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RESEARCH ARTICLE

QR Code Scanning app for Mobile Devices

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Abstract - QR code (abbreviated from Quick Response Code) is the trademark for a type of matrix barcode first designed for the automotive industry [1]. Today the QR code is widely used in all industries. In our paper we present an implementation of an Android device using libraries and combined algorithms in order to be able to scan any QR code fast accurate and easy. The devices that we targeted for our application are the Google Glasses and an Android operated phone. The implementation for each of the devices was slight different, but the core algorithms and libraries were the same.

Keywords – QR code, information, mobile, smartphones, Android

I. INTRODUCTION

A barcode is a machine-readable optical label that contains information about the item to which it is attached. The bar code can best be described as an "optical Morse code"[2],[15]. Series of black bars and white spaces of varying widths are printed on labels to uniquely identify items [3]. The bar code labels are read with a scanner, which measures reflected light and interprets the code into numbers and letters that are passed on to a computer. In order to have a bar code that was small in size, easy to read and capable of holding both a large amount of data and a large variety of character types, the market called for a new approach. Enter 2-Dimensional bar codes. The 2-Dimensional barcodes offers good advantages like high density, high capacity, error detection, small areas. PDF417 is a stack of two-dimensional barcode. The matrix barcode is that codes the data based on the position of black spots within a matrix. Each black element is the same dimension and it is the position of the element that codes the data.

One of the most popular 2-D bar code formats, Denso Wave's QR Code. A QR code uses four standardized encoding modes (numeric, alphanumeric, byte / binary, and kanji) to store data. A QR code consists of black spots arranged in a square grid on a white background, which can be read by an imaging device and processed using Reed–Solomon error correction until the image can kk be appropriately interpreted; data is then extracted from patterns present in both horizontal and vertical components of the image.

Below are some examples of 2-Dimensional barcodes [16]:

Fig 1. Example of **PDF417 Code [16]**

The following barcodes are created by us:

Fig 2. Example of a **QR code** and **Data Matrix code**

II. OVERVIEW OF THE PROJECT

The purpose of the project is to facilitate users to accomplish multi-purpose activities and tasks with the QR Technology and with Google Glass™ or any mobile device via Android. We chose Google Glass™ as our primary target device for QR Scanning to help everyday people to simplify daily tasks and waste no more time with unnecessary activities like staying in line at market or just to help people make inventories quicker and easier. With the help of the device the users don’t have to worry about pressing buttons or searching the mobile for the right application, the only thing he has to do is to give vocal commands eg „Ok glass, please scan”[5] , as we can see in the Fig 3.

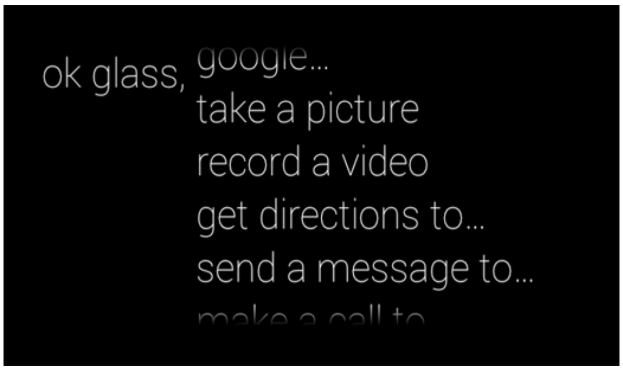


Fig 3. Example of Google Glass™ voice commands [11]

The Google Glass™ are light weight glasses without optical lens, as shown in Fig 4.

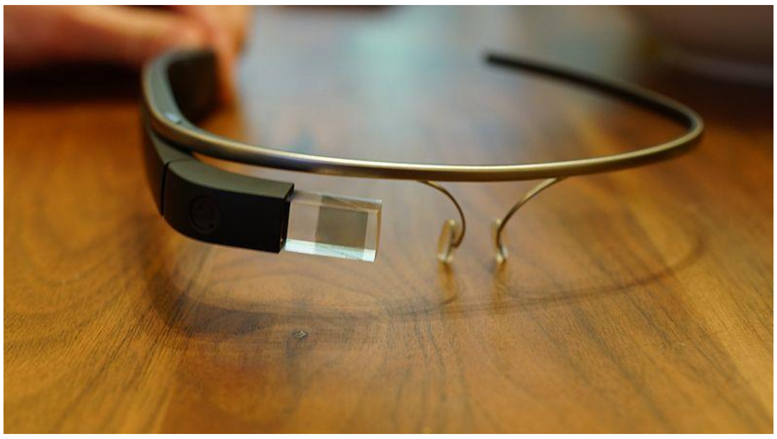


Fig 4. Google Glass™ device [7]

After the user gives the right command the QR Scanner app starts and user interface initializes. The user interface consists of a camera view which contains a partial shadow with a horizontal green line. When the user approaches a QR code the application establish the required patterns like position, alignment, timing and the application decodes it and translates into URI, as described in [6]. If the code it’s valid the application prompts a dialog message with a text view that consists the URL. and asks if you want to open that page. When the users accepts, a web view it’s opened inside the device and the page it’s shown.

