eRemote: A Remote File Downloader for Low-Speed Network

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Abstract: Downloading is generally copy data from one computer to another computer over the internet. A download manager is a software or hardware tool that is used to manage downloading files on computer devices from the internet. When it comes to downloading large-sized files, many mechanisms have been invented so far to accomplish the downloading task. A hardware-level device equipped with Raspberry Pi zero module, that can be remotely controlled through an android mobile application capable of downloading large scale files to local storage from any network at any time frame. Thus, a remote file download manager named eRemote has been developed to download files as an offline downloader. This device has been tested in a different network including wired and wireless networks, has shown efficacious results. This paper presents the design and implementation details of the remote downloader and offers a comparative study on existing downloaders.

Keywords: Remote, Downloading, File downloader, Remote file downloader

Introduction:

Nowadays people always do their work with laptops, smartphones, or various electronic devices. In this digital age where information is shared between communities and countries in a matter of seconds, downloading of information has become a normal part of people's lives. People tend to download various kinds of information to their devices to complete day-to-day tasks. It may be downloading an official document from the company or simply downloading and watching a funny video sent on WhatsApp by your friend. Hence, downloading information has become the main channel of sharing information between people.

According to statistics, most people download more than one file per day (Mushroor et al., 2019) including software, audio, video etc. But when it comes to downloading large files such as games, software, archives, etc., it takes a considerable amount of time as well as a huge data/network usage. When downloading large-sized files, it is required to keep the devices active throughout the process or else the process will be paused or stopped. Also, a common side effect of downloading files include draining the device's their battery life during the process and hence require keeping the device plugged in during file downloading procedure. To address these problems, a system could be introduced where the downloading process takes place in a different device and the device that is in use will not be affected.

The traditional way of downloading files causes extreme consumption of resources such as time, data usage and device battery. Hence, it is difficult to download large files and to keep using the device at the same time. Also, no mechanism has been introduced to allow users to download files using a remote or separate network connection.

As a solution to the above-defined problem, a remote file download device can be built using raspberry pi that could be controlled using an android application through firebase. This system will be able to take the load off the electronic device that is in use by

the user, saving time and device resources. Also, this system could be used in separate networks.

The main aim of the system is to provide a mechanism or method for users to download files over a network they are not physically present at. Hence, allowing the user to remotely control the download and save resources of the device that is being in-use by the user.

The main objectives that are expected of the system are mentioned below.

1.Downloading files.

2.Providing download links through a mobile application

3.Providing real-time status of files that are being downloaded

4.Ability to perform basic control functionalities through the mobile application

The system will function when in a separate network as well in low traffic networks and can be accessible at any time.

Technologies that are currently in-use for downloading, sharing files and remotely accessing, which will be further discussed, include torrent downloading, internet download manager, AnyDesk and TeamViewer. Each of these concepts has unique characteristics which aid in downloading, sharing files or remotely accessing a device to share and download files. But an issue seen through all these systems is that they have no mechanism to use a remote network to download files while physically existing in a different place.

The rest of the paper is organized as follows; through the section 2 of the paper, and insight will be provided about existing technologies related to downloading, sharing files, as well as existing technologies and software that allow remote accessing devices. Further section 3 of the paper will elaborate a solution system that will overcome the defined problem. Section 4 elaborates on how the proposed system works along with user response to the proposed system. Finally, section 5 concludes the paper with a note on further improvements.

Related Works

The download means accessing data and copying them to your device from a remote device over a computer network, usually servers such as web servers, FTP (File Transfer Protocol) server, email server, or some other related system. It compares with the upload, where data is sent to a remote server. A copy is a file which has been downloaded and it is also a method of downloading such a file. When it comes to downloading files and remotely controlling devices, some many mechanisms and applications have been invented so far to accomplish this task. Such as Torrent downloading, Internet download manager, AnyDesk and TeamViewer. Each of these systems will be reviewed to understand their unique functionalities and differences.

