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KAUNAS UNIVERSITY OF TECHNOLOGY

FACULTY OF INFORMATICS

COMPUTER DEPARTMENT

App Development for Smart Mobile Systems 3rd Labaratory work

Assignment completed by:

IFF 6/8 group student

Tadas Laurinaitis

Assignment evaluated by:

Prof. Rytis Maskeliūnas

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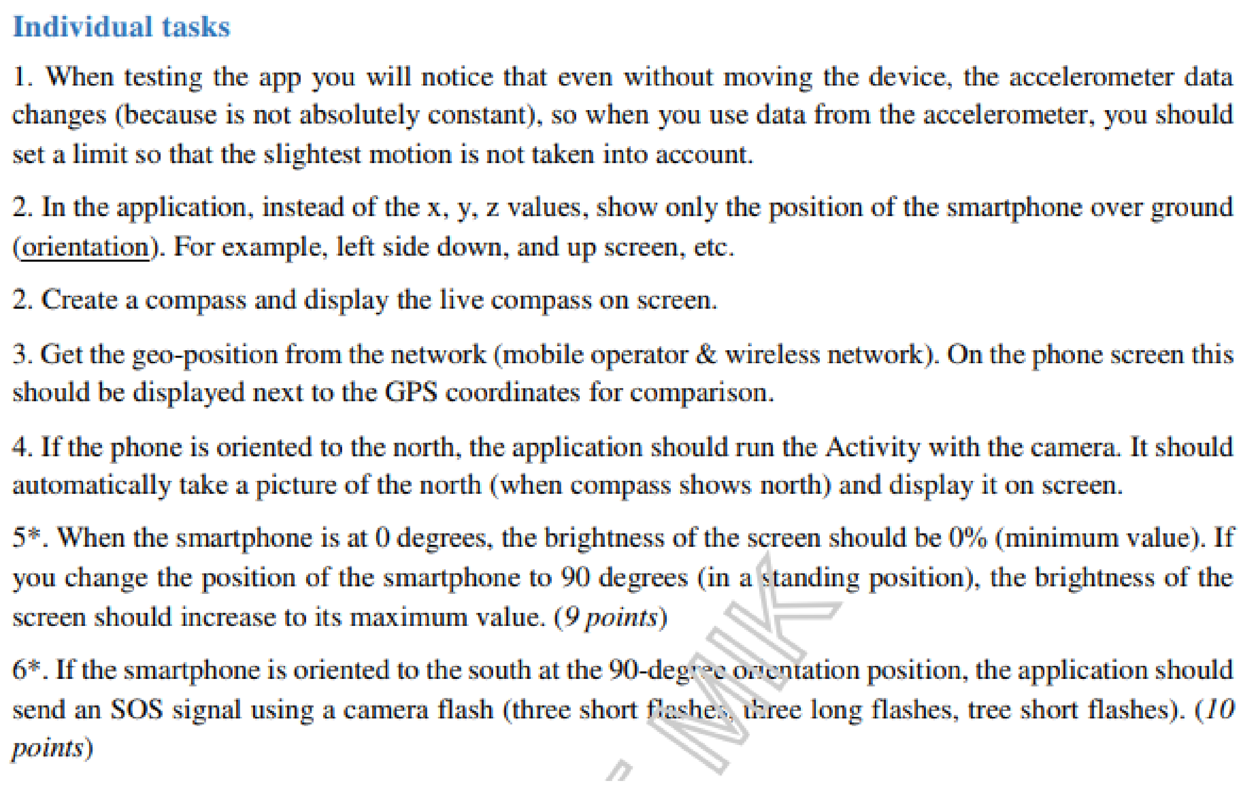


Individual tasks

1. When testing the app you will notice that even without moving the device, the accelerometer data changes (because is not absolutely constant), so when you use data from the accelerometer, you should set a limit so that the slightest motion is not taken into account.

2. In the application, instead of the x, y, z values, show only the position of the smartphone over ground (orientation). For example, left side down, and up screen, etc.

2. Create a compass and display the live compass on screen.

3. Get the geo-position from the network (mobile operator & wireless network). On the phone screen this should be displayed next to the GPS coordinates for comparison.

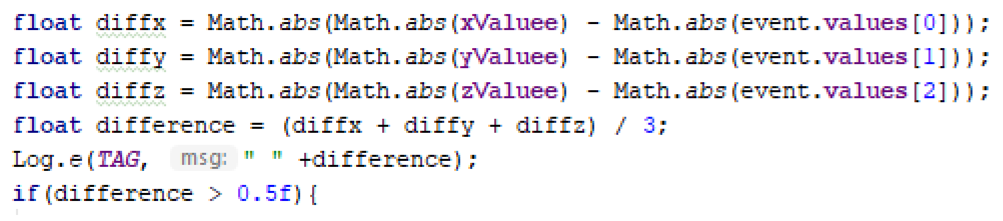
4. If the phone is oriented to the north, the application should run the Activity with the camera. It should automatically take a picture of the north (when compass shows north) and display it on screen.

5*. When the smartphone is at 0 degrees, the brightness of the screen should be 0% (minimum value). If you change the position of the smartphone to 90 degrees (in a standing position), the brightness of the screen should increase to its maximum value. (*9 points*)

6*. If the smartphone is oriented to the south at the 90-degree orientation position, the application should send an SOS signal using a camera flash (three short flashes, three long flashes, tree short flashes). (*10 points*)

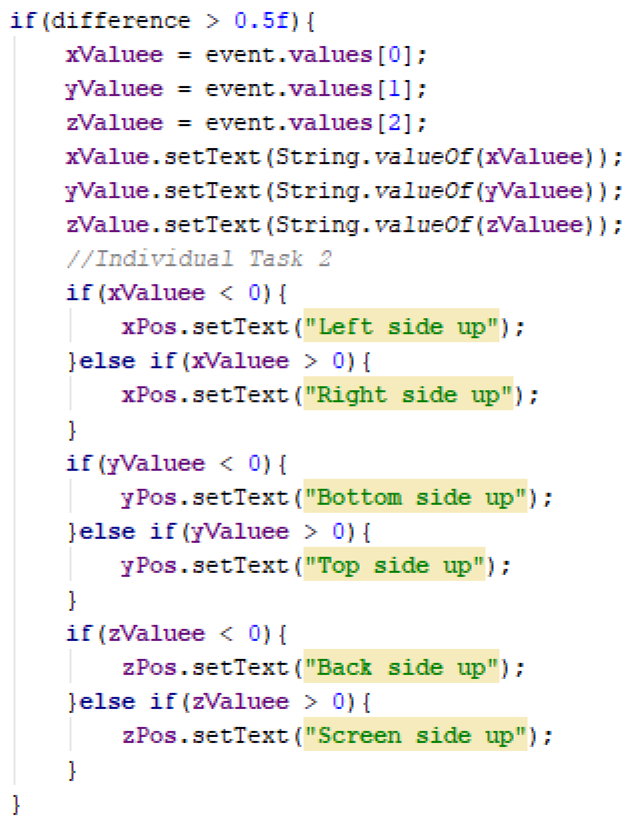
Text describing how each task was solved:

Task #1: I calculated the difference between old and new XYZ values and before changing them I would check if the difference is atleast 0.5 to avoid registering slight changes