III. THE BACKEND OF THE APPLICATION

After a long research and experimental process, we decided the best solution is to use an open source library named Zebra Crossing [8], which helped us decoding a wide variation of QR codes and that allowed us to focus more on user experience. The code behind the QR scan application was created in such a way that will allow further customization and even extend the possibility to scan other types of codes, the only change the developer will have to do it's to change or modify the current library with a new or custom made.

First thing to do when adding or upgrade the ZXing library is to add in the AndroidManifest.xml[13] the new activity which has some defaults parameters but you can customize the way you purpose. The orientation is set to *landscape*, the theme is a custom theme without a titlebar and the keyboard input is *stateAlwaysHidden*.

Along these, we added two intent filters: a main intent and second intent for the scanning process. In Fig 5. we are showing the AndroidManifest.xml file of our application.

```
<activity android:name="com.google.zxing.client.android.CaptureActivity"
   android:screenOrientation="landscape"
   android:configChanges="orientation|keyboardHidden"
   android:theme="@android:style/Theme.NoTitleBar.Fullscreen"
   android:windowSoftInputMode="stateAlwaysHidden">
   <intent-filter>
      <action android:name="android.intent.action.MAIN"/>
      <category android:name="android.intent.category.DEFAULT"/>
   </intent-filter>
   <intent-filter>
      <action android:name="com.google.zxing.client.android.SCAN"/>
      <category android:name="android.intent.category.DEFAULT"/>
    </intent-filter>
</activity>
```

Fig 5. The Android Manifest file

The next step is to create an Intent [14] where you specify what type of Intent you want to receive, as shown in Fig 6.

```
Intent intent = new Intent("com.google.zxing.client.android.SCAN");
intent.putExtra("SCAN_MODE", "QR_CODE_MODE");
startActivityForResult(intent, 0);
```

Fig 6. Example of an Intent from our implementation

And the final change it to change the *onActivityResul*t to make possible to read the results. If the *resultCode* is *RESULT_OK* the activity will get the SCAN_RESULT and SCAN_RESULT_FORMAT from the Intent. The code below shows the process (Fig. 7).

```
public void onActivityResult(int requestCode, int resultCode, Intent intent) {
   if (requestCode == 0) {
      if (resultCode == RESULT_OK) {
         String contents = intent.getStringExtra("SCAN_RESULT");
         String format = intent.getStringExtra("SCAN_RESULT_FORMAT");
         // Handle successful scan
      } else if (resultCode == RESULT_CANCELED) {
         // Handle cancel
      }
   }
}
```

Fig 7. The onActivityResult code

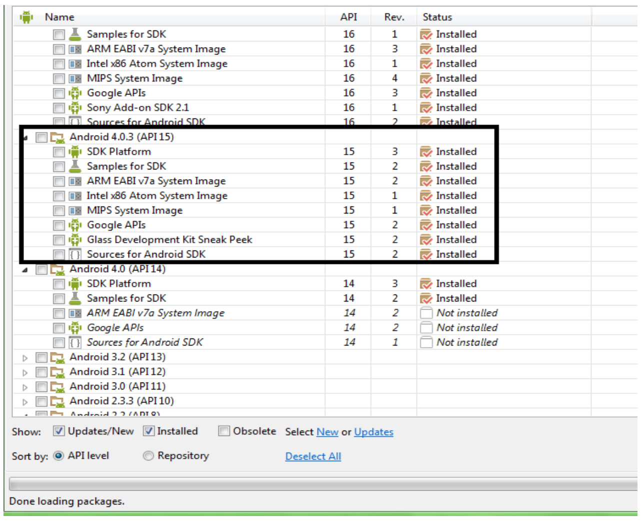
With this done you have implemented the ZXing library of course the *onActivtyResult* can be customized in many others ways same thing goes for the activity in the ActivityManifest.xml.

IV. THE STEPS OF OUR IMPLEMENTATION

IV.1 Setting up the project

Because the Google Glass is not an ordinary Android device we had to acknowledge the documentation for Google Glass available on Google's website [12]. In order to be able to implement the application we had to become familiarized with the specific concepts.

