CMER

Centre for Mobile Education and Research

Mobile Devices in Software Engineering

Week I

Overview

- What is a Mobile Application?
- Why Develop Mobile Applications?
- Challenges of Mobile Application Development
- Mobile Application Development Tools
- Ad-hoc Development
- Wireless Software Engineering Model

What is a Mobile Application?

“A wireless mobile application is defined as a software application, a wireless service or a mobile service that can be either pushed to users’ handheld wireless devices or downloaded and installed, over the air, on these devices.” [1]

“An application which resides in the mobile phone or which is accessed/used by a mobile phone over any channel such as SMS, MMS, GPRS, Voice, DTMF” [2]

What is a Mobile Application?

- **Two types of mobile applications can be accessed by wireless devices, the first type:**

- **Browser-Based**
  - **A Browser-Based application is an application that is accessed through the use of the mobile device's web browser**
  - **Browser-Based applications are coded with the use of a markup language**
  - **See Wireless Application Protocol**

What is a Mobile Application?

- **Native Applications**
  - **Native applications are those applications that are found entirely on the mobile device**
  - **These applications have their own runtime environment for execution**
  - **Highly interactive applications are really only feasible when they are native applications**
  - **See Java ME Micro Edition (Java ME)**

Why Develop Mobile Applications?

- Estimated 2.3 billion global mobile phone subscribers in 2006 which will grow to 3.3 billion by 2011 [3]
- Provide mobile phone users with applications that can keep them productive, informed, entertained, or connected whenever they feel the need
- Large potential for financial gain in the field of mobile applications
- Solve problems which have many challenges and obstacles

Mobile Applications

- **Mobile Applications can be found in any industry, they have been developed for:**
  - **Mobile Gaming (see gameloft)**
  - **Mobile Banking (see RBC)**
  - **Mobile Text, Presentation, and Spreadsheet (see Microsoft Office Mobile)**
  - **Social Networking (see Facebook)**
  - **Mobile News (see Yahoo! Mobile News)**
  - **Location Aware Services (see Loopt)**

Mobile Application Development Challenges

- Development of mobile applications provides for many challenges and obstacles that are not commonly found in the development of applications for desktop computers

- The challenges faced by developers are found in:
  - **Heterogeneity of mobile devices**
  - **Security**
  - **Network**

Challenge: Mobile Devices

- Java is a portable implementation language, any application created with Java can be run on any machine which contains a Java Runtime Environment (JRE)
- J2ME, is similarly a portable language, which can be run on any mobile device which contains a JRE, however this portability is severely affected by the heterogeneity of the mobile devices currently on the market
- Mobile devices display a wide range of characteristics that will greatly effect a mobile application's performance, usability, functionality, etc.

Challenge: Mobile Devices

- **Display/Screen Size**
  - **Mobile devices come in many different screen sizes**
  - **Consider the differentiating screen sizes between smartphones and cell phones**
  - **Smartphones offer the user a generally larger and higher resolution display screen, contrasted to cell phones which generally provide lower resolution and smaller display size**

Challenge: Mobile Devices

- **Memory**
  - **Just as screen size differs from device to device, the amount of available memory and differs from device to device**
  - **Developers must create applications which have a minimal memory footprint on the device while being of service to the user**
  - **Memory must also be carefully managed during the execution of any mobile application as it can potentially render the phone unusable until termination of the application**

Challenge: Mobile Devices

- **Processing Power**
  - **Another sign of the heterogeneity of mobile devices is the processing power**
  - **The CPUs differ from phone to phone and this must be taken into consideration by developers**
  - **Developers cannot create applications that require the user to wait an unreasonable amount of time for the service to load**

Challenge: Mobile Devices

- **Input Devices**
  - **The input devices on mobile devices range from full QWERTY keyboards to three letter button inputs**
  - **This means developers must take into account how much text is required by the user to input into their application and what kind of difficulties they may experience based on their device**

Challenge: Network

- **Transmission Errors**
  - **When creating mobile applications that utilize network connections there is a variety of issues that can effect the application**
  - **Wireless networks are exposed to interference which can alter the message received by the client or the server then what was originally sent**
  - **Applications must take into account these potential problems especially in financially sensitive services**

Challenge: Network

- **Message Latency**
  - **Messages that are to be sent to clients or servers can be delayed due to a variety of reasons such as overloaded network nodes or servers, dead or turned off cell phones, distance to travel**
  - **Applications must take this into account so as to avoid sending servers or clients stale information**