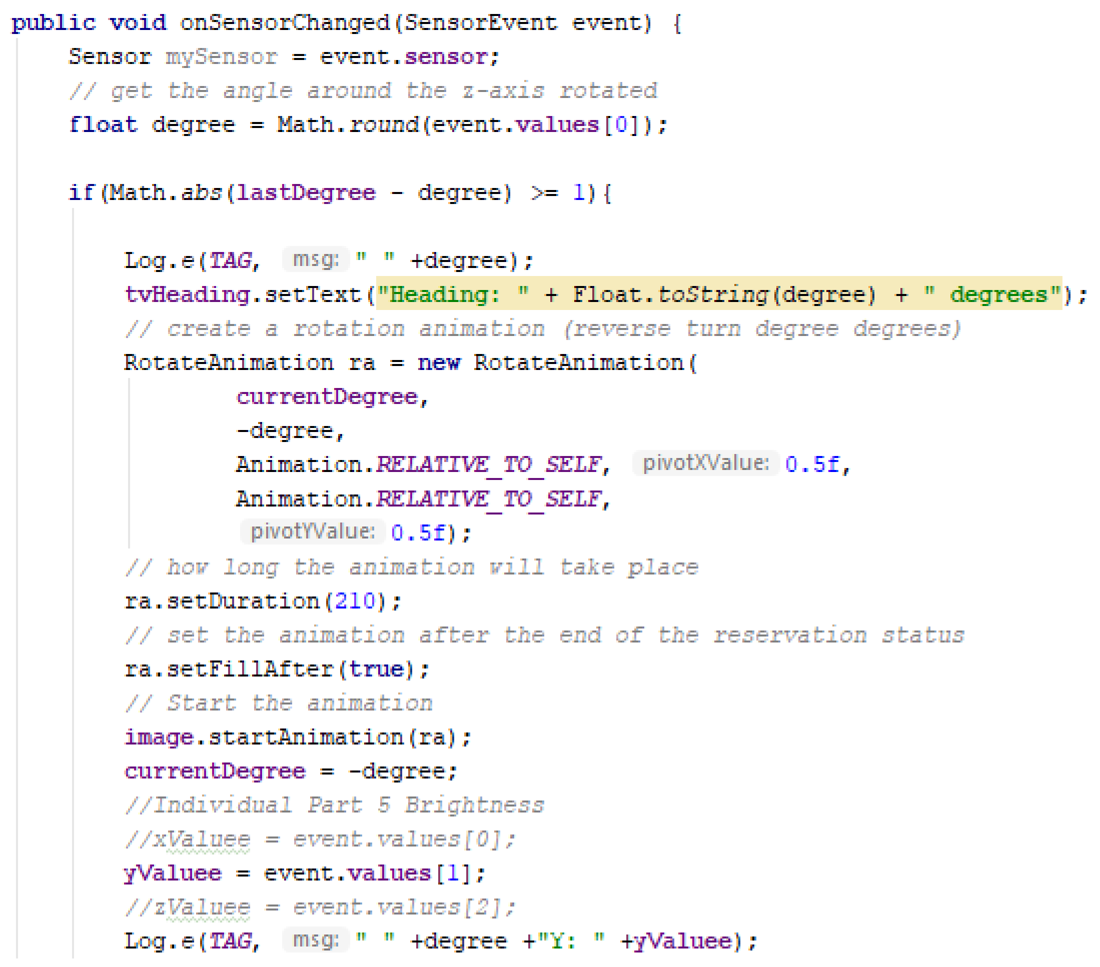
```
float diffx = Math.abs(Math.abs(xValuee) - Math.abs(event.values[0]));
float diffy = Math.abs(Math.abs(yValuee) - Math.abs(event.values[1]));
float diffz = Math.abs(Math.abs(zValuee) - Math.abs(event.values[2]));
float difference = (diffx + diffy + diffz) / 3;
Log.e(TAG,  msg: " " +difference);
if(difference > 0.5f){
```

Task #2: For this task I wrote a simple if statement which would check values of each axis and would display the position of device besides them

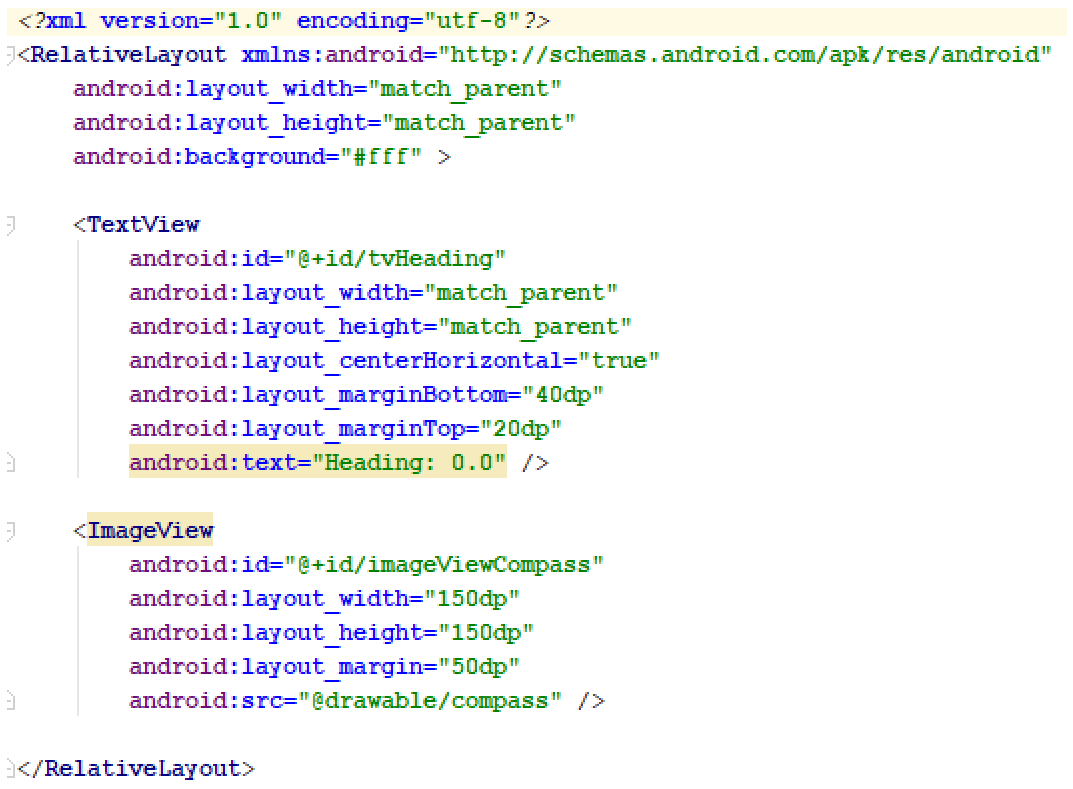


```
if(difference > 0.5f){
    xValuee = event.values[0];
    yValuee = event.values[1];
    zValuee = event.values[2];
    xValue.setText(String.valueOf(xValuee));
    yValue.setText(String.valueOf(yValuee));
    zValue.setText(String.valueOf(zValuee));
    //Individual Task 2
    if(xValuee < 0){
        xPos.setText("Left side up");
    }else if(xValuee > 0){
        xPos.setText("Right side up");
    }
    if(yValuee < 0){
        yPos.setText("Bottom side up");
    }else if(yValuee > 0){
        yPos.setText("Top side up");
    }
    if(zValuee < 0){
        zPos.setText("Back side up");
    }else if(zValuee > 0){
        zPos.setText("Screen side up");
    }
}
```

Task #3: I created a separate activity which displays compass showing north based on sensor data. The picture below shows that I get degree values based on the values of X axis and the method I use for the rotation of the image.

