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U14 – A1 Computer Games Technologies

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Introduction

I this article I will be evaluating the impact that current and emerging technologies have, and are likely to have, on the design and development of computer games. I will be explaining the current social and technological trends in computer gaming. I will be comparing the current and emerging technologies and the requirements of game players and the game industry to the past and where gaming has come from. I will be looking into multiple factors and how they've changed over time due to the advancements in technology. These factors are:

- Popular Genres
- Types of Players
- Types of Game Production
- Multiplayer
- AI
- Emerging Technologies
- The Security of integrated services and multiplayer environments

I will also be analysing and discussing the technologies used in computer gaming as the current technologies are continually evolving and changing. It is vital for developers and creators to remain up to date and to make use of what is currently available. I will be looking into 4 factors which are:

- Benefits and limitations of different platform options for the development of computer games
- Hardware options and their effect on the development of computer games
- Software options and their effect on the development of computer games
- Uses of game engines, their capabilities and how they aid computer game developers

I will be constantly comparing how technology and game development has changed from around the 1970's to now and how these changes have aided computer game development.

Social Trends in Computing

Popular Genres

In the world of gaming, the leap from the 1950s to present is huge. The technology, the broad selection of genres, the community and the way players can immerse themselves in the video game worlds, for example virtual reality, augmented reality or just simply by chatting on servers. The industry began with simplistic ideas for their consumers to enjoy, such as Atari Pong which was created in 1975 or Tetris in 1984, which is a truly iconic game and somehow manages to still be relevant today after over 30 years of being in the video game industry. The Tetris franchise is now worth over $5 Billion Dollars, which is a true testament to just how creative and impressive this game truly is. Tetris is also a game which enabled the gaming community to grow a lot larger as it attracted all kinds of ages, genders and types of players. As the gaming community grew larger and technology got slightly more advanced, more games became available to the general market. Super Mario Bros was the very beginning of all platformer games in which Mario made his first appearance in 1985 on console, which then spiralled into many more remakes and editions. From the early 90s to present, gaming changed forever. More genres of video games, like FPS's, MMO's, RPG's more advanced consoles such as the Xbox and PlayStation became available, and the ways that players can play their favourite video games. Doom was the first of many FPS's which was introduced in 1993. MMO's such as RuneScape in 2001 or World of Warcraft in 2004 were popularized. Nowadays, Battle Royale's are an immense social trend. Social Media such as Twitch, Twitter, YouTube and other platforms have made this possible. Streamers such as Ninja, Myth, Nick Eh etc. have popularized Fortnite as they have hit millions of views on their streams and clips and it has become an addiction for many young and old gamers. In the world of gaming this is one of the biggest hits since Minecraft which was released in early 2009. Genres can also be broken down into subgenres. These subgenres make it so even people who are only interested in one genre have more to delve in to. For example, GTA 5 has Racing, Action and RPG elements which broadens its audience it can appeal to. The jump from a few simple platforming genres to now over 50+ new videogame genres is massive and can be associated to the advancements in technology.

Players

The types of players are an important factor that has changed over the years due to the change in technology and pop culture. Back when games were a lot more simplistic, mostly around 1975, there were not as many types of players. Most people played games casually either going to an arcade or rarely owning a console/machine of their own. There was not as much diversity between the types of players. Today there are multiple different types of players who enjoy their favourite games in their own ways. Examples such as:

Casuals – Usually play games for fun and when they have time. They don't really get involved in any of the pro scene or any of the competitive modes that are available. They also often don't care about their own skill and are only playing to have a good time.

Hardcore – Dedicates a lot of their time to improving themselves at their chosen game and spends time playing more competitive, ranked modes. They usually are also more involved in watching and catching up with the pro scene (if there is one for their game) such as League of Legends which includes a ranked system and a massive pro scene.

Pros – Pros are like Hardcore players, in which they put in a lot of time improving themselves, but they are playing at a professional level either for a team or at tournaments around the world. Pros usually use social media platforms, such as twitch a game streaming service, to increase their following. Pros usually aim their career around gaming or a specific game they play. A good example of a pro would be Rekkles who plays League of Legends professionally for a team called Fnatic.

