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Internship Report 2019-2020

CONFIDENTIAL

Smart screenshot capture of online videos for TV guides

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Abbreviations

Vod - Video on demand
FPS - Frame per second
HTML - Hyper Text Markup Language
WPF - Windows Presentation Foundation

1. Introduction

Facing the difficult choices of a dozen of television channels and Vod platforms (replay or streaming), ToddTV project focus on serving clients faster and more convenient use experience of numeric guide of TV programs/Vod (Video on demand)/Replay, as well as the direct access to the media or social network online related to the current program.

The goal of the future platform is to provide TV/Vod 3.0 guide service which is designed specifically for users, making searches easier and shorter. In addition to this, the highly personalized recommendation is also a major feature of Tod.tv.

1.1 Who?

ToddTV is a startup which was established by Jordan Nicot, a computer science engineer, and Mathieu Delalandre who is the researcher of the University of Tours. This project ToddTV is part of a context of innovation around the fields of media, web technologies and image processing.

The University of Tours and the Laboratory of Fundamental and Applied Computer Science of Tours (LIFAT - Laboratoire d'Informatique Fondamentale et Appliquée de Tours) enabled the creation of this project. A collaboration contract has been established between the university and the private promoter of the project for a period of 3 years (2018-2021). As part of this project, it was agreed that LIFAT would make its computing server and its premises available for the development and testing needs of the project.

1.2 Target users

The application is primarily intended for public users. The number of the users and subscribers will proceed the commercial strategy to be launched for advertisers.

- Public users: ToddTV give users a new choice and way to use digital guide of TV programs or other video platforms which can reduce efficiently the time that users spend to visit all platforms.

  In the website of ToddTV, it's easily to find that we can follow the French TV channel's program. Furthermore, the Figure2 is the guide of the Vod platforms to simplify the search of the TV schedule and Vod videos which could significantly save user's time.