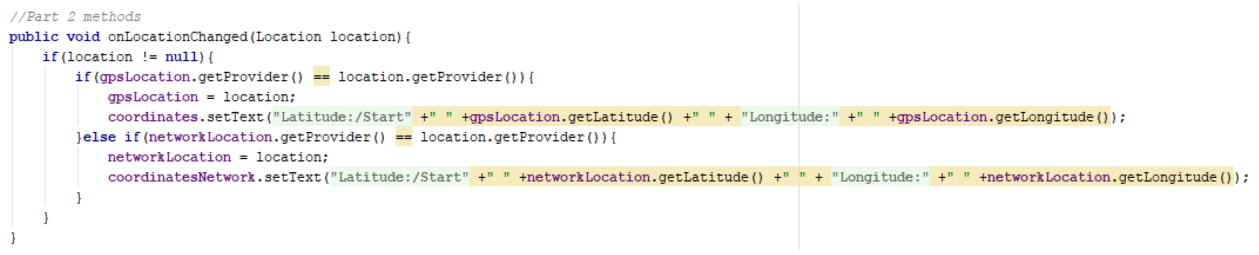


```
public void onSensorChanged(SensorEvent event) {
    Sensor mySensor = event.sensor;
    // get the angle around the z-axis rotated
    float degree = Math.round(event.values[0]);

    if(Math.abs(lastDegree - degree) >= 1){

        Log.e(TAG,  msg: " " +degree);
        tvHeading.setText("Heading: " + Float.toString(degree) + " degrees");
        // create a rotation animation (reverse turn degree degrees)
        RotateAnimation ra = new RotateAnimation(
                currentDegree,
                -degree,
                Animation.RELATIVE_TO_SELF,  pivotXValue: 0.5f,
                Animation.RELATIVE_TO_SELF,
                 pivotYValue: 0.5f);
        // how long the animation will take place
        ra.setDuration(210);
        // set the animation after the end of the reservation status
        ra.setFillAfter(true);
        // Start the animation
        image.startAnimation(ra);
        currentDegree = -degree;
        //Individual Part 5 Brightness
        //xValuee = event.values[0];
        yValuee = event.values[1];
        //zValuee = event.values[2];
        Log.e(TAG,  msg: " " +degree +"Y: " +yValuee);
```

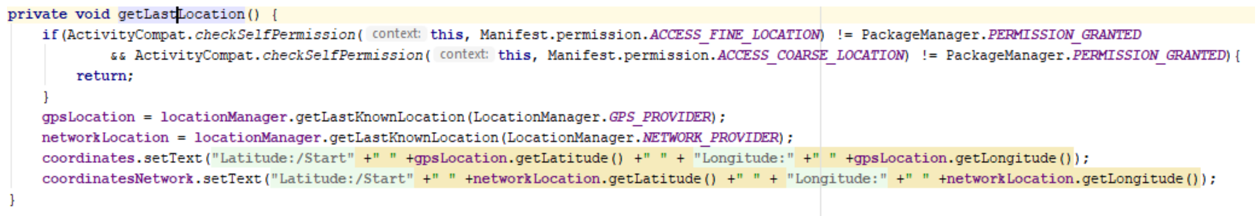


```xml
<?xml version="1.0" encoding="utf-8"?>
<RelativeLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:background="#fff" >

    <TextView
        android:id="@+id/tvHeading"
        android:layout_width="match_parent"
        android:layout_height="match_parent"
        android:layout_centerHorizontal="true"
        android:layout_marginBottom="40dp"
        android:layout_marginTop="20dp"
        android:text="Heading: 0.0" />

    <ImageView
        android:id="@+id/imageViewCompass"
        android:layout_width="150dp"
        android:layout_height="150dp"
        android:layout_margin="50dp"
        android:src="@drawable/compass" />

</RelativeLayout>
```

Task #4: The task was solved by receiving data from both GPS provider and Network provider and converting that data to coordinates.

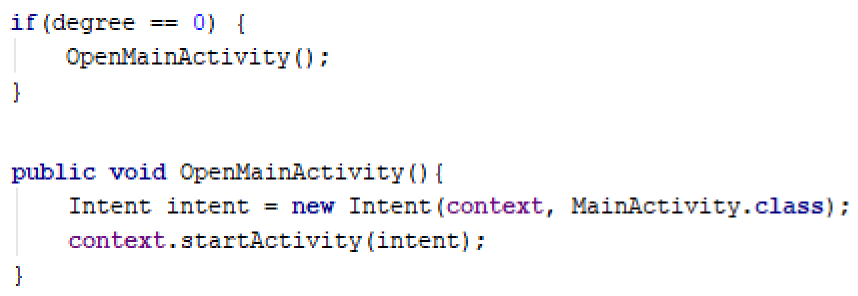


```java
//Part 2 methods
public void onLocationChanged(Location location){
    if(location != null){
        if(gpsLocation.getProvider() == location.getProvider()){
            gpsLocation = location;
            coordinates.setText("Latitude:/Start" +" " +gpsLocation.getLatitude() +" " + "Longitude:" +" " +gpsLocation.getLongitude());
        }else if(networkLocation.getProvider() == location.getProvider()){
            networkLocation = location;
            coordinatesNetwork.setText("Latitude:/Start" +" " +networkLocation.getLatitude() +" " + "Longitude:" +" " +networkLocation.getLongitude());
        }
    }
}
```



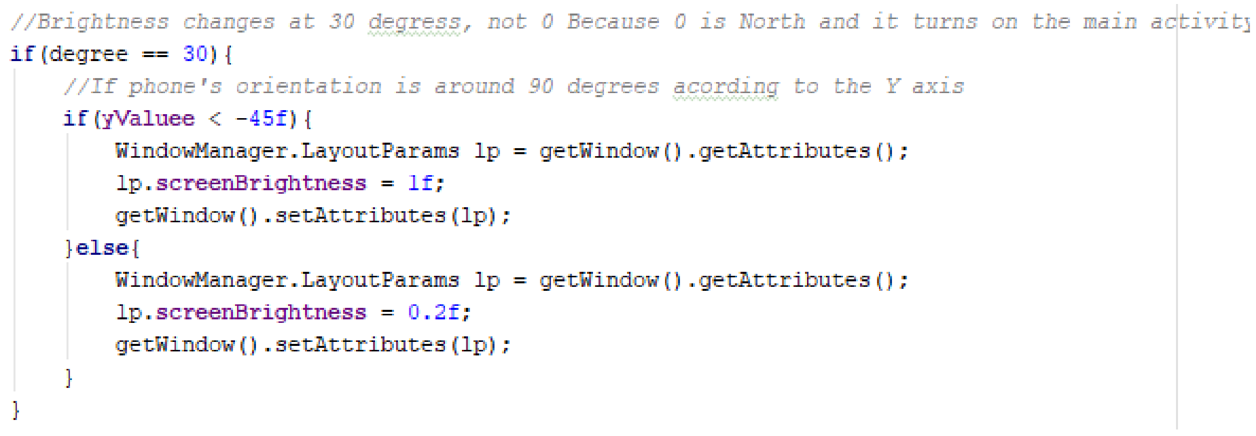
```java
private void getLastLocation() {
    if(ActivityCompat.checkSelfPermission( context: this, Manifest.permission.ACCESS_FINE_LOCATION) != PackageManager.PERMISSION_GRANTED
            && ActivityCompat.checkSelfPermission( context: this, Manifest.permission.ACCESS_COARSE_LOCATION) != PackageManager.PERMISSION_GRANTED){
        return;
    }
    gpsLocation = locationManager.getLastKnownLocation(LocationManager.GPS_PROVIDER);
    networkLocation = locationManager.getLastKnownLocation(LocationManager.NETWORK_PROVIDER);
    coordinates.setText("Latitude:/Start" +" " +gpsLocation.getLatitude() +" " + "Longitude:" +" " +gpsLocation.getLongitude());
    coordinatesNetwork.setText("Latitude:/Start" +" " +networkLocation.getLatitude() +" " + "Longitude:" +" " +networkLocation.getLongitude());
}
```

Task #5: The task was solved by writing a simple if statement which checks if the compass degrees are equal to 0 (North). If the statement is true, then it opens mainActivity which contains the camera. The only thing that doesn’t work is automatic photo capture and showing.