Challenge: Network

- **Bandwidth Usage**
  - **Wireless customers are forced to pay fees to access the wireless network and internet**
  - **While phones with WIFI capabilities allow for some users to have free connectivity at times it is important to keep messages to a minimum and compact**
  - **Applications that cost a lot to use will not be popular with many of the financially conscious users**

Challenge: Security

- Wireless networks by default are not as secure as wired networks, it is important to note that message can be intercepted when travelling through the air
- Mobile applications must secure the sensitive data that is being transmitted over the air
- There are different methods to implement security but it must be relative to the information we want to secure and the resources that we wish to use for securing it

Solution: Mobile Devices

- **Display/Screen Size**
  - **There is no one single method to overcome to problem of different screen sizes however there are some ways to help**

    1: When dealing with graphics that should be placed on edges use methods which retrieve the edge of the display

    2: When creating an for a particular set of mobile devices (ie. Blackberry's, cell phones) create the layout to the smallest display size

Solution: Mobile Devices

- **Memory**
  - **Compact data representation will help reduce the amount of memory it requires to load and use your application**
  - **Use optimization techniques to reduce the amount of code required to write your application (see J2ME tech tips)**
  - **Compress any graphic images that you use in your application and save graphics in a format which takes the least space**

Solution: Mobile Devices

- **Processing Power**
  - **A result of reducing the memory consumption and footprint of the application should help time required to load applications**
  - **If the mobile application has a client-server architecture consider the partitioning of the application**
  - **Allow the server to do the brunt of the calculations and processing work and pass the information to the mobile device for less CPU intensive calculations**

Solution: Mobile Devices

- **Input Devices**
  - **To overcome some of the problems that can occur with the different input devices make input requirements concise, therefore the user should be able to perform the most common tasks in an application with the least amount of button presses**
  - **Provide users with menus when possible to help reduce the amount of button input required**

Solution: Network

- **Transmission Errors**
  - **Transmissions errors may be inevitable when dealing with wireless networks but there are some wireless network protocols than can correct or at the least detect these errors**
  - **One solution does not exist for every single type of transmission error that may occur, it is important to plan for these types of errors and be able to deal with them accordingly**

Solution: Network

- **Message Latency**
  - **In a client-server architecture the server can store messages that do not arrive at the mobile device and attempt to resend them at specific intervals**
  - **Servers can also store the message and send it when the mobile device reconnects to the system**
  - **Let the user know if they receive a message that can possibly be out of date or no longer valid, this could be done using timestamps**

Solution: Network

- **Bandwidth Usage**
  - **Pass as little messages as required between the client and the server**
  - **Keep the messages as short as possible, you can use symbols to represent commands for the server**
  - **If your application must use a lot of bandwidth at least notify the user of this fact**

Solution: Security

- Important to implement security to a level which is appropriate for the data being exchanged
- Mobile devices, having limited processing power, cannot generate large cryptographic keys in a reasonable amount of time
- There has been research into creating keys for algorithms such as RSA and others and sending this to the mobile device to use but this is an area that is still developing

Mobile Application Development

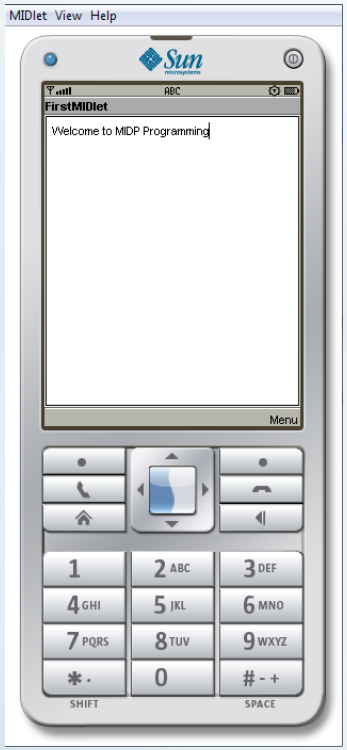
- Knowing the challenges faced by developers with mobile applications we can look at the tools and steps developers take when creating applications
- Mobile application development differs from development of applications on desktops because mobile applications are developed on one platform and then deployed on a totally different platform
- This leads to many issues that developers face after moving their application to another platform and stresses an importance on testing

Development Tools

- From a software perspective there are several Integrated Development Environments (IDEs) that are available for use such as:
  - Sun Java Wireless Toolkit for CLDC
  - Blackberry Java Development Environment
  - Metrowerks CodeWarrior Wireless Studio
  - Borland JBuilder with MobileSet