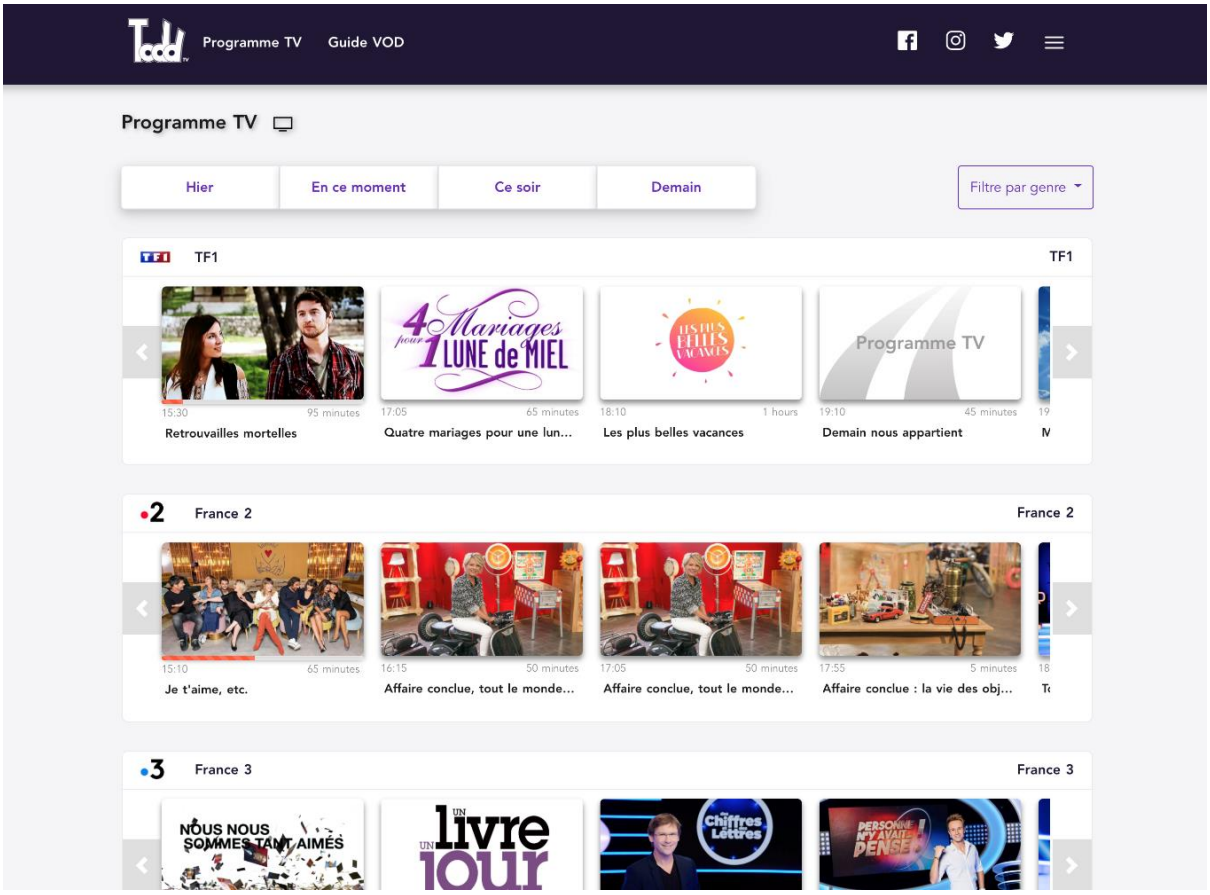


Figure 1 ToddTV Website – TV Program

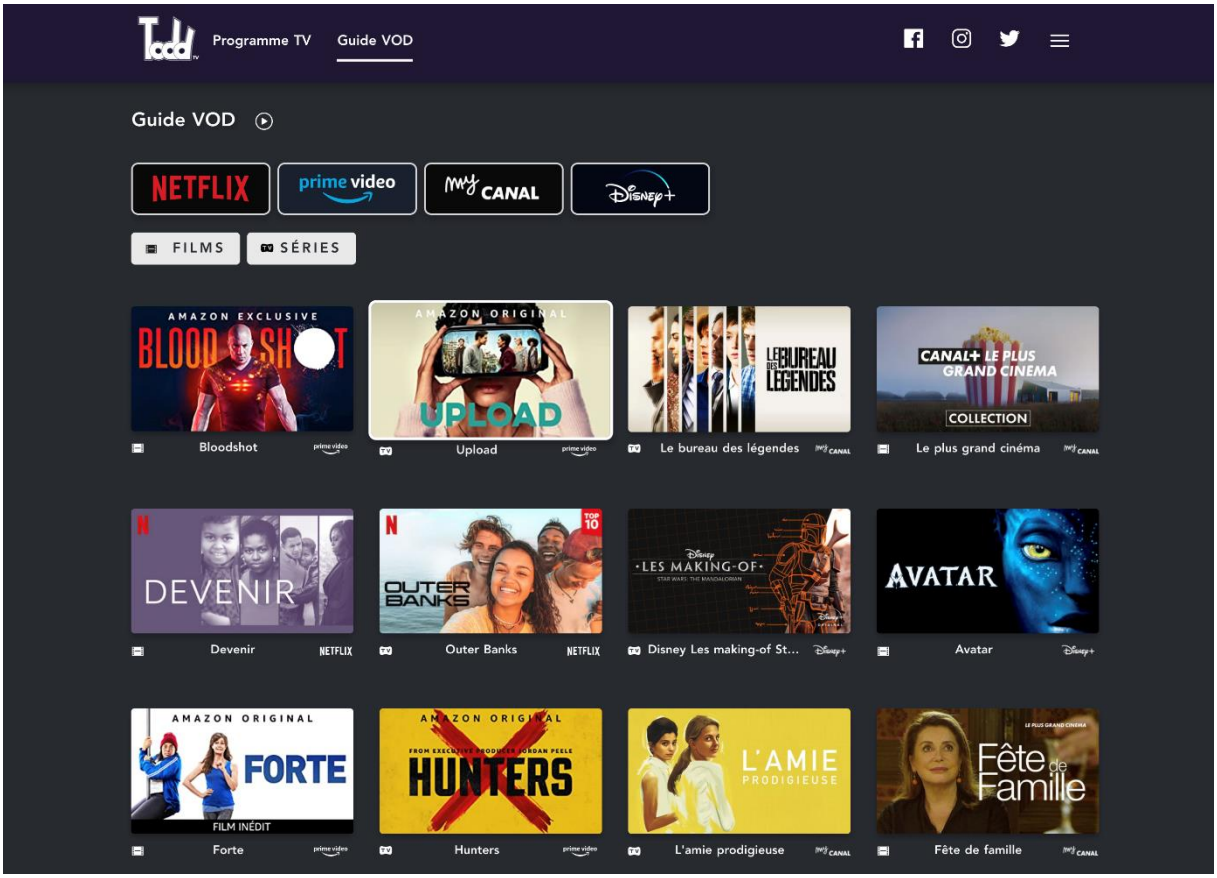


Figure 2 ToddTV Website – Vod guide

- Advertisers, once a unifying community exists: Providing a dynamic solution to advertisers which can targeting the suitable users.

2. Description of the Internship

The project is aimed at finding a solution to automatically capture the frames of the video which can be used and selected as the image materials of TV channels or Vod platforms for ToddTV website.

The general idea of this project is to develop a screen capture tool which can collect as much as picture material to build an image database by taking screenshot of videos.

2.1 French TV Web Portal and Video Player

First we need to collect the TV channels which are integrated in the ToddTV application. In the Table 1, there are the websites of the French channels and the video player be used in the specific website.

Table1 French TV channels and video player

TV channel List	Player
Arte : https:www.arte.tv/fr/	Player intégré au site (ArteVP Player)
BFMTV : https:www.bfmtv.com/	Brightcove Player
France 2, France 3, France 4, France 5, France O, France Info : https://www.france.tv/	Player intégré au site
Gulli : https://www.gulli.fr/	Jw Player
LCP : http://www.lcp.fr/	Dailymotion Player
M6, W9, 6ter : https://www.6play.fr/	Player intégré au site
CNews : https://www.cnews.fr/	Dailymotion Player
Canal+(En claire), C8, Cstar : https://www.canalplus.com/	OnePlayer
L'équipe : https://www.lequipe.fr/	Dailymotion Player
NRJ12/Chérie25 : https://www.nrj-play.fr/	Jw Player
RMC Story : https://rmcstory.bfmtv.com/	Brightcove Player
RMCDécouverte : https://rmcdecouverte.bfmtv.com/	Brightcove Player
TF1, TMC, TFX, HD1 Série FIlms, LCI : https://www.tf1.fr/	Player intégré au site (Wat.tv)

2.1.1 Streaming

Streaming media is multimedia that is constantly received by and presented to an end-user while being delivered by a provider [1]. Streaming technology can provide users watching or listening media in real-time while it is being sent to their browser, instead of waiting for it to completely download and then playing it.

2.1.2 Flash VS HTML5

Figure 3 HTML5 and Flash

Flash has been around for more than 20 years; it has been a standard in the online video distribution industry. Because of some issues which revolve around security and speed, first Apple release of the iPhone in 2007 didn't support Flash, this trend is visible in the market including some web Browsers dropping Flash support. Flash is no longer the dominant force it once was, like in July 2016, Firefox phase out the support for Flash; Google will stop the support for Flash in December of 2020.

Times are changing, Flash has been taking place by more modern, faster standard. HTML5 is slowly and steadily filling gaps which Flash has dominated during its peak, HTML (Hyper Text Markup Language) is used to design web pages using markup language. HTML5 is the latest major version of HTML, there are some main features of HTML5 [2]:

- It has introduced new multimedia features which supports audio and video controls by using <audio> and <video> tags.
- There are new graphics elements including vector graphics and tags.
- Enrich semantic content by including <header><footer>, <article>, <section> and <figure> are added.
- Drag and Drop – The user can grab an object and drag it further dropping it on a new location.
- Geo-location services – It helps to locate the geographical location of a client.
- Web storage facility which provides web application methods to store data on web browser.
- Uses SQL database to store data offline.
- Allows to draw various shapes like triangle, rectangle, circle, etc.
- Capable of handling incorrect syntax.
- Easy DOCTYPE declaration.
- Easy character encoding.