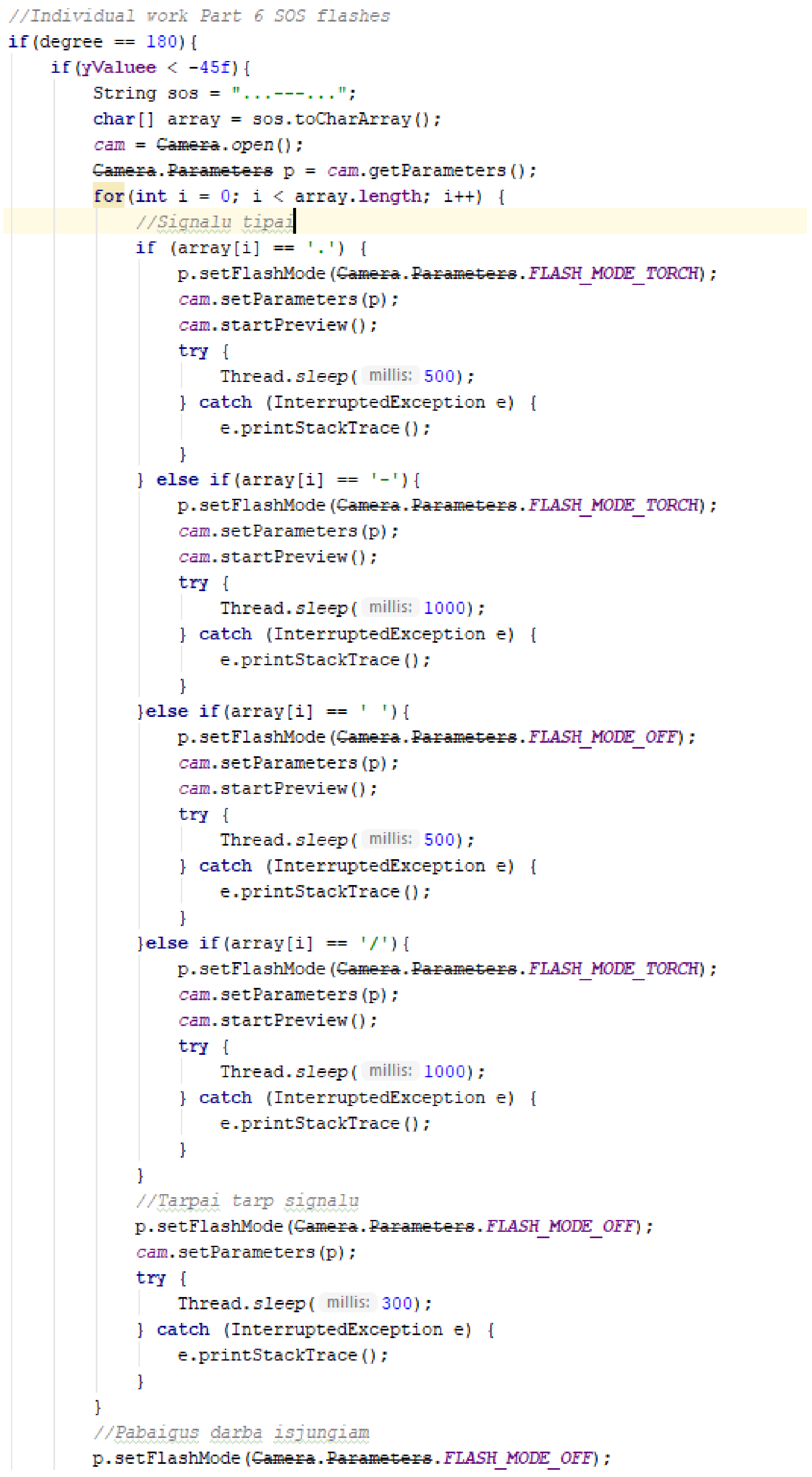
```
if(degree == 0) {
    OpenMainActivity();
}

public void OpenMainActivity(){
    Intent intent = new Intent(context, MainActivity.class);
    context.startActivity(intent);
}
```

Task #6: The task was solved by using an if statement which checks if the value of compass degrees is equal to 30 (using 30 instead of 0 because 0 is the value of North and it would automatically bring me to mainActivity) and then checks the orientation of the device (if the device is laying flat it sets the brightness to 0% and if the device is oriented at around 90 degrees based on Y axis, then the brightness is set to Maximum).



```
//Brightness changes at 30 degress, not 0 Because 0 is North and it turns on the main activit
if(degree == 30){
    //If phone's orientation is around 90 degrees acording to the Y axis
    if(yValuee < -45f){
        WindowManager.LayoutParams lp = getWindow().getAttributes();
        lp.screenBrightness = 1f;
        getWindow().setAttributes(lp);
    }else{
        WindowManager.LayoutParams lp = getWindow().getAttributes();
        lp.screenBrightness = 0.2f;
        getWindow().setAttributes(lp);
    }
}
```

Task #7: The task was solved by using an if statement which checks if the value of compass degrees is equal to 180 (South) and then checks the orientation of the device (if the device is oriented at around 90 degrees based on Y axis) and sends SOS code in flashes (…---…). For this part I used method which I created for my project work which uses older camera API to access its flash.



```
//Individual work Part 6 SOS flashes
if(degree == 180){
    if(yValuee < -45f){
        String sos = "...---...";
        char[] array = sos.toCharArray();
        cam = ~~Camera~~.open();
        ~~Camera.Parameters~~ p = cam.getParameters();
        for(int i = 0; i < array.length; i++) {
            //Signalu tipai
            if (array[i] == '.') {
                p.setFlashMode(~~Camera.Parameters~~.FLASH_MODE_TORCH);
                cam.setParameters(p);
                cam.startPreview();
                try {
                    Thread.sleep( millis: 500);
                } catch (InterruptedException e) {
                    e.printStackTrace();
                }
            } else if(array[i] == '-'){
                p.setFlashMode(~~Camera.Parameters~~.FLASH_MODE_TORCH);
                cam.setParameters(p);
                cam.startPreview();
                try {
                    Thread.sleep( millis: 1000);
                } catch (InterruptedException e) {
                    e.printStackTrace();
                }
            }else if(array[i] == ' '){
                p.setFlashMode(~~Camera.Parameters~~.FLASH_MODE_OFF);
                cam.setParameters(p);
                cam.startPreview();
                try {
                    Thread.sleep( millis: 500);
                } catch (InterruptedException e) {
                    e.printStackTrace();
                }
            }else if(array[i] == '/'){
                p.setFlashMode(~~Camera.Parameters~~.FLASH_MODE_TORCH);
                cam.setParameters(p);
                cam.startPreview();
                try {
                    Thread.sleep( millis: 1000);
                } catch (InterruptedException e) {
                    e.printStackTrace();
                }
            }
            //Tarpai tarp signalu
            p.setFlashMode(~~Camera.Parameters~~.FLASH_MODE_OFF);
            cam.setParameters(p);
            try {
                Thread.sleep( millis: 300);
            } catch (InterruptedException e) {
                e.printStackTrace();
            }
        }
        //Pabaigus darba isjungiam
        p.setFlashMode(~~Camera.Parameters~~.FLASH_MODE_OFF);
```

Literature list:

https://www.androidcode.ninja/android-compass-code-example/

https://stackoverflow.com/questions/6068803/how-to-turn-on-front-flash-light-programmatically-in-android

