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APPENDICES

APPENDIX A

Program 01

Java application program

```
import java.io.*;
import java.util.*;

public class GlobalVar
{
	public static String MONITOR_FILE = "mymonitor.txt";

	//public static boolean g_datavalid;
	public static Boolean g_datavalid = new Boolean(false); // my var

	public static double g_coefxyz2rgb[][]= new double[3][3];
	public static double g_coefrgb2xyz[][]= new double[3][3];

	public static double g_gog[][] = new double[3][2]; //[3][2] GOG modal
	public static double g_sy_max[] = new double[8]:
	public static double g_sx_max[] = new double[8];

	public static double g_xmin, g_ymin, g_zmin;
	public static double g_xyzmin[] = { 0.0, 0.0, 0.0 }; //my var


	public static void calibrate(){
		calibrate(g_coefxyz2rgb, g_coefrgb2xyz,
			g_gog, g_sx_max, g_sy_max,
			g_xyzmin, g_datavalid);
		System.out.println( " File name = " + MONITOR_FILE );
		//for( int i=0; i<3; i++ )
			//for( int j=0; j<3; j++ )
				//System.out.println( g_coefrgb2xyz[i][j]);
		for( int i=0;i<3;i++ )
			for(int j=0;j<2;j++)
				System.out.println( g_gog[i][j]);
	}

	public static void calibrate(double coefxyzrgb[][], double coefrgbxyz[][],
			double gog[][], double sx_max[], double sy_max[],
//			double& xmin, double& ymin, double& zmin, bool& valid)
			double xyzmin[], Boolean valid)
	{
		//double sy[18],sx[18],lmax[8],l[18];
		//double xl[3][18],x0,y0,z0;
		double sy[] = new double[18];
		double sx[] = new double[18];
		double lmax[] = new double[8];
		double l[] = new double[18];
		double xl[][] = new double[3][18];
		double x0,y0,z0;
		double sx_min,sy_min,lmin;
			sx_min = sy_min = lmin = 0;
		//int i,j,ns,nt,dac[3][18],dummy;
		int i,j,ns,nt,dummy;
		int dac[][] = new int[3][18];
		int inter,neq;

		String oneLine;

		valid = new  Boolean( false );
```

```
                ns = 15;
                nt = 40;
                inter = 1;
                neq = 1;

                //using greys + 1 white.
                ns = ns +1;

                //FILE *fp;
                try{
                        //DataInputStream fp = new DataInputStream( new
BufferedInputStream ( new FileInputStream (MONITOR_FILE)));
                        BufferedReader fp = new BufferedReader( new FileReader(
MONITOR_FILE ));
                        //valid = false;

                        //check the existance of the file monitor.h
                        //if(_access(MONITOR_FILE, 00) != 0)
                        //      return ;

                        //fp = fopen(MONITOR_FILE,"r");

                        //reading white, r,g,b maximum
                        for (i=0;i<4;i++){
                                //fscanf(fp,"%d %d %d %lf %lf %lf",&dummy,&dummy,
&dummy,
                                //                      &sx_max[i],&sy_max[i],&lmax[i]);
                                oneLine = fp.readLine();
                                StringTokenizer token = new StringTokenizer( oneLine );
                                int col = 0;
                                while( token.hasMoreTokens() ){
                                        switch( col ){
                                                case 3 : sx_max[i] = Double.parseDouble(
token.nextToken() ); break;
                                                case 4 : sy_max[i] = Double.parseDouble(
token.nextToken() ); break;
                                                case 5 : lmax[i] = Double.parseDouble(
token.nextToken() ); break;
                                                default : token.nextToken();
                                        }
                                        col++;
                                }
                        }

                        //find X0,Y0,Z0
                        x0 = 100.0/sy_max[0]*sx_max[0];
                        y0 = 100.0;
                        z0 = 100.0/sy_max[0]*(1.0-sx_max[0]-sy_max[0]);

                        //reading grey samples
                        for (i=0;i<ns;i++) {
                                //fscanf(fp,"%d %d %d %lf %lf %lf",&dac[0][i],&dac[1][i],
                                //                      &dac[2][i],&sx[i],&sy[i],&l[i]);
                                oneLine = fp.readLine();
                                StringTokenizer token = new StringTokenizer( oneLine );
                                int col = 0;
                                while( token.hasMoreTokens() ){
                                        switch( col ){
```

```
                                        case 0 : dac[0][i] = Integer.parseInt(
token.nextToken() ); break;
                                        case 1 : dac[1][i] = Integer.parseInt(
token.nextToken() ); break;
                                        case 2 : dac[2][i] = Integer.parseInt(
token.nextToken() ); break;
                                        case 3 : sx[i] = Double.parseDouble(
token.nextToken() ); break;
                                        case 4 : sy[i] = Double.parseDouble(
token.nextToken() ); break;
                                        case 5 : l[i] = Double.parseDouble(
token.nextToken() ); break;
                                        default : token.nextToken();
                                }
                                col++;
                        }

                        if(i==ns-1)
                        {
                                lmax[4]=l[i];
                                sx_max[4]=sx[i];
                                sy_max[4]=sy[i];
                        }
                }
                for (i=5;i<9;i++){
                        //fscanf(fp,"%d %d %d %lf %lf %lf",&dummy,&dummy,
&dummy,
                        //              &sx_max[i],&sy_max[i],&lmax[i]);
                        oneLine = fp.readLine();
                        StringTokenizer token = new StringTokenizer( oneLine );
                        int col = 0;
                        while( token.hasMoreTokens() ){
                                if (i==8){
                                        //fscanf(fp,"%d %d %d %lf %lf %lf",&dummy,
&dummy,&dummy,
                                        //                      &sx_min,&sy_min,
&lmin);   // dac 0 0 0 point
                                        switch( col ){
                                                case 3 : sx_min =
Double.parseDouble( token.nextToken() ); break;
                                                case 4 : sy_min =
Double.parseDouble( token.nextToken() ); break;
                                                case 5 : lmin = Double.parseDouble
( token.nextToken() ); break;
                                                default : token.nextToken();
                                        }

                                } else {
                                        switch( col ){
                                                case 3 : sx_max[i] =
Double.parseDouble( token.nextToken() ); break;
                                                case 4 : sy_max[i] =
Double.parseDouble( token.nextToken() ); break;
                                                case 5 : lmax[i] =
Double.parseDouble( token.nextToken() ); break;
                                                default : token.nextToken();
                                        }
                                }
```

```
                                col++;
                        }
                }

                //fclose(fp);
                fp.close();
        } catch ( Exception e ) { System.out.println(e); return;}


/*      for (i=0;i<8;i++){
                System.out.println( sx_max[i] + " " + sy_max[i] + " " + lmax[i]);
        }
        for (i=0;i<ns;i++){
                System.out.print( dac[0][i] + " " + dac[1][i] + " " + dac[2][i]+ " ");
                System.out.println( sx[i] + " " + sy[i] + " " + l[i]);
        }
        System.out.println( sx_min + " " + sy_min + " " + lmin);
//*/

        //Make average for w, r,g,b.
        for (i=0;i<4;i++)
        {
                lmax[i] = (lmax[i]+lmax[i+4])/2;
                sx_max[i] = (sx_max[i]+sx_max[i+4])/2;
                sy_max[i] = (sy_max[i]+sy_max[i+4])/2;
        }

        xyzmin[1] = lmin;
        xyzmin[0] = xyzmin[1]/sy_min*sx_min;
        xyzmin[2] = xyzmin[1]/sy_min*(1.0-sy_min-sx_min);

                // 3 guns: r,g,b, xl[0][]-r scalar using matrix inversion.
        cm_plccMatrix_burns(sx_max[1],sy_max[1],sx_max[2],sy_max[2],
                                sx_max[3],sy_max[3],lmax,coefrgbxyz,coefxyzrgb);
        for (i=0;i<3;i++)
        {
                if(inter == 1)
                {
                        for(j=0;j<ns;j++)  //include interreflection.
                        {
                                xl[i][j] =((l[j]/sy[j]*sx[j])-xyzmin[0])*coefxyzrgb[i][0]
                                                +(l[j]-xyzmin[1])*coefxyzrgb
[i][1]
                                                +(l[j]/sy[j]*(1.0-sx[j]-sy[j])-
xyzmin[2])*coefxyzrgb[i][2];
                        }
                }
                else
                {
                        for(j=0;j<ns;j++)  //not include interreflection.
                        {
                                xl[i][j] =(l[j]/sy[j]*sx[j])*coefxyzrgb[i][0]
                                                +l[j]*coefxyzrgb[i][1]
                                                +l[j]/sy[j]*(1.0-sx[j]-sy[j])
*coefxyzrgb[i][2];
                        }
                }
        }
```

```
            //normalise xl so that white has xl = 1.0;
            for (i=0;i<3;i++)
                    for(j=0;j<ns;j++)
                            xl[i][j] /=xl[i][ns-1];
            calmonit_simplex(dac,ns,xl,gog); //gog[][0] - gamma, gog[][1]-gain

            valid = new Boolean(true);
            g_datavalid = new Boolean(true);
    }

    public static boolean IsdataValid(){
            return g_datavalid.booleanValue();
    }

    /* Burns' matrix */
    static void cm_plccMatrix_burns(double sxr,double syr,double sxg,double syg,double
sxb,
                    double syb,double lmax[],double coefrgbxyz[][],double coefxyzrgb[][])
    {
                    double a[][] = new double[3][3];
                    double  szr,szg,szb;
                    int i;

                    szr=1.0 - sxr - syr;
                    szg=1.0 - sxg - syg;
                    szb=1.0 - sxb - syb;
                    a[0][0] = sxr*lmax[1]/syr; a[1][0] = lmax[1]; a[2][0] = szr*lmax[1]/syr;
                    a[0][1] = sxg*lmax[2]/syg; a[1][1] = lmax[2]; a[2][1] = szg*lmax[2]/syg;
                    a[0][2] = sxb*lmax[3]/syb; a[1][2] = lmax[3]; a[2][2] = szb*lmax[3]/syb;

                    for ( i = 0; i < 3; i++ )
                    {
                                    coefrgbxyz[i][0] =a[i][0];
                                    coefrgbxyz[i][1] =a[i][1];
                                    coefrgbxyz[i][2] =a[i][2];
                    }
                    cm_plccInvMatrix(coefrgbxyz,coefxyzrgb);
    }

    /*
     * Calculating Inverse of 3x3 Matrix
     */
    public static void cm_plccInvMatrix(double a[][],double c[][])
    {
                    //double  b[3][3],sum;
                    double  b[][] = new double[3][3];
                    double sum;
                    int i,j;

                    b[0][0] = a[1][1]*a[2][2] - a[1][2]*a[2][1];
                    b[0][1] = a[1][2]*a[2][0] - a[1][0]*a[2][2];
                    b[0][2] = a[1][0]*a[2][1] - a[1][1]*a[2][0];
                    b[1][0] = a[0][2]*a[2][1] - a[0][1]*a[2][2];
                    b[1][1] = a[0][0]*a[2][2] - a[0][2]*a[2][0];
                    b[1][2] = a[0][1]*a[2][0] - a[0][0]*a[2][1];
                    b[2][0] = a[0][1]*a[1][2] - a[0][2]*a[1][1];
                    b[2][1] = a[0][2]*a[1][0] - a[0][0]*a[1][2];
                    b[2][2] = a[0][0]*a[1][1] - a[0][1]*a[1][0];
```

```
                sum = a[0][0]*(a[1][1]*a[2][2] - a[1][2]*a[2][1]);
                sum = sum - a[0][1]*(a[1][0]*a[2][2] - a[1][2]*a[2][0]);
                sum = sum + a[0][2]*(a[1][0]*a[2][1] - a[1][1]*a[2][0]);

                for ( i = 0; i < 3; i++ )
                for ( j = 0; j < 3; j++ )
                c[j][i] = b[i][j]/sum;
}

static void calmonit_simplex(int dac[][],int ns,double rgb[][],double co[][])
{

        //double *x,**p,*y,dd[18],scalar[18],ftol,f;
        double x[], p[][] ,y[];
        double dd[] = new double[18];
        double scalar[] = new double[18];
        double ftol,f;
        int i,j,m,np,mp,ndim;

        np=2;
        mp=np+1;
        ftol=0.000001;
        ndim=np;
        x = new double[np];
        y = new double[mp+1];
//      p = new (double(*[mp+1]));
//      for (i=0;i<=mp;i++)     p[i] = new double[np+1];
        p = new double[mp+1][np+1];

        for (m=0;m<3;m++)       {
                for (j=0;j<ns;j++)          {
                        dd[j]= dac[m][j]/255.;
                        scalar[j]=rgb[m][j];
                }
                for (i=1;i<=mp;i++)
                {
                        for (j=1;j<=np;j++)
                                x[j-1]=p[i][j]=(i == (j+1)? 2.0:0.8);
                        y[i] = calmonit_func(scalar,dd,ns,x);

                }
                calmonit_amoeba(p,y,ns,ndim,ftol,scalar,dd);
                for (i=1;i<=np;i++) {
                        co[m][i-1]=(p[1][i]+p[2][i]+p[3][i])/3.;
                }
        }

        //delete [] x;
        //delete [] y;
        //for (i=0;i<=mp;i++) delete [np+1] p[i];
        //delete [mp+1] p;
}

static double calmonit_func(double x[],double dac[],int ns,double y[])
{
        double s,xd, f;
        int i;
```

```
        s=0.0;
        for (i=0;i<ns;i++)          {
                if(y[1]*dac[i]+(1.0-y[1]) <= 0.0) xd = 0.0;
                else     xd= Math.pow(y[1]*dac[i]+1.0-y[1],y[0]);
                //printf("\nxd = %lf",xd);
                //s += (x[i] - pow(10.,xd))*(x[i] - pow(10.,xd));
                s += (x[i] - xd)*(x[i] -xd);
        }
        f =100.*Math.sqrt(s/ns);
        //fprintf(stdout, "\nf = %lf", *f);
        return f;
}

static void calmonit_amoeba(double p[][], double y[],int ns,int ndim, double ftol,
                        double xyz[],double dd[])

{