A. Torrent Downloading

A normal download is generally a direct download where downloading files is done via the browser or a download client. The concept of torrent downloading is a similar process to normal download, but the file is downloaded via a torrent client. In the tech world, when you hear the word "torrenting" it typically refers to a file downloading concept that uses a peer-to-peer protocol named BitTorrent to download files in a distributed manner. BitTorrent protocol joins the device as a part of the swarm(Han et al., 2010) (a group of devices uploading and downloading the same torrent simultaneously) and when a user needs to download a file via torrent, the user is first required to download the torrent file of the respective file that is needed to be

downloaded. Usually, a torrent file comes with the .torrent extension and it does not contain the actual material to be distributed. The .torrent file is a database file that contains metadata and list of network locations of trackers("How Does BitTorrent Work?," n.d.) which will be used to join a swarm of that specific torrent file through a BitTorrent client such as uTorrent, BitTorrent. Once the torrent file is entered into the BitTorrent client, the client contacts the list of trackers stored in the .torrent file. The tracker shares the IP address of the device with the rest of the swarm allowing them to connect. Once connected, the download of the actual file begins. The required file is extracted from the Seeders that are connected to the swarm, which makes this a useful concept in keeping the load off the central server ("How Does BitTorrent Work?" n.d.).

Torrent downloading is advantageous as a large group of devices can download the same file without putting too much load on the central server. Hence, less time consuming as it avoids traffic to access and download files from the central server (February 5 and Reply, 2016).

Torrent downloading has few drawbacks being a distributed download system. Since tracker shares the user IP address to all devices in the swarm, all peers will be able to see your IP address, hence, exposes the device to many risks. Lots of production and record companies are recruiting people to go in and track all of these IP addresses hence, discover uploading torrents so they can be passed on to ISPs("Torrent : Disadvantages and Controversies - DotNet Guide," n.d.). However, connecting to a virtual private network (VPN) will allow to change the device IP address when downloading torrents and keep the device anonymous. This is a vital resource to use when downloading torrents to keep your ISP from understanding what is being done.

B. Internet Download Manager

Internet Download Manager (IDM) is a tool for download management and scheduling("Internet Download Manager Features: reliability, high speed, and 24h support," n.d.). The main advantage of this application is that the maximum bandwidth of the network can be utilized using this application. Basic features include, recovery and restart capability due to dropped link, network problems, and power outages to restore the disrupted downloads (Soffar, 2016a).

Internet Download Manager uses simple Graphical User Interface (GUI) such that it is simple and easy to use. Also, the application uses concepts such as smart download logic accelerator that features smart dynamic file segmentation and secure multipart download technology to speed up the download of files ("10+ Ways to Get the Best from Internet Download Manager," 2015). Internet download manager facilitates the collection of proxy servers, FTP and HTTP (Hypertext Transfer Protocol) protocols, firewalls, redirects, cookies, permissions, audio and video content. Other features of the application include multilingual support, zip preview, download categories, sounds on different events, HTTPS support, HTML aid and tutorial, enhanced download virus security, progressive download with quotas (This feature is useful for connections that use some kind of equal access policy or FAP such as Direct PC or Direcway etc.), accelerator built-in etc.

IDM is mostly known for effortlessly integrating with Microsoft internet explorer, Netscape, MSN Explorer, Opera, Mozilla, Mozilla Firefox, Avant browser and any other common browsers to manage your downloads automatically. Usage of this application is simple as dragging and dropping files or using the command-line Internet Download Manager. As IDM allows scheduling downloads, users can dial the

modem at the specified time, download the files that are required, stop or shut down your computer when it is completed ("How Internet Download Manager (IDM) works? Interesting facts you may not know about best download manager - Cyber Programmers - Learn Programming," n.d.). When downloading a file, IDM divides the files into pieces and transfers them to the device/computer simultaneously. The downloaded pieces are temporarily stored in file format on the hard disk, then merged to carry back the original file that was downloaded.

