# Activity Based Mobile User Interface Visualization for Geo-Applications

Tekeste Demesie Dagne[1], Elefelious G. Belay[2(✉)], and Stefano Valtolina[2]

[1] Faculty of Computing, Bahir Dar University, Bahir Dar, Ethiopia
lolteke@gmail.com
[2] Department of Computer Science, University of Milan, Celoria 20, 20133 Milan, Italy
elefelious.belay@unimi.it, valtolin@di.unimi.it

**Abstract.** Mobile interface design covers wide range of issues, ranging from user type to user activity. Considering mobile interaction in spatial context of use, we propose activity based UI configuration for mobile geo-applications. The proposed approach were evaluated using point-of-interests application on three common human activities. The results showed that our approach ensures good context detection performance and enhances usability.

**Keywords:** Mobile interaction design · User activity · UI visualization
User experience

## 1 Introduction

The diversified environment in which mobile device is used has become a critical challenge for the development of mobile apps [1]. As mobile apps become more complex and versatile, specific development tools as well as efficient UI design frameworks have paramount importance. This eventually facilitates development of usable, interactive and high-quality mobile applications.

Nowadays, mobile apps are being used in various situations, user types, and context of use. These applications need to adjust their behavior and interface to respond as per the current contextual factors and user preference. Usability of the applications also depend on different contextual factors, these factors include user, task, environment and device [2]. It is therefore important to analyze and define the various contexts and context of use to design and develop applications, which will know when and what to adapt to improve usability.

Mobile apps that can change user interface at runtime based on the context (such as activity) will enhance user satisfaction, efficiency, and effectiveness, it will also foster good user experience. Adaption provide a way to adjust various display options during the context change. The change includes layout item, size, color, ways of displaying interface, presentation of menus and lists.

This paper presents some evaluation results of our model in providing suitable mobile (geo-app) UI based on user's activity and provide a visual adjustment.


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## 2 Related Work

Mobile interaction design is about shaping the experience of using a mobile apps [3]. In recent years, a number of efforts has been devoted in designing mobile interfaces considered various aspect of the users and user groups. These features includes the user skill, knowledge, experience, and their context of use [4–6].

Adaptive mobile applications can adapt itself at runtime automatically based on the dynamic user profile and contextual data gained from the end user or the environment [7]. An experiment were conducted using smartphone (AdaptiveCalc) to measure the performance and acceptance of the adaptive UI with the non-adaptive one. And the overall result showed has better acceptance and performance rate [7]. Other efforts include: ArcheoApp which is an adaptive application developed to support various user groups who have different needs [8]. Other author also consider comprehensive user profiles (such as visual, cognitive and emotional-processing parameters) to improve performance of adaptions [8]. Other research also presents some concepts (like hiding unused fields, pre-selection) and challenges (like determining which variables to use for developing adaptions) of context-based adaptions [9].

## 3 Methodology

First, we analyzed existing literatures and develop model that addresses activity based visual adjustment. Following that we develop application that respond to contextual change.

The application, Tour BD is adaptive mobile geo-app developed based on our model. Interaction log files were recorded to analyze the accuracy of visualized adaptation implemented in our application. The application were installed in 15 research participants for evaluation and log files were captured. The experiment is performed on three human activities: sitting (standing), walking and running for 30 min. As a result, adaptation performance is evaluated on the basis of synthetic metrics indicators.

A standard user satisfaction measurement also applied to measure the usability of the application. The following section will briefly discuss the silent findings of the evaluation.

## 4 Findings and Discussions

In our model, the UI adaptation is performed based on the contextual data collected at runtime. This process is carried out in asynchronous manner where tasks are not altered during the process of UI adaptation. The UI will automatically load after the contextual information is collected and modified. For example, if users' activity mode changed from sitting/standing to walking, the runtime execution object informs the context interpreter to re-adjust the UI, thus the UI adjustment will effect.

The application developed for this evaluation is Tour BD (which is also found in Google Play Store). The primary aim of this geo app is to explore and validate the benefits of context adaptation in order to achieve the usability metrics.

The context detection performance and user satisfaction were measured using synthetic metrics indicators and standard user satisfaction measurement tools. For adaptation performance log files were analyzed to validate the accuracy of visualized adaptation implemented by our application.