(Jacob, 2018)

The types of players also differ because of new restrictions and laws on certain video games. The PEGI rating indicates what games are meant for certain age groups. These rating are based on multiple factors that the game shows. The different ratings are:

3 – Where the game is considered suitable for all ages with comical violence.

7 – May contain some frightening scenes. Violence is unrealistic and directed towards fantasy characters.

12 – Slightly more realistic violence. Mild language used by characters. Sexual posturing and innuendo feature.

16 – Violence towards human characters, including death. Sexual activity within game, but no visible nudity. Use of alcohol, drugs and tobacco by characters.

18 – Adult classification. Violence, death and destruction within game. Characters may glamorise drugs, alcohol and crime and use expletives throughout.

(Ask About Games, 2018)

Players can also be split by their loyalty to a certain platform. This was obsolete in the 1970s as most people would go to an arcade instead, but now in the modern day, people own smaller entertainment devices that can run their games at home. The main split is between PC gamers, PlayStation gamers and Xbox gamers. Each have benefits and drawbacks. A good example would be exclusive titles. Some games that are developed are only targeted at a specific platform that other platforms won't be able to play unless they own the other. For example, Uncharted (which is meant to be one of the best 3rd person RPG's) is only exclusively available on PlayStations platform. This can increase sales for Sony which benefits them, but the developer can also lose out on potential customers who would want to play the game on their own platform. This also fuels the debate more on which console is better as each side has amazing exclusives like Microsoft's HALO franchise. There has been steps to try and bridge this gap though. This can be seen by 2018's Fortnite and how they used cross play so that people playing on PlayStation can play with people on Xbox. The split between platforms shows that with the technological advancements in gaming, the player base has also split even more via the use of independent companies with their exclusive platforms.

Game Production

Game production has also changed dramatically over the years mostly due to the advancements in technology that the game development studios have available and what technology the consumer has available. Game production in the 1970's was different to how it is now. This is mostly due to consoles becoming more optimised and having better technology such as faster processors, better memory or even dedicated graphics. The first-generation consoles between around 1968 and 1977, which included the Magnavox Odyssey, Telstar, Home Pong and Colour TV-Game had simple characteristics. These typical characteristics found in each console was:

- Discrete transistor-based digital game logic.
- Games were native components of consoles rather than based on external or removable media.
- Entire game playfield occupies only one screen.
- Players and objects consist of very basic lines, dots or blocks.
- Colour graphics are basic (mostly black and white or other dichromatic combination; later games may display three or more colours).
- Either single-channel or no audio.
- Lacked features of second-generation consoles, such as microprocessor logic, ROM cartridges, flip-screen playfields, sprite-based graphics, and multi-colour graphics.

The Second generation of consoles gave developers more freedom and assets to work with. This was between 1976 and 1983. The second-generation consoles also had similar, typical characteristics. These characteristics were:

- Microprocessor-based game logic.
- AI simulation of computer-based opponents, allowing for single-player gaming.
- ROM cartridges for storing games, allowing any number of different games to be played on one console.
- Game playfields able to span multiple flip-screen areas.
- Blocky and simplistic-looking sprites, with a screen resolution of around 160 × 192 pixels.
- Basic colour graphics, generally between 2-color (1-bit) and 16-color (4-bit).
- Up to three channel audios.
- Lacked features of third-generation consoles, such as scrolling tile-based playfields.

(Wikipedia, 2018)

As you can see there are many improvements processor wise and gameplay wise. The AI simulation created more options for developers to work with when creating a game as they can have the opponents interact with the player in more ways such as being more unpredictable. The use of audio now made games more immersive as players could physically hear the action which before was not the norm.

Nowadays, the consoles used are almost over 10x faster and more efficient in every way. This can be due to their faster hardware which can allow the developers to do a lot more than what they used to be able to do back in the 1970s/80s.

Because of this availability of technology which is also available to the public, anyone can create a game. This has created many different game production genres. Mainstream publishers such as Nintendo or

Microsoft have a lot more money and resources and can afford to make larger games with more detail and support. These are also called triple A games. These usually retail for a standard price at around £50. These mainstream games cost this much as they must cover the cost for a larger development team, advertising etc. An example of a triple A game would be Call of Duty developed by Activision and Treyarch.