        int i, ihi,inhi,j,mpts=ndim+1,nfunk,ilo;
        double rtol,sum,swap,ysave,ytry,psum[];

        psum= new double[ndim];
        nfunk=0;
        //GET_PSUM;
        for (j=1;j<=ndim;j++) {
                for (sum=0.0,i=1;i<=mpts;i++) sum += p[i][j];
                psum[j-1] = sum;
        }

        for (;;) {
                ilo=1;
                //ihi = y[1]>y[2] ? (inhi=2,1) : (inhi=1,2);
                if (y[1]>y[2]){
                        inhi=2;
                        ihi =1;
                } else {
                        inhi=1;
                        ihi =2;
                }
                for (i=1;i<=mpts;i++) {
                        if (y[i] <= y[ilo]) ilo=i;
                        if (y[i] > y[ihi]) {
                                inhi=ihi;
                                ihi=i;
                        } else if (y[i] > y[inhi] && i != ihi) inhi=i;
                }
                rtol=2.0*Math.abs(y[ihi]-y[ilo])/(Math.abs(y[ihi]+y[ilo]));
                if (rtol < ftol) {
                        //SWAP(y[1],y[ilo])
                        swap = y[1];
                        y[1] = y[ilo];
                        y[ilo] = swap;
                        //for (i=1;i<=ndim;i++) SWAP(p[1][i],p[ilo][i])
                        for (i=1;i<=ndim;i++){
                                swap = p[1][i];
                                p[1][i] = p[ilo][i];
                                p[ilo][i] = swap;
                        }
```

```
                        //printf("\niteration = %d\n",nfunk);
                        break;
                    }
                    //if (nfunk >= NMAX) fprintf(stderr,"NMAX exceeded");
                    nfunk +=2;
                    ytry=calmonit_amotry(p,y,psum,ns,ndim,xyz,dd,ihi,-1.0);
                    if (ytry <=y[ilo])
                        ytry=calmonit_amotry(p,y,psum,ns,ndim,xyz,dd,ihi,2.0);
                    else if (ytry >= y[inhi]) {
                        ysave=y[ihi];
                        ytry=calmonit_amotry(p,y,psum,ns,ndim,xyz,dd,ihi,0.5);
                        if (ytry >= ysave) {
                            for (i=1;i<=mpts;i++) {
                                if (i != ilo) {
                                    for (j=1;j<=ndim;j++)
                                        p[i][j]=psum[j-1]=0.5*(p[i][j]
+p[ilo][j]);
                                    y[i]=calmonit_func(xyz,dd,ns,psum);
                                }
                            }
                            nfunk += ndim;
                            //GET_PSUM
                            for (j=1;j<=ndim;j++) {
                                for (sum=0.0,i=1;i<=mpts;i++) sum += p[i][j];
                                psum[j-1] = sum;
                            }
                        }
                    } else --(nfunk);
                }
                //psum=float(psum);
                //delete [] psum;
            }

            static double calmonit_amotry(double p[][], double y[], double psum[],int ns, int ndim,
                double xyz[],double dd[],int ihi, double fac)
            {
                int j;
                double fac1,fac2,ytry,ptry[];

                ptry = new double[ndim];
                fac1=(1.0-fac)/ndim;
                fac2=fac1-fac;
                for (j=1;j<=ndim;j++) ptry[j-1]=psum[j-1]*fac1-p[ihi][j]*fac2;
                ytry = calmonit_func(xyz,dd,ns,ptry);
                if (ytry < y[ihi]) {
                    y[ihi]=ytry;
                    for (j=1;j<=ndim;j++) {
                        psum[j-1] += ptry[j-1]-p[ihi][j];
                        p[ihi][j]=ptry[j-1];
                    }
                }
                //delete [] ptry;
                return ytry;
            }

            public static void main(String[] args)
            {
                calibrate();
```

```
                for( int i=0; i<3; i++ )
                        for( int j=0; j<3; j++ )
                                System.out.println( g_coefrgb2xyz[i][j]);


/*              double m_coefxyz2rgb[][] = new double[3][3];
                System.out.println("Hello World!"+ g_coefxyz2rgb.length);
                for( int i=0; i< g_coefxyz2rgb.length; i++){
                        g_coefxyz2rgb[i][0]=i*3+1;
                        g_coefxyz2rgb[i][1]=i*3+2;
                        g_coefxyz2rgb[i][2]=i*3+3;
                        //m_coefxyz2rgb[i][i]=i;

                }
                System.arraycopy(g_coefxyz2rgb,0,m_coefxyz2rgb,0,m_coefxyz2rgb.length);
                for(int i=0; i< g_coefxyz2rgb.length; i++){
                        for(int j=0; j< g_coefxyz2rgb.length; j++){
                                System.out.print( g_coefxyz2rgb[i][j]+ " " );
                        }
                        System.out.println();
                }
                for(int i=0; i< g_coefxyz2rgb.length; i++){
                        for(int j=0; j< g_coefxyz2rgb.length; j++){
                                System.out.print( m_coefxyz2rgb[i][j]+ " " );
                        }
                        System.out.println();
                }
//*/
        }
}
```

```
/*      //global value
        extern bool   g_datavalid;
        extern double g_coefxyz2rgb[3][3], g_coefrgb2xyz[3][3];
        extern double g_gog[3][2], g_sx_max[8], g_sy_max[8];
        extern double g_xmin, g_ymin, g_zmin;
// */

class CColorSpace
{
        double m_X0, m_Y0, m_Z0;  //bright light
        int m_rgb[]; //space r,g,b => m_rgb[0],m_rgb[1],m_rgb[2]
        double m_XYZ[]; //space X,Y,Z => m_XYZ[0],m_XYZ[1],m_XYZ[2]
        //double m_h, m_L, m_C; //space h, L*, C*
        //double m_a, m_b;      //space L, a*, b*
        Double m_h, m_L, m_C; //space h, L*, C*
        Double m_a, m_b;      //space L, a*, b*
        double m_gog[][]; //[3][2] GOG modal
        double m_coefrgb2xyz[][];  //[3][3]coeffication from space RGB to XYZ
        double m_coefxyz2rgb[][];  //[3][3]coeffication from space XYZ to RGB
   double sy_max[], sx_max[]; //[8]
        double m_xmin, m_ymin, m_zmin;
        boolean m_boutrange;

    //construction
        public CColorSpace(){
                m_rgb = new int[3]; //space r,g,b => m_rgb[0],m_rgb[1],m_rgb[2]
                m_XYZ = new double[3]; //space X,Y,Z => m_XYZ[0],m_XYZ[1],m_XYZ[2]
                m_gog= new double[3][2]; //[3][2] GOG modal
                m_coefrgb2xyz = new double[3][3];  //[3][3]coeffication from space RGB to
XYZ
                m_coefxyz2rgb = new double[3][3];  //[3][3]coeffication from space XYZ to
RGB
                sy_max = new double[8];
                sx_max = new double[8]; //[8]
        }


        //Set and Get method in color space r,g,b
        public void Set_rgb(int rgb[]) {m_rgb[0] = rgb[0];m_rgb[1] = rgb[1];m_rgb[2] = rgb[2];}
        public void Get_rgb(int rgb[]) {rgb[0] = m_rgb[0];rgb[1] = m_rgb[1];rgb[2] = m_rgb[2];}

        //Set and Get method in color space XYZ
        public void Set_XYZ(double XYZ[]) {m_XYZ[0] = XYZ[0];m_XYZ[1] = XYZ[1];m_XYZ
[2] = XYZ[2];}
        public void Get_XYZ(double XYZ[]) {XYZ[0] = m_XYZ[0];XYZ[1] = m_XYZ[1];XYZ[2] =
m_XYZ[2];}

        //Set and Get method in color space hLC
        public void Set_h(double h) {m_h = new Double(h);}
        public void Set_L(double L) {m_L = new Double(L);}
        public void Set_C(double C) {m_C = new Double(C);}

        public double Get_h() {return m_h.doubleValue();}
        public double Get_L() {return m_L.doubleValue();}
        public double Get_C() {return m_C.doubleValue();}

        //Set and Get method in color space Lab
```

```
        public void Set_a(double a) {m_a = new Double(a);}
        public void Set_b(double b) {m_b = new Double(b);}

        public double Get_a()  {return m_a.doubleValue();}
        public double Get_b()  {return m_b.doubleValue();}

        //space convertion method
/*      public boolean ColorXYZ2rgb();
        public boolean Colorrgb2XYZ();

        public boolean ColorXYZ2LabCh();
        public boolean ColorLab2XYZ();
        public boolean ColorLch2XYZ();
//*/
        public boolean IsOutOfRange() {return m_boutrange;};


        public void Inilize()
        {

                m_boutrange = false;

                m_xmin = 0.0; //0.256;
                m_ymin = 0.0; //0.262;
                m_zmin = 0.0;  //0.2215;
                //sRGB coeffication of the rgb=>xyz convertion
                m_coefrgb2xyz[0][0] = 41.23809;
                m_coefrgb2xyz[0][1] = 35.75728;
                m_coefrgb2xyz[0][2] = 18.04523;
                m_coefrgb2xyz[1][0] = 21.26199;
                m_coefrgb2xyz[1][1] = 71.51388;
                m_coefrgb2xyz[1][2] = 7.21499;
                m_coefrgb2xyz[2][0] = 1.93435;
                m_coefrgb2xyz[2][1] = 11.92122;
                m_coefrgb2xyz[2][2] = 94.05066;

                //calculate the inverse matrix of m_coefrgb2xyz
                GlobalVar.cm_plccInvMatrix(m_coefrgb2xyz,m_coefxyz2rgb);

                //calculate the bright light coeff
                sy_max[0] = 0.3290;
                sx_max[0] = 0.3127;

                m_X0 = 100.0/sy_max[0]*sx_max[0];
                m_Y0 = 100.0;
                m_Z0 = 100.0/sy_max[0]*(1.0-sx_max[0]-sy_max[0]);

                //GOG modal, gog[][0]->gamma, gog[][1]->gain, 1-gog[][1]->offset
                m_gog[0][0] = 2.4;
                m_gog[0][1] = 1.055;
                m_gog[1][0] = 2.4;
                m_gog[1][1] = 1.055;
                m_gog[2][0] = 2.4;
                m_gog[2][1] = 1.055;

                m_X0 = 100.0/sy_max[0]*sx_max[0];
                m_Y0 = 100.0;
                m_Z0 = 100.0/sy_max[0]*(1.0-sx_max[0]-sy_max[0]);
```

```
                //read the data calibrated from the monitor.txt file
                if( GlobalVar.IsdataValid())
                {

                        //memcpy(m_coefxyz2rgb, g_coefxyz2rgb, sizeof(m_coefxyz2rgb));
                        //memcpy(m_coefrgb2xyz, g_coefrgb2xyz, sizeof(m_coefrgb2xyz));
                        //memcpy(m_gog, g_gog, sizeof(m_gog));
                        //memcpy(sx_max, g_sx_max, sizeof(sx_max));
                        //memcpy(sy_max, g_sy_max, sizeof(sy_max));

                        System.arraycopy
(GlobalVar.g_coefxyz2rgb,0,m_coefxyz2rgb,0,m_coefxyz2rgb.length);
                        System.arraycopy
(GlobalVar.g_coefrgb2xyz,0,m_coefrgb2xyz,0,m_coefrgb2xyz.length);
                        System.arraycopy(GlobalVar.g_gog,0,m_gog,0,m_gog.length);
                        System.arraycopy(GlobalVar.g_sx_max,0, sx_max,0,
sx_max.length);
                        System.arraycopy(GlobalVar.g_sy_max,0, sy_max,0,
sy_max.length);

                        m_xmin = GlobalVar.g_xmin;
                        m_ymin = GlobalVar.g_ymin;
                        m_zmin = GlobalVar.g_zmin;
                }
        }



        //space match method
        public boolean ColorXYZ2rgb()
        {

                Integer inGamt = new Integer(0);
//              cm_plccXYZ2RGB(m_XYZ[0],m_XYZ[1],m_XYZ
[2],m_coefxyz2rgb,m_gog,m_xmin, m_ymin, m_zmin,
//                                                      &m_rgb[0],&m_rgb[1],&m_rgb[2],
&inGamt);
                m_boutrange = cm_plccXYZ2RGB(m_XYZ[0],m_XYZ[1],m_XYZ
[2],m_coefxyz2rgb,m_gog,m_xmin, m_ymin, m_zmin,
                                                        m_rgb, inGamt);

                //m_boutrange = (inGamt.intValue() == 0)?true:false;
                //System.out.println(m_boutrange);
                return true;
        }

        /*
         * Convert XYZ to Monitor RGB
         */
        boolean cm_plccXYZ2RGB(double X,double Y,double Z,double coefxyzrgb[][],double
gog[][],
                                                        double xmin,double ymin,double
zmin,int RGB[], Integer inGamt)
        {
                        //double  rgb[3],xyzc[3],dacrgb[3];
                        double  rgb[] = new double[3];
                        double  xyzc[] = new double[3];
```

```
        double  dacrgb[] = new double[3];

        int i,j;

        xyzc[0] = X -xmin;
        xyzc[1] = Y -ymin;
        xyzc[2] = Z -zmin;
        inGamt = new Integer(1);
        for ( i = 0; i < 3; i++ )
        {
                rgb[i] = 0.0;
                for ( j = 0; j < 3; j ++)
                        rgb[i] = rgb[i] + coefxyzrgb[i][j]*xyzc[j];

                if ( rgb[i] <= 0.0 )
                {
                        rgb[i] = 0.0;
                        inGamt = new Integer(0);
                }
                if ( rgb[i] >= 1.0 )
                {
                        rgb[i] = 1.0;
                        inGamt = new Integer(0);
                }
        }

        // GOG method
        if (GlobalVar.IsdataValid()) // if can read file
        {
                for ( i = 0; i < 3 ; i++ )
                {
                        if (rgb[i] == 0.0 ) dacrgb[i] = 0.0;
                        else
                        dacrgb[i] = 255.0*(Math.pow(rgb[i],1.0/gog[i][0]) -
                                                        (1.0-gog[i][1]))/gog[i]
[1];
                        if (dacrgb[i] < 0.0) dacrgb[i] = 0.0;
                }
        } else { // can't read file [use sRGB system]
                for ( i = 0; i < 3 ; i++)
                {
                        if (rgb[i] <= 0.00304 ) dacrgb[i] = 255.0*12.92*rgb[i];
                        else
                        dacrgb[i] = 255.0*(1.055*Math.pow(rgb[i],1.0/2.4)-
0.055);
                        if (dacrgb[i] < 0.0) dacrgb[i] = 0.0;
                }
        }


        //RGB[0] = (int) floor(dacrgb[0] + 0.5);
        RGB[0] = (int) (dacrgb[0] + 0.5);
        RGB[1] = (int) (dacrgb[1] + 0.5);
        RGB[2] = (int) (dacrgb[2] + 0.5);

        return ( inGamt.intValue() == 0 );
    }
```

```
public boolean Colorrgb2XYZ()
{

        //int inGamt = 0;
        Integer inGamt = new Integer(0);
        cm_plccRGB2XYZ(m_rgb[0],m_rgb[1],m_rgb[2],m_coefrgb2xyz,m_gog,
                        //&m_XYZ[0],&m_XYZ[1],&m_XYZ[2],&inGamt);
                        m_XYZ, inGamt);
        return true;
}

/*
 * Convert Monitor RGB  to XYZ
 */
void cm_plccRGB2XYZ(int R,int G,int B,double coefrgbxyz[][],double gog[][],
                        double XYZ[], Integer inGamt)
{