Table 2 Flash VS HTML5

	Release company	Language
Flash	Adobe (1996), proprietary	JS, CSS
Html5	W3C (2014), open source	C++

2.1.3 HTML5 Video player

All the Video Players used to play the online video using HTML5 standard, so at the beginning of the project, the research of the video player is necessary to see if the download of the video is possible so that we can use the FFmpeg, a free and open-source project for handling video, audio and other multimedia files and streams [Wikipedia]. In the Table 3, we can easily find that it's difficult to realize downloading video in each player.

Table 3 HTML5 Video player

Player	Protocole	Type de player	Price
ArteVP	HLS	Arte	-
Brightcove	HLS	Open Source	Starting from $99/month (30 days free trial) Marketing Starter - 50 or 200 videos, up to 100,000 plays, 2 or 5 users - HTML5, Responsive Video Player - Video Gallery Marketing professional - Unlimited video, 100,000+ plays, 10+ users - Full API Access - Partner Ecosystem Access Marketing Enterprise - Multi-Account Environment
OnePlayer	HLS, DASH	Canal+	-
JwPlayer	HLS, DASH	Open Source	Developper(free) - Full API&SDK Access - Non-commercial License - 25GB Hosting/ 75GB Streaming Starter($10/month) - HTML5 Video Player - Passwordword Protected Sharing - Video Gallery Enterprise (Custom Pricing) - High-volume limits
WatTV	HDS	MyTF1	-
Dailymotion	HLS	Open Source	Full API Access

2.2 Screen Record Software

The usage of screens has become inevitable these days. Screen recording software has become a significant tool for sharing screen resources whether it is for business, education or entertainment. Optimizations of Open Source screen capture tool for capture frames from online video takes too much time, we cannot accelerate the process of recording video, or it'll reduce the FPS (Frame per second) of the result.

Table 4 Html5 video players

HTML5 Online Video Player
Afterglow
Brightcove player
Contus Vplay
Dailymotion
Flow Player
Jplayer
JWPlayer
Kaltura
MediaElement JS
PLYR
Projekktor
Sublime
VideoJS
VPlayed
YouTube

3. Screen Capture Tool Development

3.1 Concept

There is no Screen Record software that meets our needs, so I developed a simple Screen Capture Tool which can Capture images automatically from the French TV Portal Websites using Visual Studio.

3.1.1 Visual Studio and WPF

The WPF (Windows Presentation Foundation) API was introduced by Microsoft; it provides developers with a unified programming model for building line-of-business desktop applications on Windows. It is as well as a next generation UI framework to create applications with a rich user experience [3].

Figure 4 WPF - Windows Presentation Foundation

3.1.2 What is XAML?

XAML is a declarative markup language. As applied to the .NET Core programing model, XAML simplifies creating a UI for a .NET app. You can create visible UI elements in the declarative XAML markup, and then separate the UI definition from the run-time logic by using code-behind files that are joined to the markup through partial class definitions. XAML directly represents the instantiation of objects in a specific set of backing types defined in assemblies. This is unlike most other markup languages, which are typically an interpreted language without such a direct tie to a backing type system. XAML enables a workflow where separate parties can work on the UI and the logic of an app, using potentially different tools [4].

3.1.3 Material Design

Material is a design system created by Google to help teams build high-quality digital experiences for Android, iOS, Flutter and the web. In the development of the application.

Material Components are interactive building blocks for creating a user interface. In the development of the application, we can simplify the workflow by using Material tools.