Source code of my tasks:

```
package hehehe.destroyer.lab3mobileapps;

import android.app.Activity;
import android.content.Context;
import android.content.Intent;
import android.hardware.Camera;
import android.hardware.Sensor;
import android.hardware.SensorEvent;
import android.hardware.SensorEventListener;
import android.hardware.SensorManager;
import android.os.Bundle;
import android.provider.Settings;
import android.util.Log;
import android.view.WindowManager;
import android.view.animation.Animation;
import android.view.animation.RotateAnimation;
import android.widget.Button;
import android.widget.ImageView;
import android.widget.TextView;

import hehehe.destroyer.lab3mobileapps.R;

public class CompassActivity extends Activity implements SensorEventListener {

    private Context context = this;
    private static final String TAG = "Compass: ";
    // define the display assembly compass picture
    private ImageView image;
    // record the compass picture angle turned
    private float currentDegree = 0f;
    private float lastDegree = 0f;
    // device sensor manager
    private SensorManager mSensorManager;
    TextView tvHeading;

    //Part 5 BRIGHTNESS
    private int brightness;
    private SensorManager senSensorManager;
    private Sensor senAccelerometer;
    private boolean InformationObtained;

    //Part 6 SOS
    public static Camera cam = null;

    //Part 1 and 2 Individual
    private float xValuee;
    private float yValuee;
    private float zValuee;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.compass_activity);

        // our compass image
        image = (ImageView) findViewById(R.id.imageViewCompass);

        // TextView that will tell the user what degree is he heading
        tvHeading = (TextView) findViewById(R.id.tvHeading);

        // initialize your android device sensor capabilities
        mSensorManager = (SensorManager) getSystemService(SENSOR_SERVICE);
        /*
        try{
            Settings.System.putInt(getContentResolver(),
                    Settings.System.SCREEN_BRIGHTNESS_MODE,
                    Settings.System.SCREEN_BRIGHTNESS_MODE_MANUAL);

            brightness = System.g(getContentResolver(),
                    Settings.System.SCREEN_BRIGHTNESS);
        }
        catch(Settings.SettingNotFoundException e){
            Log.e("Error", "Cannot access system brightness");
            e.printStackTrace();
        }*/
        senSensorManager = (SensorManager) getSystemService(Context.SENSOR_SERVICE);
        senAccelerometer =
senSensorManager.getDefaultSensor(Sensor.TYPE_ACCELEROMETER);
        xValuee = 0;
        yValuee = 0;
        zValuee = 0;
    }

    @Override
    protected void onResume() {
        super.onResume();

        // for the system's orientation sensor registered listeners
        mSensorManager.registerListener(this,
mSensorManager.getDefaultSensor(Sensor.TYPE_ORIENTATION),
                SensorManager.SENSOR_DELAY_GAME);
    }

    @Override
    protected void onPause() {
        super.onPause();

        // to stop the listener and save battery
        mSensorManager.unregisterListener(this);
    }
    public void OpenMainActivity(){
        Intent intent = new Intent(context, MainActivity.class);
        context.startActivity(intent);
    }

    @Override
    public void onSensorChanged(SensorEvent event) {
        Sensor mySensor = event.sensor;
        // get the angle around the z-axis rotated
        float degree = Math.round(event.values[0]);

        if(Math.abs(lastDegree - degree) >= 1){

            Log.e(TAG, " " +degree);
            tvHeading.setText("Heading: " + Float.toString(degree) + " degrees");
            // create a rotation animation (reverse turn degree degrees)
            RotateAnimation ra = new RotateAnimation(
                    currentDegree,
                    -degree,
                    Animation.RELATIVE_TO_SELF, 0.5f,
                    Animation.RELATIVE_TO_SELF,
                    0.5f);
            // how long the animation will take place
            ra.setDuration(210);
            // set the animation after the end of the reservation status
            ra.setFillAfter(true);
            // Start the animation
            image.startAnimation(ra);
            currentDegree = -degree;
            //Individual Part 5 Brightness
            //xValuee = event.values[0];
            yValuee = event.values[1];
            //zValuee = event.values[2];
            Log.e(TAG, " " +degree +"Y: " +yValuee);
            //If phone is pointing north, turn on the camera activity
            if(degree == 0) {
                OpenMainActivity();
            }
            //Brightness changes at 30 degress, not 0 Because 0 is North and it turns
on the main activity
            if(degree == 30){
                //If phone's orientation is around 90 degrees acording to the Y axis
                if(yValuee < -45f){
                    WindowManager.LayoutParams lp = getWindow().getAttributes();
                    lp.screenBrightness = 1f;
                    getWindow().setAttributes(lp);
                }else{
                    WindowManager.LayoutParams lp = getWindow().getAttributes();
                    lp.screenBrightness = 0.2f;
                    getWindow().setAttributes(lp);
                }
            }
            //Individual work Part 6 SOS flashes
            if(degree == 180){
                if(yValuee < -45f){
                    String sos = "...---...";
                    char[] array = sos.toCharArray();
                    cam = Camera.open();
                    Camera.Parameters p = cam.getParameters();
                    for(int i = 0; i < array.length; i++) {
                        //Signalu tipai
                        if (array[i] == '.') {
                            p.setFlashMode(Camera.Parameters.FLASH_MODE_TORCH);
                            cam.setParameters(p);
                            cam.startPreview();
                            try {
                                Thread.sleep(500);
                            } catch (InterruptedException e) {
                                e.printStackTrace();
                            }
                        } else if(array[i] == '-'){
                            p.setFlashMode(Camera.Parameters.FLASH_MODE_TORCH);
                            cam.setParameters(p);
                            cam.startPreview();
                            try {
                                Thread.sleep(1000);
                            } catch (InterruptedException e) {
                                e.printStackTrace();
                            }
                        }else if(array[i] == ' '){
                            p.setFlashMode(Camera.Parameters.FLASH_MODE_OFF);
                            cam.setParameters(p);
                            cam.startPreview();
                            try {
                                Thread.sleep(500);
                            } catch (InterruptedException e) {
                                e.printStackTrace();
                            }
                        }else if(array[i] == '/'){
                            p.setFlashMode(Camera.Parameters.FLASH_MODE_TORCH);
                            cam.setParameters(p);
                            cam.startPreview();
                            try {
                                Thread.sleep(1000);
                            } catch (InterruptedException e) {
                                e.printStackTrace();
                            }
                        }
                        //Tarpai tarp signalu
                        p.setFlashMode(Camera.Parameters.FLASH_MODE_OFF);
                        cam.setParameters(p);
                        try {
                            Thread.sleep(300);
                        } catch (InterruptedException e) {
                            e.printStackTrace();
                        }
                    }
                    //Pabaigus darba isjungiam
                    p.setFlashMode(Camera.Parameters.FLASH_MODE_OFF);
                    cam.setParameters(p);
                }
            }
        }
        lastDegree = degree;
    }

    @Override
    public void onAccuracyChanged(Sensor sensor, int accuracy) {
        // not in use
    }
}
```

```
package hehehe.destroyer.lab3mobileapps;

import android.Manifest;
import android.content.Context;
import android.content.Intent;
import android.content.pm.PackageManager;
import android.graphics.Camera;
import android.graphics.ImageFormat;
import android.graphics.SurfaceTexture;
import android.hardware.Sensor;
import android.hardware.SensorEvent;
```

```java
import android.hardware.SensorEventListener;
import android.hardware.SensorManager;
import android.hardware.camera2.CameraAccessException;
import android.hardware.camera2.CameraCaptureSession;
import android.hardware.camera2.CameraCharacteristics;
import android.hardware.camera2.CameraDevice;
import android.hardware.camera2.CameraManager;
import android.hardware.camera2.CameraMetadata;
import android.hardware.camera2.CaptureRequest;
import android.hardware.camera2.TotalCaptureResult;
import android.hardware.camera2.params.StreamConfigurationMap;
import android.location.Location;
import android.location.LocationListener;
import android.location.LocationManager;
import android.media.Image;
import android.media.ImageReader;
import android.os.Environment;
import android.os.Handler;
import android.os.HandlerThread;
import android.support.annotation.NonNull;
import android.support.annotation.Nullable;
import android.support.v4.app.ActivityCompat;
import android.support.v7.app.AppCompatActivity;
import android.os.Bundle;
import android.util.Log;
import android.util.Size;
import android.util.SparseArray;
import android.util.SparseIntArray;
import android.view.Surface;
import android.view.TextureView;
import android.view.View;
import android.view.animation.Animation;
import android.view.animation.RotateAnimation;
import android.widget.ImageView;
import android.widget.TextView;
import android.widget.Button;
import android.widget.Toast;

import java.io.File;