                //double  rgb[3],xyzc[3],drgb[3],temp;
                double  rgb[] = new double[3];
                double  xyzc[] = new double[3];
                double  drgb[] = new double[3];
                double temp;
                int i,j;


                drgb[0] =  (double) R;
                drgb[1] =  (double) G;
                drgb[2] =  (double) B;
                inGamt = new Integer(1);

                if (GlobalVar.IsdataValid())  // if can read file
                {
                        for (  i = 0; i < 3; i++ )
                        {
                                // GoG method
                                temp = gog[i][1]*drgb[i]/255.0 + 1.0-gog[i][1];
                                if (temp >= 0.0)
                                        rgb[i] = Math.pow(temp,gog[i][0]);
                                else
                                        rgb[i] = 0.0;
                        }
                } else { // can't read file [use sRGB system]
                        for (  i = 0; i < 3; i++ )
                        {
                                temp = drgb[i]/255.0;
                                if ( temp <= 0.03928 ){ rgb[i] = temp/12.92;}
                                if ( temp > 0.03928){ rgb[i] = Math.pow((temp+
0.055)/1.055,2.4);}
                                if ( temp < 0.0){ rgb[i] = 0.0;}
                        }
                }

                for ( i = 0; i < 3; i++)
                {
                        xyzc[i] = 0.0;
                        for ( j = 0; j < 3; j++ )
                                xyzc[i] = xyzc[i] + coefrgbxyz[i][j]*rgb[j];
```

```
                }
                XYZ[0] = xyzc[0];
                XYZ[1] = xyzc[1];
                XYZ[2] = xyzc[2];
        }       //void cm_plccRGB2XYZ

        public boolean ColorXYZ2LabCh()
        {
                //cm_CIELabch(m_X0,m_Y0,m_Z0,m_XYZ[0],m_XYZ[1],m_XYZ[2],&m_L,
&m_a,&m_b,&m_C,&m_h);
                cm_CIELabch(m_X0,m_Y0,m_Z0,m_XYZ[0],m_XYZ[1],m_XYZ
[2],m_L,m_a,m_b,m_C,m_h);
                return true;
        }

        /*
         *
         *      1976 CIE L*a*b* Uniform Colour Space
         *          L*, a*, b*, C*, h coordinates
         *      Input parameters : X, Y, Z
         *              X0 Y0 Z0 (illuminant)
         *      Output parameters : L(L*), a(a*), b(b*), c(c*) and h
         */
        void cm_CIELabch(double X0,double Y0,double Z0,double X,double Y,double Z,
//                                      double *L,double *a,double *b,double *c,double *h)
                                        Double L,Double a,Double b,Double c,Double h)

        {
                //double ILL[3],XYZ[3],FN[3];
                double ILL[] = new double[3];
                double XYZ[] = new double[3];
                double FN[] = new double[3];
                int i;

                ILL[0] = X0;
                ILL[1] = Y0;
                ILL[2] = Z0;
                XYZ[0] = X;
                XYZ[1] = Y;
                XYZ[2] = Z;
                for ( i = 0; i < 3; i++)
                if ( XYZ[i]/ILL[i]  < 0.008856 )
                        FN[i] = 7.787*XYZ[i]/ILL[i] + 16.0/116.0;
                else
                        FN[i] = Math.pow(XYZ[i]/ILL[i], 1.0/3.0);
                L = new Double(116.0*FN[1] - 16.0);
                //a = new Double(500.0*(FN[0] - FN[1]));
                m_a = new Double(500.0*(FN[0] - FN[1]));
                //b = new Double(200.0*(FN[1] - FN[2]));
                m_b = new Double(200.0*(FN[1] - FN[2]));
                c = new Double(Math.sqrt(Math.pow(m_a.doubleValue(),2.0) +
Math.pow(m_b.doubleValue(),2.0)));
                h = new Double(cm_arctan(m_a.doubleValue(),m_b.doubleValue()));
                m_C = new Double(Math.sqrt(Math.pow(m_a.doubleValue(),2.0) +
Math.pow(m_b.doubleValue(),2.0)));
                m_h = new Double(cm_arctan(m_a.doubleValue(),m_b.doubleValue
()));
        } // void cm_CIELabch
```

```
/*
 *      Calculating the arctangent function
 *      h = arctan ( b/a )
 */
double cm_arctan(double a,double b)
{
      double  h;

      if ( a == 0.0 )
      {
            if ( b > 0.0)
                  return(90.0);
            else if ( b < 0 )
                  return(270.0);
      }
      if ( b == 0.0 )
      {
            if ( a >= 0.0 )
                  return(0.0);
            else if ( a < 0 )
                  return(180.0);
      }
      h = Math.atan(b/a)*180.0/Math.PI;
      if ( a < 0.0 )
            h = h + 180.0;
      else if ( b < 0.0 )
           h = h + 360.0;
      return(h);
}

          public boolean ColorLab2XYZ()
          {
                    cm_CIELab2XYZ(m_X0,m_Y0,m_Z0,m_L.doubleValue(),m_a.doubleValue
(),m_b.doubleValue(),m_XYZ);
                    return true;
          }

          /*
           *     Transforming the 1976 CIE L*a*b*, L*, a* and b*
           *          values to the tristimulus values
           *     Input parameters : L (L*),  a (a*), b (b*)
           *                        X0 Y0 Z0 (illuminant)
           *     Output parameters : X, Y, Z
           */
          void cm_CIELab2XYZ(double X0,double Y0,double Z0,double L,double a,double b,
                                                    double XYZarg[])
          {
                    //double  FN[3], ILL[3], XYZ[3];
                    double  FN[] = new double[3];
                    double  ILL[] = new double[3];
                    double  XYZ[] = new double[3];

                    int i;

                    ILL[0] = X0;
                    ILL[1] = Y0;
                    ILL[2] = Z0;
                    FN[1]  = L/116.0;
```

```
                FN[0]  = FN[1] + a/500.0;
                FN[2]  = FN[1] - b/200.0;
                for (i = 0; i < 3; i++)
                        if ( FN[i] <= 0.068961672 )
                                XYZ[i] = ILL[i]*FN[i]/7.787;
                        else   XYZ[i] = ILL[i]*Math.pow(FN[i] + 16.0/116.0, 3.0);
                XYZarg[0] = XYZ[0];
                XYZarg[1] = XYZ[1];
                XYZarg[2] = XYZ[2];
        }


        public boolean ColorLch2XYZ()
        {
                cm_CIELch2XYZ(m_X0,m_Y0,m_Z0,m_L.doubleValue(),m_C.doubleValue
(),m_h.doubleValue(),m_XYZ);
                return true;
        }

        /*
         *    Transforming the 1976 CIE L*a*b*, L*, c* and h
         *         values to the tristimulus values
         *    Input parameters : L (L*), c (c*), h
         *                X0 Y0 Z0 (illuminant)
         *    Output parameters : X, Y, Z
         */
        void cm_CIELch2XYZ(double X0,double Y0,double Z0,double L,double c,double h,
                                                double XYZ[])
        {
                double  a,b,d;

                d = h*Math.PI/180;
                a  = c*Math.cos(d);
                b  = c*Math.sin(d);
                cm_CIELab2XYZ(X0,Y0,Z0,L,a,b,XYZ);
        }


};
```

```
import java.awt.*;
import java.awt.event.*;
import javax.swing.*;
//import java.applet.*;
import javax.swing.event.*;
import java.util.*;
import java.io.*;

class CColorConvertDlg  extends JFrame implements ActionListener, WindowListener,
MouseListener, MouseMotionListener, ChangeListener
{

        private static final int FRAME_WIDTH = 700;
        private static final int FRAME_HEIGHT = 575;

        private static final int FRAME_X_ORIGIN = 50;
        private static final int FRAME_Y_ORIGIN = 0;

        private static final int BUTTON_WIDTH = 150;
        private static final int BUTTON_HEIGHT = 30;

        static final int LENGTH_LHC_C = 100;
        static final int LENGTH_LHC   = 100;
        static final int LENGTH_LAB   = 100;

        static final int ROW_SAMPLE   = 4;
        static final int COL_SAMPLE   = 4;

        static final int ratio_c      = 2;//(200.0 / LENGTH_LHC_C)
        static final Color bgcolor = new Color( 0xCC, 0xCC, 0xCC );

        static int m_Hold = 0;
        static int m_Lold = LENGTH_LHC-60;

        public static void SaveColorEmotion(double L, double h, double C, PrintWriter pout){
                CalculateColorEmotion( L, h, C, false);
                //(float)m_warm, (float)m_light, (float)m_deep, (float)m_heavy, (float)m_vivid,
                //(float)m_gaudy, (float)m_striking, (float)m_dynamic, (float)m_distinct, (float)
m_transparent, (float)m_soft,(float)m_strong);
                pout.print((float)m_warm+" "+ (float)m_light+" "+ (float)m_deep+" "+ (float)
m_heavy+" "+ (float)m_vivid);
                pout.println((float)m_gaudy+" "+ (float)m_striking+" "+ (float)m_dynamic+" "+
(float)m_distinct+" "+ (float)m_transparent+" "+ (float)m_soft+" "+(float)m_strong);
        }

        public static void CalculateColorEmotion(double L, double h, double C, boolean
bRefresh){

                double  deep;
                double  distinct;
                double  dynamic;
                double  gaudy;
                double  heavy;
                double  light;
                double  soft;
                double  striking;
                double  strong;
                double  transparent;
```

```
                double  vivid;
                double  warm;
/*
                if(h <=180 && h >= 0)
                        warm = 0.154*L + 39.378*Math.pow(C,0.372) - 0.303*h - 113.855;
                else
                        warm = 0.355 *L + 23.476*Math.pow(C,0.429) - 0.159*(360 - h) -
105.710;

                if(h <=180 && h >= 0)
                        light = 2.121*L + 1.798*C - 0.022*h - 175.642;
                else
                        light = 2.295*L + 2.886*C + 0.117*(360 - h) - 198.033;

                if(h <=180 && h >= 0)
                        deep = -3.590*L + 0.451*C + 0.040*h + 189.467;
                else
                        deep = -3.674*L - 0.216*C + 0.098*(360 - h) + 189.127;

                if(h <=180 && h >= 0)
                        heavy = -3.340*L + 0.476*C + 0.037*h + 175.467;
                else
                        heavy = -3.477*L - 0.264*C + 0.072*(360 - h) + 182.866;

                if(h <=180 && h >= 0)
                        vivid = 0.713*L + 11.209*Math.pow(C,0.668) + 0.009*h - 147.825;
                else
                        vivid = 0.982*L + 14.643*Math.pow(C,0.660) + 0.091*(360 - h) -
165.574;

                if(h <=180 && h >= 0)
                        gaudy = -0.332*L + 4.574*Math.pow(C,0.867) - 0.081*h - 73.973;
                else
                        gaudy = -0.114*L + 13.195*Math.pow(C,0.664) - 0.005*(360 - h) -
103.481;

                if(h <=180 && h >= 0)
                        striking = -0.750*L + 2.847*Math.pow(C,0.961) - 0.052*h - 35.564;
                else
                        striking = -0.748*L + 10.597*Math.pow(C,0.684) + 0.060*(360 - h) -
54.801;

                if(h <=180 && h >= 0)
                        dynamic = -0.296*L + 3.162*Math.pow(C,0.931) - 0.073*h - 68.835;
                else
                        dynamic = -0.120*L + 4.385*Math.pow(C,0.864) + 0.032*(360 - h) -
84.791;

                if(h <=180 && h >= 0)
                        distinct = 1.820*L + 1.214*C + 0.077*h - 144.740;
                else
                        distinct = 1.746*L + 2.393*C + 0.111*(360 - h) - 147.418;

                if(h <=180 && h >= 0)
                        transparent = 2.363*L + 0.876*C + 0.040*h - 180.640;
                else
                        transparent = 2.119*L + 1.863*C + 0.072*(360 - h) - 169.497;
```

```
                if(h <=180 && h >= 0)
                        soft = 2.900*L - 0.510*C - 0.051*h - 146.700;
                else
                        soft = 2.953*L + 0.424*C - 0.020*(360 - h) - 159.795;

                if(h <=180 && h >= 0)
                        strong = -2.625*L + 1.185*C + 0.053*h + 116.320;
                else
                        strong = -2.758*L + 0.353*C + 0.050*(360 - h) + 135.877;
*/
                double dh40 = 40-h;
                double dh290 = h+70;
//              if ( (0<h) && (h<=110) )   dh290 = h+70;
                if ( (110<h) && (h<=290) ) dh290 = 290 - h;
                if ( (290<h) && (h<=360) ) dh290 = h - 290;

//              if ( (0<h) && (h<=40) )   dh40 = 40 - h;
                if ( (40<h) && (h<=220) ) dh40 = h - 40;
                if ( (220<h) && (h<=360) ) dh40 = 400 - h;

                double one_dhC = (1 - dh290/360) * C;

                light           = Math.pow( Math.pow(3.4*(L-10),2) + Math.pow(4.5
*one_dhC,2), 0.5 ) - 184;
                soft            = - Math.pow( Math.pow(2.2*(L-90),2) + Math.pow(0.9
*one_dhC,2),0.5) + 79;
                warm            = Math.pow( Math.pow(0.27*(L-100),2) + Math.pow(1.48*(1
+Math.cos(Math.toRadians(dh40)))*one_dhC,2),0.5) - 58;
                transparent     = Math.pow( Math.pow(3.1*(L-30),2) + Math.pow(2.7
*one_dhC,2),0.5) - 122;
                deep            = Math.pow( Math.pow(2.6*(L-100),2) + Math.pow(1.8
*one_dhC,2),0.5) - 90;
                distinct = Math.pow( Math.pow(1.9*(L-60),2) + Math.pow(3.3*one_dhC,2),0.5)
- 62;
                heavy           = Math.pow( Math.pow(2.6*(L-100),2) + Math.pow(0.6
*one_dhC,2),0.5) - 96;
                vivid           = Math.pow( Math.pow(2.2*(L-10),2) + Math.pow(5
*one_dhC,2),0.5) - 157;
                strong          = Math.pow( Math.pow(2.1*(L-90),2) + Math.pow(0.6
*one_dhC,2),0.5) - 52;
                dynamic         = Math.pow( Math.pow(1.1*(L-20),2) + Math.pow(3.8
*one_dhC,2),0.5) - 100;
                gaudy           = Math.pow( Math.pow(0.4*(L-10),2) + Math.pow(3.8
*one_dhC,2),0.5) - 95;
                striking = Math.pow( Math.pow(1.6*(L-90),2) + Math.pow(3.1*one_dhC,2),0.5)
- 65;

                //double emotion[12] = {0};
                double emotion[] = new double[12];
                emotion[0] = deep;
                emotion[1] = distinct;
                emotion[2] = dynamic;
                emotion[3] = gaudy;
                emotion[4] = heavy;
                emotion[5] = light;
                emotion[6] = soft;
                emotion[7] = striking;
```

```
                emotion[8] = strong;
                emotion[9] = transparent;
                emotion[10] = vivid;
                emotion[11] = warm;

                for(int i = 0; i < 12; i++)
                {
