Too Long; Didn’t Watch! Extracting Relevant Fragments from Software Development Video Tutorials

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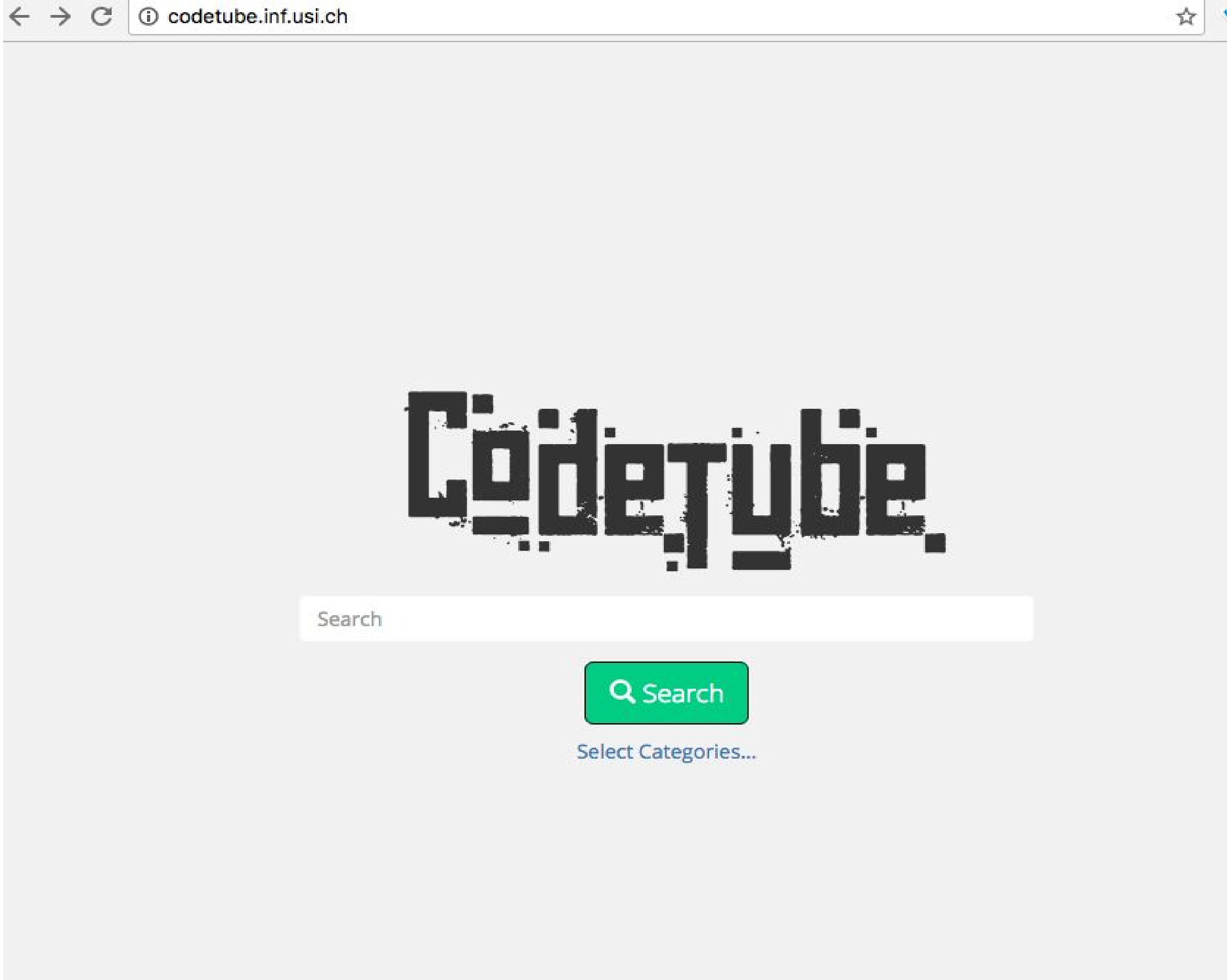
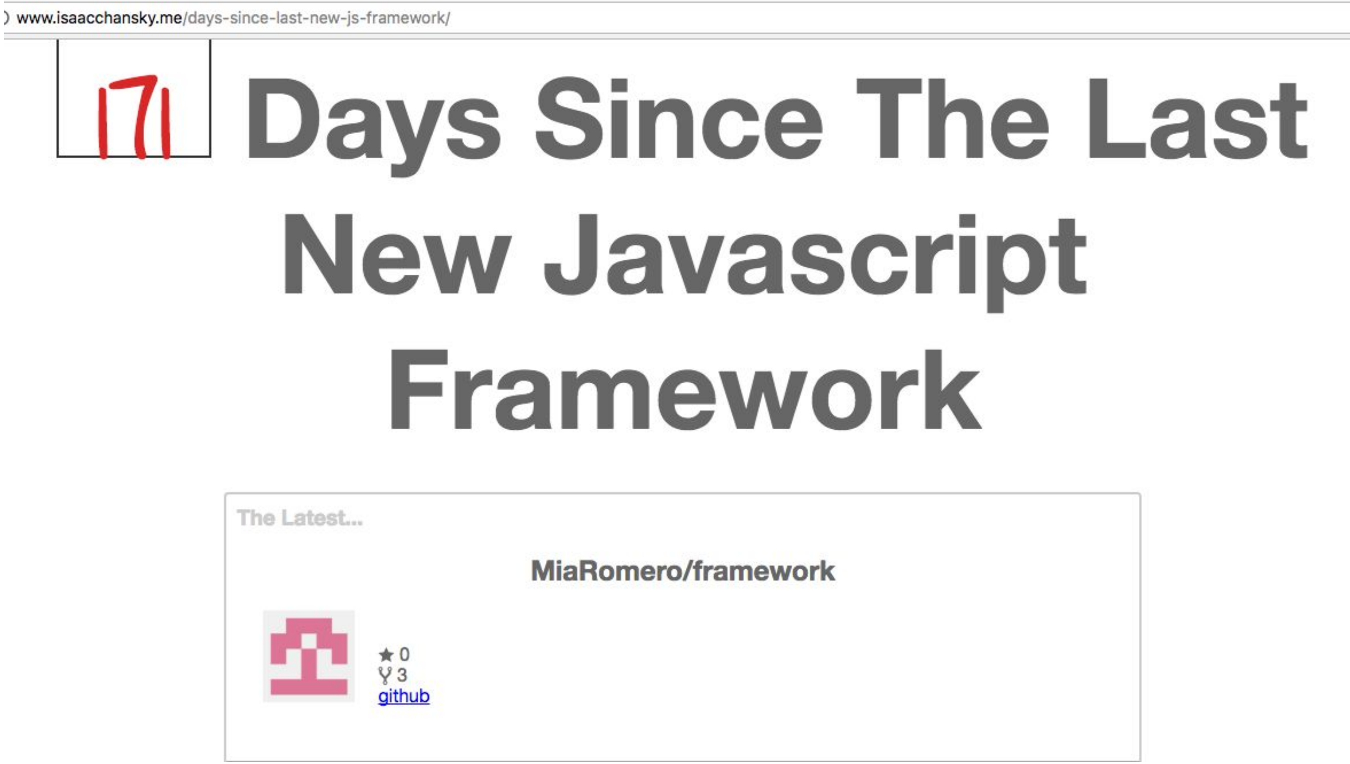
Problem Statement