import java.io.FileNotFoundException;
import java.io.FileOutputStream;
import java.io.IOException;
import java.io.OutputStream;
import java.nio.ByteBuffer;
import java.util.ArrayList;
import java.util.Arrays;
import java.util.List;

public class MainActivity extends AppCompatActivity implements SensorEventListener,
LocationListener{
    //Part 1 - Accelerometer
    private SensorManager senSensorManager;
    private Sensor senAccelerometer;
    private Button startAndStop;
    private TextView xValue;
    private TextView yValue;
    private TextView zValue;
    private boolean InformationObtained;

    //Part 1 and 2 Individual
    private TextView xPos;
    private TextView yPos;
    private TextView zPos;
    private float xValuee;
    private float yValuee;
    private float zValuee;

    //Compass
    private Context context = this;
    private Button compassButton;

    //Part 2 - GPS
    private TextView coordinates;
    private TextView coordinatesNetwork;
    private LocationManager locationManager;
    private Location gpsLocation;
    private Location networkLocation;

    //Part 3 - Camera
    private static final String TAG = "AndroidCameraApi";
    private Button takePictureButton;
    private TextureView textureView;
    private static final SparseIntArray ORIENTATIONS = new SparseIntArray();
    static{
        ORIENTATIONS.append(Surface.ROTATION_0, 90);
        ORIENTATIONS.append(Surface.ROTATION_90, 0);
        ORIENTATIONS.append(Surface.ROTATION_180, 270);
        ORIENTATIONS.append(Surface.ROTATION_270, 180);
    }
    private String cameraId;
    protected CameraDevice cameraDevice;
    protected CameraCaptureSession cameraCaptureSessions;
    protected CaptureRequest.Builder captureRequestBuilder;
    private Size imageDimension;
    private ImageReader imageReader;
    private File file;
    private static final int REQUEST_CAMERA_PERMISION = 200;
    private Handler mBackgroundHandler;
    private HandlerThread mBackgroundThread;

    @Override
    protected void onCreate(@Nullable Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.main_activity);
        //Part 1 and 2
        InformationObtained = false;
        startAndStop = (Button) findViewById(R.id.start_and_stop);
        startAndStop.setOnClickListener(StartAndStopButtonListener);
        xValue = (TextView) findViewById(R.id.x_value);
        yValue = (TextView) findViewById(R.id.y_value);
        zValue = (TextView) findViewById(R.id.z_value);
        xPos = (TextView) findViewById(R.id.x_pos);
        yPos = (TextView) findViewById(R.id.y_pos);
        zPos = (TextView) findViewById(R.id.z_pos);

        coordinates = (TextView) findViewById(R.id.coordinates);
        coordinatesNetwork = (TextView) findViewById(R.id.coordinates_network);
        senSensorManager = (SensorManager) getSystemService(Context.SENSOR_SERVICE);
        senAccelerometer =
senSensorManager.getDefaultSensor(Sensor.TYPE_ACCELEROMETER);
        locationManager = (LocationManager)
getSystemService(Context.LOCATION_SERVICE);
        getLastLocation();

        xValuee = 0;
        yValuee = 0;
        zValuee = 0;

        //Compass button
        compassButton = (Button) findViewById(R.id.compass);
        compassButton.setOnClickListener(compassListener);

        //Part 3
        textureView = (TextureView) findViewById(R.id.textureView);
        assert  textureView != null;
        textureView.setSurfaceTextureListener(textureListener);
        takePictureButton = (Button) findViewById(R.id.take_photo);
        assert takePictureButton != null;
        takePictureButton.setOnClickListener(new View.OnClickListener(){
            @Override
            public void onClick(View v){
                takePicture();
            }
        });
    }
    View.OnClickListener StartAndStopButtonListener = new View.OnClickListener(){
        @Override
        public void onClick(View v){

            if(senAccelerometer == null){
                Toast.makeText(MainActivity.this, getString(R.string.no_sensor),
Toast.LENGTH_LONG).show();
                return;
            }

            if(InformationObtained){
                startAndStop.setText(getString(R.string.start));
                senSensorManager.unregisterListener(MainActivity.this,
senAccelerometer);
                InformationObtained = false;
            } else{
                senSensorManager.registerListener(MainActivity.this, senAccelerometer,
SensorManager.SENSOR_DELAY_NORMAL);
                startAndStop.setText(getString(R.string.stop));
                InformationObtained = true;
            }
        }
    };
    public void runCompass(){
        Intent intent = new Intent(context, CompassActivity.class);
        context.startActivity(intent);
    }
    View.OnClickListener compassListener = new View.OnClickListener(){
        @Override
        public void onClick(View v){
            runCompass();
        }
    };
    @Override
    public void onSensorChanged(SensorEvent event){

        Sensor mySensor = event.sensor;

        if(mySensor.getType() == Sensor.TYPE_ACCELEROMETER){
            //For accuracy (Individual Task 1)
            float diffx = Math.abs(Math.abs(xValuee) - Math.abs(event.values[0]));
            float diffy = Math.abs(Math.abs(yValuee) - Math.abs(event.values[1]));
            float diffz = Math.abs(Math.abs(zValuee) - Math.abs(event.values[2]));
            float difference = (diffx + diffy + diffz) / 3;
            Log.e(TAG, " " +difference);
            if(difference > 0.5f){
                xValuee = event.values[0];
                yValuee = event.values[1];
                zValuee = event.values[2];
                xValue.setText(String.valueOf(xValuee));
                yValue.setText(String.valueOf(yValuee));
                zValue.setText(String.valueOf(zValuee));
                //Individual Task 2
                if(xValuee < 0){
                    xPos.setText("Left side up");
                }else if(xValuee > 0){
                    xPos.setText("Right side up");
                }
                if(yValuee < 0){
                    yPos.setText("Bottom side up");
                }else if(yValuee > 0){
                    yPos.setText("Top side up");
                }
                if(zValuee < 0){
                    zPos.setText("Back side up");
                }else if(zValuee > 0){
                    zPos.setText("Screen side up");
                }
            }
        }
    }
    @Override
    public void onAccuracyChanged(Sensor sensor, int accuracy){
    }
    @Override
    protected  void onPause(){
        super.onPause();
        if(senAccelerometer != null)
            senSensorManager.unregisterListener(MainActivity.this, senAccelerometer);

        if(ActivityCompat.checkSelfPermission(this,
Manifest.permission.ACCESS_FINE_LOCATION) != PackageManager.PERMISSION_GRANTED
        && ActivityCompat.checkSelfPermission(this,
Manifest.permission.ACCESS_COARSE_LOCATION) != PackageManager.PERMISSION_GRANTED){
            return;
        }
        this.locationManager.removeUpdates(this);
        stopBackgroundThread();

    }

    @Override
    protected  void onResume(){
        super.onResume();

        if(senAccelerometer != null && InformationObtained)
            senSensorManager.registerListener(MainActivity.this, senAccelerometer,
SensorManager.SENSOR_DELAY_NORMAL);

        if(ActivityCompat.checkSelfPermission(this,
Manifest.permission.ACCESS_FINE_LOCATION) != PackageManager.PERMISSION_GRANTED
                && ActivityCompat.checkSelfPermission(this,
Manifest.permission.ACCESS_COARSE_LOCATION) != PackageManager.PERMISSION_GRANTED){
            return;
        }
        this.locationManager.requestLocationUpdates(LocationManager.GPS_PROVIDER, 400,
1, this);
```

```
        startBackgroundThread();
        if(textureView.isAvailable()){
            openCamera();
        }else{
            textureView.setSurfaceTextureListener(textureListener);
        }
    }

    //Part 2 methods
    public void onLocationChanged(Location location){
        if(location != null){
            if(gpsLocation.getProvider() == location.getProvider()){
                gpsLocation = location;
                coordinates.setText(getString(R.string.latitude_text) +" "
+gpsLocation.getLatitude() +" " + getString(R.string.longitude_text) +" "
+gpsLocation.getLongitude());
            }else if(networkLocation.getProvider() == location.getProvider()){
                networkLocation = location;
                coordinatesNetwork.setText(getString(R.string.latitude_text) +" "
+networkLocation.getLatitude() +" " + getString(R.string.longitude_text) +" "
+networkLocation.getLongitude());
            }
        }
    }
    @Override
    public void onStatusChanged(String provider, int status, Bundle extras){
    }

    @Override
    public void onProviderEnabled(String provider){
    }

    @Override
    public void onProviderDisabled(String provider){
    }
    private void getLastLocation() {
        if(ActivityCompat.checkSelfPermission(this,
Manifest.permission.ACCESS_FINE_LOCATION) != PackageManager.PERMISSION_GRANTED
                && ActivityCompat.checkSelfPermission(this,
Manifest.permission.ACCESS_COARSE_LOCATION) != PackageManager.PERMISSION_GRANTED){
            return;
        }
        gpsLocation =
locationManager.getLastKnownLocation(LocationManager.GPS_PROVIDER);
        networkLocation =
locationManager.getLastKnownLocation(LocationManager.NETWORK_PROVIDER);
        coordinates.setText(getString(R.string.latitude_text) +" "
+gpsLocation.getLatitude() +" " + getString(R.string.longitude_text) +" "
+gpsLocation.getLongitude());
        coordinatesNetwork.setText(getString(R.string.latitude_text) +" "
+networkLocation.getLatitude() +" " + getString(R.string.longitude_text) +" "
+networkLocation.getLongitude());
    }







    //Part 3 methods CAMERA STUFF BELOW
    TextureView.SurfaceTextureListener textureListener = new
TextureView.SurfaceTextureListener() {
        @Override
        public void onSurfaceTextureAvailable(SurfaceTexture surface, int width, int
height) {
            openCamera();
        }
        @Override
