UNIVERSITY OF ANBAR

College of computer science and Information Technology
Department of information systems

Course experiments Specification

Subject title : Mobile Computing
STAGE: 4
Course: 1
Hours : 4
Students No.: 70
Groups No.: 35

Description: Mobile Computing is a technology that allows transmission of data, voice and video via a computer or any other wireless enabled device without having to be connected to a fixed physical link. The main concept involves −

- Mobile communication
- Mobile hardware
- Mobile software

Objectives:

1. Understand the basic concepts of mobile computing
2. Be familiar with the network protocol stack
3. Learn the basics of mobile telecommunication system
4. Be exposed to Ad-Hoc networks
5. Gain knowledge about different mobile platforms and application development

Academic Year: 2019/2020

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PRACTICAL : 1

Title : 1) To check orthogonality of two codes.
2) Generation of Walsh codes.

Objective : To study orthogonal codes.

Reference : Mobile Communication by Schiller.

Prerequisite : Knowledge of orthogonal codes.

Description :

1. Orthogonal codes

Two vectors are said to be orthogonal if their inner product is zero. Consider two vectors (2,0,3) and (3,5, -2). Their inner product is (2*3) + (0*5) +(3 * -2) = 6 + 0+ (-6) = 0. hence they are orthogonal.

Example:

code 1 : 0 1 0 1
code 2:   0 1 1 0
Bipolar code1 : -1 1 -1 1
Bipolar code2 : -1 1 1 -1
cod1 * code2 = 1 1 -1 -1
sum = (1 + 1+ (-1) + (-1)) = 0
Hence two codes are orthogonal.

Algorithm:

1) start
2) Enter length of the code , n
3) Enter code1, code1[ ]
4) Enter code2 , code2 [ ]
5) convert code1 into bipolar sequence.
6) convert code2 into bipolar sequence.
7) Multiply two codes. C [ ] = code [ ] * code2 [ ]
8) Add value of vector C . If sum is 0 then codes are orthogonal
9) stop.

Conclusion : The pair of codes is tested for orthogonality.

2. Walsh Codes

Walsh codes are also known as Walsh Hardmard codes. Walsh codes are most commonly used orthogonal codes in CDMA application.

If we define W_1 as

$W_1 = (0)$ then $W_{2n} = \begin{bmatrix} Wn & Wn \\ Wn & \overline{Wn} \end{bmatrix}$

Walsh matrix has a property that every code is orthogonal to every other code in a matrix.

For n=1 we get W2,

$$W2 = \begin{bmatrix} w1 & w1 \\ w1 & \overline{w1} \end{bmatrix}$$

$$= \begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix}$$

For n=2 we get W4,

$$W4 = \begin{bmatrix} w2 & w2 \\ w2 & \overline{w2} \end{bmatrix}$$

$$= \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 \\ & & & \end{bmatrix}$$

0 1 1 0

Algorithm :

1) Start
2) Assign values to 2*2 matrix such that W2 = $\begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix}$

OR

W2 = $\begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}$

3) Input value of n and Print the result.
3) Stop.

Conclusion: Walsh codes have been studied.

PRACTICAL 2:

Title : To implement Code Division Multiple Access (CDMA).

Objective : To study code division Multiplexing.

Reference : Mobile communication by Schiller

Prerequisite : Knowledge of orthogonal codes and Code Division Multiplexing.

Description :

Code Division Multiple Access (CDMA) is a method of multiplexing that does not divide a channel by time as in TDMA or frequency as in FDMA. Instead all active users use the same frequency at the same time. Separation of channels is now achieved by code . This scheme encodes data using special code associated with each channel called chipping sequence (or Pseudo random Noise sequence).The codes used here are orthogonal and has good auto-correlation property.

CDMA multiples the data being transmitted by a "noise" signal (chipping sequence). This noise signal is a pseudo random sequence of 1 and −1 values, at a frequency much higher than that of the original signal, thereby spreading the energy of the original signal into a much wider band.

De spreading requires the receiver to apply the same PN sequence on the received signal to recover data.