Table 1 shows the average results of activity detection for each activity modes tested per 10 min. The continuity of detection ranged from 284–290. This indicates that the adaptation were smooth in different activity modes. The columns indicates the number of correctly and incorrectly identified tasks executed for each modes/levels of context detection, while rows indicates the number of relevant tasks that are retrieved for each modes/levels of context detection in a column.

**Table 1.** Average results of activity detection/10 min logged from 15 participants.

| | Sitting/standing | Walking | Running |
|---|---|---|---|
| Sitting/standing | 284 | 11 | 5 |
| Walking | 2 | 270 | 13 |
| Running | 0 | 9 | 266 |
| Total | 286 | 290 | 284 |

The accuracy of activity detection results are affected by differences in mobile phone. Table 2 illustrates the average precision, recall, F-score, and accuracy results of activity detection. The average accuracy results for all three metrics where above 92%. It is interesting to note that the detection achieved high level of accuracy in sitting (or standing) mode. In all, the average accuracy rate ranged from 89% to 94%.

**Table 2.** Average precision (P), recall (R), F-score (F) and accuracy (A) of detection.

| | | Activity modes | | |
|---|---|---|---|---|
| | | Sitting/standing | Walking | Running |
| Accuracy measures | P | 0.99 | 0.93 | 0.94 |
| | R | 0.95 | 0.95 | 0.97 |
| | F | 0.97 | 0.94 | 0.95 |
| | A | 0.94 | 0.89 | 0.91 |

As shown in Fig. 1, 94.07%, 100% and 92.89% detection attempts was correct in running, sitting (or standing) and walking activity modes respectively. The average detection accuracy is 95.66%. The continuity of task execution in adaptation ranged from 211–248 per 10 min indicates the smoothness of activity detection. Additionally, the accuracy (92%) indicates the quality of adaptation.

It is important to note that the succession of tasks in activity detection can highly affect the smoothness of adaptation. The rise of the gap between detected tasks implies that detection was interrupted due to some reason. One of the reason is the capability of mobile devices in order to perform continuous tasks effectively. Tracing the execution of sensors task helps to analyze the succession of tasks execution during context detection. The highest and lowest number of tasks executed in three modes of activity detection were ranged from 284–290, indicates that it were smooth. Figure 2 describes the results of task execution patterns of each activity modes.

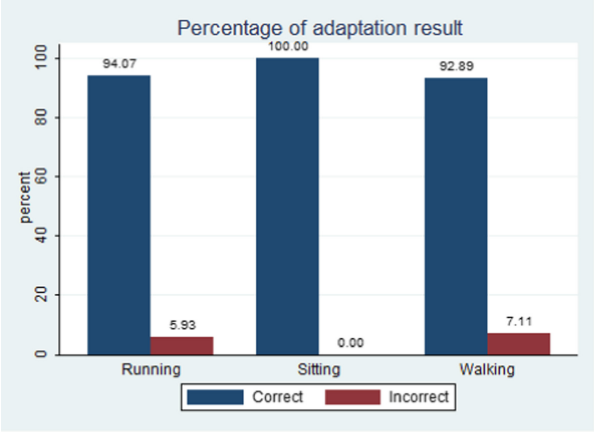


**Fig. 1.** Percentage of adaptation result for each activity mode.

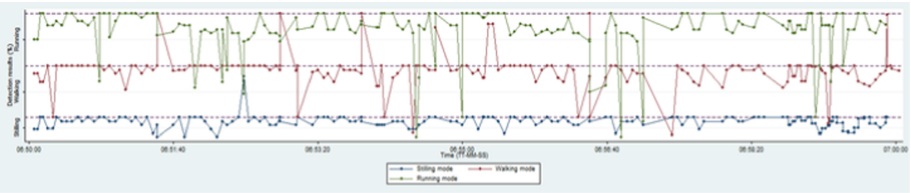

**Fig. 2.** Task execution patterns of each mode.

## 5 Conclusion

In this paper, we designed a new approach for automatic user's physical activity recognition using a smartphone. This is mainly used for visualization adjustment which work based on user context. The data used in this paper were obtained from sensors integrated into smartphones. For evaluating the proposed approach, the study develops mobile application. We used different measurement techniques to analyze the accuracy of activity detection. The activity based UI configuration were employed on three common activities and achieved a promising results.

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