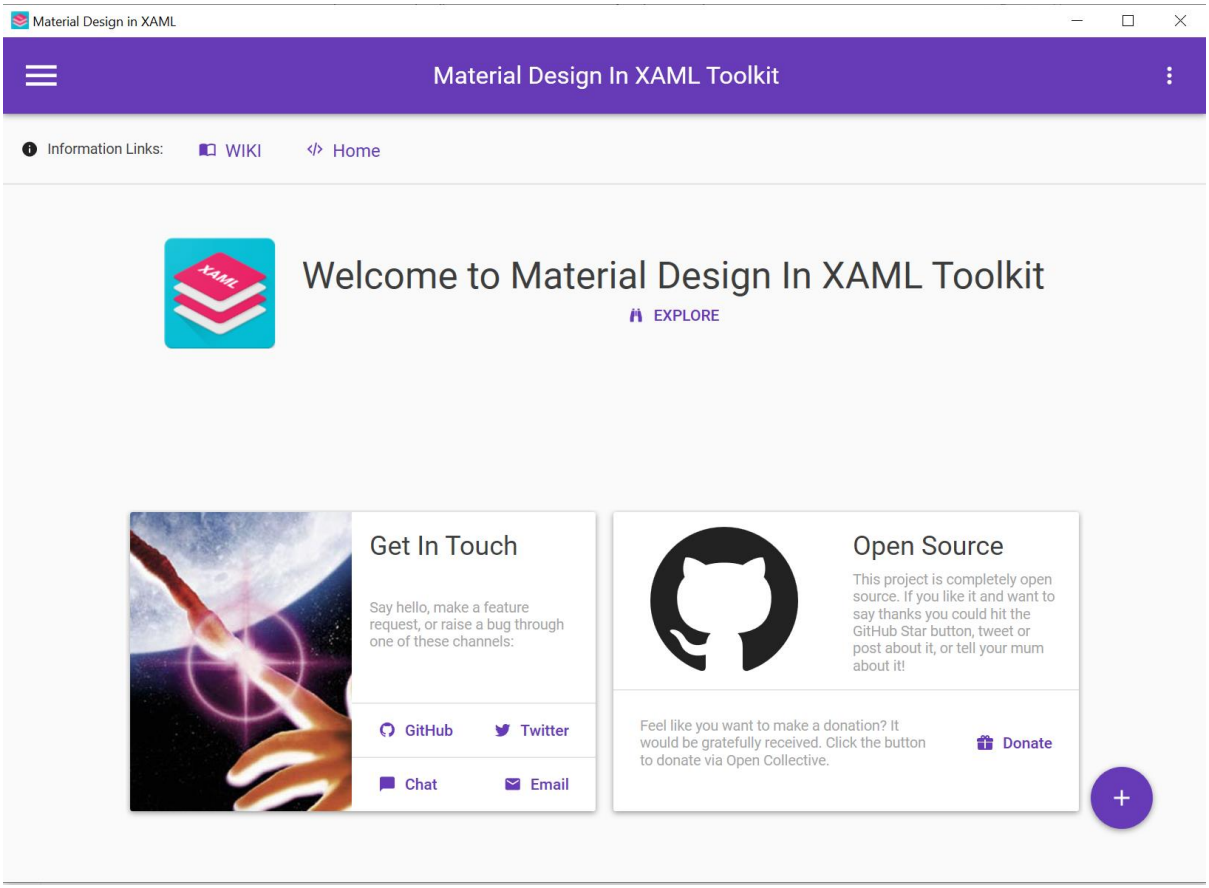


Figure 5 Material Design Toolkit

3.1.4 Design of the application

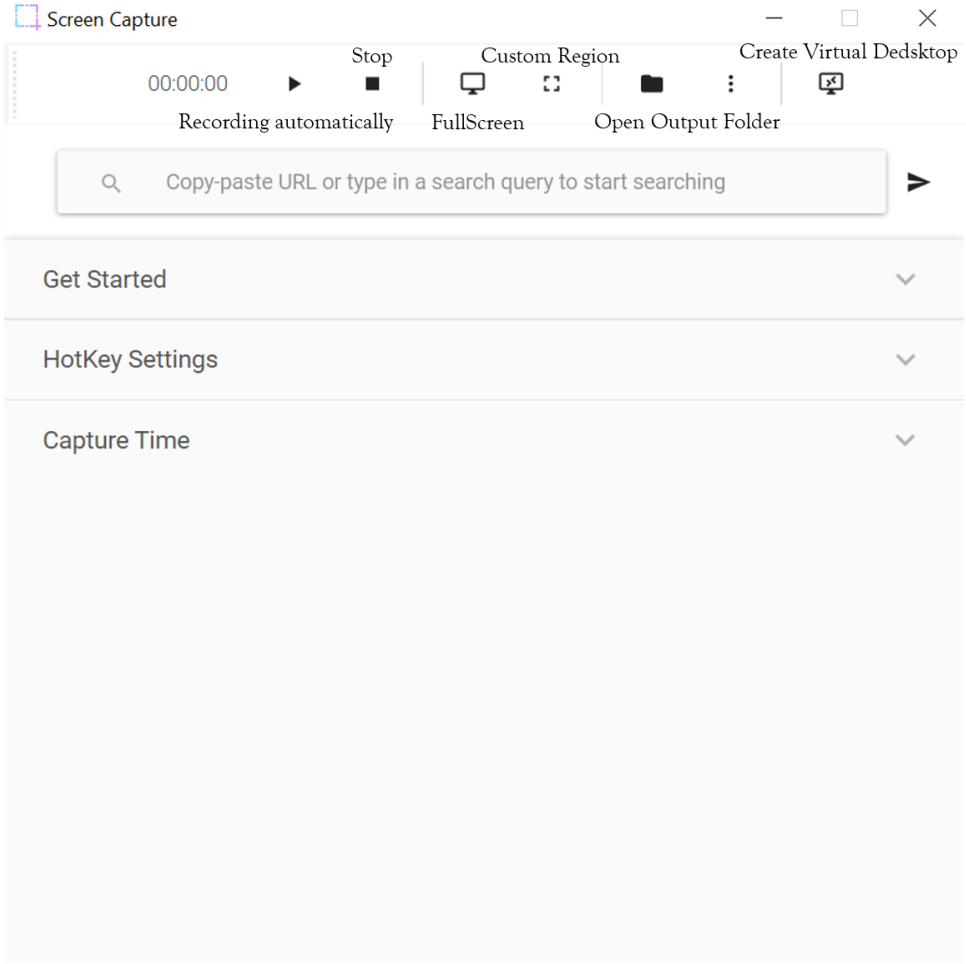


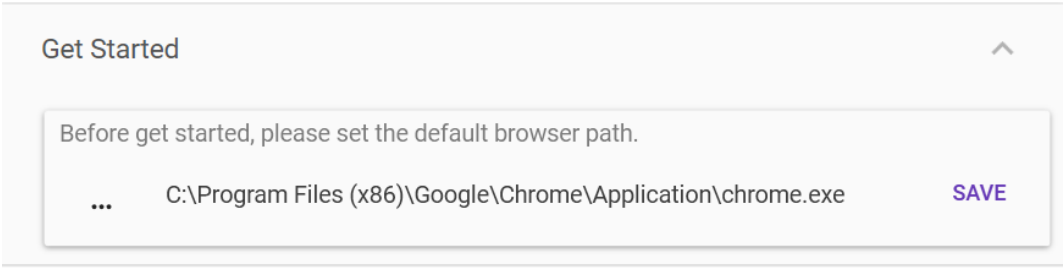
Figure 6 Screen Capture Tool

The Figure 6 is the main window of this tool, in the toolbar, there are key functions button:

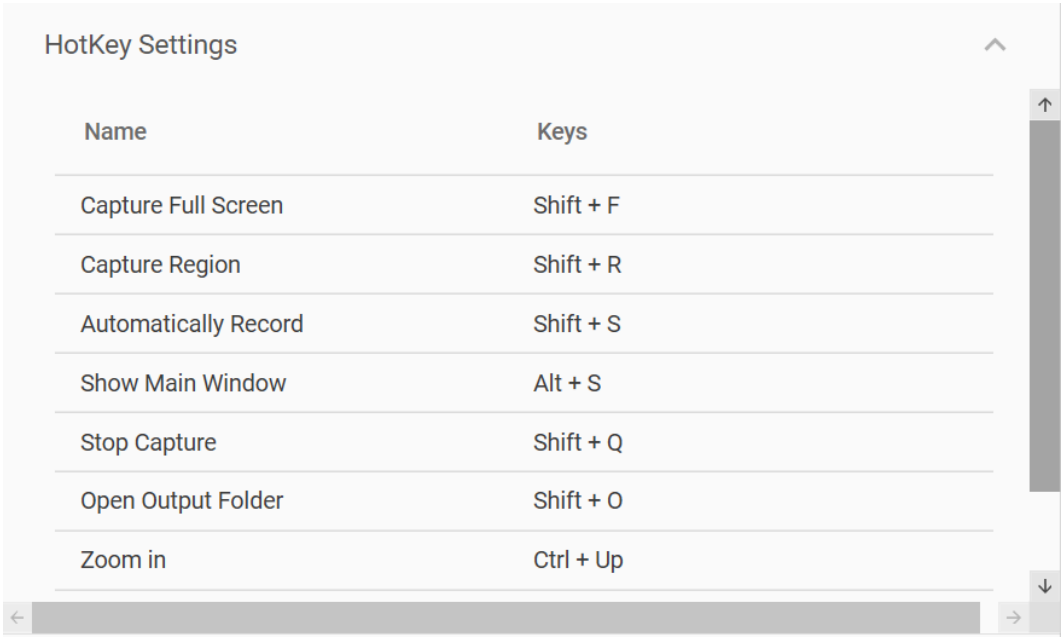
- Recording automatically;
- Stop;
- Screenshot Full Screen and Custom Region;
- Open and change output folder;
- Create Virtual Desktop.