                        if(emotion[i] < -100)
                                emotion[i] = -100.0;
                        else if(emotion[i] > 100.0)
                                emotion[i] = 100.0;
                        emotion[i] = (int)(emotion[i] * 100) / 100.0;

                }

                m_deep    = emotion[0];
                m_distinct        = emotion[1];
                m_dynamic       = emotion[2];
                m_gaudy           = emotion[3];
                m_heavy           = emotion[4];
                m_light     = emotion[5];
                m_soft      = emotion[6];
                m_striking        = emotion[7];
                m_strong          = emotion[8];
                m_transparent =           emotion[9];
                m_vivid     = emotion[10];
                m_warm            = emotion[11];

                if(bRefresh)
                        UpdateData(false);


        }

        public void stateChanged(ChangeEvent e){
                if (e.getSource() == m_sldH)
                {
                                if ( m_Hold > m_sldH.getValue())
                                {
                                        m_Hold = m_sldH.getValue();
                                        m_Hold = m_Hold - (m_Hold % 10);
                                        m_sldH.setValue(m_Hold);
                                } else if( m_Hold < m_sldH.getValue())
                                {
                                        m_Hold = m_sldH.getValue();
                                        m_Hold = m_Hold -( m_Hold % 10) + ( ((m_Hold %
10)==0)?0:10 );
                                        m_sldH.setValue(m_Hold);
                                }
                                System.out.println( "change" );
                 } else if(e.getSource() == m_sldL){
                                if ( m_Lold > m_sldL.getValue())
                                {
                                        m_Lold = m_sldL.getValue();
                                        m_Lold = m_Lold - (m_Lold % 10);
                                        m_sldL.setValue(m_Lold);
                                } else if( m_Lold < m_sldL.getValue())
```

```
                                {
                                        m_Lold = m_sldL.getValue();
                                        m_Lold = m_Lold -( m_Lold % 10) + ( ((m_Lold % 10)
==0)?0:10 );
                                        m_sldL.setValue(m_Lold);
                                }
                                System.out.println( "change" );
                        }
                }

                void onClickedRectLab(Point point){
                        //setTitle("Lab");
                        int rgb[]= new int[3];
                        int RGB[]= new int[3];
                        int i,j,k;
                        int cx, cy;
                        cx = LENGTH_LAB;
                        cy = LENGTH_LAB;

                        i = (point.x - cx);
                        j = (point.y - cy);
                        j =  - j;

                        m_colorLab[LENGTH_LAB + i][LENGTH_LAB+j].Get_rgb(rgb);
                        for(k = 0; k < 3; k++)
                        {
                                RGB[k] = (int)(rgb[k]);
                        }

                        if(!m_colorLab[LENGTH_LAB + i][LENGTH_LAB+j].IsOutOfRange() &&
                                max(RGB[0], max(RGB[1], RGB[2])) <= 255 && min(RGB[0], min
(RGB[1], RGB[2])) >= 0)
                        {
                                m_ptLabOld = m_ptLab;
                                m_ptLab = point;
//                              rectOld = CRect(m_ptLabOld.x - 4, m_ptLabOld.y - 4, m_ptLabOld.x
+ 5, m_ptLabOld.y + 5);
//                              rect    = CRect(m_ptLab.x - 4, m_ptLab.y - 4, m_ptLab.x + 5,
m_ptLab.y + 5);
                                m_clrMarkLab = new Color(255-RGB[0], 255-RGB[1],255-RGB[2]);
                                m_bHasClicked = true;
                                m_rectLab.setm_bHasClicked(true);
                                m_rectLhc.setm_bHasClicked(true);
                                m_rectLab.setPointMark(point);
                                m_rectLab.setClrMark( m_clrMarkLab );
                                m_rectLab.repaint();



//                              InvalidateRect(&rectOld);
//                              InvalidateRect(&rect);

//                              CClientDC dc(this);

                                m_clrSelected = new Color(RGB[0], RGB[1], RGB[2]);
                                m_lhcSelected[0] = m_colorLab[LENGTH_LAB + i]
[LENGTH_LAB+j].Get_L();
                                m_lhcSelected[1] = m_colorLab[LENGTH_LAB + i]
```

```
[LENGTH_LAB+j].Get_h();
                        m_lhcSelected[2] = m_colorLab[LENGTH_LAB + i]
[LENGTH_LAB+j].Get_C();

                        //InvalidateRect(&m_rectSample);
                        m_rectSample.setBackground( m_clrSelected );

                        double XYZ[] = new double[3];
                        double xy[] = new double[2];
                        m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Get_XYZ(XYZ);
                        for(k = 0; k < 3; k++)
                        {
                                XYZ[k] = ((int)(XYZ[k] * 10000)) / 10000.0;
                        }
                        cm_XYZ2xy(XYZ[0],XYZ[1],XYZ[2],xy);

                        xy[0] = ((int)(xy[0] * 10000)) / 10000.0;
                        xy[1] = ((int)(xy[1] * 10000)) / 10000.0;

                        m_X = XYZ[0];
                        m_Y = XYZ[1];
                        m_Z = XYZ[2];

                        m_lx = xy[0];
                        m_ly = xy[1];

                        m_red = (int)(rgb[0]);
                        m_green = (int)(rgb[1]);
                        m_blue = (int)(rgb[2]);

                        m_l = m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Get_L();
                        m_h = m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Get_h();
                        m_c = m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Get_C();
                        m_a = m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Get_a();
                        m_b = m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Get_b();
                        m_a = ((int)(m_a * 10000)) / 10000.0;
                        m_b = ((int)(m_b * 10000)) / 10000.0;


                        CalculateColorEmotion(m_l, m_h, m_c,true);

                        m_sldA.setValue((int)m_a);
                        m_sldB.setValue(-(int)m_b);


                        //reflesh the space of the Lhc
                        //for draw the mark point of Lab
                        m_sldH.setValue((int)(m_h+0.5));
                        m_sldC.setValue((int)(m_c+0.5));
                        m_sldL.setValue(LENGTH_LHC - (int)(m_l+0.5));

                        m_c = ((int)(m_c * 10000)) / 10000.0;
                        m_h = ((int)(m_h * 10000)) / 10000.0;

                        UpdateData(false);
```

```
                        m_ptLhc = new Point((int)(m_c*ratio_c+0.5), (LENGTH_LHC - (int)
(m_l+0.5))*2);
                        m_rectLhc.setPointMark(m_ptLhc);
                        m_clrMarkLhc = new Color(255-RGB[0], 255-RGB[1],255-RGB[2]);
                        m_rectLhc.setClrMark( m_clrMarkLhc );
                        //BeginWaitCursor();
                        DrawLhcGraph(m_h);
                        //dc.BitBlt(m_rectLhc.left, m_rectLhc.top, m_rectLhc.Width(),
m_rectLhc.Height(), &m_LhcDC, 0, 0, SRCCOPY);
                        //EndWaitCursor();



                        //InvalidateRect(&m_rectLhc);
//*/
                }
        }


        void onClickedRectLhc(Point point){
                int rgb[]= new int[3];
                int RGB[]= new int[3];
                int i,j,k;
                //setTitle("x="+point.getX()+" y="+point.getY());

                //calculate the address, caution is the address of j is in opposite
                i = (int)(point.getX() / (ratio_c) + 0.5);
                j = (int)(point.getY() / 2);
                j = LENGTH_LHC - j;  //reverse the y axis

                //get and display rgb
                m_colorLhc[i][j].Get_rgb(rgb);
                for(k = 0; k < 3; k++)
                {
                        RGB[k] = (int)(rgb[k]);
                }

                if(!m_colorLhc[i][j].IsOutOfRange() && max(RGB[0], max(RGB[1], RGB[2]))
<= 255 && min(RGB[0], min(RGB[1], RGB[2])) >= 0)
                {
                        //color and invalide area of mark
//                      m_ptLhcOld = m_ptLhc;
//                      m_ptLhc = point;
//                      rectOld = CRect(m_ptLhcOld.x - 4, m_ptLhcOld.y - 4, m_ptLhcOld.x
+ 5, m_ptLhcOld.y + 5);
//                      rect    = CRect(m_ptLhc.x - 4, m_ptLhc.y - 4, m_ptLhc.x + 5,
m_ptLhc.y + 5);
                        m_bHasClicked = true;
                        m_rectLab.setm_bHasClicked(true);
                        m_rectLhc.setm_bHasClicked(true);
                        m_rectLhc.setPointMark(point);
                        m_clrMarkLhc = new Color(255-RGB[0], 255-RGB[1],255-RGB[2]);
                        m_rectLhc.setClrMark( m_clrMarkLhc );
                        m_rectLhc.repaint();

                        //force to draw the mark
//                      InvalidateRect(&rectOld);
//                      InvalidateRect(&rect);
```

```
//                  CClientDC dc(this);

                    //get the mouse clicked color
//                  m_clrSelected = RGB(RGB[0], RGB[1], RGB[2]);
                    m_clrSelected = new Color(RGB[0], RGB[1], RGB[2]);

                    m_lhcSelected[0] = m_colorLhc[i][j].Get_L();
                    m_lhcSelected[1] = m_colorLhc[i][j].Get_h();
                    m_lhcSelected[2] = m_colorLhc[i][j].Get_C();

//                  InvalidateRect(&m_rectSample);
                    m_rectSample.setBackground( m_clrSelected );


                    //display the result of value in different color space
                    double XYZ[] = new double[3];
                    double xy[] = new double[2];
                    m_colorLhc[i][j].Get_XYZ(XYZ);
                    for(k = 0; k < 3; k++)
                    {
                            XYZ[k] = ((int)(XYZ[k] * 10000)) / 10000.0;
                    }
                    //calculate of x and y from XYZ
                    cm_XYZ2xy(XYZ[0],XYZ[1],XYZ[2],xy);

                    xy[0] = ((int)(xy[0] * 10000)) / 10000.0;
                    xy[1] = ((int)(xy[1] * 10000)) / 10000.0;

                    m_X = XYZ[0];
                    m_Y = XYZ[1];
                    m_Z = XYZ[2];

                    m_lx = xy[0];
                    m_ly = xy[1];

                    m_red = (int)(rgb[0]);
                    m_green = (int)(rgb[1]);
                    m_blue = (int)(rgb[2]);

                    m_l = m_colorLhc[i][j].Get_L();
                    m_h = m_colorLhc[i][j].Get_h();
                    m_c = m_colorLhc[i][j].Get_C();
                    m_a = m_colorLhc[i][j].Get_a();
                    m_b = m_colorLhc[i][j].Get_b();
                    m_a = ((int)(m_a) * 10000) / 10000.0;
                    m_b = ((int)(m_b) * 10000) / 10000.0;
                    m_h = ((int)(m_h) * 10000) / 10000.0;

                    //color emotion
                    CalculateColorEmotion(m_l, m_h, m_c,true);

                    //slider control position setting
                    m_sldL.setValue(LENGTH_LHC - (int)(m_l+0.5));
                    m_sldC.setValue((int)(m_c+0.5));

                    UpdateData(false);
```

```
                        //for draw the mark point of Lab
                        m_sldA.setValue((int)(m_a+0.5));
                        m_sldB.setValue(-(int)(m_b+0.5));

                        int cx = m_rectLab.getWidth() /2;
                        int cy = m_rectLab.getHeight() /2;
                        m_ptLab = new Point((int)(m_a) + cx, -(int)(m_b) + cy);
                        m_rectLab.setPointMark(m_ptLab);
                        m_clrMarkLab = new Color(255-RGB[0], 255-RGB[1],255-RGB[2]);
                        m_rectLab.setClrMark( m_clrMarkLab );
                        DrawLabGraph();
//                      InvalidateRect(&m_rectLab);
//*/
                }
        }


        void OnInitDialog(){
                GlobalVar.calibrate();
                m_nWebs = 0;


                DrawLabGraph();
                DrawLhcGraph(m_sldH.getValue());

                m_bHasClicked = false;
        }

        void DrawLhcGraph(double h){  //draw the Lhc Graph
                int i,j;
                int rgb[] = new int[3];
                int RGB[] = new int[3];

                //Graphics dc = m_rectLhc.getGraphics();
                //if (dc == null){return;}
                m_colorLhc = m_rectLhc.getColorSpace();

                for(i = 0; i < LENGTH_LHC_C; i++)
                {
                        for(j = 0; j < LENGTH_LHC; j++)
                        {
                                m_colorLhc[i][j].Inilize();
                                m_colorLhc[i][j].Set_C(i);
                                m_colorLhc[i][j].Set_h(h);

                                m_colorLhc[i][j].Set_L(j);
                                m_colorLhc[i][j].ColorLch2XYZ();
                                m_colorLhc[i][j].ColorXYZ2rgb();
                                m_colorLhc[i][j].ColorXYZ2LabCh();
                                m_colorLhc[i][j].Get_rgb(rgb);
                                //repeat the setting of Lch to avoid the deviation of Lhc's
calculated from ColorXYZ2LabCh();
                                m_colorLhc[i][j].Set_C(i);
                                m_colorLhc[i][j].Set_h(h);
                                m_colorLhc[i][j].Set_L(j);
                                for(int k = 0; k < 3; k++)
                                {
                                        RGB[k] = (int)(rgb[k]);
```

```
                                }
                                //is the color can be displayed?
