C# Based Media Center

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Abstract – **In this paper, we design and implement a novel all-in-one Media Center that can be directly connected to a high-definition television (HDTV). C# programming is used for developing modular structured media center for home entertainment. Therefore it is possible and easy to add new limitless number of modules and software components. The most importantly, user interface is designed by considering two important factors; simplicity and tidiness. Proposed media center provides opportunities to users to have an experience on listening to music/radio, watching TV, connecting to Internet, online Internet videos, editing videos, Internet connection to pharmacy on duty, checking weather conditions, song lyrics, CD/DVD burning, connecting to Wikipedia. All the modules and design steps are explained in details for user friendly cost effective all-in-one media center.**

I. INTRODUCTION

It would be difficult to argue that the invention of the television affected more people compared to any other innovation in the last century. Once the usage of the TV expanded and the word is spread, movies quickly followed. When going to the movies was the only alternative to see a recent movie, people figured out that if they could get those movies to show on their screens at home which led to the birth of home theater systems. And this initiative fact triggered different areas of home theater usage. People then demanded to play their favorite music, view the pictures they took and watch other visual content using their home theater system by simply hooking it up into their television sets. Then they determined that this activity can be expanded widely, after that devices called Home Theater Personal Computers (HTPC) drew the interests which are basically media center boxes but capable of doing everything that a personal computer is able to.

In this study, firstly, HTPC systems are explained. Then modular C# based Media Center is introduced as all-in-one media system. Finally, complete system architecture of media center is given and some differences between implemented media center and media centers that are available in the market are explained.

II. HISTORY OF MEDIA CENTERS

The birth of HTPC is related to several innovations in technology which started in early 1990's, including the shift from CRT monitor to high definition screens, speedy home computers, the development in digital media and the integration of the TV and personal computers. By the year 2000, consumers were focused on seeking the ways to improve the picture quality. Then the DVD became very popular. But since the use of stand alone DVD players only supported the obvious feature, this fact drove more usage to the personal computers as a DVD player and home media device.

The working principle of a DVD covers progressive scanning and it is used for storing film-based material into a DVD as certain formats [1]. P-scan is used for most CRT computer monitors, all LCD computer monitors, and most of the HDTV because the display ratios and pixel resolutions are progressive by default. Some of the televisions and most of the projectors have one or more progressive scan inputs. Before high definition displays became very common, some high end displays supported 480p. This allowed these displays to be used with a device which outputs p-scan like DVD players and most of the video game consoles.

In 2002, software developments started to get media and content presentation facilitated. Open source software called MythTV led the way and provided a solution using Linux environment [2, 4]. The concept was to integrate PC capabilities, program guides and digital video recording out of a TV broadcast. Then the XBMC came up as another open solution. The purpose was to use the Xbox game console as a HTPC. Then other versions also for Windows and Macintosh have been released under the names of Boxee and Plex. Some of the popular software packages contained Windows XP Media Center Edition which was bundled with Windows Operating System.

As satellite and digital broadcast happened to be standard, HTPC software became in need of receiver boxes, and these had membership costs. In 2009, hardware restrictions were taken away for cable CARD devices and this maintained the possibility of integration to the HTPC [3, 4].

A. Home Entertainment Systems

Graphic User Interface (GUI) and the interaction between user and home entertainment systems are two important factors for a home entertainment system. The interaction with home entertainment system is different from interacting with a typical desktop computer which the user is sitting at a desk with a computer monitor and using a keyboard and a mouse. It is expected that the control and the navigation on menus to be founded very easy to control by the user. The remote control also has to be easy to use and the elements have to be clear to be distinguished. It is assumed that the user's eyes when using a desktop computer are approximately 2 feet away from the screen. And the phrase "10 foot User Inter-

