A QUALITY OF EXPERIENCE APPROACH IN SMARTPHONE VIDEO SELECTION FRAMEWORK FOR ENERGY EFFICIENCY

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DEDICATION

Alhamdulilah,
By the name of Allah, the Most Beneficent, Most Gracious, The Most Merciful. All praise is due to Allah.

Utterly for my beloved late father
Jofri bin Hassan Husi @ Sanusi,
and lovely mother, Mainah Binti Lani.

To my lovely Wife Nor Rasida Binti Abd Rahman,
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ABSTRACT

Online video streaming is getting more common in the smartphone device nowadays. Since the Corona Virus (COVID-19) pandemic hit all human across the globe in 2020, the usage of online streaming among smartphone user are getting more vital. Nevertheless, video streaming can cause the smartphone energy to drain quickly without user to realize it. Also, saving energy alone is not the most significant issues especially if with the lack of attention on the user Quality of Experience (QoE). A smartphones energy management is crucial to overcome both of these issues. Thus, a QoE Mobile Video Selection (QMVS) framework is proposed. The QMVS framework will govern the tradeoff between energy efficiency and user QoE in the smartphone device. In QMVS, video streaming will be using Dynamic Video Attribute Pre-Scheduling (DVAP) algorithm to determine the energy efficiency in smartphone devices. This process manages the video attribute such as brightness, resolution, and frame rate by turning to Video Content Selection (VCS). DVAP is handling a set of rule in the Rule Post-Pruning (RPP) method to remove an unused node in list tree of VCS. Next, QoE subjective method is used to obtain the Mean Opinion Score (MOS) of users from a survey experiment on QoE. After both experiment results (MOS and energy) are established, the linear regression technique is used to find the relationship between energy consumption and user QoE (MOS). The last process is to analyze the relationship of VCS results by comparing the DVAP to other recent video streaming applications available. Summary of experimental results demonstrate the significant reduction of 10% to 20% energy consumption along with considerable acceptance of user QoE. The VCS outcomes are essential to help users and developer deciding which suitable video streaming format that can satisfy energy consumption and user QoE.

ABSTRAK

Penstriman video dalam talian menjadi kebiasaan bagi peranti telefon pintar pada masa kini. Sejak wabak Virus Corona (COVID-19) melanda semua pengguna di seluruh dunia pada tahun 2020, penggunaan penstriman dalam talian pengguna telefon pintar sangat penting. Walaubagaimanapun, penstriman video menggunakan tenaga dengan banyak lantas mengurangkan kapasiti bateri dengan cepat Selain itu, masalah utama adalah Kualiti Pengalaman pengguna (*QoE*). Oleh itu, *QoE Mobile Video Selection* (*QMVS*) dicadangkan untuk mengatasi masalah ini. Rangka kerja *QMVS* akan mengatur pertukaran tenaga dan *QoE* pengguna dalam peranti telefon pintar mengatur kecekapan penggunaan tenaga tersebut. Penstriman video menggunakan algoritma Pra-Penjadualan Atribut Video Dinamik (*DVAP*) menentukan kecekapan tenaga dalam peranti telefon pintar. Proses menguruskan atribut video seperti kecerahan, resolusi, dan laju bingkai dengan beralih ke Pemilihan Kandungan Video (*VCS*). *DVAP* peraturan dalam kaedah Pemangkasan Pasca-Peraturan (*RPP*) dengan membuang nod yang tidak digunakan dalam pohon *VCS*. Seterusnya, dengan menggunakan kaedah subjektif *QoE* untuk mendapatkan Skor Pendapat Maksud (*MOS*) pengguna dari tinjauan terhadap eksperimen untuk *QoE*. Setelah kedua-dua hasil eksperimen (*VCS*) ditetapkan, teknik regresi linear digunakan untuk mencari hubungan antara penggunaan tenaga dan pengguna QoE (*MOS*). Proses terakhir adalah menganalisis hasil *VCS* dengan membandingkan *DVAP* dengan aplikasi penstriman video lain yang ada. Hasil eksperimen menunjukkan pengurangan penggunaan tenaga sebanyak 10% hingga 20% dan ia membantu dalam penerimaan *QoE* pengguna. Hasil *VCS* sangat penting untuk membantu pengguna dan pembangun untuk menentukan format penstriman video yang sesuai yang dapat memuaskan *QoE* pengguna dan juga menjimatkan tenaga.

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LIST OF SYMBOLS AND ABBREVIATIONS

QoE	-	Quality of Experience
ACR	-	Absolute Category Rating
QMVS	-	QoE Mobile Video Selection
DVAP	-	Dynamic Video Attribute Pre-Scheduling
VCS	-	Video Content Selection
QoS	-	Quality of Services
MOS	-	Mean Opinion Score
SLA	-	Service Level Agreement
SLR	-	Systematic Literature Review
SPM	-	Static Power Management
mAh	-	Milliampere-Hour
DPM	-	Dynamic Power Management
CPU	-	Center Processsing Unit
ROM	-	Read Only Memory
RAM	-	Random Access Memory
VA	-	Video Attributes
RQ	-	Research Question
V*oc*	-	Voltage open circuit
QCIF	-	Quarter Common Intermediate Formats
QVGA	-	Quarter Video Graphic Array
CGA	-	Color Graphic Adapter
AVI	-	Audio Video Interface
REP	-	Reduced Error-Pruning
RPP	-	Rule Post-Pruning

R*i*	-	Internal resistance
HTC	-	High-Tech Computer
P_{est}	-	Total power consumption of the device
C_{offset}	-	Base power consumption
LTE	-	Long-Term Evolution
VLT	-	Video Load Testing
DPM	-	Dynamic Power Management
C_i	-	coefficients
GPS	-	Global Positioning System
Vm	-	Volt Meter
R	-	Resistance
-	-	Negative charge
+	-	Positive charge
V	-	Voltage
I	-	Current
SoC	-	State of Charge
e	-	Energy
Br	-	Brightness
σ	-	Available sensor in smartphone
Tot_CPUcore	-	Total number of smartphone CPU
&&	-	AND
=	-	Equal
<	-	Less than
NULL	-	Empty
P(m)	-	Proposition
m	-	Number of task
n	-	Number of service providers
x	-	Multiply
SDK	-	Software development kit
API	-	Application programming interface

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Nowadays, the rapid enhancement of Internet connectivity and smartphone technologies recent progression lead to better smartphone quality towards video streaming activity. Additionally, the Internet has been flooded with a purpose such as entertainment, education, production, and marketing (Das and Das, 2016). This impact propagates the importance of smartphone usage among people nowadays, not only for the user but also for smartphone hardware and software preferences.

Even though the smartphone has been considerably improving in terms of a fast processing core, greater graphic detail, more significant storage, and larger memory (both ROM and RAM), the battery technology growth still need much upgrading (Jain *et al*., 2018). The battery preferences must be specific criteria such as small and pack with some massive energy storage to endure daily usage. The impulsion for a thinner design for more "*stylish*" smartphones also has some tradeoff between battery size capacity and the consumers' perspective. The invention also affected the bigger size of smartphone screen panels, unable to keep up with software and chipset optimizations. The battery design restriction includes capacity, dimension, and size, which is compulsory to be lightweight and minuscule. This due to the factor inserted inside a smartphone device.

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