"In many cases, video tutorials are lengthy, and lack an index to allow finding specific fragments of interest."



Example

"JavaScript frameworks seem like death and taxes; inevitable and unavoidable" Joe Gregorio - OSCON 2015



www.isaacchansky.me/days-since-last-new-js-framework/

171 Days Since The Last New Javascript Framework

The Latest...

MiaRomero/framework

★ 0
3
github

CodeTube Overview

“CodeTube is the first, and freely available approach to perform video fragment analysis for software development.”

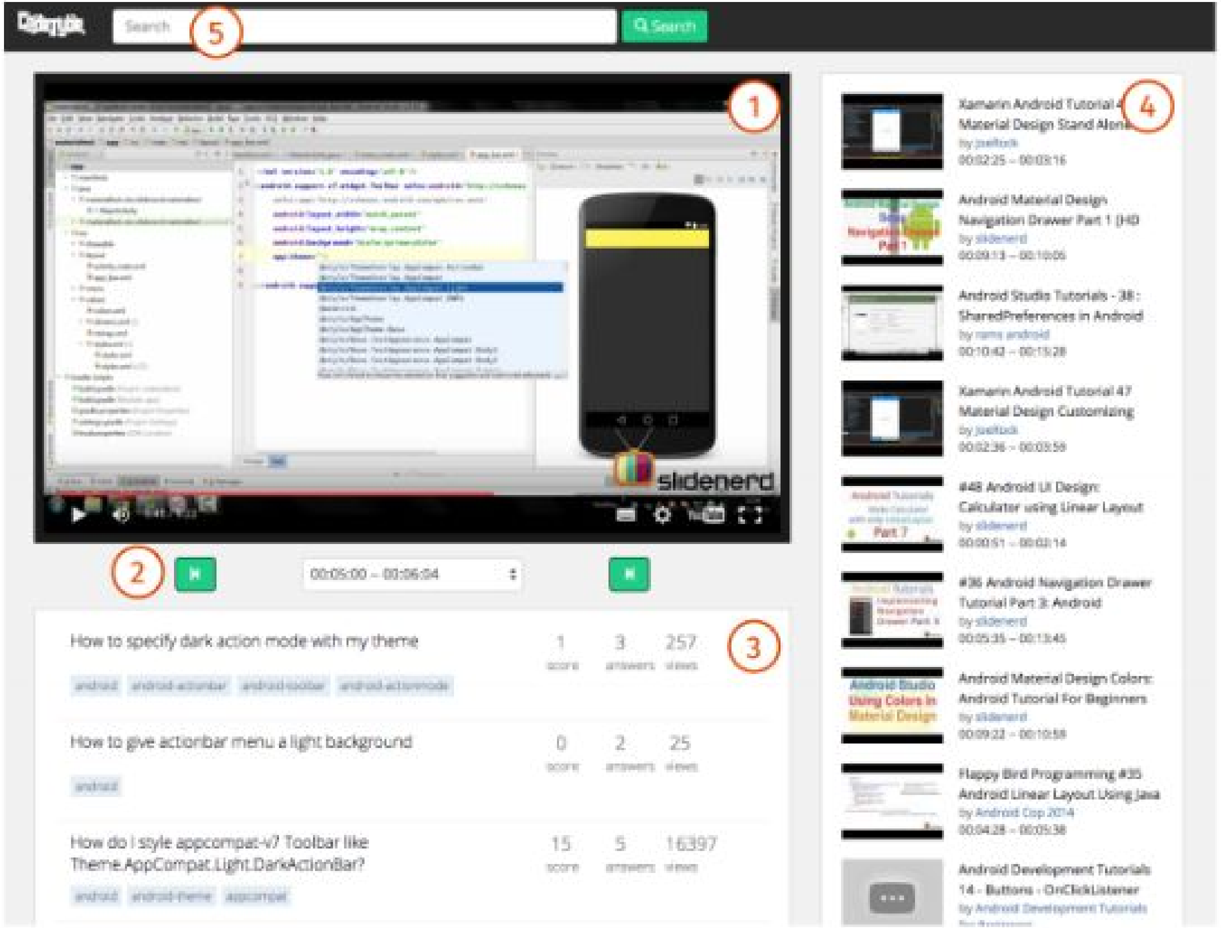
CodeTube uses mixed of existing approaches and technologies such as OCR and island parsing to analyze the complex unstructured contents of the video tutorials.

CodeTube extracts video fragments “by merging the code information located and extracted within video frames, together with the speech information provided by audio transcripts” and complements them with relevant Stack Overflow discussions.