face" [5] is used to differentiate the interface style from desktop computers' and it is designed for display on large screen televisions in order the remote control interaction not to be different than using the TV. "10 foot" refers to the condition when the user is sitting 10 feet away from the large screen television so that the GUI elements such as texts, menus, buttons, and so on have to be large enough to easily be read from that distance. The Fig.1 is an example representation of the 10 foot experience.
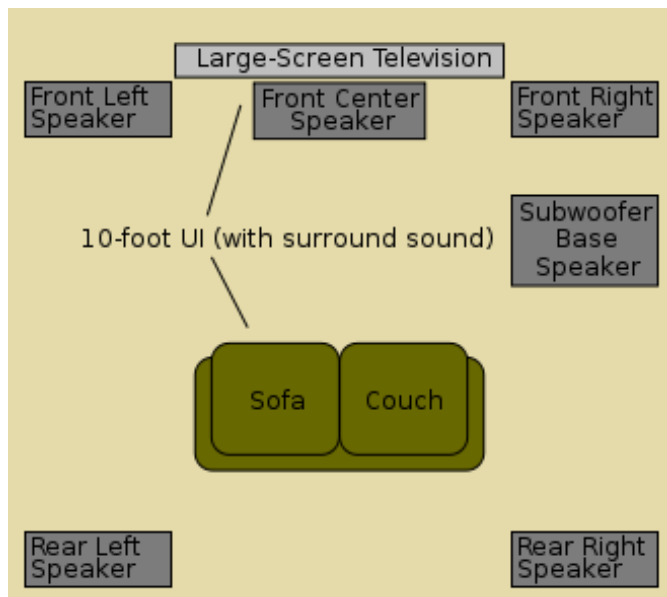

Fig.1. The most convenient setup for the 10-foot UI is a home theater or living room surround sound setup. The distance between viewer and TV may change, but is commonly 10 feet with a rather large screen TV display.

B. Home Theater Personal Computer Software

The most important point for a HTPC system is the selection of convenient software. We select Media Portal because it is flexible, open source and intended for developing in Microsoft .NET framework. Media Portal software is also suitable for future development and it gives us the possibility to customize the interface design according to the design guidelines of the 10 foot UI. Following items are a few design guidelines that we considered: *installation*, *user input* by means of Microsoft remote control (alternatively a game input device such as a joystick or a keyboard can be used, when the user wants to play games, *display*, and *size of user interface elements*.

III. GENERAL SPECIFICATIONS OF THE IMPLEMENTED MEDIA CENTER

Specifications of home entertainment system are the most important point for new design of such system. Implemented media center has Turkish language support. Unfortunately, almost none of media center that are available in the market does not have Turkish language support. This is one of the contributions for media center design. The other contributions are the ease of use design, skin design and plugin & extensions. The new media center contains HDTV support, picture viewer, weather forecast, web browser, traffic cameras, song lyrics, play/write CD/DVD, video player, on-line videos, games, emergency numbers, Wikipedia connection, video editor, music player, news feed, radio, pharmacies on duty, e-mail support and alarm clock. Implemented media center and its components are shown in Fig.2.
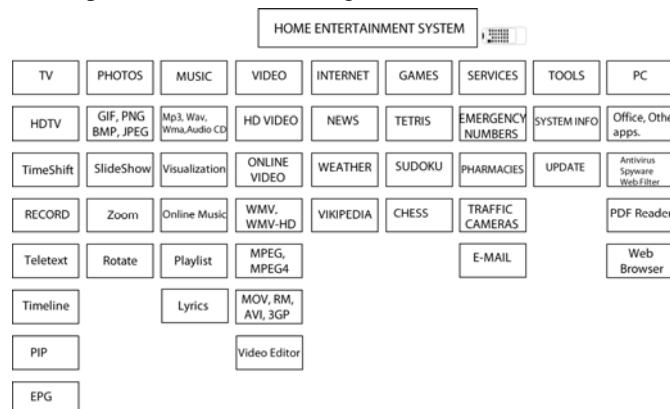

HOME ENTERTAINMENT SYSTEM								
TV	PHOTOS	MUSIC	VIDEO	INTERNET	GAMES	SERVICES	TOOLS	PC
HDTV	GIF, PNG BMP, JPEG	Mp3, Wav, Wma, Audio CD	HD VIDEO	NEWS	TETRIS	EMERGENCY NUMBERS	SYSTEM INFO	Office, Other apps.
TimeShift	SlideShow	Visualization	ONLINE VIDEO	WEATHER	SUDOKU	PHARMACIES	UPDATE	Antivirus Spyware Web Filter
RECORD	Zoom	Online Music	WMV, WMV-HD	VIKIPEDIA	CHESS	TRAFFIC CAMERAS		PDF Reader
Teletext	Rotate	Playlist	MPEG, MPEG4			E-MAIL		Web Browser
Timeline		Lyrics	MOV, RM, AVI, 3GP					
PIP			Video Editor					
EPG								

Fig.2. Home Entertainment System Components.