                                if(m_colorLhc[i][j].IsOutOfRange() || max(RGB[0], max(RGB
[1], RGB[2])) > 255 || min(RGB[0], min(RGB[1], RGB[2])) < 0)
                                {
                                        RGB[0] = RGB[1] = RGB[2] = 192;
                                }
                                //draw the color in rectangle 2 x 2

                                //dc.setColor( new Color(RGB[0], RGB[1], RGB[2]) );
                                //HGDIOBJ oldPen = SelectObject(dc, CreatePen
(PS_SOLID, 1, RGB(RGB[0], RGB[1], RGB[2])));
                                //HGDIOBJ oldBrush = SelectObject(dc, brush);
                                //dc.Rectangle((int)(ratio_c*i+0.5), 2*LENGTH_LHC-2*j, (int)
(ratio_c*(i+1)+0.5),2*LENGTH_LHC-(2*j+2));
                                //dc.drawRect((int)(ratio_c*i+0.5), 2*LENGTH_LHC-2*j, (int)
(ratio_c*(i+1)+0.5),2*LENGTH_LHC-(2*j+2));
                                //dc.fillRect((int)(ratio_c*i+0.5), 2*LENGTH_LHC-2*j, 2,2);
                        }
                }
                m_rectLhc.repaint();


        }
        void DrawLabGraph(){                    //draw the Lab Graph
                int i, j, k;
                int rgb[] = new int[3];
                int RGB[] = new int[3];
                int cx, cy;

                //center of the CDC (in memory, not in window client)
                cx = LENGTH_LAB;
                cy = LENGTH_LAB;

                //CBrush brush;
                //brush.CreateSolidBrush(RGB(192, 192, 192));
                //HGDIOBJ oldPen = SelectObject(dc, CreatePen(PS_SOLID, 1, RGB
(192,192,192)));
                //HGDIOBJ oldBrush = SelectObject(dc, brush);
                //CRect rect = CRect(0,0,m_rectLab.Width(), m_rectLab.Height());
                //dc.Rectangle(rect);
                //DeleteObject(SelectObject(dc, oldPen));
                //DeleteObject(SelectObject(dc, oldBrush));

                //Graphics dc = m_rectLab.getGraphics();
                //if (dc == null){return;}

                //m_rectLab.setBackground(bgcolor);

                m_colorLab = m_rectLab.getColorSpace();

                for(i = -LENGTH_LAB; i < LENGTH_LAB; i++)
                {
                        for(j = -LENGTH_LAB; j < LENGTH_LAB; j++)
                        {
                                //calculate the conversion of color space
                                m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Inilize();
                                m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Set_a(i);
```

```
                                m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Set_b(j);
                                m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Set_L
(LENGTH_LHC - m_sldL.getValue());
                                m_colorLab[i+LENGTH_LAB]
[j+LENGTH_LAB].ColorLab2XYZ();
                                m_colorLab[i+LENGTH_LAB]
[j+LENGTH_LAB].ColorXYZ2rgb();
                                m_colorLab[i+LENGTH_LAB]
[j+LENGTH_LAB].ColorXYZ2LabCh();
                                m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Get_rgb
(rgb);
                                //System.out.println( rgb[0] + " " + rgb[1] + " " + rgb[2]);
                                //repeat the setting of Lab to avoid the deviation of Lhc's
calculated from ColorXYZ2LabCh();
                                m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Set_a(i);
                                m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Set_b(j);
                                m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Set_L
(LENGTH_LHC - m_sldL.getValue());
                                for(k = 0; k < 3; k++)
                                {
                                        RGB[k] = (int)(rgb[k]  + 0.5);
                                }
                                //System.out.println( RGB[0] + " " + RGB[1] + " " + RGB[2]);
                                //System.out.print( m_colorLab[i+LENGTH_LAB]
[j+LENGTH_LAB].IsOutOfRange() +" ");

                                //determine whether the color can be displayed in format
RGB
                                if(m_colorLab[i+LENGTH_LAB]
[j+LENGTH_LAB].IsOutOfRange() || max(RGB[0], max(RGB[1], RGB[2])) > 255 || min(RGB
[0], min(RGB[1], RGB[2])) < 0)
                                {
                                        RGB[0] = RGB[1] = RGB[2] = 192;  //background
color
                                }
                                //draw pixel color, -j+cy stands for axis conversion,from
bottom to top
                                //dc.SetPixel(i+cx, -j+cy, RGB(RGB[0], RGB[1], RGB[2]));
                                //dc.setColor( new Color(RGB[0], RGB[1], RGB[2]) );
                                //dc.setColor( new Color(100+i, 100+j,100+(i+j)/2) );
                                //dc.drawLine( i+cx, -j+cy,  i+cx, -j+cy);
                        }
                }
                m_rectLab.repaint();
        }
        static int max(int a, int b){
                return ( a > b )? a : b;
        }
        static int min(int a, int b){
                return ( a < b )? a : b;
        }

        JPanel contentPane;
        BorderLayout borderLayout1 = new BorderLayout();


        //rectangle area of painting Lhc and Lab space
        hcCanvas m_rectLhc;
```

```
        abCanvas m_rectLab;

        //the mouse click to get the sample
        //is mouse clicked? to avoid the first OnPaint() to display the error color
        boolean m_bHasClicked;
        Canvas m_rectSample;  //rect for painting the sample color
        WebCanvas m_rectWeb;    //rect for the color samples displaying
        int m_nWebs;        //quantities of the  colors sample

        CColorSpace m_colorLhc[][];  //100*100 colors for space Lhc
        CColorSpace m_colorLab[][];  //100*100 colors for space Lab

//      CDC   m_LhcDC, m_LabDC;   //the CDCs of Lhc and Lab painting
//      CBitmap m_bmLhc, m_bmLab;  //the bitmap of Lhc and Lab, related to m_LhcDC and
m_LabDC

        Point m_ptLhc, m_ptLhcOld;  //the point to display the mouse click mark
        Point m_ptLab, m_ptLabOld;

        Color m_clrMarkLhc;      //the color of the mark
        Color m_clrMarkLab;


        //the m_clrSample and m_lhcSample stand the same color. The reason for use two
color
        //space is that the RGB format is in integrate which will cause the error of Hue, and
thus
        //the whole color sample. It is used in mouse left button double click event
        Color m_clrSample[][] = new Color[ROW_SAMPLE][COL_SAMPLE];     //color in
RGB format for saving
        double   m_lhcSample[][][] = new double[ROW_SAMPLE][COL_SAMPLE][3];  //color
in Lhc format for saving
        Color m_clrSelected;                                                    //color
selected
        double   m_lhcSelected[] = new double[3];

        //CStatic         m_ctlWeb;
        //CStatic         m_ctlSample;
        JSlider  m_sldL;
        JSlider  m_sldH;
        JSlider  m_sldC;
        JSlider  m_sldB;
        JSlider  m_sldA;
        //CStatic         m_ctlLhc;
        //CStatic         m_ctlLab;
        //UINT  m_blue;
        //UINT  m_green;
        //UINT  m_red;
        static int         m_blue;
        static int         m_green;
        static int         m_red;
        static double      m_a;
        static double      m_b;
        static double      m_c;
        static double      m_h;
        static double      m_l;
        static double      m_lx;
        static double      m_ly;
```

```
        static double   m_X;
        static double   m_Y;
        static double   m_Z;
        static double   m_deep;
        static double   m_distinct;
        static double   m_dynamic;
        static double   m_gaudy;
        static double   m_heavy;
        static double   m_light;
        static double   m_soft;
        static double   m_striking;
        static double   m_strong;
        static double   m_transparent;
        static double   m_vivid;
        static double   m_warm;


/**Component initialization*/
        private void jbInit() throws Exception  {
                contentPane = (JPanel) this.getContentPane();
                //contentPane.setLayout(borderLayout1);
                contentPane.setLayout(null);
                setSize( FRAME_WIDTH, FRAME_HEIGHT );
                setResizable( false );
                setTitle( "Colour Emotion of Thai");
                setLocation( FRAME_X_ORIGIN, FRAME_Y_ORIGIN );
                addWindowListener( this );
                //addMouseMotionListener( this );
                setBackground( new Color(0xCC, 0xCC, 0xCC));

                exitButton = new Button( "EXIT" );
                exitButton.setFont(new Font("TimesRoman",0,10));
                exitButton.setBounds( 540,515, BUTTON_WIDTH, BUTTON_HEIGHT );
                contentPane.add( exitButton );
                exitButton.addActionListener( this );
                saveButton = new Button( "SAVE" );
                saveButton.setFont(new Font("TimesRoman",0,10));
                saveButton.setBounds( 400, 240,110,30);
                contentPane.add( saveButton );
                saveButton.addActionListener( this );

                textFieldEmotion = new TextField[12];
                labelEmotion = new Label[12];
                for(int i=0; i<textFieldEmotion.length; i++){
                        textFieldEmotion[i] = new TextField("0");
                        textFieldEmotion[i].setBounds( 106+200*(i/6), 30*(i%6+1), 60, 20);
                        textFieldEmotion[i].setFont( new Font("TimesRoman",0,12));
                        textFieldEmotion[i].setBackground( new Color(0xcc, 0xcc, 0xcc) );
                        textFieldEmotion[i].setEnabled( false );
                        //textFieldEmotion[i].setFont( textFont );
                        contentPane.add(textFieldEmotion[i]);
                        labelEmotion[i] = new Label( stringEmotion[i]+":" );
                        labelEmotion[i].setFont( new Font("TimesRoman",0,14));
                        labelEmotion[i].setBounds( 20+165*(i/6), 30*(i%6+1), 120, 20);
                        contentPane.add( labelEmotion[i] );
                }

                labelCValue = new Label[13];
```

```
textFieldCValue = new TextField[13];
for(int i=0; i<13; i++){
        labelCValue[i] = new Label( stringCValue[i] + ":" );
        labelCValue[i].setFont( new Font("TimesRoman",0,12));
        labelCValue[i].setBounds(550, 30+ 22*i, 15, 20);
        contentPane.add( labelCValue[i]);
        textFieldCValue[i] = new TextField( "0" );
        textFieldCValue[i].setBounds(570, 30+ 22*i, 100, 20);
        textFieldCValue[i].setFont( new Font("TimesRoman",0,12));
        textFieldCValue[i].setBackground( new Color( 0xcc,0xcc, 0xcc) );
        textFieldCValue[i].setFont( new Font("TimesRoman",0,12));
        contentPane.add( textFieldCValue[i] );
}

//JSlider(int orientation, int min, int max, int value)

Label labelH = new Label("Hue");
labelH.setBounds(160,230,50,20);
//labelH.setBackground( Color.blue );
labelH.setFont( new Font("TimesRoman",0,14));
contentPane.add( labelH );
Label labelL = new Label("L*");
labelL.setBounds(30,390,20,20);
labelL.setFont( new Font("TimesRoman",0,14));
contentPane.add( labelL );
Label labelC = new Label("C*");
labelC.setBounds(160,520,20,20);
labelC.setFont( new Font("TimesRoman",0,14));
contentPane.add( labelC );
Label labela = new Label("a*");
labela.setBounds(420,520,20,20);
labela.setFont( new Font("TimesRoman",0,14));
contentPane.add( labela );
Label labelb = new Label("b*");
labelb.setBounds(280,390,20,20);
labelb.setFont( new Font("TimesRoman",0,14));
contentPane.add( labelb );

m_sldH = new JSlider(JSlider.HORIZONTAL, 0, 360,0);
//m_sldH = new Scrollbar(Scrollbar.HORIZONTAL, 0, 1, 0, 360);
//m_sldH.setBlockIncrement(10);
//m_sldH.setMajorTickSpacing(36);
//m_sldH.setMinorTickSpacing(36);
//m_sldH.setSnapToTicks(true);
m_sldH.setBounds( 75, 260, 200, 50 );
contentPane.add( m_sldH );
m_sldH.addChangeListener( this );
//m_sldH.addMouseMotionListener( this );
m_sldH.addMouseListener( this );
m_sldH.setLabelTable(m_sldH.createStandardLabels(90));
m_sldH.setPaintLabels(true);

m_sldL = new JSlider(JSlider.VERTICAL, 0, 100, LENGTH_LHC-60);
//m_sldL.setBlockIncrement(10);
m_sldL.setInverted(true);
m_sldL.setBounds( 50, 300, 50, 200 );
contentPane.add( m_sldL );
m_sldL.addChangeListener( this );
```

```
m_sldL.addMouseListener( this );
Hashtable sldLabels = new Hashtable();
sldLabels.put(new Integer(100),new JLabel("0"));
sldLabels.put(new Integer(80),new JLabel("20"));
sldLabels.put(new Integer(60),new JLabel("40"));
sldLabels.put(new Integer(40),new JLabel("60"));
sldLabels.put(new Integer(20),new JLabel("80"));
sldLabels.put(new Integer(0),new JLabel("100"));
m_sldL.setLabelTable(sldLabels);
m_sldL.setPaintLabels(true);

m_sldA = new JSlider(JSlider.HORIZONTAL, -100, 100, 0);
m_sldA.setBounds( 330, 500, 200, 40 );
//m_sldA.setEnabled( false );
contentPane.add( m_sldA );
m_sldA.setLabelTable(m_sldA.createStandardLabels(40));
m_sldA.setPaintLabels(true);

m_sldB = new JSlider(JSlider.VERTICAL, -100, 100, 0);
m_sldB.setInverted(true);
m_sldB.setBounds( 300, 300, 40, 200 );
contentPane.add( m_sldB );
Hashtable sldBLabels = new Hashtable();
sldBLabels.put(new Integer(100),new JLabel("-100"));
sldBLabels.put(new Integer(75),new JLabel("-75"));
sldBLabels.put(new Integer(50),new JLabel("-50"));
sldBLabels.put(new Integer(25),new JLabel("-25"));
sldBLabels.put(new Integer(0),new JLabel("0"));
sldBLabels.put(new Integer(-100),new JLabel("100"));
sldBLabels.put(new Integer(-75),new JLabel("75"));
sldBLabels.put(new Integer(-50),new JLabel("50"));
sldBLabels.put(new Integer(-25),new JLabel("25"));
m_sldB.setLabelTable(sldBLabels);
m_sldB.setPaintLabels(true);

m_sldC = new JSlider(JSlider.HORIZONTAL, 0, 100, 0);
m_sldC.setBounds( 70, 500, 200, 40 );
contentPane.add( m_sldC );
m_sldC.setLabelTable(m_sldC.createStandardLabels(20));
m_sldC.setPaintLabels(true);

m_rectLhc = new hcCanvas();
m_rectLhc.setBounds(75,300, 200, 200);
m_rectLhc.setBackground( bgcolor );
m_rectLhc.addMouseListener( this );
contentPane.add( m_rectLhc );

m_rectLab = new abCanvas();
m_rectLab.setBounds( 330,300,200,200);
m_rectLab.setBackground( bgcolor );
m_rectLab.addMouseListener( this );
contentPane.add( m_rectLab );

m_rectSample = new Canvas();
m_rectSample.setBounds(400,50 ,120,170);
m_rectSample.setBackground( bgcolor );
contentPane.add( m_rectSample );
```

```
            m_rectWeb = new WebCanvas(ROW_SAMPLE,COL_SAMPLE);
            m_rectWeb.setBounds(550,335,120,160);
            contentPane.add( m_rectWeb );
        }