        public void onSurfaceTextureSizeChanged(SurfaceTexture surface, int width, int
height) {

        }
        @Override
        public boolean onSurfaceTextureDestroyed(SurfaceTexture surface) {
            return false;
        }
        @Override
        public void onSurfaceTextureUpdated(SurfaceTexture surface) {
        }
    };
    private final CameraDevice.StateCallback stateCallback = new
CameraDevice.StateCallback() {
        @Override
        public void onOpened(CameraDevice camera) {
            Log.e(TAG, "onOpened");
            cameraDevice = camera;
            createCameraPreview();
        }

        @Override
        public void onDisconnected(@NonNull CameraDevice camera) {
            cameraDevice.close();
        }

        @Override
        public void onError(@NonNull CameraDevice camera, int error) {
            cameraDevice.close();
            cameraDevice = null;
        }
    };

    final CameraCaptureSession.CaptureCallback captureCallbackListener = new
CameraCaptureSession.CaptureCallback() {
        @Override
        public void onCaptureCompleted(CameraCaptureSession session, CaptureRequest
request, TotalCaptureResult result) {
            super.onCaptureCompleted(session, request, result);
            Toast.makeText(MainActivity.this, "Saved:" + file,
Toast.LENGTH_SHORT).show();
            createCameraPreview();
        }
    };

    protected void startBackgroundThread(){
        mBackgroundThread = new HandlerThread("Camera Background");
        mBackgroundThread.start();
        mBackgroundHandler = new Handler(mBackgroundHandler.getLooper());
    }

    protected void stopBackgroundThread(){
        mBackgroundThread.quitSafely();
        try{
            mBackgroundThread.join();
            mBackgroundThread = null;
            mBackgroundHandler = null;
        }catch (InterruptedException e){
            e.printStackTrace();
        }
    }

    protected void takePicture(){
        if(null == cameraDevice){
            Log.e(TAG, "cameraDevice is null");
            return;
        }

        CameraManager manager = (CameraManager)
getSystemService(Context.CAMERA_SERVICE);

        try{
            CameraCharacteristics characteristics =
manager.getCameraCharacteristics(cameraDevice.getId());
            Size[] jpegSizes = null;
            if(characteristics != null){
                jpegSizes =
characteristics.get(CameraCharacteristics.SCALER_STREAM_CONFIGURATION_MAP).getOutputSi
zes(ImageFormat.JPEG);
            }
            int width = 640;
            int height = 480;
            if(jpegSizes != null && 0 < jpegSizes.length){
                width = jpegSizes[0].getWidth();
                height = jpegSizes[0].getHeight();
            }
            ImageReader reader = ImageReader.newInstance(width, height,
ImageFormat.JPEG, 1);
            List<Surface> outputSurfaces = new ArrayList<Surface>(2);
            outputSurfaces.add(reader.getSurface());
            outputSurfaces.add(new Surface(textureView.getSurfaceTexture()));
            final CaptureRequest.Builder captureBuilder =
cameraDevice.createCaptureRequest(CameraDevice.TEMPLATE_STILL_CAPTURE);
            captureBuilder.addTarget(reader.getSurface());
            //Overall mode of 3A
            captureBuilder.set(CaptureRequest.CONTROL_MODE,
CameraMetadata.CONTROL_MODE_AUTO);
            //Orientation
            int rotation = getWindowManager().getDefaultDisplay().getRotation();
            captureBuilder.set(CaptureRequest.JPEG_ORIENTATION,
ORIENTATIONS.get(rotation));
            //Output file
            final File file = new
File(Environment.getExternalStorageDirectory()+"/pic.jpg");

            ImageReader.OnImageAvailableListener readerListener = new
ImageReader.OnImageAvailableListener() {
                @Override
                public void onImageAvailable(ImageReader reader) {
                    Image image = null;
                    try{
                        image = reader.acquireLatestImage();
                        ByteBuffer buffer = image.getPlanes()[0].getBuffer();
                        byte[] bytes = new byte[buffer.capacity()];
                        buffer.get(bytes);
                        save(bytes);
                    } catch(FileNotFoundException e){
                        e.printStackTrace();
                    }catch (IOException e){
                        e.printStackTrace();
                    }finally {
                        if(image != null){
                            image.close();
                        }
                    }
                }
                private void save(byte[] bytes) throws IOException{
                    OutputStream output = null;
                    try{
                        //save to file
                        output = new FileOutputStream(file);
                        output.write(bytes);
                    }finally {
                        if(null != output){
                            output.close();
                        }
                    }
                }
            };

            reader.setOnImageAvailableListener(readerListener, mBackgroundHandler);

            //This callback is ivoked when a request triggers a capture to start, and
when the capture is complete.
            final CameraCaptureSession.CaptureCallback captureListener = new
CameraCaptureSession.CaptureCallback() {
                @Override
                public void onCaptureCompleted(CameraCaptureSession session,
CaptureRequest request, TotalCaptureResult result) {
                    super.onCaptureCompleted(session, request, result);
                    Toast.makeText(MainActivity.this, "Saved:" + file,
Toast.LENGTH_SHORT).show();
                    createCameraPreview();
                }
            };

            cameraDevice.createCaptureSession(outputSurfaces, new
CameraCaptureSession.StateCallback(){
                @Override
                public void onConfigured(CameraCaptureSession session){
                    try{
                        session.capture(captureBuilder.build(), captureListener,
mBackgroundHandler);
                    } catch (CameraAccessException e){
                        e.printStackTrace();
                    }
                }
                @Override
                public void onConfigureFailed(CameraCaptureSession session){

                }
            }, mBackgroundHandler);
        }catch (CameraAccessException e){
            e.printStackTrace();
        }
    }
    protected void createCameraPreview(){
        try{
            SurfaceTexture texture = textureView.getSurfaceTexture();
            assert texture != null;
            texture.setDefaultBufferSize(imageDimension.getWidth(),
imageDimension.getHeight());
            Surface surface = new Surface(texture);
            captureRequestBuilder =
cameraDevice.createCaptureRequest(CameraDevice.TEMPLATE_PREVIEW);
            captureRequestBuilder.addTarget(surface);
            cameraDevice.createCaptureSession(Arrays.asList(surface), new
CameraCaptureSession.StateCallback() {
                @Override
                public void onConfigured(@NonNull CameraCaptureSession
cameraCaptureSession) {
                    if(null == cameraDevice){
                        return;
                    }

                    cameraCaptureSessions = cameraCaptureSession;
                    updatePreview();
                }

                @Override
                public void onConfigureFailed(@NonNull CameraCaptureSession session) {
                    Toast.makeText(MainActivity.this, "Configuration change",
Toast.LENGTH_SHORT).show();
                }
            }, null);
        } catch (CameraAccessException e){
            e.printStackTrace();
        }
    }

    private void openCamera(){
        CameraManager manager = (CameraManager)
getSystemService(Context.CAMERA_SERVICE);
        Log.e(TAG, "is camera open");

        try{
            cameraId = manager.getCameraIdList()[0];
            CameraCharacteristics characteristics =
manager.getCameraCharacteristics(cameraId);
            StreamConfigurationMap map =
characteristics.get(CameraCharacteristics.SCALER_STREAM_CONFIGURATION_MAP);
            assert map != null;
            imageDimension = map.getOutputSizes(SurfaceTexture.class)[0];

            if(ActivityCompat.checkSelfPermission(this, Manifest.permission.CAMERA) !=
PackageManager.PERMISSION_GRANTED
                    && ActivityCompat.checkSelfPermission(this,
Manifest.permission.WRITE_EXTERNAL_STORAGE) != PackageManager.PERMISSION_GRANTED){
                ActivityCompat.requestPermissions(MainActivity.this,
                        new String[]{Manifest.permission.CAMERA,
Manifest.permission.WRITE_EXTERNAL_STORAGE}, REQUEST_CAMERA_PERMISION);
                return;
            }
            manager.openCamera(cameraId, stateCallback, null);
        }catch (CameraAccessException e){
            e.printStackTrace();
        }
        Log.e(TAG, "open camer X");
    }

    protected void updatePreview(){
        if(null == cameraDevice){
            Log.e(TAG, "updatePreview error, return");
        }
        captureRequestBuilder.set(CaptureRequest.CONTROL_MODE,
CameraMetadata.CONTROL_MODE_AUTO);
```

```
        try{
            cameraCaptureSessions.setRepeatingRequest(captureRequestBuilder.build(),
null, mBackgroundHandler);
        }catch(CameraAccessException e){
            e.printStackTrace();
        }
    }

    private void closeCamera(){
        if(null != cameraDevice){
            cameraDevice.close();
            cameraDevice = null;
        }
        if(null != imageReader){
            imageReader.close();
            imageReader = null;
        }
    }

    @Override
    public void onRequestPermissionsResult(int requestCode, @NonNull String[]
permissions, @NonNull int[] grantResults){
        if(requestCode == REQUEST_CAMERA_PERMISION){
            if(grantResults[0] == PackageManager.PERMISSION_DENIED){
                Toast.makeText(MainActivity.this, "You cant use this app without
granting permission", Toast.LENGTH_SHORT).show();
                finish();
            }
        }
    }
}
```