A. Hardware Specifications

In this study, lowest power consumption and the performance are two important criterias that we need for the 1080p formatted movie playback. Therefore, hardware components are searched by considering these criterias. Zotac ION seems to meet our requirements. It is a fully functioning Mini-ITX type motherboard which is suitable for the case we are planning to use. It is also capable of working with DirectX, OpenGL and CUDA features through its integrated graphics unit. It also contains the Intel Atom 330 processor with 1.6GHz clock rate. It is the best solution around with its low power consumption and excellent performance compared to the other dual core processors. Intel Atom 330 processor delivers enough of power for Internet based applications, e-mail, multimedia applications, office productivity, web browsing and many other applications. The NVIDIA ION graphic processor also supports up to 4GB RAM. The Mini PCI express slot, SATA/e SATA 3Gbs with RAID supports, onboard Geforce 9400M GPU and the 802.11/n Wi-Fi interface card are the other components also embedded to the system. Ports on the back contain D-Sub, DVI, HDMI and two S/PDIF outputs. Zotac ION motherboard is capable enough to play 1080p high definition videos and all of the other media formats. Since the main target of this study is to maintain the HD support at all times, this features comes handy. Also robust support for DirectX 10, OpenGL 2.1, NVIDIA CUDA and PhysX games and applications are other features that the device is capable of handling.

The integrated NVIDIA GeForce 9400M GPU series graphics card offers ultra-realistic effects and perfect functionality for all types of PC gaming and multimedia environment. These functionalities are possible with the advanced NVIDIA PureVideo HD technology.

The other hardware components of media center system are summarized below.

1) Satellite Receiver

SkyStar USB 2 external satellite receiver is mounted inside media center's case. Receiver contains DVB-S (digital video broadcasting, satellite) that is basically a modulation standard used in satellite systems. The compact box of the receiver which connects through a USB 2.0 interface supports the reception of unencrypted TV and radio satellite broadcasts such as TurkSat 42 degrees. The prerequisites we take into consideration for the receiver are as follows: At least 20 GB available memory for the DVR function, one available USB connection, 3D graphics card, sound card with a digital connection, DirectX 9.0 or higher.

2) Slim DVD Writer

Media center devices usually use mini-ITX cases with a maximum power output of 300 watts. Since the cases are designed to be as small as possible the room for the DVD drive is also limited. That is why just like on the laptops, the case we use has the slot for the slim type mini-dvd internal drive. We mounted Sony's optiarc AD 7580S model which weighs about 170 grams and 12.7 mm wide. It features high recording and reading speeds for fast and easy operations. Up to 8x recording speed for single-layer DVD-R media and up to 5x recording speed for DVD-RAM is supported.

B. Software Specifications

C# based Media Center is developed in modular manner and under a GNU public licensed MediaPortal media center software. It is possible to develop and implement limitless number of modules, but on the other hand, the user interface has to be simple and tidy. ding to the goal of the project. In this chapter, usage, implementation and features of the modules are going to be discussed.

1) Media Portal General Specifications and UI Architecture

The software MediaPortal only runs under Microsoft Windows operating systems unlike most of the other media center softwares. The software by default features a DirectX GUI, a video renderer to be used in mixing, a renderer for rendering the video content, advanced digital DVB support for DVBEPG and several integrated plugins, however it can be extended with extra plugins. It also has the internal support with custom keymapping that allows the user to map basically every key on a PC keyboard onto remote devices.