        public CColorConvertDlg(){
            enableEvents(AWTEvent.WINDOW_EVENT_MASK);
            try {
              jbInit();
            }
            catch(Exception e) {
              e.printStackTrace();
            }

            m_a = 0.0;
            m_b = 0.0;
            m_blue = 0;
            m_c = 0.0;
            m_green = 0;
            m_red = 0;
            m_h = 0.0;
            m_l = 0.0;
            m_lx = 0.0;
            m_ly = 0.0;
            m_X = 0.0;
            m_Y = 0.0;
            m_Z = 0.0;
            m_deep = 0.0;
            m_distinct = 0.0;
            m_dynamic = 0.0;
            m_gaudy = 0.0;
            m_heavy = 0.0;
            m_light = 0.0;
            m_soft = 0.0;
            m_striking = 0.0;
            m_strong = 0.0;
            m_transparent = 0.0;
            m_vivid = 0.0;
            m_warm = 0.0;
            m_ptLhc = new Point(0,0);
            m_ptLab = new Point(0,0);
            m_ptLhcOld = new Point(0,0);
            m_ptLabOld = new Point(0,0);
            OnInitDialog();
        }
/*
        void DrawLhcGraph(CDC& dc, double h);  //draw the Lhc Graph
        void DrawLabGraph(CDC& dc);                    //draw the Lab Graph

        void DrawPointMark(CDC& dc, CPoint point, COLORREF& colorref); //draw the
mouse click mark

        void DrawWebColors(CDC& dc);        //draw the saved color
//*/


        void DrawPointMark(Point point, Color colorref){} //draw the mouse click mark
```

```
        void DrawWebColors(){}          //draw the saved color


        void SavePanelColorAndAttribute(String filename){}
        float DoubleTypeFormat(double number){ return 0.0f;}


        // implements WindowListener
        public void windowClosing( WindowEvent event ){
                System.out.println("Closing");
                m_rectWeb.savePanel();
                //System.exit(0);
        }
        public void windowActivated( WindowEvent event ){};
        public void windowClosed( WindowEvent event ){};
        public void windowDeactivated( WindowEvent event ){};
        public void windowDeiconified( WindowEvent event ){};
        public void windowIconified( WindowEvent event ){};
        public void windowOpened( WindowEvent event ){};

        // implements ActionListener
        public void actionPerformed( ActionEvent event ){
                String label = event.getActionCommand();
                System.out.println( label );
                if (label.equals("SAVE"))
                {
                        //setTitle( "You Clicked SAVE" );
                        if (m_bHasClicked)
                        {
                                m_rectWeb.insertColor( m_rectSample.getBackground
(),m_lhcSelected);
                        }
                } else if (label.equals("EXIT")){
                        m_rectWeb.savePanel();
                        System.exit(0);
                }

        }

        // implements MouseListener
        public void mouseClicked(MouseEvent e){
                int x = e.getX();
                int y = e.getY();
                //setTitle( "CLICKED x=" + x + "y="+ y );
                if (e.getSource() == m_rectLhc)
                {
                        onClickedRectLhc(e.getPoint());
                } else if (e.getSource() == m_rectLab){
                        onClickedRectLab(e.getPoint());
                }

                //DrawLabGraph();
                //DrawLhcGraph(m_sldH.getValue());
        }
        public void mousePressed(MouseEvent e){ }
        public void mouseReleased(MouseEvent e){
                if ( e.getSource() == m_sldH )
```

```
                {
                        m_ptLab = m_ptLhc = new Point(0,0);
                        m_rectLab.setPointMark( m_ptLab );
                        m_rectLhc.setPointMark( m_ptLhc );
                        DrawLhcGraph(m_sldH.getValue());
                        if (m_bHasClicked)
                        {
                                m_rectLab.repaint();
                                m_bHasClicked = false;
                                m_rectLab.setm_bHasClicked(true);
                                m_rectLhc.setm_bHasClicked(true);
                        }
                        System.out.println("m_sldH " + m_sldH.getValue());
                } else if ( e.getSource() == m_sldL )
                {
                        m_ptLab = m_ptLhc = new Point(0,0);
                        m_rectLab.setPointMark( m_ptLab );
                        m_rectLhc.setPointMark( m_ptLhc );
                        DrawLabGraph();
                        if (m_bHasClicked)
                        {
                                m_rectLhc.repaint();
                                m_bHasClicked = false;
                                m_rectLab.setm_bHasClicked(true);
                                m_rectLhc.setm_bHasClicked(true);
                        }
                        System.out.println("m_sldL " + m_sldL.getValue());
                }
        }
        public void mouseEntered(MouseEvent e){ }
        public void mouseExited(MouseEvent e){ }

        // implements MouseMotionListener
        public void mouseDragged(MouseEvent e){
        }
        public void mouseMoved(MouseEvent e){
                setTitle("x="+ e.getX() +" y="+ e.getY());
        }


        static TextField[] textFieldEmotion;
        Label[] labelEmotion;
        static final String[] stringEmotion = { "Warm-Cool", "Light-Dark", "Deep-Pale", "Heavy-
Light",
                                                "Vivid-
Sombre", "Gaudy-Plain", "Striking-Subdued", "Strong-Weak",
                                                "Dynamic-
Passive", "Distinct-Vague", "Transparent-Turbid", "Soft-Hard"
                                                };
        Label[] labelCValue;
        static TextField[] textFieldCValue;
        static final String[] stringCValue = { "R", "G", "B", "L*", "a*", "b*", "C*", "h", "X", "Y", "Z",
"x", "y"};
        Button exitButton;
        Button saveButton;
```

```
/*******************************************************/
/*
 * Transforming the tristimulus values to the
 *            chromaticity coordinates
 *      Input parameters : X, Y, Z (tristimulus values)
 *      Output parametsrs : x, y
 */
void cm_XYZ2xy(double X,double Y,double Z,double xy[])
{
        double  sum;

        sum = X + Y + Z;
        if (sum == 0.0)
        {
                xy[0] = 0.0;
                xy[1] = 0.0;
        }
        else
        {
                xy[0] = X/sum;
                xy[1] = Y/sum;
        }
}

static void UpdateData(boolean flag){
        //static final String[] stringCValue = { "R", "G", "B", "L*", "a*", "b*", "C*", "h",
"X", "Y", "Z", "x", "y"};
        //TextField[] textFieldCValue;
        textFieldCValue[0].setText( String.valueOf(m_red));
        textFieldCValue[1].setText( String.valueOf(m_green));
        textFieldCValue[2].setText( String.valueOf(m_blue));
        textFieldCValue[3].setText( String.valueOf(m_l));
        textFieldCValue[4].setText( String.valueOf(m_a));
        textFieldCValue[5].setText( String.valueOf(m_b));
        textFieldCValue[6].setText( String.valueOf(m_c));
        textFieldCValue[7].setText( String.valueOf(m_h));
        textFieldCValue[8].setText( String.valueOf(m_X));
        textFieldCValue[9].setText( String.valueOf(m_Y));
        textFieldCValue[10].setText( String.valueOf(m_Z));
        textFieldCValue[11].setText( String.valueOf(m_lx));
        textFieldCValue[12].setText( String.valueOf(m_ly));

        /*      static final String[] stringEmotion = { "Warm-Cool", "Light-Dark",
"Deep-Pale", "Heavy-Light",

"Vivid-Sombre", "Gaudy-Plain", "Striking-Subdued", "Strong-Weak",

"Dynamic-Passive", "Distinct-Vague", "Transparent-Turbid", "Soft-Hard"

};
        */
        textFieldEmotion[0].setText( String.valueOf(m_warm));
        textFieldEmotion[1].setText( String.valueOf(m_light));
        textFieldEmotion[2].setText( String.valueOf(m_deep));
        textFieldEmotion[3].setText( String.valueOf(m_heavy));
        textFieldEmotion[4].setText( String.valueOf(m_vivid));
        textFieldEmotion[5].setText( String.valueOf(m_gaudy));
        textFieldEmotion[6].setText( String.valueOf(m_striking));
```

```
            textFieldEmotion[7].setText( String.valueOf(m_strong));
            textFieldEmotion[8].setText( String.valueOf(m_dynamic));
            textFieldEmotion[9].setText( String.valueOf(m_distinct));
            textFieldEmotion[10].setText( String.valueOf(m_transparent));
            textFieldEmotion[11].setText( String.valueOf(m_soft));
        }

        public static void main(String[] args)
        {
            System.out.println("Hello World!");
        }


}
```

APPENDIX B

Program 02

Java applet program

```
import java.awt.*;
import java.awt.event.*;
import javax.swing.*;
import java.applet.*;
import javax.swing.event.*;
import java.util.*;

public class CColorConvertDlg  extends Applet implements ActionListener, WindowListener,
MouseListener, MouseMotionListener, ChangeListener
{
        private static final int FRAME_WIDTH = 700;
        private static final int FRAME_HEIGHT = 575;

        private static final int FRAME_X_ORIGIN = 50;
        private static final int FRAME_Y_ORIGIN = 0;

        private static final int BUTTON_WIDTH = 150;
        private static final int BUTTON_HEIGHT = 30;

        static final int LENGTH_LHC_C = 100;
        static final int LENGTH_LHC   = 100;
        static final int LENGTH_LAB   = 100;

        static final int ROW_SAMPLE   = 6;
        static final int COL_SAMPLE   = 6;

        static final int ratio_c      = 2;//(200.0 / LENGTH_LHC_C)
        static final Color bgcolor = new Color( 0xCC, 0xCC, 0xCC );

        static int m_Hold = 0;
        static int m_Lold = LENGTH_LHC-60;

        void CalculateColorEmotion(double L, double h, double C, boolean bRefresh){

                double  deep;
                double  distinct;
                double  dynamic;
                double  gaudy;
                double  heavy;
                double  light;
                double  soft;
                double  striking;
                double  strong;
                double  transparent;
                double  vivid;
                double  warm;

                double dh40 = 40-h;
                double dh290 = h+70;
//              if ( (0<h) && (h<=110) )   dh290 = h+70;
                if ( (110<h) && (h<=290) ) dh290 = 290 - h;
                if ( (290<h) && (h<=360) ) dh290 = h - 290;

//              if ( (0<h) && (h<=40) )   dh40 = 40 - h;
                if ( (40<h) && (h<=220) ) dh40 = h - 40;
                if ( (220<h) && (h<=360) ) dh40 = 400 - h;
```

```
                [illegible]360) * C;

                light           = Math.pow( Math.pow(3.4*(L-10),2) + Math.pow(4.5
*one_dhC,2), 0.5 ) - 184;
                soft            = - Math.pow( Math.pow(2.2*(L-90),2) + Math.pow(0.9
*one_dhC,2),0.5) + 79;
                warm            = Math.pow( Math.pow(0.27*(L-100),2) + Math.pow(1.48*(1
+Math.cos(Math.toRadians(dh40)))*one_dhC,2),0.5) - 58;
                transparent     = Math.pow( Math.pow(3.1*(L-30),2) + Math.pow(2.7
*one_dhC,2),0.5) - 122;
                deep            = Math.pow( Math.pow(2.6*(L-100),2) + Math.pow(1.8
*one_dhC,2),0.5) - 90;
                distinct = Math.pow( Math.pow(1.9*(L-60),2) + Math.pow(3.3*one_dhC,2),0.5) -
62;
                heavy           = Math.pow( Math.pow(2.6*(L-100),2) + Math.pow(0.6
*one_dhC,2),0.5) - 96;
                vivid           = Math.pow( Math.pow(2.2*(L-10),2) + Math.pow(5
*one_dhC,2),0.5) - 157;
                strong          = Math.pow( Math.pow(2.1*(L-90),2) + Math.pow(0.6
*one_dhC,2),0.5) - 52;
                dynamic                 = Math.pow( Math.pow(1.1*(L-20),2) + Math.pow(3.8
*one_dhC,2),0.5) - 100;
                gaudy           = Math.pow( Math.pow(0.4*(L-10),2) + Math.pow(3.8
*one_dhC,2),0.5) - 95;
                striking = Math.pow( Math.pow(1.6*(L-90),2) + Math.pow(3.1*one_dhC,2),0.5) -
65;


                //double emotion[12] = {0};
                double emotion[] = new double[12];
                emotion[0] = deep;
                emotion[1] = distinct;
                emotion[2] = dynamic;
                emotion[3] = gaudy;
                emotion[4] = heavy;
                emotion[5] = light;
                emotion[6] = soft;
                emotion[7] = striking;
                emotion[8] = strong;
                emotion[9] = transparent;
                emotion[10] = vivid;
                emotion[11] = warm;

                for(int i = 0; i < 12; i++)
                {
                        if(emotion[i] < -100)
                                emotion[i] = -100.0;
                        else if(emotion[i] > 100.0)
                                emotion[i] = 100.0;
                        emotion[i] = (int)(emotion[i] * 100) / 100.0;

                }

                m_deep    = emotion[0];
                m_distinct        = emotion[1];
```

```
                m_dynamic       = emotion[2];
                m_gaudy         = emotion[3];
                m_heavy         = emotion[4];
                m_light     = emotion[5];
                m_soft      = emotion[6];
                m_striking      = emotion[7];
                m_strong        = emotion[8];
                m_transparent =         emotion[9];
                m_vivid     = emotion[10];
                m_warm          = emotion[11];

                if(bRefresh)
                        UpdateData(false);


        }


        public void stateChanged(ChangeEvent e){
                if (e.getSource() == m_sldH)
                {
                                if ( m_Hold > m_sldH.getValue())
                                {
                                        m_Hold = m_sldH.getValue();
                                        m_Hold = m_Hold - (m_Hold % 10);
                                        m_sldH.setValue(m_Hold);
                                } else if( m_Hold < m_sldH.getValue())
                                {
                                        m_Hold = m_sldH.getValue();
                                        m_Hold = m_Hold -( m_Hold % 10) + ( ((m_Hold % 10)
==0)?0:10 );
                                        m_sldH.setValue(m_Hold);
                                }
                                System.out.println( "change" );
                } else if(e.getSource() == m_sldL){
                                if ( m_Lold > m_sldL.getValue())
                                {
                                        m_Lold = m_sldL.getValue();
                                        m_Lold = m_Lold - (m_Lold % 10);
