the cloud, furthermore, we can realize rapid analysis with the characteristics of easy to extend and load balancing of cloud system, then, the whole analysis process can be finished in 5   seconds.

2.4 Result feedback

Finally, at the end of diagnosis, feedbacks including results or proposal to the user or to the doctors will be generated. It at least includes (but not limited to) "yes" and "no" answer, so it can communicate testing result to the user and assist the doctor to make diagnosis. So, the system will send back an analysis report including the result and suggestion. Figure 4 is a sketch of the proposed system.
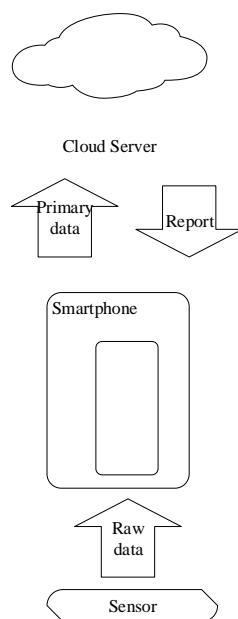
Figure 4. sketch of the proposed system

3 Summary

This in vitro diagnosis product based on mobile internet has the following characteristics : point of care testing, hardware-free portability, simplicity of operation, convenient to use and rapid report generation. Routine urine indicators were collected under family environment in contrast to obtain result via urine detector under hospital. This in vitro diagnosis product could reduce the test cost and facilitate health census. This study have realized data acquisition function of chemical physiology, and extended detected modules containing biochemistry, immunity are under way, specific protein analysis and gene analysis, which has a broad market application value. Moreover, This research laid a solid foundation for physiological data standardization and remote automatic screening diagnosis.

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