As its extensive features, IDM has its share of drawbacks such as integration failures between browsers, lack of support and a chunky interface ("Will Internet Download Manager Work For You?" 2016). Malware programmers or cybercriminals exploit the IDM program files to trick users into downloading malware into their devices. IDMan.exe is usually the operation file of IDM that is being corrupted such that when called, it may destroy the software and hardware of the computer ("How to Remove the IDMan.exe Virus? | IDMan.exe Malware," n.d.).

C. AnyDesk

AnyDesk is an independent software platform that allows remote access, file transfer and VPN functionality to devices running the host application("AnyDesk | Your Remote Desktop Application for Windows 10," n.d.). This software operates on multiple platforms such as Windows, Linux, MacOS, iOS, Android, etc. Although this application works on a variety of platforms, an independent version of the software needs to be installed on the devices that the files are being transferred or shared to.

The user is required to provide the relevant username and password of that specific device to access the remote device. After accessing the remote device, the user can operate the remote device without being physically present near that device. However, AnyDesk application cannot be considered as a secure platform as any user However, AnyDesk application cannot be considered as a secure platform as any user can install the application to a certain device and remotely access the data and information stored in that device without authorized permission. Also, AnyDesk application allows administrative authorities of the remote device and many incidents had been reported due to the misuse of this feature including mobile access frauds("RBI AnyDesk Warning: Fraudsters can use this app to steal money from your bank account, stay safe | Zee Business," n.d.), bundling ransomware("Legitimate Application AnyDesk Bundled with New Ransomware Variant - TrendLabs Security Intelligence Blog," n.d.), technical support scams("As social engineering activities increase buyer beware of tech support scams | Verizon Insights Lab," n.d.), etc.

D. TeamViewer

TeamViewer is a proprietary software application that supports remote device control, desktop sharing, web conferencing and file sharing between computers ("TeamViewer – The Remote Connectivity Software," n.d.). This application also supports a wide range of platforms such as Windows ("TeamViewer V4 desktop collaboration app now Mac-compatible | Macworld," n.d.), Linux. ChromeOS, iOS, Android, etc.

TeamViewer remote control set-up ("How to Use TeamViewer," n.d.) this independent software operates based on temporary passwords. And to establish a connection between the two devices, a different user should authenticate the access request of the remote device. If the connection request is not accepted, the device cannot be accessed remotely. Main uses of this application include connecting multiple workstations

together which are not physically placed at the same location and file transferring between connected parties (Soffar, 2016b). However, though it is powerful software, the data usage for connecting devices together is high. The remote device will require as much data as the accessing device. Also, a user is needed to accept the connection request at the remote device if not, the device cannot be controlled or accessed remotely.

A survey was conducted to acquire information about the current download systems that are being commonly used. 11 users were selected at random, who download various types of files over the internet daily.

The users were initially asked about their experience on existing download methods they commonly use.

When asked about the most used platform to download files, it was identified that torrent downloading is the most commonly used method of downloading (36.4%). An equal amount of people out of 11 uses Internet download manager and direct website downloads (27.3%) to accomplish their day-to-day tasks. It was also discovered that 4 out of 11 users agree that the current methodology of downloading which is being used satisfied their requirements (Ref. Table 1).

54.5% of users (6 out of 11) (Ref. Table 1) agree when downloading large files, commonly used downloading applications acquire a long time to complete the download. This proves that the existing file downloading mechanisms consume time.

Thus, according to the survey, it was concluded through these technologies exist and aids file-sharing or downloading, people are quite not satisfied with its functionality. Also, it was evident through research and survey that downloading large files through these platforms consumes a lot of time.