MediaPortal is developed in C# .NET framework, and it is possible to write a plugin with any .NET language using one of the following programming environments:
- Visual Studio 2008 (commercial)
- Visual C# 2005 Express Edition (free, closed source)
- SharpDevelop 2.1 (open source)

MediaPortal supports a few sorts of plugins. It is possible to use any of the following types to extend MediaPortal's ability in a different way. The plugin types can be sorted by:

1. Process plugins: They are plugins that has no UI, and just do its work in the background. Examples of process plugins: Caller id plugin, LCD/VFD plugin and plugins that run remote controls.

2. Tag Reader Plugins: They are utilized to receive media tags from media files, for example from MP3 and AVI files.

3. External Player Plugins: They are employed for playing media using 3rd party applications, for example WinAmp, Media Player Classic and iTunes.

4. GUI Plugins are the most attractive one. They have the UI components such as "Traffic Cams", "Farmacies on Duty" and "Web Browser" that allow the user to interact with them.

MediaPortal is designed to be modified and customized. The user can either choose one of the available community skins which are accessible through the website of the software or design and create his/her own skin. The user reaches the functionality surfaced from the application code through skins which are developed using XML. The application will load the appropriate XML skin file upon initialization. For instance, when the software starts off, the initial skin to usually be loaded will be the Home.xml or myHome.xml depending on which setting the user has configured. The utilization of XML basically provides a more precise way to let MediaPortal know the page layout, fonts, positioning of each item on screen such as color of text, graphics transparency etc. By changing the XML file within a skin the entire look and feel can be modified. Although the details are very different, the idea is the same as making a webpage however XML files have a distinct structure and they are case sensitive. The XML files are located in the skins folder under the main MediaPortal application folder.

There are also folders under the relevant skin folder for fonts, media and sounds. The most commonly used "media" folder has all the visuals that the skin file uses (normally in PNG format for best quality and transparency support for better appearance). Software Architecture of the system is shown in Fig.3.

2) XML File Aspects

Inside the skin directory, there are two special XML files. One is fonts.xml, the other is references.xml.

The fonts provided to the relevant skin are defined in the fonts.xml file. The actual fonts are stored in the font's sub-folder. Each font element defines:
- The name that the font will be referenced as in the skin files
- The filename of the actual font file
- The height of the font which can be bold or italic
- The numeric start character (default 0)
- The numeric end character (default 255)

The references.xml file contains information about the skin version and resolution at minimum. It may also contain other values for any of the controls that exist in the skin so for example, the sizes of buttons do not have to be defined every time you use it in other skin files. It can also define styles that can be applied to any control.

3) Application of Media Center Plugins

This section contains the principal features and brief explanation of the plugins that the software runs. These are mostly GUI plugins that allow users to interact directly which are also possible to adjust via the configuration.exe according to the needs. Every installed plugin adds an entry into the plugin configuration section and they can be customized instantly. Installing plugins is a fairly easy operation. Only process that should be done is that after compiling the prepared C# project, Microsoft's implementation of shared library concept called the DLL files and the XML files are both sent under Media Center's skin and plugin directories with the relevant images and visuals. This operation enables the configuration.exe to view such plugin. The following are the plugins that Media Center contains.

a) Television

The following is the features listed that are supported by Media Center's integrated TV-Engine. There are two different TV engines; the built-in engine which gets installed with Media Center automatically and the new stand-alone TV Server, which can be used to replace the built-in engine. Analog TV support is also available (both with software and hardware), DVB-C (cable), DVB-T (antenna), DVB-S (satellite). Other supported plugins are:
• HDTV and AC3 audio codec support.
• Support for several tuners.
• Instant or scheduled recording, watching, and time shifting possibility of the live TV.
• Advanced scheduler to record: Record now, once, daily, weekly, on weekdays, every time a program shows up on the certain TV channel, or every time a program appears on any TV channel.
• Advanced recording features: Handles file name conflicts, and sets recording priorities. Converts recordings to any desired file format such as wmv, xvid, or mpeg. Disk Management can be set to automatically remove old recordings. TV supports over 10,000 channels and teletext, automatic channel tuning. Standby control that puts the Media Center to sleep. It awakes when there is a scheduled recording. Comskip feature skips commercials in recordings.