Example:

1) Sender A's data Ad = 1 => Bipolar Ad = +1

Sender B's data Bd = 0 => Bipolar Bd = -1

2) A's Chip code is codeA[ ] : 0 0 1 1 0 0 1 1 =>

Bipolar conversion is : -1 -1 +1 +1 -1-1 +1 +1

B's Chip code is codeB[]: 0 1 1 0 0 1 1 0

Bipolar conversion is : -1 +1 +1 -1 -1 +1 +1 -1

3) Spread A's data

As =1 * (-1 -1 +1 +1 -1 -1 +1 +1) = (-1 -1 +1 +1 -1 -1 +1 +1)

Spread B's data

Bs = -1 * (-1 +1 +1 -1 -1 +1 +1 -1) = (+1 -1 -1 +1 +1 -1 -1 +1)

4) Send the sum of As+Bs

Cs = As + Bs = (0 -2 0 2 0 -2 0 2)

5) Recover As Data from received signal Cs

Cs * codeA[ ] = (0 -2 0 2 0 -2 0 2) * (-1 -1 +1 +1 -1-1 +1 +1)

= (0 2 0 2 0 2 0 2)

Sum = 8 > 0 hence A's transmitted data was Ad=1

6) Recover B's Data from received signal Cs

Cs * codeB[ ] = (0 -2 0 2 0 -2 0 2) * (-1 +1 +1 -1 -1 +1 +1 -1)

= (0 -2 0 -2 0 -2 0 -2)

Sum = -8 < 0 hence B's transmitted data was Bd = 0

Algorithm :

```
1) Start
2) Enter sender A's data : Ad , Convert into bipolar
3) Enter sender B's data : Bd , Convert into bipolar
4) Enter A's PN sequence : codeA[ ]  and Convert into bipolar
5) Enter B's PN sequence : codeB[ ]  and Convert into bipolar
6) Spread A's data : As[ ] = Ad * codeA[ ]
7) Spread B's data : Bs[ ] = Bd * codeB[ ]
8) Add As[ ] and B[ ] : c[ ] = As[ ] + Bs[ ]
9) De spread A's signals
   ResultA [ ] = c[ ] * codeA[ ]
   Add values of ResultA[ ]
   If sum > 0 then A's transmitted data is 1 else 0.
10)     De spread B's signals
   ResultB [ ] = c[ ] * codeB[ ]
   Add values of ResultB[ ]
   If sum > 0 then A's transmitted data is 1 else 0.
11)     Stop.
```

Conclusion : CDMA has been studied.

PRACTICAL : 3

Title : Write a program to divide the given area into equal hexagons and create clusters using given set of frequencies.

Objective : To study frequency reuse.

Reference : Mobile communication by schiller.

Prerequisite : Knowledge of frequency reuse.

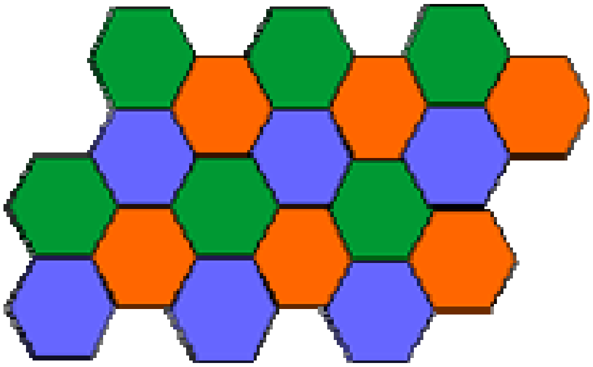
Description:

Cellular system for mobile communication implements SDM. Each transmitter typically called a base station covers a certain area called a cell.
However to avoid interference between transmitters which are within each others interference range, we use FDM. The general goal is never use the same frequency at the same time within the interference range. In order to do this , cells are grouped in to disjoint frequency units called clusters. The number of different frequencies used in a cluster is termed as frequency reuse factor N.