CodeTube User Interface

Currently CodeTube is available with a set of 4,747 indexed videos related to Android development (extracted from YouTube) with a total of 38,783 fragments.

The mean length of videos is 908s (15.133 minutes).



00:05:00 – 00:06:04

How to specify dark action mode with my theme
1 score 3 answers 257 views
android android-actionbar android-toolbar android-actionmode

How to give actionbar menu a light background
0 score 2 answers 25 views
android

How do I style appcompat-v7 Toolbar like Theme.AppCompat.Light.DarkActionBar?
15 score 5 answers 16397 views
android android-theme appcompat

Xamarin Android Tutorial 4 Material Design Stand Alone
by joeltock
00:02:25 – 00:03:16

Android Material Design Navigation Drawer Part 1 (HD
by slidenerd
00:09:13 – 00:10:05

Android Studio Tutorials - 38 : SharedPreferences in Android
by rams android
00:10:42 – 00:15:28

Xamarin Android Tutorial 47 Material Design Customizing
by joeltock
00:02:36 – 00:03:59

#48 Android UI Design: Calculator using Linear Layout
by slidenerd
00:00:51 – 00:02:14

#36 Android Navigation Drawer Tutorial Part 3: Android
by slidenerd
00:05:35 – 00:13:45

Android Material Design Colors: Android Tutorial For Beginners
by slidenerd
00:09:22 – 00:10:59

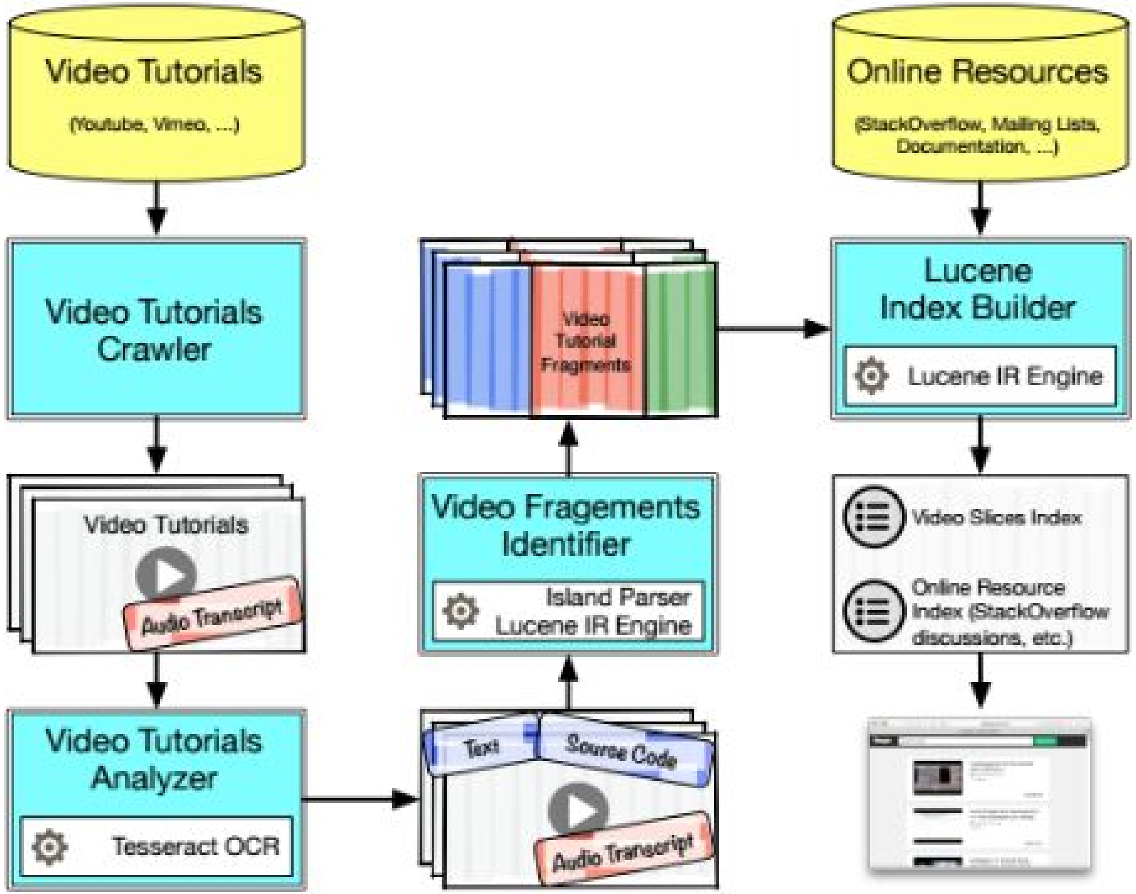
Flappy Bird Programming #35 Android Linear Layout Using Java
by Android Cop 2014
00:04:28 – 00:05:38