b) Movies and DVD Plugins

There are two separate plugins for video files and DVD playback. The DVD plugin instantly detects the DVD media inside the DVD drive and displays the root menu. More features are as follows:
• Any movie format can be played. Every possible codec that video and audio files need in order to play, is installed in the system. .mkv, .avi, .mp4 etc. are example file extensions that the system has no problem playing.
• All the movies are stored in Media Center's video database.
• View and sort your movies by title, actors, genre, release year, rating. The relevant information is retrieved such as pictures, actors and so on from database.
• Stacking/unstacking is possible if the movie consists of multiple files.
• On Screen Display (OSD) for pause, rewind, fast forward, stop, mute, bookmarks, switching audio streams and subtitle languages.
• It asks the user if to resume from previously stopped playback or not on next play.

c) Radio

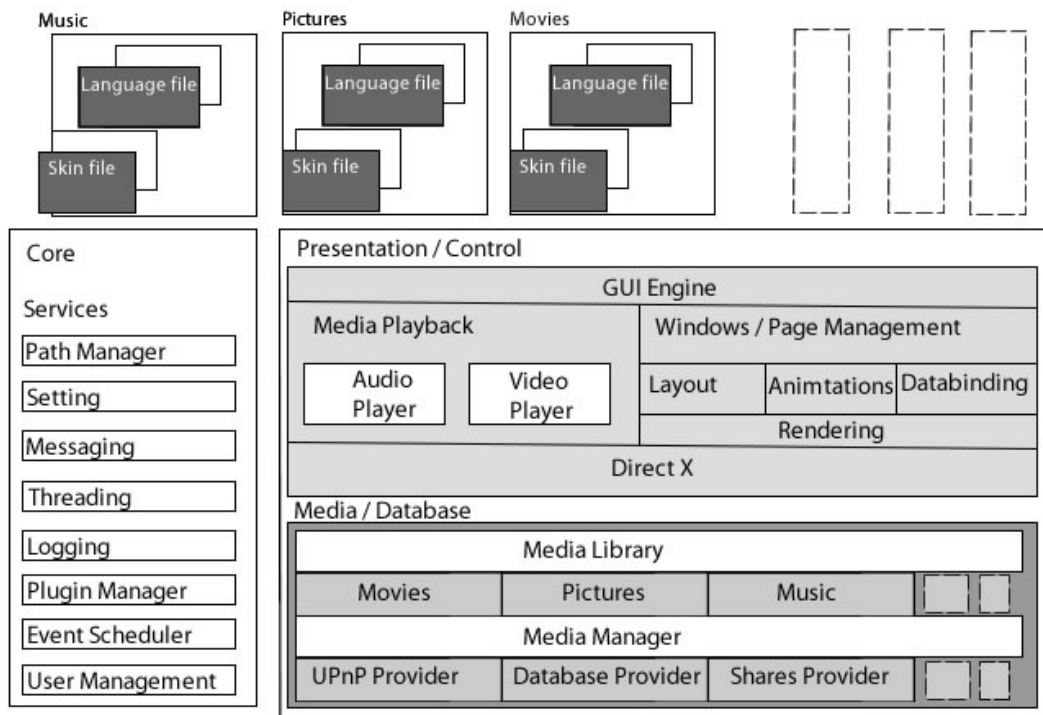Via radio plugin, FM, DVB and also Internet streams and

Fig.3. Software Architecture of Media Center System.

shoutcasts may be listened. FM radio tunes automatically. The logos can be displayed for each radio station and a nickname for each radio station can be supplied however it is a manual process. It is possible to start listening to the selected radio station on startup automatically.