Emulators/Simulators

- The IDE's mentioned come with emulators to mimic the functionality and look seen on a mobile device, while these are extremely helpful for the developer there is ultimately no substitute for the real device



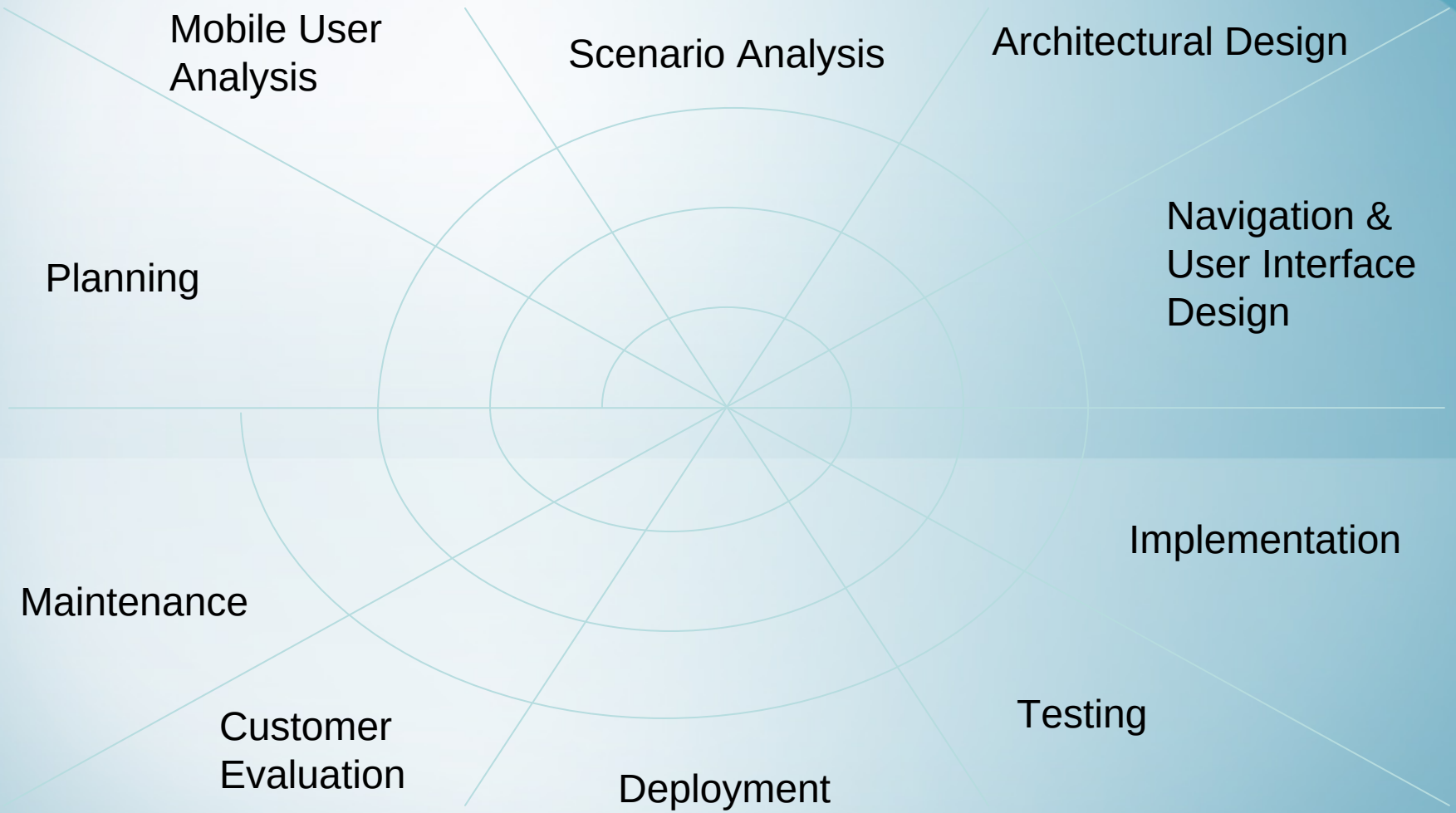
Ad-hoc Development

- A common development process is to create the mobile application within the preferred IDE
- The application is then tested in the IDE's emulation environment
- Many of the IDE's contain different devices which can be emulated for the developer to test their application
- The final step is to test the application on a physical device and if applicable, network
- There is no substitute for testing the application on a real device as it will provide the developer with real insight as to the characteristics of the mobile phone