Android Development Tutorials 14 - Buttons - OnClickListener
by Android Development Tutorials for Beginners

CodeTube Pipeline

1. an offline analysis phase aimed at collecting and indexing video tutorials and other resources

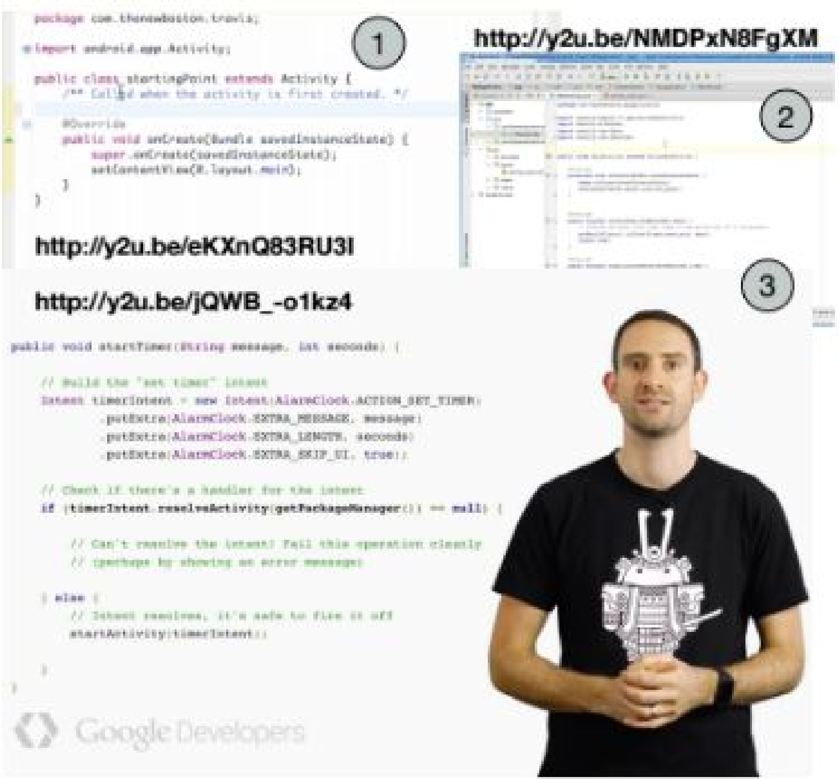
2. an online service where developers can search these processed resources.



Crawling and Analyzing Video Tutorials

English Term Extraction: Using Tesseract OCR to extract the text from the frame and OS X dictionary to match the proper English words.

Java Code Identification:
Using Shape Detection, Frame Segmentation, and Island Parser.


1
http://y2u.be/eKXnQ83RU3I
http://y2u.be/NMDPxN8FgXM
2
3
http://y2u.be/jQWB_-o1kz4
Google Developers

```
package com.thenewboston.travis;

import android.app.Activity;

public class startingPoint extends Activity {
    /** Called when the activity is first created. */

    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.main);
    }
}
```

```
public void startTimer(String message, int seconds) {

    // Build the "set timer" intent
    Intent timerIntent = new Intent(AlarmClock.ACTION_SET_TIMER)
            .putExtra(AlarmClock.EXTRA_MESSAGE, message)
            .putExtra(AlarmClock.EXTRA_LENGTH, seconds)
            .putExtra(AlarmClock.EXTRA_SKIP_UI, true);

    // Check if there's a handler for the intent
    if (timerIntent.resolveActivity(getPackageManager()) == null) {

        // Can't resolve the intent! Fail this operation cleanly
        // (perhaps by showing an error message)

    } else {
        // Intent resolves, it's safe to fire it off
        startActivity(timerIntent);

    }
}
```

Figure 2: Example frames from which CodeTube is able to extract code fragments.