Below the toolbar, we can easily find there are three expanders:

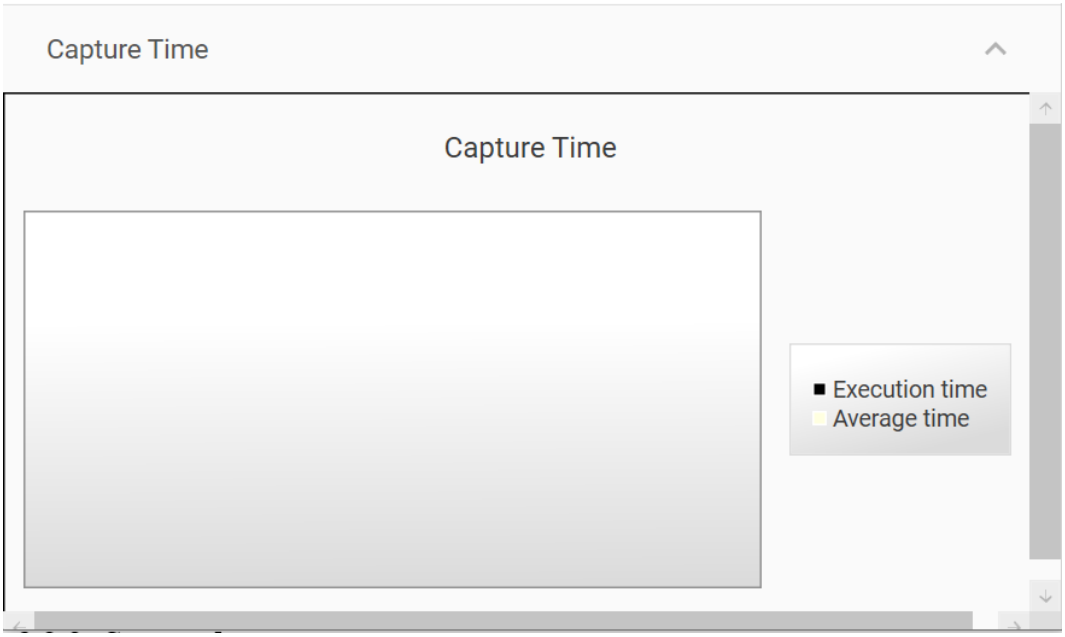
- Get Started, before we get started, we need to choose the Google Chrome path in your computer;



- Hot Keys Settings, there are some main shortcuts of the application;



- Capture time, after the capture we can find the result figure in this part.



3.2 Main Functions

3.2.1 Create Virtual Desktop

Windows Virtual Desktop is a desktop and app virtualization service that runs on the cloud, specifically on Microsoft Azure. It enables users to have access to a complete access to a complete modern desktop from any device, it can also offer a multi-user Windows 10 experience [5].

When users launch the application in the virtual desktop which can do the job in the new created desktop without influencing the actual desktop work.

3.2.2 Screenshot

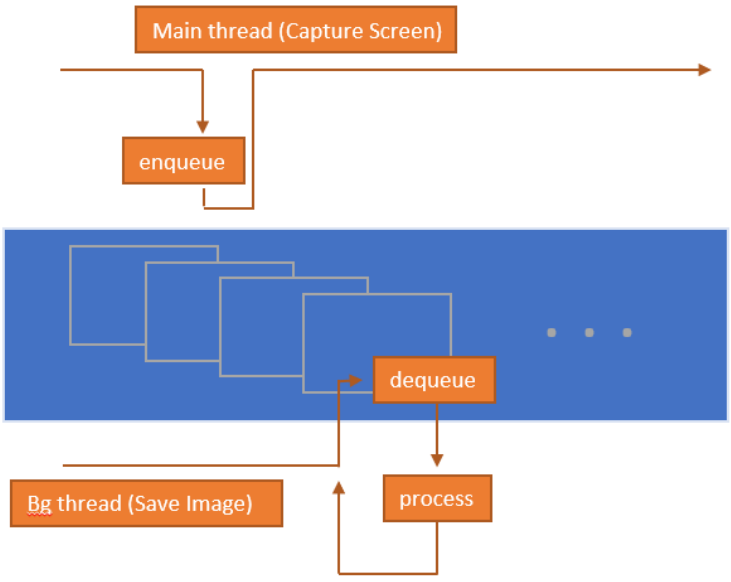
The key function in the application is Screenshot, the usage of system function calls can copy the desktop to achieve the screen capture function.

```
bitmap = new Bitmap(iw, ih, System.Drawing.Imaging.PixelFormat.Format32bppRgb);
graphics = Graphics.FromImage(bitmap);
graphics.CopyFromScreen(ix, iy, 0, 0, new System.Drawing.Size(iw, ih), CopyPixelOperation.SourceCopy);
graphics.Dispose();
```

There are two ways of capturing screen:

- Full Screen
- Custom Region

In order to improve the screen capture efficiency, I used a multi-threaded queue for image saving.