Table 1 - Questionnaire results

Question	Agree	Neutral	Disagree
Satisfied with available file downloading platforms?	36.4%	36.4%	27.3%
A lot of time spent on downloading large files through those platforms?	54.5%	45.5%	0%

A common feature seen through all these applications and mechanisms is that they do not allow file download through a separate network. Files could be shared among the remote device or the device in-use could download the file using those applications. Applications such as TeamViewer and AnyDesk (as mentioned above) requires a different user to be present, operating the remote device and should accept the connection request to access the device. Even if the access was granted, sharing the file with the remote device would require both data usage and resource usage of both the devices connected. Applications such as torrent downloading, and internet download manager directly use resources of the device that is in use and cannot remotely download using a different network than what the device in-use is connected to. Hence, after reviewing existing technologies related to file downloading, the proposed system was designed and developed.

Design & Implementation

Addressing the main problem, which is the inability to download files without physically being present; and reviewing the current technologies, the proposed solution is a remote file download system (eRemote). Figure 1 depicts the basic process of the eRemote File Downloading System.
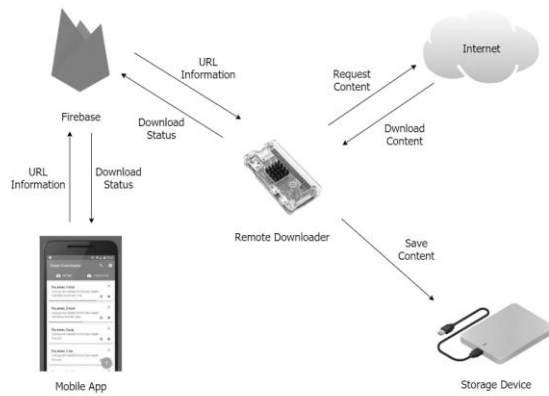
Figure 1 – System Architecture

Main components used in the construction of this system are the Raspberry Pi module as the main device and Firebase as the database connector between the Android application and the device. A mobile application is built using Android Studio as a base platform to operate the system. This mobile application can be considered as the "user-interface" (Ref. figure 2) of the system and hence used to interact with the system. To capture changes in the device and to keep the device synchronized with the mobile application, Firebase platform is used.
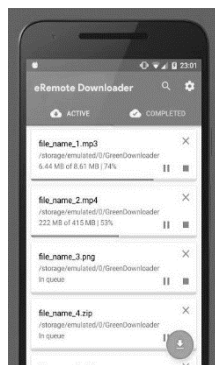

Figure 2 – The user interface of the system

The user interface of the system (Ref. figure 2) is designed in a straightforward and user-friendly manner. Using this, the user can manage the device. User can add download URL, resume, pause, stop, restart, or delete a download using the application.

To understand the system purpose in-depth, the main functionalities of the system are listed below.

A. Process of Downloading files

The URL link provided by the user is forwarded to the device through a Firebase platform. The device that is placed in a remote location to the user, will access this URL and identify the file that is to be downloaded through the URL link. Since the device is connected to a network, it will begin downloading the file and storing the file in an external storage device that is connected to the system.

B. URL managing module

The user is required to provide a URL link to the mobile application to download a specific file. The interface of the mobile application will allow the user to paste a URL link. Once the user enters the URL link to the system, the request will be forwarded to the Firebase database system. This device can be used to download documents, media file, archived files, etc.

C. Real-time status Module

Firebase database system captures real-time changes that occur in applications, hence when a specific file is being downloaded from the device, the real-time status of the download can be viewed in the mobile application through Firebase. The user will have the ability to view the downloading status of the file from a remote location via the mobile application.

D. Main Control Module

The user will be given privileges to remotely control the device and the files that are being downloaded. The user can resume, pause, stop, restart, or delete a file that is being downloaded through the device. User can also schedule downloads and download files at a predefined time through the mobile application.

The device can be placed in a different location connected to a network and be accessed through a mobile application remotely. The system can connect to the

network via Wi-Fi or Ethernet cable (using ethernet adapter). This can be considered as a major advantage as the user is not required to be present at the location and connected to the specific network to download the file. Hence, the user's in-use device resources will not be drained. This system is ideally useful in a scenario where downloading a company-related file on off-peak hours to preserve peak time internet resources of the company. Hence, due to downloading files during off-peak hours ensures low network traffic, the speed of the download will be increased, and files would not be corrupted after completing the download process.

