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Project Title: Context Aware User Interface in Mobile Devices

Sponsor: ASELSAN

Motivation and Purpose:

When a device is said to be ""mobile" it means that one can use it wherever needed even if the user is in moving or the environmental conditions changes. However, due to the standard user interface designs of these devices, they cannot respond to environmental changes or motion of the user. One may have difficulties in seeing the screen content and using the device when light conditions change or she/he moves. Since we feel uncomfortable about this situation, we decided to choose this project and produce software solution to this problem in mobile devices.

<u>Project Description</u>:

In this project the users will benefit easy usage of mobile devices that are using accelerometer, light sensor/camera.

- With the support of light sensor/camera:

  We can change the brightness and contrast of the screen according to illumination. Colors may also be adjusted regarding their visibility degrees for human visual system. For example, when we think about GPS systems, roads are more distinguishable in high contrast when illumination is low.

- With the support of accelerometer/camera:

  When moving, typing and reading become more challenging since we cannot focus on main subject because of large set of details. In this manner, details can be hidden to create more space for main content. This can be reflected to user as enlargement in font size and images and locating frequently used buttons on more reachable positions on the screen.

As can be seen, we have more than one hardware options to achieve these tasks. We can use only one camera or an accelerometer and a light sensor pair. Both of them have their advantages and disadvantages.

- Discussing camera:

  Nowadays, cameras exist nearly on all mobile devices. Therefore, if this technology is developed using camera, there is no need for extra hardware resulting in more portability. However, there are some drawbacks. Cameras consume more power than the other options. Therefore this option is not appropriate for a mobile device. Another problem is that processing each incoming image from camera requires more powerful processors, especially in determining the motion.

- Discussing accelerometer-light sensor pair:

  This option gives more accurate results since they are built for these tasks. Besides, they consume less power than the camera option. Interpreting the information produced from these devices reduce complexity, resulting in high performance. The only drawback is the requirement of additional hardware that does not exist on all mobile devices. Nonetheless, we prefer this option since overall advantages of this option dominates those of camera.

<u>Users of the Project:</u>

This project was first intended to be used for military purposes since our sponsor is ASELSAN. This software will be integrated to a large variety of devices used in military. Soldiers will be able to use in all areas where the environment conditions is not appropriate for comfortably using the device. If we make progress successfully, we have the intention to extend our project. We believe that this project is going to be useful for personal purposes and to all mobile device users. Besides, this software will be able to be implemented in all applications of mobile devices.

<u>Market and Literature Survey:</u>

Based on our literature research, *"Context is the set of environmental states and settings that either determines an application's behavior or in which an application event occurs and is interesting to the user."*[1] According to the definition, the context can be discussed in three different approaches:

- User Context: Users' movement, users' location, people nearby the users, objects nearby the users or even the psychological situation of the users can be counted as user context.
- Time Context: Time of the day, week, month and season can all be discussed under time context umbrella.
- Physical context: Lighting of the environment, noise level in the environment, temperature of the weather and traffic density in the environment are all considered as physical context change.

All the worldwide studies to change the user interface of the mobile devices were conducted according to the context changes mentioned above. Some of the studies related with context aware user interface:

<u>Nokia Research Center and Waseda University collaboration</u> [2]:

They have similar ideas with us. They have managed to implement text and image viewing application that responds to users' movement on a platform called Muffin.

<u>Nokia</u> [3]:

The idea of Nokia has some similarities with ours, but it focuses more on input manipulation rather than output manipulation. In other words, Nokia uses sensor technology to reduce input errors while moving, configuring system accordingly. What we are trying to is configuring output to improve readability.

<u>Technology for Enabling Awareness</u> [1]:

Adaptive GSM phone and PDA: They designed this product to change the user interface of these devices by using user's activity, light level, pressure, and proximity of other people contexts. In the PDA scenario a notepad application was adapted to change by user's movement (large font when the user is walking) in the phone scenario, the profiles of the mobile phone are selected automatically. The phone chooses to ring, vibrate, adjust the ring volume, or keep silent, depending on whether the phone is in hand, on a table, in a suitcase, or outside. This project seems to have a lot of similarities with the project that we are willing to work on.

<u>Paper with the title "Multi-sensor context-awareness"</u> [4]:

The paper discusses the usage of single generic context-sensors such as camera and location sensors versus integration of multiple diverse sensors. Position sensors provide access to location's particular characteristics. Position is a static description of an environment and does not capture dynamic aspects of a situation. Because of this, its reliability depends on the previously obtained knowledge about locations. Cameras provide access to potentially rich information that can be derived by computer vision techniques. By usage of vision techniques can be employed to capture activity and other dynamic aspects, but extraction of septic context is computationally expensive and problematic in mobile devices. On the other hand, paper suggests multi-sensor context-awareness as an alternative approach toward aware mobile devices. In this approach, the single powerful sensor is replaced by a collection of diverse simple sensors, and context is derived from multi-sensor data. This approach was first introduced in the European project TEA on mobile situation awareness, with the aim to provide comparatively powerful cheap technology both with respect to processing requirements and component cost. The research prototype integrated sensors for motion, orientation, light, and temperature, and relates to work with its emphasis on small, lightweight, low-power and cheap

components. Separation of sensors also means that both sensors and feature extraction methods can be developed and replaced independently of each other.

Other than doing some research about context awareness, we tried to gain some information about how to detect movement, how to measure the light of the environment, and etc.

References

[1]   Chen, G., & Kotz, D. (2000). *A Survey of Context-Aware Mobile Computing Research.* Dartmouth College, Department of Computer Science.

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[3]   Nurmi, M. (2008). *Adaptive user interface input device.* U.S: Nokia Corporation.

[4]   Gellersen, H. W., Schmidt, A., & Beigl, M. (2002, October). Multi-sensor context-awareness in mobile devices and smart artifacts. *Mobile Networks and Applications, 7*(5).