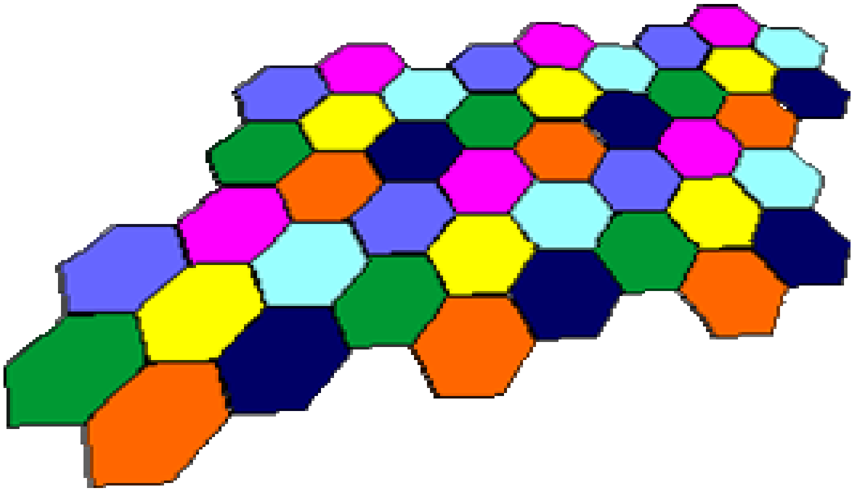
The following diagram shows two clusters one with 3 cells and one with 7 cells.
We select frequency reuse factor N such a way that , the following condition satisfied.

$N = i^2 + i*j + j^2$

Thus for N =3 => i=1, j=1;



For N=7 = > i=2 , j =1



Algorithm:

1. start
2. Accept value of number of cells per cluster i.e. N from the user.
3. Create a function that draws a hexagon.
4. Draw a clusters with N hexagons in each cluster.
5. Write appropriate frequencies in each cluster.
6. stop.

Conclusion:

Frequency reuse has been studied.

PRACTICAL : 4

Title : To create a MIDlet suite using two MIDlets.

Objective : To study basic concepts of J2ME.

Reference : Complete Reference J2ME.

Prerequisite : Knowledge of Java programming.

Description:

Introduction to J2ME:

Traditional computing devices use fairly standard hardware configurations such as display, keyboard,large amount of memory and permanent storage. However new breed of computing devices lacs hardware configuration. J2ME is specially designed for developing applications for small computing devices such as cell phones, PDA etc.

J2ME Configurations:

Configuration defines the JVM for a particular small computing device.
Two types of configuration haves been defined.

1) CLDC (Connected limited Device configuration)

   CLDC is used for the devices with the limited resources. CLDC devices use stripped version of JVM called KVM. CLDC devices are mobile phones,PDA etc.

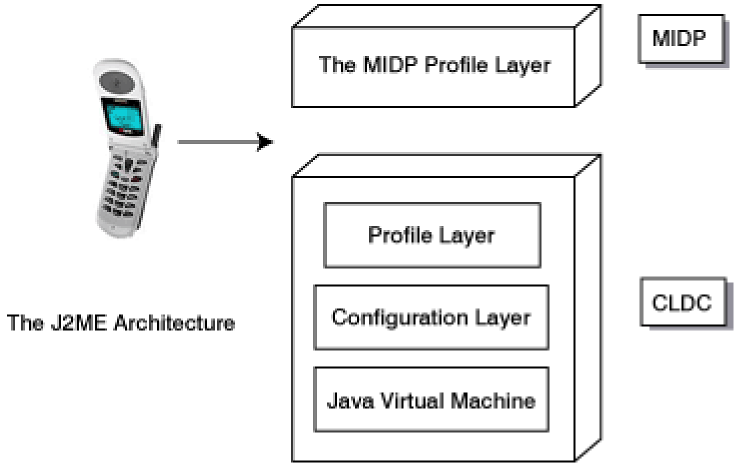
2) CDC (Connected device configuration)

   CDC devices use complete JVM. CDC devices are set-top box, Home appliances such as Air conditioner etc..

J2ME Profiles:

Profile consists of classes that enable developers to implements features found n a related group of small computing devices.
Many profile are available . Here we use MIDP (Mobile Information Device Profile)
MIDP is used with CLDC configuration that provides classes for local storage, a user interface and networking capabilities.
Other profiles are Game profile, Foundation profile, RMI profile and many more..