Wireless Software Engineering

- The previous method, while it is likely sufficient for personal application development, is missing some features that are commonly found in software engineering
- A model found in (Mahmoud, Maamar, 2006) addresses these missing areas and proposes a development process for mobile applications
- The model from a visual perspective is similar to the spiral model found in software engineering

Wireless Software Engineering Model



Wireless Software Engineering Model

- This model is very similar to the spiral model, however it has a better focus towards mobile application development
- This model can also be used to manage a project with multiple stages of application deployment
- This model has ten phases and one of the concepts behind it is the knowledge that testing and design take special consideration in mobile application development

Model Phases

- **The Wireless Software Engineering Model contains ten phases:**
  - **Planning**
  - **Mobile User Analysis**
  - **Scenario Analysis**
  - **Architectural Design**
  - **Navigation & User Interface Design**
  - **Implementation**
  - **Testing**
  - **Deployment**
  - **Customer Evaluation**
  - **Maintenance**

Planning

- The planning phase deals with:
  - Identifying the objectives of the application
  - Specifying the scope of the first step
  - Estimating the possible cost of the project
  - Analyzing the possible risks involved
  - Creating a tentative schedule

Mobile User Analysis

- This phase deals with understanding our target audience for the application
- We need to examine the types of users that with use the application and any special requirements or functionality they require
- We can gather information by:
  - Asking experts in the field
  - Reading literature on the topic
  - Asking current users

Scenario Analysis

- Similar to requirements analysis in classical software engineering
- We focus on three areas:
  - Screen and Interaction Analysis
    - How the user will interact with the system, how content will be displayed
  - Usage Analysis
    - The functionality of the system, use cases should be considered to relay this information
  - Environment Analysis
    - The interaction between this system and other networks and devices

Architectural Design

- This phase deals with the architecture of the system when dealing with network based applications
- It should discuss how the system will be split and the challenges and benefits of such a design
- As discussed, attention must be paid to message latency and application partitioning to ensure performance, reliability, and security

Navigation & User Interface Design

- The design of the user interface is done here and is important to the success of the system
- A poorly designed interface will detract the user from the system while a clean and easy to use interface will show professionalism and perception
- Keep in mind the challenges discussed previously with user input, screen sizes, and display characteristics as these play important roles in designing an interface
- Screen mock-ups are important to display the look and feel to potential customers

Implementation

- Implementation of the application is done in this phase with the use of any number of development tools
- Code Conventions, class and object diagrams, API specifications can all be included in any documentation that is created at this point for the system
- This allows developers who join the project at later stages to follow the same format and style as the original authors

Testing

- Testing is extremely important in mobile application development not only due to the heterogeneity of mobile devices
- It is important to test not only in an emulator but on the physical device as well, and to test on all or as many physical devices as the application can be located
- Testing also assists us to remove bugs and flaws in programs which become inevitable in larger systems as they become complex
- Use Cases are a helpful tool in generating test cases for the system

Deployment

- Deployment of the application on physical devices will allow you to see the system in the real world
- Applications may be fine in an emulator but when transferred to a mobile device developers may find the application slow, impossible to use, not functioning all together, or consuming too much bandwidth
- It may not economically feasible to test on every possible device that a system may be used on but a wide variety of devices should be tested

Customer Evaluation

- At this point the application is ready for download by customers in the network
- Customers should be given a way of providing feedback to the developers and reporting any issues they encounter when using the application
- Consider providing an email or web form where users can fill in the necessary info or provide an automated process which sends the error to the server

Maintenance

- **Maintenance of the system after deployment deals with several issues:**
  - **Resolving any bugs found in the application and creating necessary patches**
  - **Improving the quality of the application with upgrades**
  - **Providing new services and capabilities to customers**

References

- [1] Mahmoud, Qusay H., and Zakaria Maamar. "Engineering Wireless Mobile Applications." Int. J. of Information Technology and Web Engineering 1.1 (2006): 58-73.
- [2] Gunaratne, Ruchith. "Mobile Applications." hSenid Software International. <ruchith.files.wordpress.com/2006/11/mobile-computing-mobile-applications-1.ppt>
- [3] Global Mobile Phone Subscribers Expected to Reach 3.3 Billion by 2011. Market Intelligence Center. Taipei: Market Intelligence Center, 2007. 14 May 2008 <http://mic.iii.org.tw/english/press/research_PR.asp?func=press&Doc_sqno=4641>.
- [4] Kochnev, Dmitry S., and Andrey A. Terekhov. "Surviving Java for Mobiles." Ed. Sumi Helal. Pervasive Computing (2003): 90-95.