3.2.3 Global Hotkey Settings

The global hotkey settings are necessary because of the user of the application cannot focus on the main window all the time when the browser is opened. In this part, I also use the Windows API to set customize hotkeys.

```
//if succeed, return value != 0
//if failed, reutrn 0, using GetLastError to get error information
[DllImport("user32.dll", SetLastError = true)]
9 references
public static extern bool RegisterHotKey(
    IntPtr hWnd,                //handle of window
    int id,                     //hotkey id (unique)
    KeyModifiers fsModifiers,   //set key modifiers, Alt、Ctrl、Shift、Windows
    Keys vk                     //hotkey
    );

[DllImport("user32.dll", SetLastError = true)]
9 references
public static extern bool UnregisterHotKey(
    IntPtr hWnd,                //handle of window
    int id                      //the id of the hotkey needed unregiste
    );
```

3.2.4 Computer resolution Settings

It's not very easy to change the resolution of the video player, so this function computer resolution settings can use the keyboard *up* and *down* to change the resolution of the computer to achieve the changeable resolution. But it's not used in the application because of difficult adaptation.

```
[DllImport("user32.dll")]
1 reference
public static extern int EnumDisplaySettings(
    string deviceName,
    int modeNum,
    ref DEVMODE devMode
    );

[DllImport("user32.dll")]
2 references
public static extern int ChangeDisplaySettings(
    ref DEVMODE devMode,
    int flags
    );
```

3.2.5 Capture automatically

Based on the Screenshot function, how to capture the videos automatically is a difficulty but feasible. There is a solution to resolve this problem:

1. Create a test file of website list;
2. Read each website automatically and open in a new web page;
3. Fullscreen of the video player using keyboard and mouse click control;

4. Use Video Speed Controller to realize the video jump to shorten the time of recording;
5. Close the browser when all the websites are captured.

3.2.5.1 Keyboard and Mouse Click Control

Use Windows keyboard and mouse API to simulate the keyboard and mouse click so that the video player can be controlled automatically by the default settings of each video player.

```
[DllImport("user32.dll")]
1 reference
static extern void mouse_event(MouseEventFlag flags, int dx, int dy, uint data, UIntPtr extraInfo);
[DllImport("user32.dll")]
30 references
public static extern void keybd_event(byte bVk, byte bScan, int dwFlags, int dwExtraInfo);
```

3.2.5.2 Video Speed Controller – Google Chrome Extension

Video Speed Controller is a google chrome extension which can speed up, slow down, advance and rewind HTML5 audio/video with shortcuts.

It can optimize the video viewing by allowing user to make quick playback speed adjustments, as well as rewind the video to hear the last few second one more time. This extension allows user using keyboard:

- S - decrease playback speed.
- D - increase playback speed.
- R - reset playback speed.
- Z - rewind video by 10 seconds.
- X - advance video by 10 seconds.
- V - show/hide controller.

It's necessary to set the default advance time 120 seconds.

3.2.5.3 Generic Settings for each website

In the Table 5 and Table 6, we can clearly see the generic settings of all the websites will be used in the application.

- Duration: it's the video duration of each website;
- Advertisement: advertisement duration;
- Video quality: indicate if user can choose the video quality;

- Full screen control: for most of the video players, user can use the keyboard control to realize full screen mode except canal+.tv and France.tv.
- Record duration: the recording time of each website.

Table 5 Generic settings of tv channels

Website list	Player	Duration	Advertisement	Video quality
Arte : https:www.arte.tv/fr/	Player intégré au site (ArteVP Player)	> 40 mins	-	Yes
TF1, TMC, TFX, HD1 Série FIlms, LCI : https://www.tf1.fr/	Player intégré au site (Wat.tv)	> 40 mins	85s	No
Canal+(En claire), C8, Cstar : https://www.canalplus.com/	Dailymotion Player	> 40 mins	50s	Yes
France 2, France 3, France 4, France 5, France O, France Info : https://www.france.tv/	Player intégré au site	> 40 mins	70s	Yes
Gulli : https://www.gulli.fr/	Jw Player	10 - 15 mins	30s	No
LCP : http://www.lcp.fr/	Dailymotion Player	> 40 mins	-	Yes
M6, W9, 6ter : https://www.6play.fr/	Player intégré au site	> 40 mins	140s	No
CNews : https://www.cnews.fr/	Brightcove Player	20s – 2/3mins	20s	No
BFMTV : https:www.bfmtv.com/	OnePlayer	20s – 2/3mins	-	No
L'équipe : https://www.lequipe.fr/	Dailymotion Player	20s – 2/3mins	20s	Yes
NRJ12/Chérie25 : https://www.nrj-play.fr/	Jw Player	> 40 mins	100s	No
RMC Story : https://rmcstory.bfmtv.com/	Brightcove Player	> 40 mins	40s	No
RMCDécouverte : https://rmcdecouverte.bfmtv.com/	Brightcove Player	> 40 mins	70s	No

Table 6 Generic settings of tv channels

Website list	Player	Full Screen Control	Record Duration
Arte : https:www.arte.tv/fr/	Player intégré au site (ArteVP Player)	Mouse Click	5 mins
TF1, TMC, TFX, HD1 Série FIlms, LCI : https://www.tf1.fr/	Player intégré au site (Wat.tv)	Mouse Click	5 mins
Canal+(En claire), C8, Cstar : https://www.canalplus.com/	Dailymotion Player	F	5 mins
France 2, France 3, France 4, France 5, France O, France Info : https://www.france.tv/	Player intégré au site	F	5 mins
Gulli : https://www.gulli.fr/	Jw Player	Click + F	2 mins
LCP : http://www.lcp.fr/	Dailymotion Player	Click + F	5 mins
M6, W9, 6ter : https://www.6play.fr/	Player intégré au site	Click + F	5 mins
CNews : https://www.cnews.fr/	Brightcove Player	Click + F	First 30 s
BFMTV : https:www.bfmtv.com/	OnePlayer	Click + F	First 30 s
L'équipe : https://www.lequipe.fr/	Dailymotion Player	Click + F	First 30 s
NRJ12/Chérie25 : https://www.nrj-play.fr/	Jw Player	Click + F	5 mins
RMC Story : https://rmcstory.bfmtv.com/	Brightcove Player	Click + F	5 mins
RMCDécouverte : https://rmcdecouverte.bfmtv.com/	Brightcove Player	Click + F	5 mins

