Final Project Report

May 05, 2014

Project Title: ITongue: An IPhone App for Personal Health Monitoring Based on Tongue Image

Funded by: the Interdisciplinary Innovations Fund (IIF) of the MU Information Technology Committee

Project Report Period: January 01, 2013 to December 31, 2013

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Project Description:

The "iTongue" system is able to let the users get their health status within a few minutes. What the users need to do is use their mobile device to take a picture of his/her tongue and the iTongue system will be able to diagnose his/her health status and send back the information. This system is consisting of the client side and the server side program. The client side of the system is an ios app that can run on any ios device with cameras. The system architecture is show in Figure 1.

The main functions of the app include taking photo, uploading photo to the server and recording the medical advice that the iTongue system provides to the user. From the home screen in Figure 2, we can see that the main functions of the iTongue system. The app allows the user to get diagnosis from their tongue image, keep track of their medical history and monitor their tongue appearance for abnormal changes. The process to get the diagnosis result is very simple, user only need to click on the "Tongue Diagnosis" button, and then the interface on Figure 3 (a) will show up. On this interface, the user can decide if he/she wants to shoot a new photo or use the older photos taken previously.

Then after choosing the tongue image or taking the new tongue image like Figure 3 (b), there is a questionnaire like Figure 4 that includes 8 questions the user can fill out.

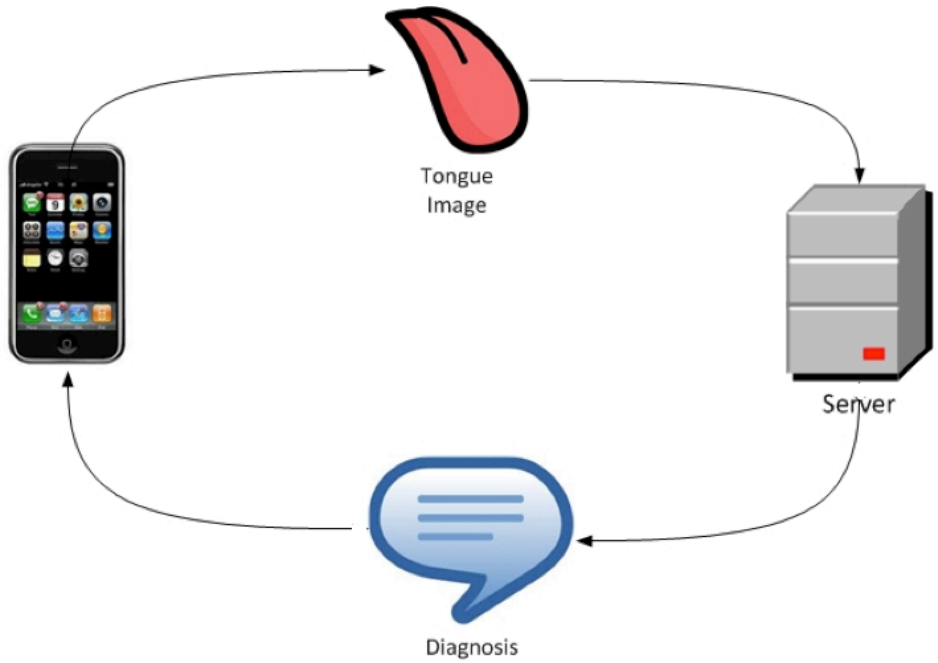


Figure **Error! No text of specified style in document.**. iTongue system architecture