d) Music

Plugin features are as follows:
• Viewing the music by artist, album, genre, rating or browse the music files and sorting the music in many ways like track, genre, filesize, artist, album.
• Visualizations from Windows Media Player 10 and higher.
• Load, create & save playlists (.m3u, .pls, .b4u). And Alarm clock plugin is integrated with the playlists we create. The Alarm tone can be set to a playlist.
• Automatically gets pictures such as album cover and info for all of the artists and albums in the directory. And they can be viewed as list, icons or big icons.
• Shuffle, party shuffle mode, repeat, fast-forward, rewind, pause functions.
• Music ratings and favorites can be marked by the user. And all of the favorite songs can be displayed in one screen.
• Winamp, or iTunes plugins for music playback can be utilized.

e) Photos

Pictures and photos can be displayed optionally with a slideshow that enables nice transitions and pause previous/next picture skip options. While viewing them, zoom in/out and rotate function is available. The rotation can be remembered next time when the file is viewed. Also the thumbnail is automatically generated for each folder. Pictures are stored in a chosen directory like to the movies but it can be accessed and deleted from the UI whenever needed. While slideshow is working a background music can be picked either from the songs from the music plugin or out of the radio.

f) Weather Forecast and News

The weather forecast plugin shows the latest weather information for previously selected cities from the configuration file. The data is retrieved via the Weather Channel so almost every city in the world is supported. 5-day forecast with the current temperature is displayed in either °C or °F with the visuals. Also the values such as UV index, humidity (%) and wind-speed can also be viewed and live satellite images from the Internet are supported.

The plugin "News" is capable of viewing asked RSS news feeds from a desired source. Periodically followed TV channels and newspapers can be added to the shortcut list and opened whenever needed.

g) Online Videos and Movie Editor

The plugin "Online videos" has a database of the websites that periodically posts videos to the Internet. And the content continuously changes and certain statistics about the viewed videos are recorded under particular titles. Online videos plugin goes through the selected source sticking to a regular expression pattern and parses the contents as thumbnails under certain titles. And desired video can instantly be viewed no matter if the content is HD or not. It is actually very functional since the contents are constantly refreshed and kept recent.

The plugin "Video Editor" enables the user to pick a mpeg video and optionally an audio file. After choosing the files it is possible to crop the video into pieces and put music onto the finished product. The operation is simple but functional since it only takes couple of minutes to roughly make customized video files.

h) Web Browser

The main goal of the Media Center is to restrict the user in a certain way when user feels relax. Designing a browser into our media center is one of the fun facts that give the user more freedom.

The plugin runs the Mozilla Firefox in full screen mode. And rest of the operation is exactly the same with using the Firefox Browser. Whenever the ESC button is pressed, the application quits and turns back to the root menu of the media center. Even though the browser have limitless abilities it is not very common to attach it into a media center system and it can lead to a trouble if it is used very often since all of the visited website content is stored under temporary files. We found a solution to this by deleting the content which is visited, after turning the browser off. So that way we will not worry about that. And other problem was coming from the memory utilization. If the browser worked in the background that means it would use the memory that is reserved for the media center. And that would lead the media center to operate not fast enough to play HD content. Our solution to such problem happened to be just turning off the browser whenever the plugin is turned off by pressing the ESC button.

i) CD/DVD Writer

The plugin "CD/DVD Burner" enables to burn data, audio or video into a CD or a DVD. The plugin makes the operation easier and faster.

j) Alarm Clock

It is possible to set every setting of the alarm clock such as weekday settings, media center wake up if put on sleep. And the music playlists that we create from the music plugin can be defined as the alarm tone and it will play respectively.

k) E-mail

From the configuration.exe incoming mail options can be set and the received mails may be selected, viewed and deleted via the plugin. If the content of the e-mail is too long to fit to the screen, it scrolls down automatically and enables the viewer to read the whole thing without touching a button.

l) Games

An entertainment box could not be without games inside. Media center comes up with the three most popular games; sudoku, tetris and chess. They let users to play just with the remote control.

m)   Pharmacies

Pharmacies that are working nightshift are viewable through the plugin. The istanbulsaglik.gov.tr website publishes the relevant pharmacies every day. So the main idea is to catch the sources sorted by city, parse them and publish it onto the plugin by using a regular expression that we have written considering the links used to navigate inside the website.

n)   Emergency

It is always good to know what number to call when something extraordinary happens. So this plugin just sorts the essential numbers in order and shows to the viewer.