3.3 Result

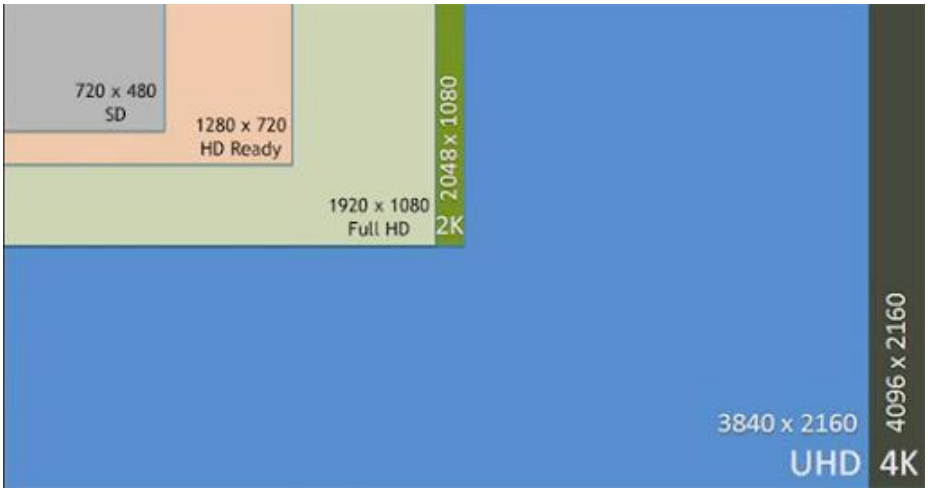
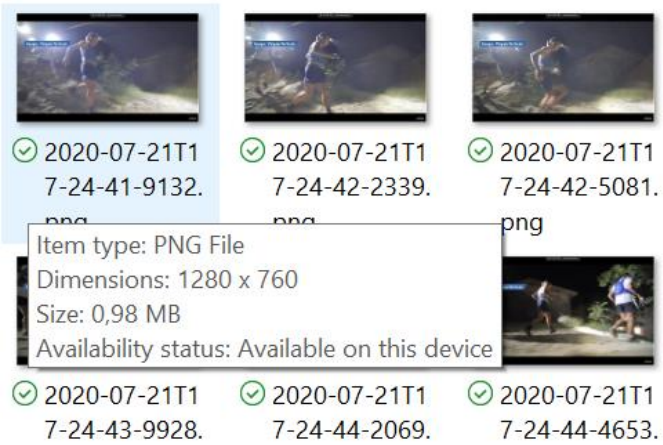


Figure 6 Image resolution

In my computer the default resolution is 2160*1440, Figure 6 shows the most commonly use image resolution and image files with timestamp, I choose HD Ready as the output image resolution.

```
Bitmap output = new Bitmap(_image, 1280, 760);
```



The Figure 7 shows a simple example of the output database.

```
13 references
public class Websites
{
    1 reference
    public static string france { get { return "france.tv"; } }
    1 reference
    public static string gulli { get { return "gulli.fr"; } }
    1 reference
    public static string lcp { get { return "lcp.fr"; } }
    1 reference
    public static string sixplay { get { return "6play.fr"; } }
    1 reference
    public static string cnews { get { return "cnews.fr"; } }
    1 reference
    public static string canalplus { get { return "canalplus.com"; } }
    1 reference
    public static string lequipe { get { return "lequipe.fr"; } }
    1 reference
    public static string nrjplay { get { return "nrj-play.fr"; } }
    3 references
    public static string bfmtv { get { return "bfmtv.com"; } }
    1 reference
    public static string arte { get { return "arte.tv"; } }
    1 reference
    public static string tf1 { get { return "tf1.tv"; } }
}
```

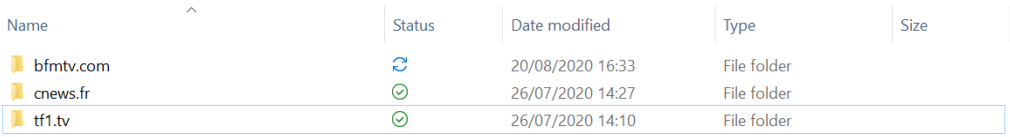
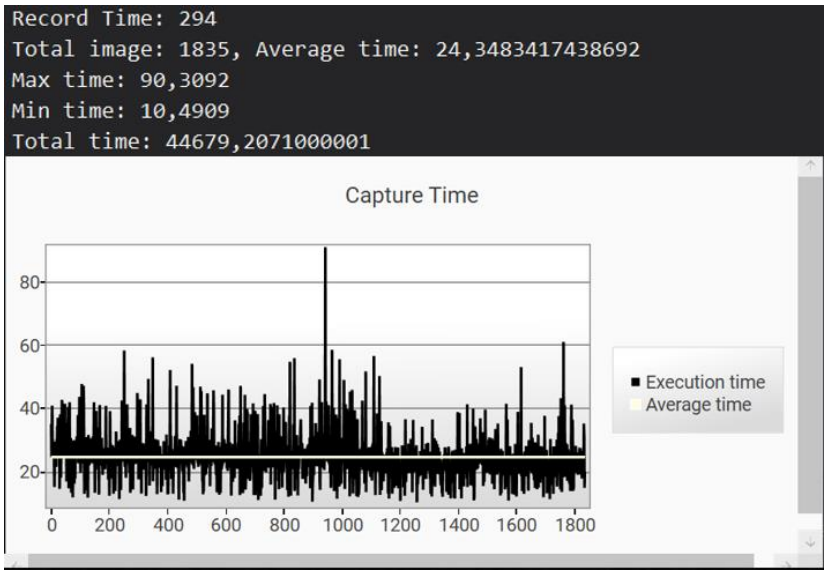