Indie games developers are smaller studios that fund themselves and try to be more innovative to sell their product. Because of the smaller size of the studio, the game is usually a lot smaller with less elements or a shorter story or objective. With this, there is also a smaller price tag as the indie game studio doesn't have to pay for as much and keeps their price low to compete with the bigger mainstream producers. Because Indie games also usually don't cost as much to produce, sometimes they are distributed free. A good example of an Indie Game would be Minecraft which is now owned by Microsoft.

Very small developers who may have a good idea for a game may make use of crowd-funding. Crowd-funded games are like indie games where there are not many people working on the game but don't have the funding to create the game. Website like Kickstarter and Indiegogo allow creators to post concepts and ideas and then the community can donate to support them. Usually, there are tiers of donation amounts were the donator can get rewards for donating over a threshold. For example, if you donated over £50, they may promise the donator a copy of the game when it releases. Crowd-funded games are usually developed independently and then are sold on larger platform such as Steam. A good example of a highly successful Crowd-developed game is Undertale.

Free to play games are again like indie games but are also produced by big mainstream companies. The main troupe to these games is that they can be downloaded and then played straight away. The way they make money from the game is usually by in game boosts, credits or cosmetic items. Because of this some free to play games can be seen to be "pay to win" meaning that, yes you can get through the game paying nothing, but people that do pay will have an extreme advantage. This has caused multiple problems in the gaming community especially with the use of loot boxes which has had a lot of attention as it promotes gambling as people want to spend a lot of money to have the chance to get a rare item. Countries like China and Singapore have already banned the use of loot boxes in games. Not all F2P games are like this though. Games like League of Legends have the perfect balance between paid items and staying free as the cosmetics such as skins, which change the look of your character in game, are paid but can also be earned by playing the game normally.

As you can see, most of these game design genres are only available because of the advancements in technology. This is mostly seen at F2P games as their games can be downloaded online and there's no extra cost in packaging the game and then selling it. Without faster internet speeds or larger storage devices this would not be possible. Also, without higher performing graphics cards or graphic production software, there would not be the same Triple A games that we see today. You can also see this in the Crowd Funded games. Without the internet being faster and vaster, there would be no such thing as Kickstarter or Indiegogo meaning that independent game designers would not be able to make their ideas become reality's. Technological advancements again have shown to have had a huge impact on Game Production.

Artificial Intelligence (AI)

AI has changed massively over the years due to technology. During the 1970s/1980s where arcade games were extremely popular, AI enemies in games had just started to become popularized. The arcade game Space Invaders tried to challenge the player by having the difficulty increase over the levels, distinct differing movement patterns, and in-game special events such as boss battles to try and challenge the player which inspired many other games to try to do the same. Galaxian later then tried to have a complex and different take on the players opponents' movements. This included fast manoeuvres by enemies who would break out of their formation and try catch the player by surprise. Pac-Man introduced enemy AI to maze games, with the feature of different styles for each of the 4 ghost enemies. Now, with the advancement of AI, we now have more complex and life like NPC's. Game AI now uses algorithms in a wide variety of quite different ways inside a game. The simplest is how NPCs are controlled in the game, although "scripting" (decision tree) is currently the most common means of control. These written decision trees usually result in "artificial stupidity" such as repetitive behaviour or being blind to things that are obvious. An example would be an AI walking past a dead body in the game and not questioning it at all.

Pathfinding can be seen in RTS' (Real Time Strategy) games. Pathfinding determines how to get an NPC from one area of a map, to another, making sure that there isn't any obstacles and terrain in the way. Mainstream, Triple A titles mostly use simple grid-based pathfinding, where the terrain is mapped onto a grid and then a pathfinding algorithm is applied to the grid to create the illusion the AI knows where it's going and aware of what's around it. Instead of just a normal, basic grid, some games use polygons to create a type of mesh out of the areas and locations on the map that NPCs can move to. This can be seen in games such as Halo Wars. Beyond pathfinding, navigation is an area of Game AI aimed on giving NPC's the ability to navigate in a changing environment, finding a way to the target designated while also trying to avoid any collisions with other entities such as buildings other NPCs or even the player or collaborating with them. For example, games such as Age of Empires or Civ V which have large numbers of units at once, often performs badly. Units sometimes get in the way of each other which can sometimes look sporadic and unnatural.