To develop Google Glass apps, we needed to add the GDK library to our project. The official GDK can be found in Eclipse's SDK Manager under the Android 4.0.3 (API 15) package, as shown in Fig 8.



Name	API	Rev.	Status
Samples for SDK	16	1	Installed
ARM EABI v7a System Image	16	3	Installed
Intel x86 Atom System Image	16	1	Installed
MIPS System Image	16	4	Installed
Google APIs	16	3	Installed
Sony Add-on SDK 2.1	16	1	Installed
Sources for Android SDK	16	2	Installed
Android 4.0.3 (API 15)			
SDK Platform	15	3	Installed
Samples for SDK	15	2	Installed
ARM EABI v7a System Image	15	2	Installed
Intel x86 Atom System Image	15	1	Installed
MIPS System Image	15	1	Installed
Google APIs	15	2	Installed
Glass Development Kit Sneak Peek	15	2	Installed
Sources for Android SDK	15	2	Installed
Android 4.0 (API 14)			
SDK Platform	14	3	Installed
Samples for SDK	14	2	Installed
ARM EABI v7a System Image	14	2	Not installed
Google APIs	14	2	Not installed
Sources for Android SDK	14	1	Not installed
Android 3.2 (API 13)			
Android 3.1 (API 12)			
Android 3.0 (API 11)			
Android 2.3.3 (API 10)			

Show: [✓ Updates/New] [✓ Installed] Obsolete Select New or Updates

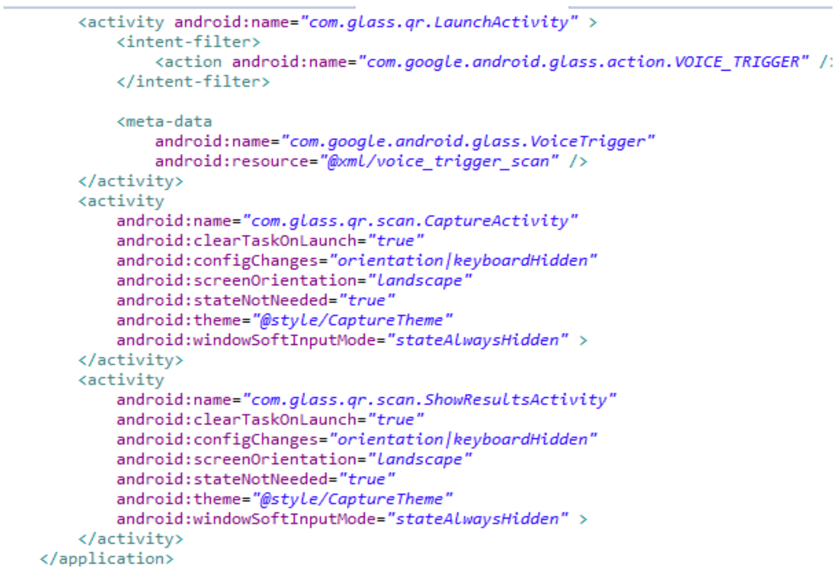
Sort by: [✓ API level] Repository Deselect All

Done loading packages.

Fig 8 The Android SDK Manager

IV.2 Configuring the project for Google Glasses

First, we included three activities: LauncherActivity, CaptureActivity and ShowResult Activity. The Android Manifest file was also updated with the necessary activities we set android:minSdkVersion=*"15"* and android:targetSdkVersion=*"15"* and we updated the Permissions for the app (Camera, Internet, Acces Wi-Fi State, Write External Storage). For a full Google Glass experience we added the Voice Trigger action via intent. The source code is shown in Fig 9.