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:orientation="vertical" android:layout_width="match_parent"
    android:layout_height="match_parent">

    <TableLayout
        android:layout_width="match_parent"
        android:layout_height="wrap_content">

        <TableRow
            android:padding="10dp">
            <TextView
                android:text="@string/x"
                android:layout_width="wrap_content"
                android:layout_height="wrap_content"
                android:paddingEnd="5dp"
                android:paddingRight="5dp"
                />

            <TextView
                android:id="@+id/x_value"
                android:text="-"
                android:layout_width="wrap_content"
                android:layout_height="wrap_content"
                />

            <TextView
                android:id="@+id/x_pos"
                android:text="-"
                android:layout_width="wrap_content"
                android:layout_height="wrap_content"
                />

        </TableRow>

        <TableRow
            android:padding="10dp">

            <TextView
                android:text="@string/y"
                android:layout_width="wrap_content"
                android:layout_height="wrap_content"
                android:paddingEnd="5dp"
                android:paddingRight="5dp"
                />

            <TextView
                android:id="@+id/y_value"
                android:text="-"
                android:layout_width="wrap_content"
                android:layout_height="wrap_content"
                />

            <TextView
                android:id="@+id/y_pos"
                android:text="-"
                android:layout_width="wrap_content"
                android:layout_height="wrap_content"
                />

        </TableRow>

        <TableRow
            android:padding="10dp">

            <TextView
                android:text="@string/z"
                android:layout_width="wrap_content"
                android:layout_height="wrap_content"
                android:paddingEnd="5dp"
                android:paddingRight="5dp"
                />

            <TextView
                android:id="@+id/z_value"
                android:text="-"
                android:layout_width="wrap_content"
                android:layout_height="wrap_content"
                />

            <TextView
                android:id="@+id/z_pos"
                android:text="-"
                android:layout_width="wrap_content"
                android:layout_height="wrap_content"
                />

        </TableRow>

    </TableLayout>

    <Button
```

```xml
    android:id="@+id/start_and_stop"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:text="@string/start"/>

<Button
    android:id="@+id/compass"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:text="@string/compass"/>

<TableLayout
    android:layout_width="match_parent"
    android:layout_height="wrap_content">

    <TableRow
        android:padding="10dp">

        <TextView
            android:text="@string/Coordinates_text"
            android:layout_width="wrap_content"
            android:layout_height="wrap_content"
            android:paddingEnd="5dp"
            android:paddingRight="5dp"
            />

        <TextView
            android:id="@+id/coordinates"
            android:text="-"
            android:layout_width="wrap_content"
            android:layout_height="wrap_content"
            />

    </TableRow>

    <TableRow
        android:padding="10dp">

        <TextView
            android:text="@string/CoordinatesNET_text"
            android:layout_width="wrap_content"
            android:layout_height="wrap_content"
            android:paddingEnd="5dp"
            android:paddingRight="5dp"
            />

        <TextView
            android:id="@+id/coordinates_network"
            android:text="-"
            android:layout_width="wrap_content"
            android:layout_height="wrap_content"
            />

    </TableRow>

</TableLayout>

<Button
    android:id="@+id/take_photo"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:text="Take Photo"/>
    <FrameLayout xmlns:android="http://schemas.android.com/apk/res/android"
        android:id="@+id/layout"
        android:layout_width="match_parent"
        android:layout_height="match_parent">

        <TextureView
            android:id="@+id/textureView"
            android:layout_width="wrap_content"
            android:layout_height="wrap_content" />

    </FrameLayout>



</LinearLayout>
```

```
<?xml version="1.0" encoding="utf-8"?>
<RelativeLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:background="#fff" >

    <TextView
        android:id="@+id/tvHeading"
        android:layout_width="match_parent"
        android:layout_height="match_parent"
        android:layout_centerHorizontal="true"
        android:layout_marginBottom="40dp"
        android:layout_marginTop="20dp"
        android:text="Heading: 0.0" />

    <ImageView
        android:id="@+id/imageViewCompass"
        android:layout_width="150dp"
        android:layout_height="150dp"
        android:layout_margin="50dp"
        android:src="@drawable/compass" />

</RelativeLayout>
```