J2ME Architecture:



- **Java Virtual Machine layer:** This layer is an implementation of a Java Virtual Machine that is customized for a particular device's host operating system and supports a particular J2ME configuration.
- **Configuration layer:** The configuration layer defines the minimum set of Java Virtual Machine features and Java class libraries available on a particular category of devices. In a way, a configuration defines the commonality of the Java platform features and libraries that developers can assume to be available on all devices belonging to a particular category. This layer is less visible to users, but is very important to profile implementers.
- **Profile layer:** The profile layer defines the minimum set of application programming interfaces (APIs) available on a particular family of devices. Profiles are implemented upon a particular configuration. Applications are written for a particular profile and are thus portable to any device that supports that profile. A device can support multiple profiles. This is the layer that is most visible to users and application providers.
- **MIDP layer:** The Mobile Information Device Profile (MIDP) is a set of Java APIs that addresses issues such as user interface, persistence storage, and networking.

MIDlet Programming:

A MIDlet is class , which is controlled by the application manager. A MIDlet class must contain three abstract methods that are called by application manager.

```
 public class class-name extends MIDlet
{
public void startApp(){ }
public void pauseApp() { }
public void destroyApp( unconditional boolean) { }
}
```

Steps for creating a MIDlet suite:

1) Select a file system where you want to create a MIDlet suite. Right click on it, a pop up menu appears. From the pop up menu, select New -> MIDlet Suite.
2) Enter the Name of MIDlet suite. Click on Next.
3) It gives you two options.

- Allows you to create a new Midlet :

  Enter the package and class name . This is the name of a MIDlet that is to be created.
- Allows you to add existing MIDlet :

  To add existing MIDlet ,click on brows , select the MIDlet to be added.
  J2ME It also allows you to select icon for the given MIDlet.

4) Click Finish.

ADDING MIDlet to a MIDlet suite:

1) Select a MIDlet suite , to which you want to add Midlet. Right click on it, a pop up menu appears. Select Edit suite from the popup menu.
2) Click on ADD button to add a new MIDlet.
3) Enter name of package and class name.

4) Click on OK.

New MIDlet is added to your MIDlet suite.

Conclusion :

MIDlet suite using two MIDlets has been created.

PRACTICAL : 5

Title : Write a J2ME program to create an application using Radio buttons.

Objective : To study ChoiceGroup class and its implementation in J2ME.

Reference : Complete reference J2ME.

Prerequisite : knowledge of inheritance , event handling and listeners.

Description:

Item class is a base class for a number of derived classes that can be contained within a form class. These derived classes are ChoiceGroup , DateField, ImageItem, StringItem and TextField.

The **ChoiceGroup** class is used to create check boxes or radio buttons on a form. The state of an instance of a class derived from the Item class changes whenever user enters data into the instance ,such as radio button is selected. An ItemListener monitors the events during a life of the MIDlet and traps events that changes in the state of any Item class contained on a form.

An instance of a ChoiceGrioup class can be of two types: Exclusive or multiple. An exclusive instance appears as a set of radio buttons and a multiple instance contains set of check boxes.

Classes used:

Form Class: It is a container for the other displayable objects that appear on the screen. Any derived class instance of the Item class can be placed on the instance of Form class.

ChoiceGroup class :

J2ME classifies check boxes and radio buttons as the instance of ChoiceGroup class. We set the type of choiceGroup instance to EXCLUSIVE to create radio buttons.

ItemStateListener:

Any MIDlet that utilizes instances of the Item class withon a form must implement ItemStateListener and must have an itemStateChanged() method.

Creating a Radio buttons :

```
private ChoiceGroup gender;
gender = new ChioceGroup (“Enter gender”, Choice.EXCLUSIVE) ;
gender.append(“Female”,null);
gender.append(“Male”,null);
```

Conclusion : Concept of radio buttons using J2ME has been studied.

PRACTICAL : 6

Title : Write a J2ME program to insert an image in a Canvas.

Objective : To study Canvas class and its implementation in J2ME.

Reference : J2ME Complete reference .

Prerequisite :

Description:

There are two types of images that can be displayed.

1) Immutable
2) Mutable

An immutable images are loaded from a file or other resources and cannot be modified once the image is displayed. Examples. Icon s associated with MIDlets are immutable.