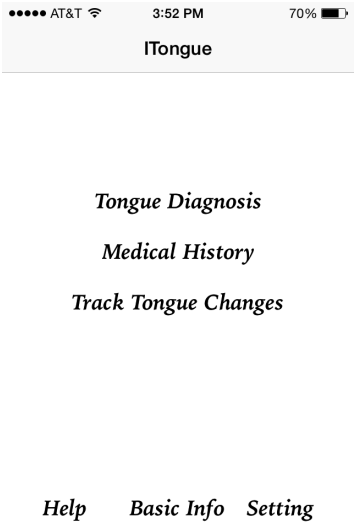
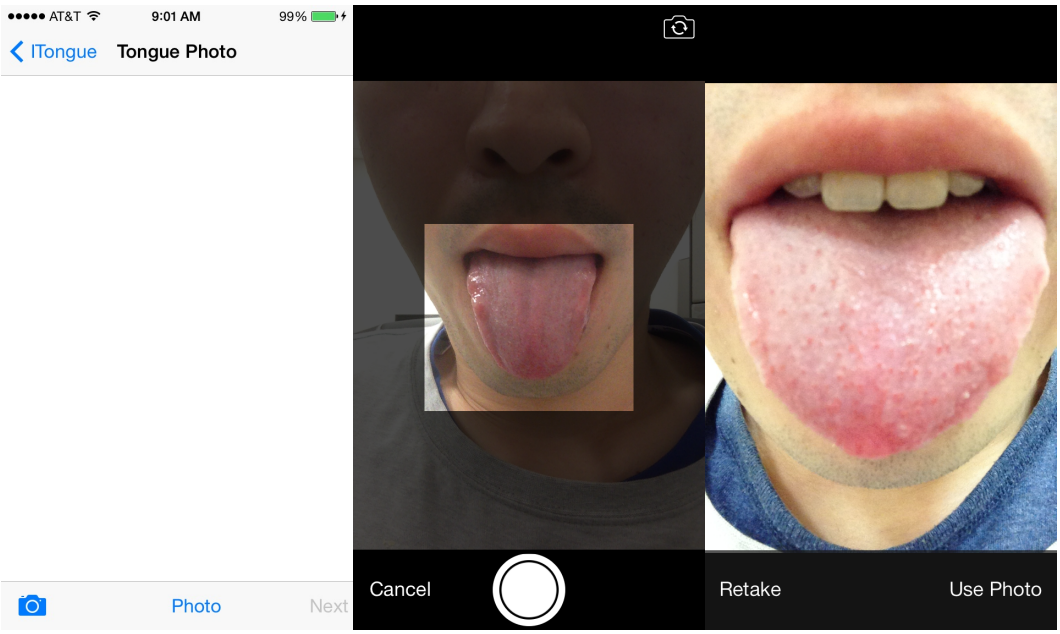


Figure 2. Home screen of the iTongue app



(a) (b) (c)

Figure 1. User Interfaces to get new Diagnosis

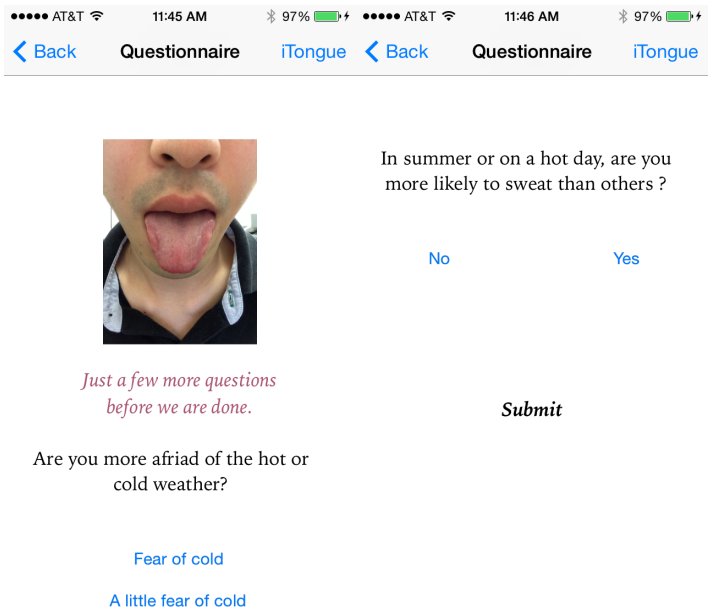


Figure 2. Questionnaire

The questionnaire is optional, but we recommend the user to fill it out because it can improve the accuracy of the diagnosis result, the questionnaire includes the following questions:

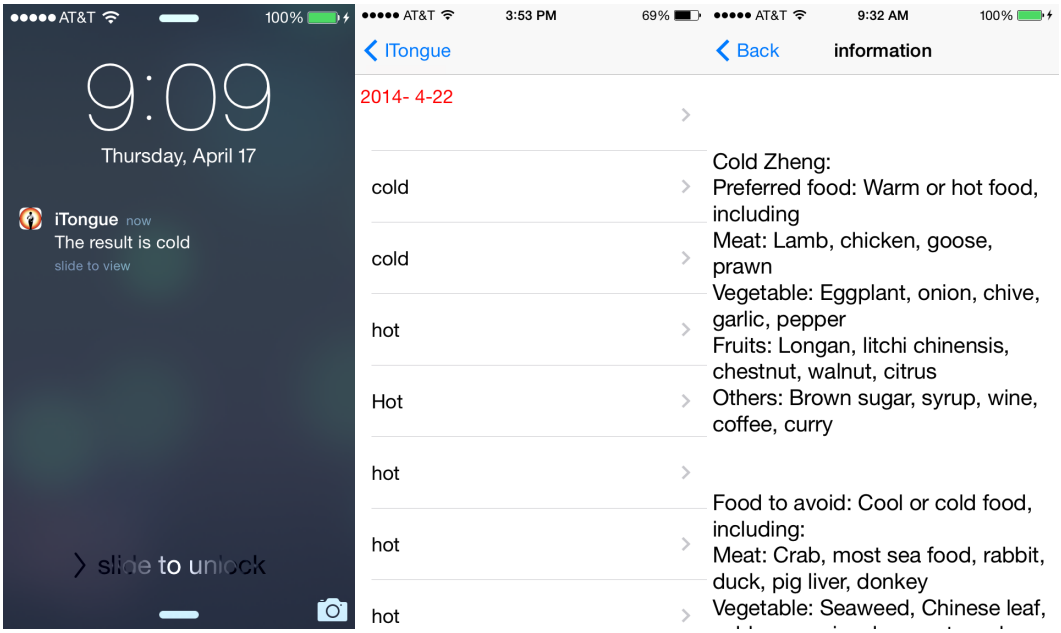
1. *Are you more afraid of the hot or cold weather?*
2. *Do you feel your hands and feet warm or cold?*
3. *Do you prefer hot or cold food and drink on daily basis?*
4. *Typical stool texture*
5. *Do you often get diarrhea after eating raw or cold food?*
6. *D you often flush and feel thirsty*
7. *In cold day, do you need to wear more clothes than others?*
8. *In summer or on a hot day, are you more likely to sweat than others?*