                                        m_sldL.setValue(m_Lold);
                                } else if( m_Lold < m_sldL.getValue())
                                {
                                        m_Lold = m_sldL.getValue();
                                        m_Lold = m_Lold -( m_Lold % 10) + ( ((m_Lold % 10)==
0)?0:10 );
                                        m_sldL.setValue(m_Lold);
                                }
                                System.out.println( "change" );
                }
        }

        void onClickedRectLab(Point point){
                //setTitle("Lab");
                int rgb[]= new int[3];
                int RGB[]= new int[3];
                int i,j,k;
```

```
                int cx, cy;
                cx = LENGTH_LAB;
                cy = LENGTH_LAB;

                i = (point.x - cx);
                j = (point.y - cy);
                j =  - j;

                m_colorLab[LENGTH_LAB + i][LENGTH_LAB+j].Get_rgb(rgb);
                for(k = 0; k < 3; k++)
                {
                        RGB[k] = (int)(rgb[k]);
                }

                if(!m_colorLab[LENGTH_LAB + i][LENGTH_LAB+j].IsOutOfRange() &&
                        max(RGB[0], max(RGB[1], RGB[2])) <= 255 && min(RGB[0], min(RGB
[1], RGB[2])) >= 0)
                {
                        m_ptLabOld = m_ptLab;
                        m_ptLab = point;
//                      rectOld = CRect(m_ptLabOld.x - 4, m_ptLabOld.y - 4, m_ptLabOld.x + 5,
m_ptLabOld.y + 5);
//                      rect    = CRect(m_ptLab.x - 4, m_ptLab.y - 4, m_ptLab.x + 5, m_ptLab.y +
5);
                        m_clrMarkLab = new Color(255-RGB[0], 255-RGB[1],255-RGB[2]);
                        m_bHasClicked = true;
                        m_rectLab.setm_bHasClicked(true);
                        m_rectLhc.setm_bHasClicked(true);
                        m_rectLab.setPointMark(point);
                        m_rectLab.setClrMark( m_clrMarkLab );
                        m_rectLab.repaint();



//                      InvalidateRect(&rectOld);
//                      InvalidateRect(&rect);

//                      CClientDC dc(this);

                        m_clrSelected = new Color(RGB[0], RGB[1], RGB[2]);
                        m_lhcSelected[0] = m_colorLab[LENGTH_LAB + i]
[LENGTH_LAB+j].Get_L();
                        m_lhcSelected[1] = m_colorLab[LENGTH_LAB + i]
[LENGTH_LAB+j].Get_h();
                        m_lhcSelected[2] = m_colorLab[LENGTH_LAB + i]
[LENGTH_LAB+j].Get_C();

                        //InvalidateRect(&m_rectSample);
                        m_rectSample.setBackground( m_clrSelected );

                        double XYZ[] = new double[3];
                        double xy[] = new double[2];
                        m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Get_XYZ(XYZ);
                        for(k = 0; k < 3; k++)
                        {
                                XYZ[k] = ((int)(XYZ[k] * 10000)) / 10000.0;
```

```
                    }
                    cm_XYZ2xy(XYZ[0],XYZ[1],XYZ[2],xy);

                    xy[0] = ((int)(xy[0] * 10000)) / 10000.0;
                    xy[1] = ((int)(xy[1] * 10000)) / 10000.0;

                    m_X = XYZ[0];
                    m_Y = XYZ[1];
                    m_Z = XYZ[2];

                    m_lx = xy[0];
                    m_ly = xy[1];

                    m_red = (int)(rgb[0]);
                    m_green = (int)(rgb[1]);
                    m_blue = (int)(rgb[2]);

                    m_l = m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Get_L();
                    m_h = m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Get_h();
                    m_c = m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Get_C();
                    m_a = m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Get_a();
                    m_b = m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Get_b();
                    m_a = ((int)(m_a * 10000)) / 10000.0;
                    m_b = ((int)(m_b * 10000)) / 10000.0;


                    CalculateColorEmotion(m_l, m_h, m_c,true);

                    m_sldA.setValue((int)m_a);
                    m_sldB.setValue(-(int)m_b);


                    //reflesh the space of the Lhc
                    //for draw the mark point of Lab
                    m_sldH.setValue((int)(m_h+0.5));
                    m_sldC.setValue((int)(m_c+0.5));
                    m_sldL.setValue(LENGTH_LHC - (int)(m_l+0.5));

                    m_c = ((int)(m_c * 10000)) / 10000.0;
                    m_h = ((int)(m_h * 10000)) / 10000.0;

                    UpdateData(false);


                    m_ptLhc = new Point((int)(m_c*ratio_c+0.5), (LENGTH_LHC - (int)(m_l+
0.5))*2);
                    m_rectLhc.setPointMark(m_ptLhc);
                    m_clrMarkLhc = new Color(255-RGB[0], 255-RGB[1],255-RGB[2]);
                    m_rectLhc.setClrMark( m_clrMarkLhc );
                    //BeginWaitCursor();
                    DrawLhcGraph(m_h);
                    //dc.BitBlt(m_rectLhc.left, m_rectLhc.top, m_rectLhc.Width(),
m_rectLhc.Height(), &m_LhcDC, 0, 0, SRCCOPY);
                    //EndWaitCursor();
```

```
                        //InvalidateRect(&m_rectLhc);
//*/
                }
        }

        void onClickedRectLhc(Point point){
                int rgb[]= new int[3];
                int RGB[]= new int[3];
                int i,j,k;
                //setTitle("x="+point.getX()+" y="+point.getY());

                //calculate the address, caution is the address of j is in opposite
                i = (int)(point.getX() / (ratio_c) + 0.5);
                j = (int)(point.getY() / 2);
                j = LENGTH_LHC - j;  //reverse the y axis

                //get and display rgb
                m_colorLhc[i][j].Get_rgb(rgb);
                for(k = 0; k < 3; k++)
                {
                        RGB[k] = (int)(rgb[k]);
                }

                if(!m_colorLhc[i][j].IsOutOfRange() && max(RGB[0], max(RGB[1], RGB[2])) <=
255 && min(RGB[0], min(RGB[1], RGB[2])) >= 0)
                {
                        //color and invalide area of mark
//                      m_ptLhcOld = m_ptLhc;
//                      m_ptLhc = point;
//                      rectOld = CRect(m_ptLhcOld.x - 4, m_ptLhcOld.y - 4, m_ptLhcOld.x + 5,
m_ptLhcOld.y + 5);
//                      rect    = CRect(m_ptLhc.x - 4, m_ptLhc.y - 4, m_ptLhc.x + 5, m_ptLhc.y +
5);
                        m_bHasClicked = true;
                        m_rectLab.setm_bHasClicked(true);
                        m_rectLhc.setm_bHasClicked(true);
                        m_rectLhc.setPointMark(point);
                        m_clrMarkLhc = new Color(255-RGB[0], 255-RGB[1],255-RGB[2]);
                        m_rectLhc.setClrMark( m_clrMarkLhc );
                        m_rectLhc.repaint();

                        //force to draw the mark
//                      InvalidateRect(&rectOld);
//                      InvalidateRect(&rect);

//                      CClientDC dc(this);

                        //get the mouse clicked color
//                      m_clrSelected = RGB(RGB[0], RGB[1], RGB[2]);
                        m_clrSelected = new Color(RGB[0], RGB[1], RGB[2]);

                        m_lhcSelected[0] = m_colorLhc[i][j].Get_L();
                        m_lhcSelected[1] = m_colorLhc[i][j].Get_h();
                        m_lhcSelected[2] = m_colorLhc[i][j].Get_C();
```

```
//              InvalidateRect(&m_rectSample);
                m_rectSample.setBackground( m_clrSelected );


                //display the result of value in different color space
                double XYZ[] = new double[3];
                double xy[] = new double[2];
                m_colorLhc[i][j].Get_XYZ(XYZ);
                for(k = 0; k < 3; k++)
                {
                        XYZ[k] = ((int)(XYZ[k] * 10000)) / 10000.0;
                }
                //calculate of x and y from XYZ
                cm_XYZ2xy(XYZ[0],XYZ[1],XYZ[2],xy);

                xy[0] = ((int)(xy[0] * 10000)) / 10000.0;
                xy[1] = ((int)(xy[1] * 10000)) / 10000.0;

                m_X = XYZ[0];
                m_Y = XYZ[1];
                m_Z = XYZ[2];

                m_lx = xy[0];
                m_ly = xy[1];

                m_red = (int)(rgb[0]);
                m_green = (int)(rgb[1]);
                m_blue = (int)(rgb[2]);

                m_l = m_colorLhc[i][j].Get_L();
                m_h = m_colorLhc[i][j].Get_h();
                m_c = m_colorLhc[i][j].Get_C();
                m_a = m_colorLhc[i][j].Get_a();
                m_b = m_colorLhc[i][j].Get_b();
                m_a = ((int)(m_a) * 10000) / 10000.0;
                m_b = ((int)(m_b) * 10000) / 10000.0;
                m_h = ((int)(m_h) * 10000) / 10000.0;

                //color emotion
                CalculateColorEmotion(m_l, m_h, m_c,true);

                //slider control position setting
                m_sldL.setValue(LENGTH_LHC - (int)(m_l+0.5));
                m_sldC.setValue((int)(m_c+0.5));

                UpdateData(false);

                //for draw the mark point of Lab
                m_sldA.setValue((int)(m_a+0.5));
                m_sldB.setValue(-(int)(m_b+0.5));

                int cx = m_rectLab.getWidth() /2;
                int cy = m_rectLab.getHeight() /2;
                m_ptLab = new Point((int)(m_a) + cx, -(int)(m_b) + cy);
                m_rectLab.setPointMark(m_ptLab);
```

```
                    m_clrMarkLab = new Color(255-RGB[0], 255-RGB[1],255-RGB[2]);
                    m_rectLab.setClrMark( m_clrMarkLab );
                    DrawLabGraph();
//                  InvalidateRect(&m_rectLab);
//*/
                }
        }


        void OnInitDialog(){
                GlobalVar.calibrate();
                m_nWebs = 0;


                DrawLabGraph();
                DrawLhcGraph(m_sldH.getValue());

                m_bHasClicked = false;
        }

        void DrawLhcGraph(double h){  //draw the Lhc Graph
                int i,j;
                int rgb[] = new int[3];
                int RGB[] = new int[3];

                //Graphics dc = m_rectLhc.getGraphics();
                //if (dc == null){return;}
                m_colorLhc = m_rectLhc.getColorSpace();

                for(i = 0; i < LENGTH_LHC_C; i++)
                {
                        for(j = 0; j < LENGTH_LHC; j++)
                        {
                                m_colorLhc[i][j].Inilize();
                                m_colorLhc[i][j].Set_C(i);
                                m_colorLhc[i][j].Set_h(h);

                                m_colorLhc[i][j].Set_L(j);
                                m_colorLhc[i][j].ColorLch2XYZ();
                                m_colorLhc[i][j].ColorXYZ2rgb();
                                m_colorLhc[i][j].ColorXYZ2LabCh();
                                m_colorLhc[i][j].Get_rgb(rgb);
                                //repeat the setting of Lch to avoid the deviation of Lhc's
calculated from ColorXYZ2LabCh();
                                m_colorLhc[i][j].Set_C(i);
                                m_colorLhc[i][j].Set_h(h);
                                m_colorLhc[i][j].Set_L(j);
                                for(int k = 0; k < 3; k++)
                                {
                                        RGB[k] = (int)(rgb[k]);
                                }
                                //is the color can be displayed?
                                if(m_colorLhc[i][j].IsOutOfRange() || max(RGB[0], max(RGB[1],
RGB[2])) > 255 || min(RGB[0], min(RGB[1], RGB[2])) < 0)
                                {
```

```
                                        [redacted]= 192;
                                }
                                //draw the color in rectangle 2 x 2

                                //dc.setColor( new Color(RGB[0], RGB[1], RGB[2]) );
                                //HGDIOBJ oldPen = SelectObject(dc, CreatePen(PS_SOLID, 1,
RGB(RGB[0], RGB[1], RGB[2])));
                                //HGDIOBJ oldBrush = SelectObject(dc, brush);
                                //dc.Rectangle((int)(ratio_c*i+0.5), 2*LENGTH_LHC-2*j, (int)
(ratio_c*(i+1)+0.5),2*LENGTH_LHC-(2*j+2));
                                //dc.drawRect((int)(ratio_c*i+0.5), 2*LENGTH_LHC-2*j, (int)
(ratio_c*(i+1)+0.5),2*LENGTH_LHC-(2*j+2));
                                //dc.fillRect((int)(ratio_c*i+0.5), 2*LENGTH_LHC-2*j, 2,2);
                        }
                }
                m_rectLhc.repaint();


        }
        void DrawLabGraph(){                    //draw the Lab Graph
                int i, j, k;
                int rgb[] = new int[3];
                int RGB[] = new int[3];
                int cx, cy;

                //center of the CDC (in memory, not in window client)
                cx = LENGTH_LAB;
                cy = LENGTH_LAB;

                //CBrush brush;
                //brush.CreateSolidBrush(RGB(192, 192, 192));
                //HGDIOBJ oldPen = SelectObject(dc, CreatePen(PS_SOLID, 1, RGB
(192,192,192)));
                //HGDIOBJ oldBrush = SelectObject(dc, brush);
                //CRect rect = CRect(0,0,m_rectLab.Width(), m_rectLab.Height());
                //dc.Rectangle(rect);
                //DeleteObject(SelectObject(dc, oldPen));
                //DeleteObject(SelectObject(dc, oldBrush));

                //Graphics dc = m_rectLab.getGraphics();
                //if (dc == null){return;}

                //m_rectLab.setBackground(bgcolor);

                m_colorLab = m_rectLab.getColorSpace();

                for(i = -LENGTH_LAB; i < LENGTH_LAB; i++)
                {
                        for(j = -LENGTH_LAB; j < LENGTH_LAB; j++)
                        {
                                //calculate the conversion of color space
                                m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Inilize();
                                m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Set_a(i);
                                m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Set_b(j);
                                m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Set_L
(LENGTH_LHC - m_sldL.getValue());
```

```
                                    [j+LENGTH_LAB].ColorLab2XYZ();
                                    m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].ColorXYZ2rgb();
                                    m_colorLab[i+LENGTH_LAB]
[j+LENGTH_LAB].ColorXYZ2LabCh();
                                    m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Get_rgb(rgb);
                                    //System.out.println( rgb[0] + " " + rgb[1] + " " + rgb[2]);