A mutable image is drawn on the Canvas using methods available in Graphics class. An immutable image can be drawn on the screen as well as on Canvas.
where as mutable image is drawn only on the canvas.

The Canvas Class:

Each MIDlet has a one instance of the Display class, and the Display class has a one derived class called 'displayable'. Everything a MIDlet displays on the Screen is created by an instance of a Displayable class.

The Display class hierarchy is shown below:

```
public class Displayable
    public abstract class Displayable
        public abstract class Screen extends Displayable
        public abstract class Canvas extends Displayable
    public class Graphics
```

The screen class is used to create high-level components. the Canvas class is used to gain low-level access to display.

Creating an Image using Image class:

Create an instance of an Image class by calling the createImage() method of the Image class.

```
private Image img;
img = Image.createImage(path);
```

Displaying an Image on a Canvas

Once the image is created , it can be drawn on the Canvvs using drawImage() method of the Graphics class.

Graphics.drawImage()

drawImage() method takes four parameters.

- First parameter is the reference to the image that you want to display.
- second and third parameters indicate position of the image on Canvas.

- Fourth parameter specifies the portion of the image bounding box that is placed at the specified co-ordinate position.

Example:

graphics.drawImage(img,5,20,Graphics.HCENTER | Graphics.VCENTER)
palces the center of the image at co-ordinate position (5,20).

Conclusion : Displaying an image on a Canvas has been studied.

PRACTICAL : 7

Title : Write a WML page using various tags such as select and option tags.

Objective : To study basic tags of WML.

Reference :

Prerequisite : knowledge of HTML.

Description:

WML (Wireless Markup Language) is a markup language based on XML, and is intended for the use in specifying content for narrow band devices such as mobile phones. It mainly specifies how to display text contents on a mobile device. WML is designed with the constraints of small narrow band devices in mind. This constraints includes small display and limited user input facilities , limited memory and computational resources.

It is a content format for devices that implement the Wireless Application Protocol(WAP) specification, such as mobile phones. A WAP gateway sits between mobile devices using the WAP protocol and the World Wide Web passing pages from one to other much like a proxy . This translate s pages into a form suitable for the mobiles such as WML pages.

WML pages are stored on a web server. They are accessed by a WAP gateway, which sits between mobile devices and WWW,passing pages from one to other much like a proxy. This process is hidden from the phone, so it may access the page in the same way as a browser accesses HTML using a URL.

WML TAGS :

WML document is called a “DECK”. Data in a DECK is structured into one or more “Cards”(pages).

1) <wml> </wml>

WML deck is defined by a <wml> tag. This tag conatins cards and information about WML document.

2) <card> </card>

WLL deck contains one or more cards. The <card> can contain text,links , tables images etc. The id attribute of the card sets a unique name for the card.

3) <do> </do>

The <do> tag can be used to activate a task when the user clicks on a word/phrase on the screen.

It has following attributes:

type: Required. Defines the type of the “do” element.

Type can be accept, prev, help, reset , delete

id: Sets a unique name for the element.

lable: Creates a lable for the “do” element

name : Defines name for the “do” element.

4) <go/>

The <go> tag represents the action of going to a new card. Where to go is specified by “href “ attribute.

5) <select> and <option> tag

The <option> tag is used to define the options in the selectable list.

The group of selectable list identified by the name attribute mentioned in the select tag.

E.g <select name = “name”>

```
    <option value = “ some value”> text </option>
    <option value = “ some value“> text </option>
    </select>
```

6) <optgroup> </optgroup>

The <optgroup> tag defines a group of options in a selectable list.

```
<select>
   <optgroup>
     <option>text</option>
     <option>text</option>
    </optgroup>
     <optgroup>
     <option>text</option>
     <option>text</option>
    </optgroup>

   </select>
```

7) <template> </template>

The <template> tag defines a template for all the cards in a deck. The "code" in the <template> tag is added to each card in the deck.

Conclusion: Basic tags of WML have been studied.

PRACTICAL : 8

Title : Write a WML page to display image and to accept input from the user.

Objective : To study WML tags.