Identifying Video Fragments

To identify the video frames containing a specific code snippet.

The conjecture is that a frame containing a code snippet is coupled to the surrounding video frames showing parts of the same code.

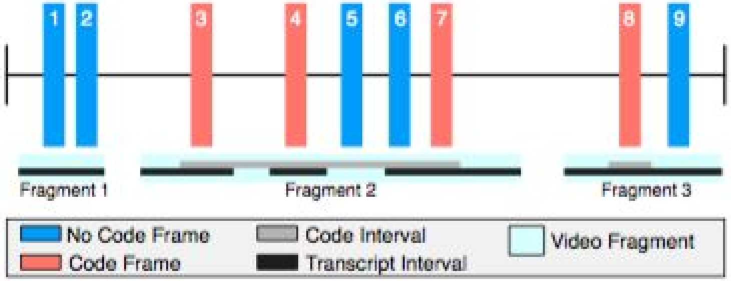
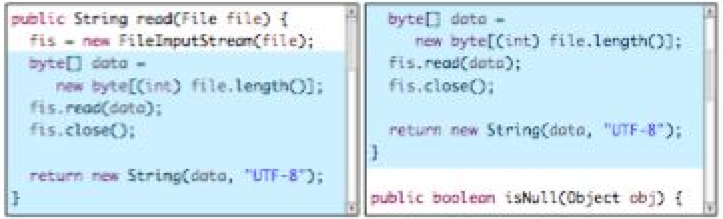


Figure 3: Identification of video fragments.



```
public String read(File file) {
  fis = new FileInputStream(file);
  byte[] data =
     new byte[(int) file.length()];
  fis.read(data);
  fis.close();

  return new String(data, "UTF-8");
}
```

```
  byte[] data =
     new byte[(int) file.length()];
  fis.read(data);
  fis.close();

  return new String(data, "UTF-8");
}

public boolean isNull(Object obj) {
```

Figure 4: LCS between two frames showing the same code. The right frame is scrolled down by the tutor.

Tuning of Code Parameters

Proper tuning of three parameters:

α – minimum percentage of LCS overlap between two frames to consider them as containing the same code fragment;

β – minimum textual similarity between two fragments to merge them in a single fragment;

γ – minimum video fragment length.

Integrating Other Sources of Information

This is the last step in the data pre-processing with the goal to complement and provide a holistic point of view on the information, it's integrated with Stack Overflow discussions.

This step is by indexing both the extracted video fragments and the Stack Overflow discussions using Lucene.

"The text indexed for a video fragment is represented by the terms contained in its frames and audio transcripts. The text indexed for the Stack Overflow post is represented by the terms they contain."

Study I: Intrinsic Evaluation

It’s an online survey questionnaire (using Qualtrics) asked to 34 developers with Android experience through an online survey with the purpose to evaluate:

- the coherence and conciseness of the video fragments produced by CodeTube, as well as their relevance to a query, as compared to the results returned by YouTube
- the relevance and complementarity of Stack Overflow discussions returned by CodeTube for specific video fragments.