Figure 7 Output database

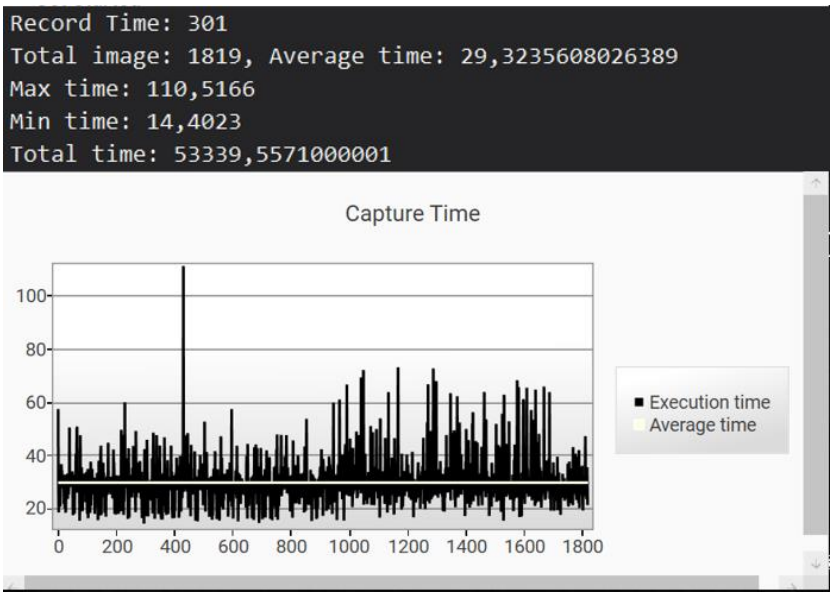
3.3.1 Test of the screenshot function

In this part I tested the screenshot function for three resolutions:

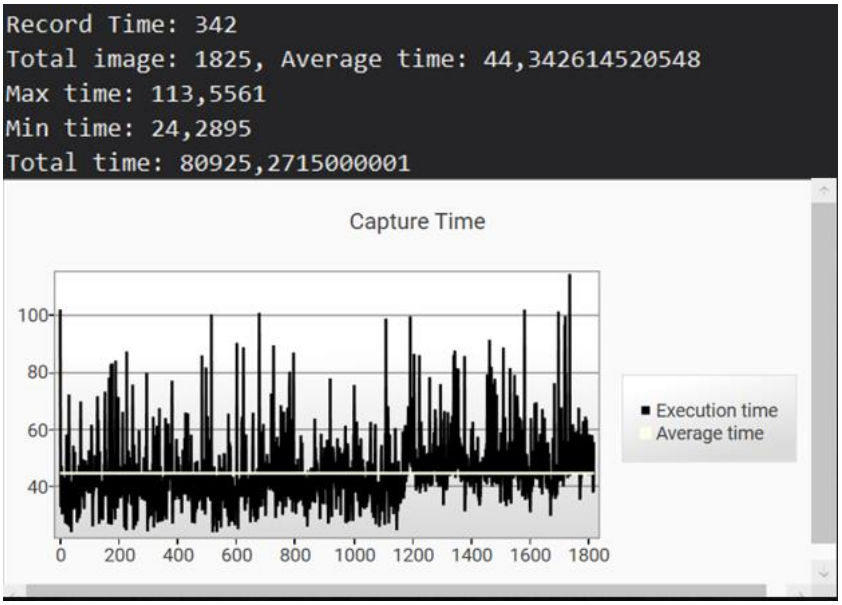
- 720*480



- 1280*720



- 1920*1280



3.3.2 Compare the parameters

After the test of the screenshot, it's easily got the average FPS (frame per second) of each image resolution in the table below.

Table 7 Result of Screenshot

Pixel	720*480	1280*720	1920*1080
Recording time/ms	294000	301000	342000
Total capture time/ms	44679,2071	53339,5571	80925,2715
Total images	1835	1819	1825
Average times/ms	24,3483	29,323	44,342
Maximum time/ms	90,3092	110,5166	113,5561
Minimum time/ms	10,4909	14,4023	24,2895
Average FPS	41,071	34,209	22,5519

4 Conclusion

After complete my internship in ToddTV, I have learned how to create an application using c# and WPF. Throughout my internship, I could understand more about the concept of capture software and how to program independently and prepare myself to become a responsible and innovative programmer in future. Along this quarantine period, I was learning how to work online and cooperate with colleagues. During my project, I cooperate with Mr. Mathieu to determine and find the solution to resolve the problems. Moreover, the project indirectly helps me to learn independently, discipline myself, be considerate, self-trust, take initiative and the ability to solve problems. Besides, my communication skills is strengthen as well when communicating with others and by preparing my regular presentation. During my internship, I have received helps and advice from my colleague when mistakes were made. However, those advices are useful guidance for me to change myself and avoid myself making the same mistakes again. Apart from that, I had also developed my programming skills through the program that I had done.

In the past 2 months, with the aid of the Visual Studio, I developed a capture screen application in order to capture online video automatically. From now, we can use it to capture most of the French tv channels online, but there are also some limits in this application:

- There is a website that we cannot capture because of the authority to the website;

TV channel List	Player
M6, W9, 6ter : https://www.6play.fr/	Player intégré au site

- The output resolution is set default;
- The video player position is not fixed, so there may be some errors when we launch the program in other computer in different resolution;
- The video player controller extension is necessary and should be configured before start capturing.

In sum, the activities that I had learned during the internship really are useful for me in future to work with foreign people and improve my personal skills of communication and work independently. Finally, I want to thanks Mr. Mathieu and Mr. Jordan to give me this opportunity to work with them, I was very happy to work in ToddTV with such inspiring environment.

5 References

[1] https://en.wikipedia.org/wiki/Streaming_media

[2] https://www.geeksforgeeks.org/html5-introduction/

[3] https://docs.microsoft.com/en-us/dotnet/desktop-wpf/fundamentals/xaml

[4] https://www.c-sharpcorner.com/UploadFile/nipuntomar/wpf-an-introduction-part-1/

[5] https://docs.microsoft.com/en-us/azure/virtual-desktop/overview

Smart screenshot capture of online videos for TV guides

Abstract

ToddTV is a startup company and provide the customized television service for users. In this project, the application has been developed by using Visual Studio WPF. It can be used to capture the specific French tv channels online through Google Chrome Browser, and the Video Player Controller extension is necessary for the usage of the application to advance the video so that we can shorten the time of capturing screen. The optimization of the screenshot is the key function of this program, I use the multithread queue to save the images which been captured by the main thread to optimize the FPS of the screenshot.

Keywords : WPF, Chrome, screenshot, multithread, queue

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