Reference :

Prerequisite : knowledge of HTML

Description :

WML mainly specifies how to display text contents on a mobile device. However we can also display images using WML , create an anchors (links) and can accept input from user.

<img> tag

WML provides <img> tag to display an image on a WML page.

```
<img src=”img.png” height=300 width=”300” alt=”some text”>
```

Image tag displays an image specified by the 'src' attribute. If the specified image is not found, it displays an alternate message specified by the 'alt' attribute.

<anchor> tag

The <anchor> tag defines an anchor (a link), which allows you to jump from one card/deck to another. The <anchor> tag always has a task ("go", "prev", or "refresh") specified. The task defines what to do when the user selects the link.

The **<prev>** task represents the action of returning to the previous card visited. If no previous URL exists, specifying <prev> has no effect.

<a> tag

The <a> tag also defines an anchor (a link), which allows you to jump from one card/deck to another.

use <a> whenever it is possible instead of <anchor> tag.

It is not allowed to nest anchors.

The following example shows how an image or text can be used as an anchor.

```
<a href="somefile">
..text..
..image..
</a>
```

<input> tag

The <input> tag defines an input field (a text field where the user can enter some text).

Attributes:

- id *:* Sets a unique name for the element
- name : REQUIRED. The name of the variable that is set with the result of the user's input
- maxlength: This *number* Sets the maximum number of characters the user can enter in the field
- size : Sets the width of the input field
- value : Sets the default value of the variable in the "name" attribute

Conclusion : Image , input and anchor tags have been studied and implemented.

STUDY ASSIGNMENT : 9

Title : Detailed study of Bluetooth.

Objective: To study basic concepts of formation of Bluetooth network , Bluetooth protocol stack , applications , profiles etc.

References :

- Mobile Communication By Schiller
- Mobile Communication By Pahlavan

Structure:

Following topics must be covered in detail:

1. Bluetooth Networking :
   Formation of bluetooth network , piconet , scatternet etc.
2. Bluetooth protocol stack (Following layer must be explained in detail)

- Radio layer
- Baseband layer
- L2CAP
- Service discovery Protocol.

3. Major baseband states of Bluetooth devices.
4. Bluetooth applications.
5. Profile.

STUDY ASSIGNMET : 10

Title : Detailed study of Wireless Application Protocol (WAP).

Objective: To study basic concepts of WAP , WAP architecture , applications etc.

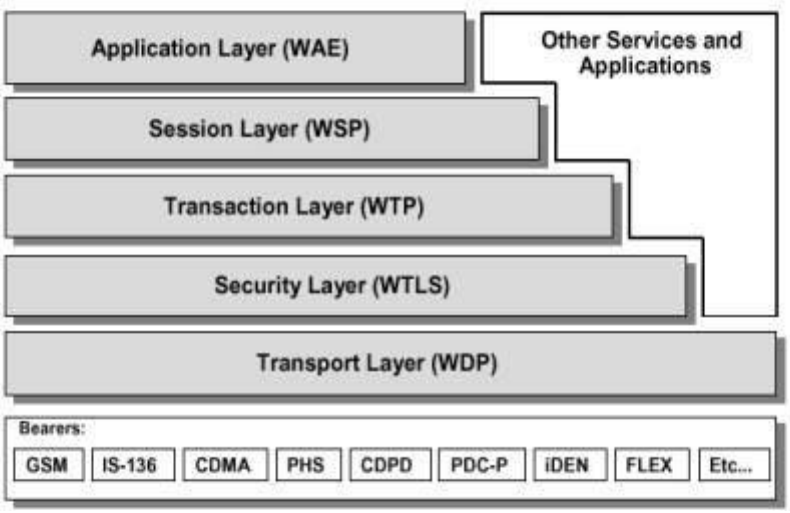
References :

- Professional WAP by Charles Archart and Nirmal Chidambaram - Wrox publication
- Mobile Communication By Schiller.

Structure:

following topics must be covered in detail.

1. Why WAP ??
2. Integration of WAP components in Web application.
3. WAP architecture (Explain functionality of each layer in detail)



4. WAP client , WAP proxy , WAP gateway, WAP server , WAP application server and bearer services.
5. WTAI.