Games nowadays such as Call of Duty or Halo are now a lot more articulate with how the enemy and friendly AI works. There are a lot more variables that need to be taken into consideration such as where the player is in relation to the AI, where they will aim so their bullets will land or where they should take cover. The AI needs to work well to keep the game interesting for the player without it being too difficult or too easy. There can still be problems with the AI, especially exploits that can make the game a lot easier and give the player "shortcuts". For example, in the game Aliens: Colonial Marines the player could just run straight through the whole level and none of the enemies would even try to attack the player. This made the game a flop as players did not find it fun as the AI was too stupid and ruined the games immersion. (Lambie, 2018)

Emerging Technologies

Although it is good to look back and see all the changes in technology from the 70's, 80's and 90's compared to now, its also good to look forward to the new technologies being developed by companies such as Microsoft, Oculus and HTC.

 VR is quickly becoming one of the most popular emerging technologies available now. There was an attempt at VR back in 1995 which was Nintendo's Virtual Boy which flopped as it was way out of its time. The virtual boy only showed the colours red and black and wasn't that immersive. It still sold 770,000 units which was pretty good, but because of the bad feedback, the Virtual Boy was discontinued March 2nd, 1996. (Wikipedia, 2018)

The next step into Virtual reality was seen with the XBOX Kinect which released in November 10, 2010. The Kinect used a 640x480 pixel, 30hz RGB camera and a 640x480 pixel, 30hz IR camera to track the players movements. This wasn't exactly virtual reality but the ability for the player to use their body as a controller replicated the feel of immersion and created the basis of what virtual reality was soon to become.

Nowadays, VR is very popular and better made and optimised being able to bring the player into a virtual world so real they feel like they are there. The Oculus Rift was one of the first mainstream, popular VR headset sold in 2014. It started as a Kickstarter project that raised 2.5 million dollars and then later bought by Facebook for 2 billion dollars. The Oculus Rift uses a head mounted display at 2160 x 1200 resolution making the quality of games very high increasing the immersion. Techopedia explains that "The Oculus Rift is designed to give a feeling of presence and provide a lifelike experience with its specialized design and software. It is customizable and adaptable to various uses. One common application is to enhance the gaming experience. The Oculus Rift comprises an integrated audio VR, thus providing a 3-D audio effect. It also includes rotational and positional tracking accomplished with the help of infrared sensors. Therefore, it can be used while users are sitting, standing or walking around the room." (Techopedia, 2018)

Other companies such as HTC and PlayStation now have developed their own virtual reality consoles/headsets. HTC with their VIVE and PlayStation with their PSVR. They all mostly work similarly being able to play similar titles but there are also some exclusives on different devices which split them apart.

Augmented Reality is also another emerging technology that got a lot of publicity back in July 6, 2016 which was when Pokémon Go came out on mobile devices. This was a big deal as it became one of the most popular and downloaded games on the Appstore with 650 million downloads. It used the players location service on their mobile device and back facing camera to allow the user to have to locate and catch the Pokémon. This game was able to do things that no other game was able to do. One mainly being getting people outside and exercising. The game made it so different areas had different Pokémon, so people would have to walk far to have chance at catching the rarer Pokémon. It also had a lot of problems technically and socially. It would consume the user's battery life as it was extremely unoptimized and the game would crash frequently because of bad net code and servers. The social problems were people getting injured staring at their phone when walking about or even road accidents where drivers have been using their phone while driving.

Streaming has become a massive platform for gaming entertainment online. With new video capture hardware and software, normal people can stream what they are playing online and then some people are able to get a massive following. For example, Ninja, who is a Fortnite streamer, blew up at the release of Fortnite as he was one of the best players on Twitch.tv. It is speculated that he earns about 500k dollars a month playing this game and gaining around 20,000 followers a day on twitch.tv. (Kim, 2018) (Social Blade, 2018)

Twitch.tv and YouTube also are used as a great way to advertise companies' new games. Famous channels can get paid to play games which can make people who watch that channel also want to play the same game. Again, using Fornite as an example, without big streamers playing Fortnite it would not be as big as it is today as it got exposure from the people broadcasting. Since a lot of people saw these famous streamers play Fortnite, they also wanted to get involved.

Overall, technology has changes drastically and is still developing further now from the Virtual Boy to now the HTC VIVE.