Raspberry Pi module is considered as the downloading device of the system. The module chosen for this set-up is Raspberry Pi Zero W module. This module consists of a both wired (using ethernet hat) and wireless network connectivity. User can connect to either according to preference. It also consists of a micro USB port to which the storage device will be connected("Buy a Raspberry Pi Zero W – Raspberry Pi," n.d.).

Threading is used such that the user will be able to download multiple files simultaneously. Raspberry Pi module is coded using the python language and Python-Firebase library is used access Firebase from raspberry pi. Python function will be called when the user enters a new URL is added to the mobile application. After the device obtains the URL link from Firebase, it will start downloading the requested file using HTTP, HTTPS and FTP (File Transfer Protocol) protocols

Firebase can be considered as mobile and web development platform that comprises with tools and mechanisms to analyse, authorize, file storage, push message, etc. data("What is Firebase?" n.d.). The role of Firebase in the system is it acts as the central database between the Raspberry Pi module and the mobile application. Firebase will be responsible for passing the URL links entered through the mobile application to the Raspberry Pi module. It is also responsible for updating the mobile application, providing real-time download status of the file.

The user is required to enter the URL information of the file that is to be downloaded to the Android mobile application. This URL will be forwarded to the device via a Firebase platform. Once the necessary information is received by the device, it will begin downloading the requested file stored in the URL link from the network it is connected to and store the downloaded file to the storage device connected to the system.

The mobile application used in this system is build using Android Studio. The android application was chosen for this set-up because of the platform's flexibility, fast and feature-rich emulator and compatibility with the set-up. Also, a mobile application can be considered portable and can be operated popularly used smartphones. Functions such as entering URL link into the system, pausing, resuming, stopping, restarting, deleting or scheduling the download can be accomplished through this. Real-time updates of the download will be displayed on the mobile application.

A storage device used for the proposed system set-up is a portable Hard disk (storage device can depend according to user preference). However, this storage device can be chosen according to user preference. After the files are downloaded and saved in the storage device, the user can eject the storage device and access the stored files through a computer.

Result & Discussion

The user uses the mobile application to provide a URL link to the system. The downloading device that is at a remote location will begin downloading the file stored in the specific URL location that was

provided into the mobile application. The downloading device will use the network it is connected to in the remote location to download the specific file and store in the storage device (External Hard Disk – 500GB). Hence the user will have the ability to download files from a separate network at a remote location.

To understand user reaction to the proposed system, it was presented to the same few testers were selected randomly to survey existing download mechanisms and applications. Also, a questionnaire was presented to them to acquire feedback about the functionality of the proposed system. The testers were first briefed about the functionality of the system and given to testing the system. Many testers considered the system a useful approach to download files, without using in-use devices' resources and storage. Hence, majority of the users agreed that the system is useful and was successfully implemented.

Testers also agreed that the system preserve resources of the device that is being used to control the downloading device. Although, mobile application consuming mobile phone resources was considered an issue.

Hence, it was evident that the functionality of the system fulfils the set-out objectives.

Conclusion and Further Works

eRemote file downloading device is a remote file downloading device that uses Raspberry Pi module as the main downloading device, Android mobile application as the controlling device and Firebase as the database connector between the device and the mobile application. This system allows the user to download files from a separate network by connecting the device through Ethernet or Wi-Fi to that specific network. The mobile application is used to enter URL links of the downloads and further, manage the download (resume, pause, stop, restart and delete).

Further, this system can be improved by developing the same set-up using Microcontroller ESP8266 instead of Raspberry Pi module. ESP866 microcontroller has TCP/IP stack as well as supports Wi-Fi and wired networking, which are all the acquired requirements of the downloading component. Since this microcontroller is less costly, the cost of implementing this set-up will drastically. Hence, due to affordability, it will ensure the availability of the system.

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