o)   Traffic

Traffic cameras that are positioned in several locations are accessible through a web service inside tkm.ibb.gov.tr website. So the plugin "traffic cameras" just connects to the traffic cameras' server and grabs the live broadcast in order to publish on the plugin. Users may navigate through the cameras and select the ones they want to view in fullscreen.

p)   Lyrics

The plugin "MyLyrics" enables the user to view the playing song's lyrics instantly. From configuration.exe lyrics of every song inside music folder that the music plugin is looking for can be searched inside a lyrics database. As soon as it is found, while playing music out of the music plugin, myLyrics plugin may be run and lyrics may be followed instantly on the screen in the style of a karaoke

q)   Software Support

For a proper and smooth operation the Media Center software needs to be setup on top of a certain hardware and software.

(1)   Supported OS

• Windows XP 32bit Edition with at least service pack 3
• Windows Media Center Edition 2005 with service pack 3
• Windows Vista 32 and 64bit with at least service pack 1
• Windows 7 32-64bit - which is built under media center.

(2)   File System

Depending on the bit rate of the transmission recordings TV can take up lots of hard disk space. By recording for one hour you get a file size peaking from around 4GB for SDTV to about 8GB for HDTV (See Table.1.).

Table.1. Recording Time depending on File System.

File System	HDTV	SDTV
FAT16	15 min.	30 min.
FAT32	30 min.	60 min.
NTFS (Recommended)	2.000 min.	4.000 min.

(3)   Drivers and Codecs

The most recent drivers for the video and audio card should be used. The open source MPV and MPA codecs are bundled with Media Center for mpeg2 allowing you to watch movies and TV out of the box. If user wants to watch HD content, then user needs to install a 3rd party h.264 codec. Popular codecs are from Cyberlink's Power DVD, Core AVC or ffdshow which are available for free. But we just go ahead and install one of the codec packs that contain popular codecs which are freely available around the Internet.

IV. CONCLUSIONS

In this paper, we developed and implemented a media center by using C# and an HTPC. The hardware is designed by considering the power consumption, noise factor and it is designed to be as practical as possible in a home theater environment. The software on top is a freely available and modifiable media center called Media Portal. The .NET platform also enabled us to develop several plugins.

Ease of use is another important factor in this study. Since the system is designed for a living room environment, complexity is the only thing that we should be avoided. We made it to work like any other plug and play device without any extra configuration. Also the user interface is kept straightforward and simple in both design wise and also application wise. The Media Center skin is designed by considering the 10-foot experience guidelines.

The possibility to upgrade the hardware components is also another quality factor that we wanted to maintain which may come handy when there are new standards in the media technology. Since the aspect of connectivity is concerned with the upgradeability, a modern media center should offer this feature for the user to upgrade his/her device with other components.

One other important factor with the media center is to support for different media formats and standards. We take compatible with various technologies into consideration. One of the main goals of the product is to give the ability to the device in order to present every high definition video format available without any trouble.

We believe that Media Center is a complete convergence device that is ready to be enjoyed with lots of technological features that respects to the developing technology in its field.

V. CONCLUSIONS

In this paper, Modular software architecture for Flight License Exam (FLEX) is proposed, developed, implemented and presented in detail as a total solution. We believe to have successfully applied the current object-oriented software engineering principles, techniques and methodology to implement a ***flight license exam software architecture***.

LAMP architecture and Content Management System is used for implementation and application development.

User account types, user account privileges, and management modules are designed in modular and flexible manner. A novel system architecture is developed, implemented and discussed.

A new, maybe the first time, functionally content rich

complete software architecture model of flight license examination is developed, implemented and presented. This modular model is implemented by LAMP and CMS model. This level of design and implementation detail does not commonly appear in the literature especially in examination software. We believe this is a significant contribution and the strength of our implementation.

Our implementation is in modular structure. So, it is easy to add new modules and software components and also it is easy to adapt FLEX as a part of information management system software of a company. Future works will be developing drag and drop type question management modules, and developing tutorials and online courses. Finally, tailor made design will provide reports in detail.

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