                                    //repeat the setting of Lab to avoid the deviation of Lhc's
calculated from ColorXYZ2LabCh();
                                    m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Set_a(i);
                                    m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Set_b(j);
                                    m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].Set_L
(LENGTH_LHC - m_sldL.getValue());
                                    for(k = 0; k < 3; k++)
                                    {
                                            RGB[k] = (int)(rgb[k]  + 0.5);
                                    }
                                    //System.out.println( RGB[0] + " " + RGB[1] + " " + RGB[2]);
                                    //System.out.print( m_colorLab[i+LENGTH_LAB]
[j+LENGTH_LAB].IsOutOfRange() +" ");

                                    //determine whether the color can be displayed in format RGB
                                    if(m_colorLab[i+LENGTH_LAB][j+LENGTH_LAB].IsOutOfRange
() || max(RGB[0], max(RGB[1], RGB[2])) > 255 || min(RGB[0], min(RGB[1], RGB[2])) < 0)
                                    {
                                            RGB[0] = RGB[1] = RGB[2] = 192;  //background color
                                    }
                                    //draw pixel color, -j+cy stands for axis conversion,from bottom to
top
                                    //dc.SetPixel(i+cx, -j+cy, RGB(RGB[0], RGB[1], RGB[2]));
                                    //dc.setColor( new Color(RGB[0], RGB[1], RGB[2]) );
                                    //dc.setColor( new Color(100+i, 100+j,100+(i+j)/2) );
                                    //dc.drawLine( i+cx, -j+cy,  i+cx, -j+cy);
                            }
                    }
                    m_rectLab.repaint();
            }
            static int max(int a, int b){
                    return ( a > b )? a : b;
            }
            static int min(int a, int b){
                    return ( a < b )? a : b;
            }

            JPanel contentPane;
            BorderLayout borderLayout1 = new BorderLayout();


            //rectangle area of painting Lhc and Lab space
            hcCanvas m_rectLhc;
            abCanvas m_rectLab;

            //the mouse click to get the sample
            //is mouse clicked? to avoid the first OnPaint() to display the error color
            boolean m_bHasClicked;
            Canvas m_rectSample;  //rect for painting the sample color
            WebCanvas m_rectWeb;     //rect for the color samples displaying
```

```
sldLabels.put(new Integer(100),new JLabel("0"));
sldLabels.put(new Integer(80),new JLabel("20"));
sldLabels.put(new Integer(60),new JLabel("40"));
sldLabels.put(new Integer(40),new JLabel("60"));
sldLabels.put(new Integer(20),new JLabel("80"));
sldLabels.put(new Integer(0),new JLabel("100"));
m_sldL.setLabelTable(sldLabels);
m_sldL.setPaintLabels(true);

m_sldA = new JSlider(JSlider.HORIZONTAL, -100, 100, 0);
m_sldA.setBounds( 330, 500, 200, 40 );
//m_sldA.setEnabled( false );
contentPane.add( m_sldA );
m_sldA.setLabelTable(m_sldA.createStandardLabels(40));
m_sldA.setPaintLabels(true);

m_sldB = new JSlider(JSlider.VERTICAL, -100, 100, 0);
m_sldB.setInverted(true);
m_sldB.setBounds( 280, 300, 40, 200 );
contentPane.add( m_sldB );
Hashtable sldBLabels = new Hashtable();
sldBLabels.put(new Integer(100),new JLabel("-100"));
sldBLabels.put(new Integer(75),new JLabel("-75"));
sldBLabels.put(new Integer(50),new JLabel("-50"));
sldBLabels.put(new Integer(25),new JLabel("-25"));
sldBLabels.put(new Integer(0),new JLabel("0"));
sldBLabels.put(new Integer(-100),new JLabel("100"));
sldBLabels.put(new Integer(-75),new JLabel("75"));
sldBLabels.put(new Integer(-50),new JLabel("50"));
sldBLabels.put(new Integer(-25),new JLabel("25"));
m_sldB.setLabelTable(sldBLabels);
m_sldB.setPaintLabels(true);

m_sldC = new JSlider(JSlider.HORIZONTAL, 0, 100, 0);
m_sldC.setBounds( 70, 500, 200, 40 );
contentPane.add( m_sldC );
m_sldC.setLabelTable(m_sldC.createStandardLabels(20));
m_sldC.setPaintLabels(true);

m_rectLhc = new hcCanvas();
m_rectLhc.setBounds(75,300, 200, 200);
m_rectLhc.setBackground( bgcolor );
m_rectLhc.addMouseListener( this );
contentPane.add( m_rectLhc );

m_rectLab = new abCanvas();
m_rectLab.setBounds( 330,300,200,200);
m_rectLab.setBackground( bgcolor );
m_rectLab.addMouseListener( this );
contentPane.add( m_rectLab );

m_rectSample = new Canvas();
m_rectSample.setBounds(400,50 ,120,170);
m_rectSample.setBackground( bgcolor );
contentPane.add( m_rectSample );
```

```
            m_rectWeb = new WebCanvas(ROW_SAMPLE,COL_SAMPLE);
            m_rectWeb.setBounds(550,350,120,120);
            contentPane.add( m_rectWeb );

        }

        public void CColorConvertDlg1(){
            enableEvents(AWTEvent.WINDOW_EVENT_MASK);
            try {
              jbInit();
            }
            catch(Exception e) {
              e.printStackTrace();
            }

            m_a = 0.0;
            m_b = 0.0;
            m_blue = 0;
            m_c = 0.0;
            m_green = 0;
            m_red = 0;
            m_h = 0.0;
            m_l = 0.0;
            m_lx = 0.0;
            m_ly = 0.0;
            m_X = 0.0;
            m_Y = 0.0;
            m_Z = 0.0;
            m_deep = 0.0;
            m_distinct = 0.0;
            m_dynamic = 0.0;
            m_gaudy = 0.0;
            m_heavy = 0.0;
            m_light = 0.0;
            m_soft = 0.0;
            m_striking = 0.0;
            m_strong = 0.0;
            m_transparent = 0.0;
            m_vivid = 0.0;
            m_warm = 0.0;
            m_ptLhc = new Point(0,0);
            m_ptLab = new Point(0,0);
            m_ptLhcOld = new Point(0,0);
            m_ptLabOld = new Point(0,0);
            OnInitDialog();
        }

/*
        void DrawLhcGraph(CDC& dc, double h);  //draw the Lhc Graph
        void DrawLabGraph(CDC& dc);                    //draw the Lab Graph

        void DrawPointMark(CDC& dc, CPoint point, COLORREF& colorref); //draw the mouse
click mark

        void DrawWebColors(CDC& dc);        //draw the saved color
//*/
```

```
        void DrawPointMark(Point point, Color colorref){} //draw the mouse click mark

        void DrawWebColors(){}          //draw the saved color


        void SavePanelColorAndAttribute(String filename){}
        float DoubleTypeFormat(double number){ return 0.0f;}


        // implements WindowListener
        public void windowClosing( WindowEvent event ){          System.exit(0);}
        public void windowActivated( WindowEvent event ){};
        public void windowClosed( WindowEvent event ){};
        public void windowDeactivated( WindowEvent event ){};
        public void windowDeiconified( WindowEvent event ){};
        public void windowIconified( WindowEvent event ){};
        public void windowOpened( WindowEvent event ){};

        // implements ActionListener
        public void actionPerformed( ActionEvent event ){
                String label = event.getActionCommand();
                if (label.equals("SAVE"))
                {
                        //setTitle( "You Clicked SAVE" );
                        if (m_bHasClicked)
                        {
                                m_rectWeb.insertColor( m_rectSample.getBackground
(),m_lhcSelected);
                        }
                } else if (label.equals("EXIT")){
                        System.exit(0);
                }

        }

        // implements MouseListener
        public void mouseClicked(MouseEvent e){
                int x = e.getX();
                int y = e.getY();
                //setTitle( "CLICKED x=" + x + "y="+ y );
                if (e.getSource() == m_rectLhc)
                {
                        onClickedRectLhc(e.getPoint());
                } else if (e.getSource() == m_rectLab){
                        onClickedRectLab(e.getPoint());
                }

                //DrawLabGraph();
                //DrawLhcGraph(m_sldH.getValue());
        }
        public void mousePressed(MouseEvent e){ }

        public void mouseReleased(MouseEvent e){
                if ( e.getSource() == m_sldH )
```

```
                {
                        m_ptLab = m_ptLhc = new Point(0,0);
                        m_rectLab.setPointMark( m_ptLab );
                        m_rectLhc.setPointMark( m_ptLhc );
                        DrawLhcGraph(m_sldH.getValue());
                        if (m_bHasClicked)
                        {
                                m_rectLab.repaint();
                                m_bHasClicked = false;
                                m_rectLab.setm_bHasClicked(true);
                                m_rectLhc.setm_bHasClicked(true);
                        }
                        System.out.println("m_sldH " + m_sldH.getValue());
                } else if ( e.getSource() == m_sldL )
                {
                        m_ptLab = m_ptLhc = new Point(0,0);
                        m_rectLab.setPointMark( m_ptLab );
                        m_rectLhc.setPointMark( m_ptLhc );
                        DrawLabGraph();
                        if (m_bHasClicked)
                        {
                                m_rectLhc.repaint();
                                m_bHasClicked = false;
                                m_rectLab.setm_bHasClicked(true);
                                m_rectLhc.setm_bHasClicked(true);
                        }
                        System.out.println("m_sldL " + m_sldL.getValue());
                }
        }

        public void mouseEntered(MouseEvent e){ }
        public void mouseExited(MouseEvent e){ }

        // implements MouseMotionListener
        public void mouseDragged(MouseEvent e){
        }
        public void mouseMoved(MouseEvent e){
                //setTitle("x="+ e.getX() +" y="+ e.getY());
        }


        TextField[] textFieldEmotion;
        Label[] labelEmotion;
        static final String[] stringEmotion = { "Warm-Cool", "Light-Dark", "Deep-Pale", "Heavy-
Light",
                                                                                "Vivid-
Sombre", "Gaudy-Plain", "Striking-Subdued", "Strong-Weak",
                                                                                "Dynamic-
Passive", "Distinct-Vague", "Transparent-Turbid", "Soft-Hard"
                                                                                };
        Label[] labelCValue;
        TextField[] textFieldCValue;
        static final String[] stringCValue = { "R", "G", "B", "L*", "a*", "b*", "C*", "h", "X", "Y", "Z", "x",
"y"};
        Button exitButton;
```

```
/*****************************************************/
/*
 * Transforming the tristimulus values to the
 *            chromaticity coordinates
 *      Input parameters : X, Y, Z (tristimulus values)
 *      Output parametsrs : x, y
 */
void cm_XYZ2xy(double X,double Y,double Z,double xy[])
{
        double  sum;

        sum = X + Y + Z;
        if (sum == 0.0)
        {
                xy[0] = 0.0;
                xy[1] = 0.0;
        }
        else
        {
                xy[0] = X/sum;
                xy[1] = Y/sum;
        }
}

void UpdateData(boolean flag){
        //static final String[] stringCValue = { "R", "G", "B", "L*", "a*", "b*", "C*", "h", "X",
"Y", "Z", "x", "y"};
        //TextField[] textFieldCValue;
        textFieldCValue[0].setText( String.valueOf(m_red));
        textFieldCValue[1].setText( String.valueOf(m_green));
        textFieldCValue[2].setText( String.valueOf(m_blue));
        textFieldCValue[3].setText( String.valueOf(m_l));
        textFieldCValue[4].setText( String.valueOf(m_a));
        textFieldCValue[5].setText( String.valueOf(m_b));
        textFieldCValue[6].setText( String.valueOf(m_c));
        textFieldCValue[7].setText( String.valueOf(m_h));
        textFieldCValue[8].setText( String.valueOf(m_X));
        textFieldCValue[9].setText( String.valueOf(m_Y));
        textFieldCValue[10].setText( String.valueOf(m_Z));
        textFieldCValue[11].setText( String.valueOf(m_lx));
        textFieldCValue[12].setText( String.valueOf(m_ly));

        /*      static final String[] stringEmotion = { "Warm-Cool", "Light-Dark", "Deep-
Pale", "Heavy-Light",

"Vivid-Sombre", "Gaudy-Plain", "Striking-Subdued", "Strong-Weak",

"Dynamic-Passive", "Distinct-Vague", "Transparent-Turbid", "Soft-Hard"

        };
        */
        textFieldEmotion[0].setText( String.valueOf(m_warm));
        textFieldEmotion[1].setText( String.valueOf(m_light));
```

```
                textFieldEmotion[2].setText( String.valueOf(m_deep));
                textFieldEmotion[3].setText( String.valueOf(m_heavy));
                textFieldEmotion[4].setText( String.valueOf(m_vivid));
                textFieldEmotion[5].setText( String.valueOf(m_gaudy));
                textFieldEmotion[6].setText( String.valueOf(m_striking));
                textFieldEmotion[7].setText( String.valueOf(m_strong));
                textFieldEmotion[8].setText( String.valueOf(m_dynamic));
                textFieldEmotion[9].setText( String.valueOf(m_distinct));
                textFieldEmotion[10].setText( String.valueOf(m_transparent));
                textFieldEmotion[11].setText( String.valueOf(m_soft));

        }

        public static void main(String[] args)
        {
                System.out.println("Hello World!");
        }


}
```

APPENDIX C

Program 03

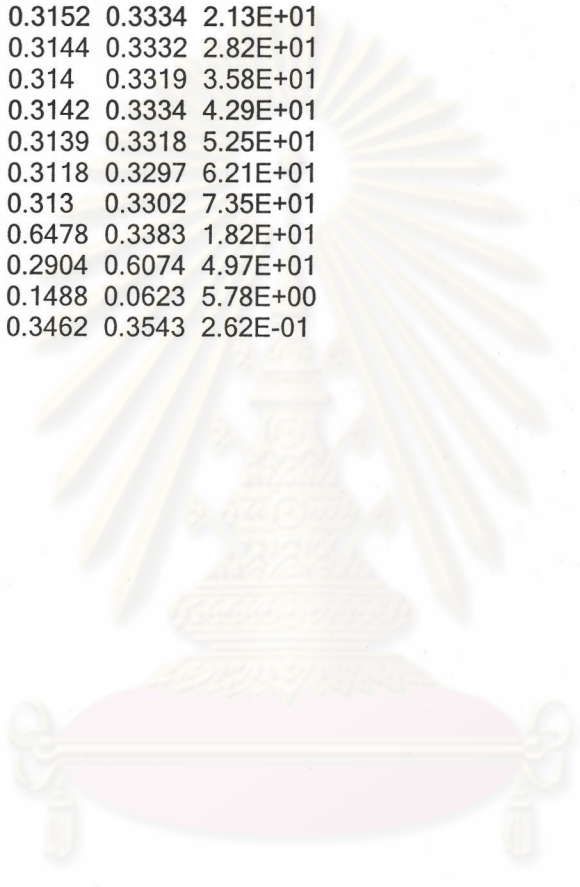
Main program

```
class ColorConvert
{
	public static void main(String[] args)
	{

		//System.out.println("Hello World!");
		if ( args.length > 0)
		{
			GlobalVar.MONITOR_FILE = args[0];
			System.out.println( GlobalVar.MONITOR_FILE );
		}

		CColorConvertDlg dlg = new CColorConvertDlg();
		dlg.setVisible( true );
	}
}
```

APPENDIX D

My monitor.txt

255	255	255	0.313	0.3302	7.35E+01
255	0	0	0.6478	0.3383	1.82E+01
0	255	0	0.2904	0.6074	4.97E+01
0	0	255	0.1488	0.0623	5.78E+00
16	16	16	0.3469	0.3538	2.73E-01
32	32	32	0.3485	0.3498	3.91E-01
48	48	48	0.343	0.348	7.84E-01
64	64	64	0.334	0.3476	1.70E+00
80	80	80	0.3265	0.3421	3.26E+00
96	96	96	0.3228	0.3395	5.29E+00
112	112	112	0.3196	0.3375	8.15E+00
128	128	128	0.3176	0.3356	1.16E+01
144	144	144	0.3161	0.3347	1.62E+01
160	160	160	0.3152	0.3334	2.13E+01
176	176	176	0.3144	0.3332	2.82E+01
192	192	192	0.314	0.3319	3.58E+01
208	208	208	0.3142	0.3334	4.29E+01
224	224	224	0.3139	0.3318	5.25E+01
240	240	240	0.3118	0.3297	6.21E+01
255	255	255	0.313	0.3302	7.35E+01
255	0	0	0.6478	0.3383	1.82E+01
0	255	0	0.2904	0.6074	4.97E+01
0	0	255	0.1488	0.0623	5.78E+00
0	0	0	0.3462	0.3543	2.62E-01



VITA

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