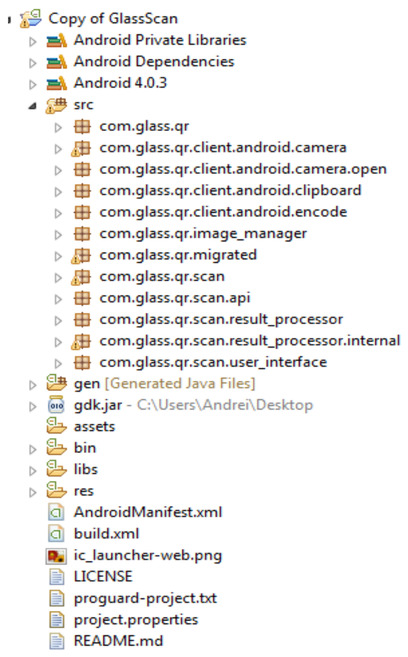
```
    <activity android:name="com.glass.qr.LaunchActivity" >
        <intent-filter>
            <action android:name="com.google.android.glass.action.VOICE_TRIGGER" /:
        </intent-filter>

        <meta-data
            android:name="com.google.android.glass.VoiceTrigger"
            android:resource="@xml/voice_trigger_scan" />
    </activity>
    <activity
        android:name="com.glass.qr.scan.CaptureActivity"
        android:clearTaskOnLaunch="true"
        android:configChanges="orientation|keyboardHidden"
        android:screenOrientation="landscape"
        android:stateNotNeeded="true"
        android:theme="@style/CaptureTheme"
        android:windowSoftInputMode="stateAlwaysHidden" >
    </activity>
    <activity
        android:name="com.glass.qr.scan.ShowResultsActivity"
        android:clearTaskOnLaunch="true"
        android:configChanges="orientation|keyboardHidden"
        android:screenOrientation="landscape"
        android:stateNotNeeded="true"
        android:theme="@style/CaptureTheme"
        android:windowSoftInputMode="stateAlwaysHidden" >
    </activity>
</application>
```

Fig 9. Another piece of code from our Android Manifest file

IV.3 Creating the classes and packages

In order to simplify processes and to have a smooth workflow we organized all the classes within specific packages. All the packages and classes were named in order to ensure an easy customization of the app.



```
Copy of GlassScan
  Android Private Libraries
  Android Dependencies
  Android 4.0.3
  src
    com.glass.qr
    com.glass.qr.client.android.camera
    com.glass.qr.client.android.camera.open
    com.glass.qr.client.android.clipboard
    com.glass.qr.client.android.encode
    com.glass.qr.image_manager
    com.glass.qr.migrated
    com.glass.qr.scan
    com.glass.qr.scan.api
    com.glass.qr.scan.result_processor
    com.glass.qr.scan.result_processor.internal
    com.glass.qr.scan.user_interface
  gen [Generated Java Files]
  gdk.jar - C:\Users\Andrei\Desktop
  assets
  bin
  libs
  res
  AndroidManifest.xml
  build.xml
  ic_launcher-web.png
  LICENSE
  proguard-project.txt
  project.properties
  README.md
```

Fig 10. The project resources and packages

The purpose of the package **android camera** is to merge several classes which ensure that it will be compatible with the Google Glass™ camera. It contains an *AutoFocusManager* which helps focus more easily the QR code an *CameraConfigurationManager* which deals with reading, parsing and settings the camera parameters which are used to configure de camera hardware. It also contains a *CameraManager* whose job was to wrap to the Camera service object and expects to be the only one talking to it. The implementation encapsulates the steps needed to take preview-sized images which are used for both preview and decoding.

The package **qr.scan** is the main collection of classes which opens the camera and takes the picture, decodes it and returns an activity. It contains a *CaptureActivity* class whose job is to open the camera, do an actual scan in a background thread and to draw a view finder. The view finder is a line that helps the user place correctly the camera when he approaches a QR Code and shows feedback as the image is being processed. The package contains a *CaptureActivityHandler* which handles all the messaging which comprises the state of machine for capture. It contains a *DecodeThread* class which helps *CaptureActivity* class to decode the images to see if is a valid QR scan. The *ResultActivity* returns the result if it's valid or not.

CONCLUSIONS

Developing a QR Scanner application for Google Glass ^{TM} was a challenge for us because the device is still a prototype, the GDK[10] is still under development so there wasn't a dedicated support for it. Another challenge was the Zxing library. We had some difficulties in using it because the Google Glass^{TM} device's camera is not that powerful compared with the modern days mobile devices. The Google Glass^{TM} uses an 5 MP camera and this forces the user to get closer to the QR Tag so that the openCV can process the image and can send it to Zxing to decode it. Our implementation opens new directions for many industries and also for the normal user of the Google Glass^{TM} devices.

Our conclusion is that if in the near future the Google Glass^{TM} will be on sale on market the people will have a better version of the device that we used mainly due to technology evolution so the auto focus will be resolved and the user will not be needed to get close, he will have the possibility to scan from a further distance and the user experience will be much more improved.

REFERENCES

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[4] http://science.howstuffworks.com/innovation/repurposed-inventions/2d-barcodes.htm

[5] https://support.google.com/glass/answer/3079305?hl=en

[6] http://en.wikipedia.org/wiki/Uniform_resource_identifier

[7] http://upload.wikimedia.org/wikipedia/commons/2/25/Google_Glass_Explorer_Edition.jpeg

[8] https://github.com/zxing/zxing/

[9] http://en.wikipedia.org/wiki/OpenCV

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