Security of integrated services and multiplayer environments

Digital distribution platforms such as Steam and U-Play take great care of securing the users accounts and keeping their personal information such as location and payment information safe. With the advancements in technology, security has improved a lot, with precautions like Steams authenticator or Origins 2-step authentication. Steam wasn't as secure as it used to be, this was mostly due to its trading where players could buy and sell skins or items in games like a gaming stock market. In 2016, Valve decided to add the steam authenticator and other security procedures such as a 15-day trade stall to try and combat scamming and general account safety. Before this, people were able to trade their items they earnt in game for other items or to sell for money without having to have a secure account. This created the possibility for people to make multiple fake accounts with the intention to get people valuable items or skins by phishing or other ways such as the "middle man scam". The steam authenticator works by having the user must download an app on their phone and then link their account to it. They are then prompted to give their mobile phone number and they will receive a text with a code. Once they input this code into the authenticator, the account and authenticator are then linked and when the user then wants to sell their items or skins, they will have to input a random code generated for their specific account into steam. This keeps the steam community and market safe as there are only legit owned accounts on steam. This works the same way on other platforms that also use the authentication programs.

There has also been a lot of problems with the security of other platforms. One specifically being Sony when multiple people where victim to cyber-attacks on PlayStation and Xbox in 2014 December. A group called Lizard Squad did a DDOS attack on both platforms overloading their systems preventing people from playing the games even if they owned a physical copy. This is bad as both platforms have a huge number of users who must access the online features to play their games. More than "110 million people

use the PlayStation Network (PSN) and at least 46 million use Xbox Live, both of which connect players to other gamers and services through the internet." (Kiss, 2018)

Following this, Sony added more important security measures for PSN account so if there is another attack no one's account information can be accessed. Sony has also started using 2 step-authentication if there is a log in fail to the account. (Young, 2018)

Technologies used in Computer Gaming

Benefits and limitations of different platform options for the development of computer games

Personal Computers

A gaming PC has many benefits and limitations in its use for the development and playing of computer games. Developers have a lot more freedom posting their games on PC instead of on console. It is a lot easier to distribute independent games on PC as they have more options to where they post their game. They would be able to post their game on forums or on their own dedicated website that people can download and play, or they can use bigger platforms such as Steam to sell their games on. This is the reason you see a lot of more indie games on PC as there is more options for developers to sell and advertise their game. Playing on a PC is very popular as there is more customisability within the game. Players can select their own specific graphical setting and frames based on what hardware their PC has. Because of this, games on PC usually run and look a lot better than on console but can be costlier if they would want to do this. There are also more problems that can go wrong as a PC gamer than on console. Users that don't know what they are doing may download games online that could have malicious content hidden such as virus' and malware.

PC – PROS: Better graphics and performance, easy to upgrade and wide range of upgradability, wider selection of games, use several monitors. CONS: Expensive to purchase and maintain, regular cleaning.

Overall, a PC is very good place for independent developers to post their games as its easier and for players to access these games. The only drawback is the price of the things you need, as you also need a keyboard and mouse, and a dedicated monitor.

Consoles

A gaming console like the PS4 or Xbox One also has many benefits and limitations for the development and playing of computer games. A drawback straight away for the development on this platform is that most independent developers will not get their game on the PS or Xbox store. The Xbox 360 used to have an Indie game page where these games could be posted by the independent developers, but this was removed on the Xbox one. This means that there is a low chance an Independent developer will get their game on console unless it does well on another platform. A benefit of playing on a console though is that the cost is a lot lower and there are less accessories that you need to own to start using the console. The console usually has everything the user needs to get started.

Consoles – PROS: stable fps, easy access for younger players, cheap and affordable, split screen gameplay, long lifetime. CONS: Replace/Upgrade with difficulty or expensive. Limited performance and graphics.

Overall, a console is a very good system for people who are starting out in gaming as it is not as complicated or costly as a PC.

Mobile Devices

A Mobile Device is a very popular platform for games to be created for and played on. This is mostly due to most people owning a smartphone. Mobile devices have multiple benefits, one being that it is very easy for independent game developers to create and post their game on app stores. They are also very easy to access by the user and to download with no problems. The drawback though is that large games can be developed for Mobile as smart phones don't have the hardware needed to run certain games. The hardware needed would be a lot more space on the phone and sometimes dedicated graphics as the small processor won't be able to run anything that is too demanding. For players, the mobile platform is perfect. It is simple to download the game and play with the touchscreen.