If the user has answered all the questions, we will get a diagnosis in the form of "hot, cold and normal" based on the answers. Then we can combine the diagnosis of the questionnaire with the diagnosis based on the tongue image. After pushing the submit button at the bottom of the questionnaire, the photo will be sent to the server. In order to send the photo faster and occupy less bandwidth, in the current version of the iTongue app, before sending the photo, we use the JPEG algorithm to compress it. Then after the server receiving the photo, the server will run the

whole diagnosis process to get the result for the user. Then the diagnosis will be sent back in the form of push notification like Figure 5(a) shows.

In order to help the user to keep track of their diagnosis history easier, we added the "Medical history" interface for the user. By pushing the "Medical History" button on the home screen, the user will be able to see the user interface like Figure 5(b). In order to let the user keep of his/her medical history easier, we categorize the entries into different dates. If the user is interested in any special entry, he/she can simply push on it and another user interface like Figure 5(c) with details will show up. In this user interface, we provide advice that improves the user's health based on his/her information.

The server side program is realized in PHP script. The server program has five functions. (1). When user upload their tongue image, the server will save it in their personal image folder and then save the new image information into the MySQL database. (2). The server runs matlab program to do the tongue image segmentation. (3). The server runs the matlab program to detect the difference area on the tongue. (4). The server use libsvm to get the diagnosis for the patient. (5). The server sends the diagnosis back to the server by push notification.



(a) (b) (c)

Figure 5. (a) The tongue diagnosis result. (b)-(c) Medical history user interface.

Project Outcome and Impact:

Thanks for the support of IIF, the project has successfully finished all the original goals. The project has drawn a lot of interests from Local, State, National, and International media. We have a Postdoc, two Ph.D students, five MS students, and several undergraduate students participated

in this project. We have forged an international interdisciplinary collaborating with Professor Xu Jiatuo from Shanghai University of Traditional Chinese Medicine. Dr. Xu is an expert in TCM and in particular tongue imaging. He is the leading author of a popular book on tongue imaging/diagnosis. He had developed professional tongue imaging device to be used in clinical setting in China. He has been visiting us in MU since last June.

Currently we are working with Brett M. Maland from the MU Office of Technology Management and Industry Relations on exploring potential technology transfer opportunities of this product. We are currently having serious talks with the SUTI Holdings INC in Irvine, CA, a company specialized in spin-off high tech stuff. An option between SUTI Holding INC and MU will be executed very soon. The following is a partial list of media coverage of the project.

http://www.emaxhealth.com/1020/tongue-analysis-future-smart-phone-app-warns-health-risks

http://www.medicaldaily.com/new-software-analyze-health-tongue-scan-240598

http://beforeitsnews.com/health/2012/05/new-software-to-analyze-health-by-tongue-scan-2185869.html

http://www.nyrnaturalnews.com/testing/2012/05/east-meets-west-as-tcm-tongue-analysis-software-detects-disease/

http://www.examiner.com/article/social-media-webcam-photos-will-be-used-to-diagnose-health-by-looking-at-tongues

http://www.dailymail.co.uk/news/article-2150915/New-smartphone-app-tell-healthy-just-taking-picture-tongue.html

http://www.smartplanet.com/blog/smart-takes/computer-analysis-of-tongue-predicts-health/26789

http://www.glamour.com/health-fitness/blogs/vitamin-g/2012/05/say-ah-3-weird-things-your-ton.html

http://in.lifestyle.yahoo.com/ancient-chinese-medicine-predicts-health-seeing-tongue-appearance-102716904.html

Fund Expenditure:

We have spent all the $25,000 awarded by the IIF committee. All the funding has been used to support the following personnel: Tayo Obafemi-Ajayi (Post-Doc), Xu Wang (graduate research assistant), Wenchuan Qi (graduate research assistant), Hao Chang (graduate research assistant), and Xiaochen Yang (graduate research assistant).