Study I: Intrinsic Evaluation

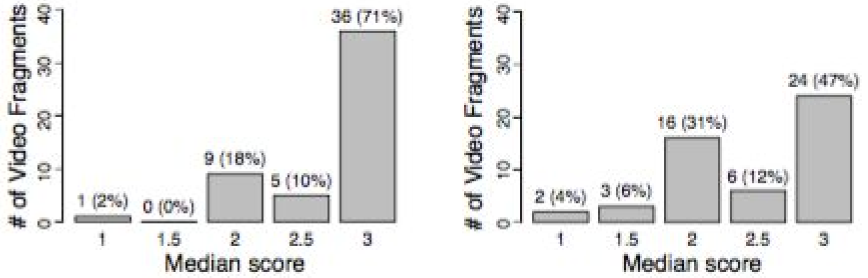
RQ1: What are the perceived benefits and obstacles of using video tutorials?

The predominant benefit is the step-by-step nature of a video.

As for the weaknesses, they are mainly on the amount of time to watch a video and the lack of searching and indexing functionalities of the contents.

Study I: Intrinsic Evaluation

RQ2: To what extent are the extracted video tutorial fragments cohesive and self-contained?



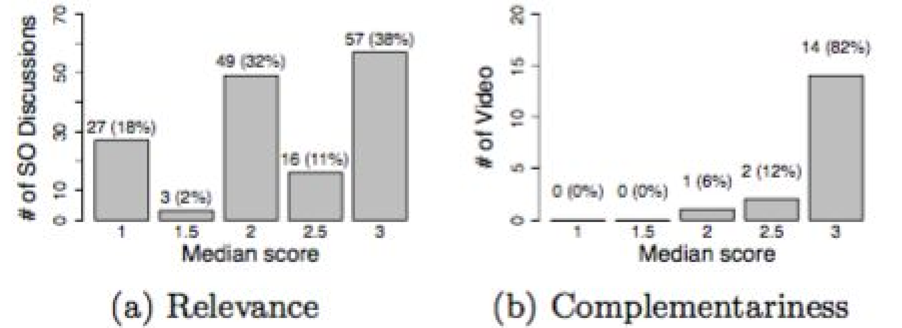
(a) Cohesion

(b) Self-Containment

Figure 6: Distribution of median cohesion and self-containment scores for the assessed video fragments.

Study I: Intrinsic Evaluation

RQ3: To what extent are the Stack Overflow discussions identified by CodeTube relevant and complementary to the linked video fragments?



(a) Relevance

(b) Complementariness

Figure 7: Relevance of Stack Overflow discussions to video fragments, and complementariness to videos.

Study I: Intrinsic Evaluation

RQ4: To what extent is CodeTube able to return results relevant to a textual query?

By asking participants to evaluate the top-three results that CodeTube and YouTube retrieved for a set of 10 queries.

Uses a three-level Likert scale:
- very related
- somewhat related
- not related

Study II: Extrinsic Evaluation

The objective is to find out the success or “industrial applicability” of CodeTube.   The participants are three leading developers (with more than five years of experience) involved in the development of Android apps.

It’s a two-hours semi-structured interview to obtain quantitative and qualitative feedback using think-aloud strategy. During the interview, the participants explored CodeTube for 90 minutes.

Study II: Extrinsic Evaluation

RQ5: Would CodeTube be useful for practitioners?

1. Do you use video tutorials during development tasks?
2. Would the extraction of shorter fragments make you more productive?
3. Is the multi-source nature of CodeTube useful?
4. Are you willing to use CodeTube in your company?

Threats to Construct Validity

Mainly related to the measurements performed in where the subjectiveness in the evaluation was mitigated by involving multiple evaluators for each video.

Threats to Internal Validity

Related to internal factors that could have influenced the results such as the knowledge of respondents about the topic.

The authors mitigated this threat by the exclusion of responses of participants with no knowledge about Android.

Instead of the usefulness to the respondents. the evaluation is related to cohesiveness, self-containment and relevance of video fragments, and relevance and complementariness of Stack Overflow discussions.

Threats to External Validity

Related to the generalizability of the findings where it's limited to video tutorials related to Android development.

In the future, both CodeTube and its evaluation need to be extended to support multiple languages.

Questions

1. What is your favorite media for learning?
2. Is it the same for learning any new topic or specific to technology related topic?
3. How do you feel about the future of CodeTube or similar method?
4. What can be improved from the current techniques?