Hardware options and their effect on the development of computer games

Hardware is very important to consider when developing a game. With advancements with GPU's CPU's and storage, developers must keep up to date when developing their games. For example, the newly released RTX cards by NVIDIA add a new graphical element called "ray tracing" which game developers can now take advantage of. The RTX cards are also 5x as fast as the GTX cards which came before it. (Judd, 2018) With these new GPU's that are being released, developers are now can make their game more graphically intensive by better ani-aliasing or just higher and more detailed renders. With better CPU's Developers can now have more happening in their game as better CPU's can run more tasks and do more graphical calculations. This can be seen in the new Ryzen Series from AMD. Ryzen CPUs use the zen architecture which is almost 5 times as efficient and fast as their FX series which came before. Larger storage devices also help with the development of computer games as the developer's game can be a lot bigger meaning that there can be larger worlds or more detailed gameplay mechanics. This can be seen in Rockstar's GTA 5 which has the biggest game world out of all the GTA games but is also around 80 GB in size which most hard drives can handle now but back in 2005 when GTA San Andreas was released, it was only 1.5 GB but had a lot less detail and a smaller game world. The internet has also hugely affected the development of computer games as most games now make use of online modes such as GTA or Call of Duty. Even single player games may use online features to compare users high scores or stats on a leader board.

CPU AND GPU:

The chain is only as strong as its weakest link – All the components in a PC must work together. For example, if you have a I5-6200U (CPU) which runs at 2.6gHz and a Nvidia 940 (GPU), certain games the graphics will load but the world won't load fast enough because of the CPU. As soon as the CPU has fetched the graphics, they will have then rendered very quickly to a high standard. The issue is the CPU can't fetch world data fast enough to send to the GPU to render.

Both the CPU and GPU are important for a better gaming experience. Any quad-core CPU with 8GB of system RAM should do the trick. CPU is what sends draw-calls, calculates A.I., and shows any text. But it's the GPU that shows all the graphics. CPU and GPU are both as equally important.

INPUT and OUTPUT:

Done through BIOS (Basic input/output system) AV, VGA, HDMI and DP are all types of outputs. Monitor, Speakers. Anything that receives data from a computer is an output. Anything that sends data through the computer is an input. Devices like, Keyboard and Mouse, Microphone, Webcam etc are input devices.

Overall the advancement in hardware options has changed the way developers have to create their game. There is a lot more to consider and decide on.

Software options and their effect on the development of computer games

There are many different software options to consider when developing a game. Operating Systems is a main thing to consider when developing a game as the games developed will have to be optimised differently to run on different operating systems. Most games are usually only optimised to run on Windows because of Direct X being used. Direct X was only supported on windows and not Mac or Linux. Direct X also only being on windows also makes it, so developers will want to make their game on windows, so they can make use of the graphical engine.

Game Engines

A game engine is used to build and create video games. They provide the developer with different features. These can be animation to artificial intelligence. Game engines are mainly responsible for rendering graphics, collision detection, memory management etc. A game engine contains multiple components. Example of these are

1. The main game program which contains the game logic
2. A rendering engine which can be used to generate 3D animated graphics
3. An audio engine which consists of algorithms which are related to sounds
4. A physics engine to implement 'physical' laws within the system
5. Artificial intelligence, a module designed to be used by software engineers with a specialist designation.

Conclusion

To conclude, technological advancements in the multiple areas have impacted and affected game development. The multiple genres that are now available are all due to new technology to make genres like MMO's available. These new genres then create new types of players as there are different games available which offer different ways for people to play like ranked modes. Multiplayer has changed from 2 to 4 people on a split screen to online and being able to communicate over the internet while they play. AI has changed to be more difficult and more precise almost replicating how a person would move their character and interact. Security has also had to change over the years as more personal information is stored on accounts and online. The technologies used in game development has also changed and become a lot more advanced. This is because of many factors including new hardware such as GPU's and CPU's and new game engines for people to use to create better, higher quality games.

Overall The technological advancements over the years have changed how games are distributed, developed and played.

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