Towards Framework for Choosing 360-degree Video SDK

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Ke words 360-degree Video SDK Software De elopment Kit

A stract 360-degree ideos are gaining popularit among consumers Still software de elopers are earl adopters of technolog so it is important to map their needs for 360-degree ideo de elopment The use software de elopment kits that help creating software on the 360-degree ideo software domain e want to find out which factors de elopers need to take into account when choosing these software de elopment kits In this position paper we descri e a preliminar 360-degree ideo SDK choosing criteria ased on literature and our own e periences which we plan to e aluate with a sur e

1 INTRODUCTION

360-degree ideos also known as spherical ideos are getting more popular Alface et al 2011 Applications for 360-degree ideos can e found for e ample from entertainment industr sur eillance and ro otics ne of the reasons for popularit is that head mounted displa s MD supporting 360-degree ideo and irtual realit V ha e ecome easil a aila le for consumers MD is a weara le displa de ice which consists of an optical s stem in a helmet with displa s located in front of user s e es creating an illusion of depth Shi ata 2002 The are applica le for presenting interacti e spatial information such as 360-degree ideos or V worlds MDs include dedicated displa de ices like culus ift and TC Vi e in addition to mo ile phone de ices attached to headsets like Google Card oard Da dream and Gear V 360-degree ideos are also getting more popular in we applications For e ample oth outu e and Face ook support 360-degree ideos

360-degree ideo domain often re uires reading the sensors of MDs and calculating sphere mathematics uckil there are Software De elopment Kits SDK that help de elopers with such tasks e define SDK using the definition Palme et al 2010 The SDK is as a set of de elopment tools that allows a de eloper to create applications for a certain software package and hardware platform SDKs differ in terms of their programming code languages their li raries and API support Thus 360-degree ideo SDK is an SDK that allows de eloping 360-degree ideo applications A 360-degree ideo SDK can for e ample offer an API that helps creating a ideo pla er which can detect the head mo ements in spherical ideos oth in monoscopic or stereoscopic mode amples of 360-degree ideo SDKs include Google V SDK pla er SDK and K Pano Comparing those SDKs and finding the est one for de elopment work can re uire a considera le amount of time

360-degree ideo SDKs offer man useful features ut naturall the ha e different specifications and features and the cannot offer e er thing for e er od For e ample our e perience is that some 360-degree ideo SDKs for mo ile de ices do not allow eas de elopment of user interface I elements such as user interaction points owe er some of those 360-degree ideo SDKs can e integrated with a popular game engine called nit 3D ith the help of nit 3D or similar game engines I elements can e added more easil on top of 360-degree ideos Still using comple tools such as nit 3D can re uire more resources For e ample inowes and Schoen 2016 state that an empt nit 3D scene for Android re uires a much igger application package than a simple nati e code application which has an increasing effect on memor and atter consumption

The moti ation for the work is that we ha e use cases for 360-degree ideos so we need to choose a con enient SDK to work with Further we noticed that there seems to e relati el few scientific pu lications a out choosing 360-degree ideo SDKs The stud aims to gain knowledge a out the growing field and the topic is significant for de elopers who need

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a scientificall structured criteria for choosing 360-degree ideo SDKs for e ample for inspecting de elopment tools

ur research uestions are

- hich criteria is important when software de elopers choose SDKs for 360-degree ideo application de elopment
- hat features software de elopers hope for 360-degree ideo SDKs to ha e

To answer these uestions we present a preliminar criteria for choosing an SDK from the de eloper s iewpoint ur stud can e seen as a contri ution to de eloper e perience studies

The structure of the paper is as follows Section 2 presents the scientific ackground for our work Section 3 descri es the identified criteria for choosing a 360-degree ideo SDK Section 4 anal ses the criteria and planned sur e from a critical point of iew Section 5 concludes the paper and descri es our on-going and planned research

2 BACKGROUND

ur work can e seen as a part of de eloper e perience studies According to Fagerholm and Munch 2012 de eloper e perience consists of e periences relating to all kinds of artifacts and acti ities that a de eloper ma encounter as part of their in ol ement in software de elopment The define three de eloper e perience categories de elopment infrastructure feelings a out work and the alue of one s own contri ution ur stud relates mostl to the first one since SDKs are a part of de elopment infrastructure

Since 360-degree ideo software de elopment has similarities to V software de elopment ier aum and ust 1 8 offers the most related ackground for our work According to them the primar re uirements for V de elopment en ironment include performance e i ilit and ease of use n a more detailed le el the list re uired capa ilities and factors such as cross-platform de elopment support for V hardware high-le el and low-le el interfaces programming languages user interaction minimal limitations and choosing etween commercial and open solutions all of which we also included in our criteria The discuss a out the whole de elopment en ironment where as we concentrate more on choosing onl the SDK The following ackground descri es research a out how de elopers choose their SDKs on other domains than 360-degree ideo domain and what the need to consider when doing that

Palme et al 2010 propose a si -dimension enchmark securit indi idual and organi ation u er choice market growth ease of implementation and net re enue for choosing a smart phone operating s stem S for mo ile application de elopment The dimensions are ased on their own opinion a out the most critical ones The take SDK related iewpoints into account for e ample sa ing that the S SDK for Android is related to ease of de elopment and market a aila ilit The also note that the license of an SDK can ha e an effect on the usage decision e did not include securit in our criteria ecause we think that securit is not among of the most essential characteristics for a 360-degree ideo SDK If there are securit related re uirements the other software components should offer the solution for most of them

ka a et al 2002 inter iewed de elopers a out their needs for SDK documentation The studied one particular documentation and gi e a detailed anal sis of useful documentation features such as necessar content taking into account the target audience and prere uisite knowledge etc Though documentation is an important part of using an SDK we are not interested onl a out documentations Documentation is howe er related to ease of implementation found in our criteria

Dalmasso et al 2013 acknowledge the pro lem of the ariet of different platforms and SDKs The formed a classification and a comparison for different cross platform de elopment tools for mo ile platforms The classification is ased on general desira le re uirements identified themsel es The criteria the use has some similar aspects to our work For e ample the included the SDK s a ilit to e used for multiple platform de elopment also mentioned in our inter iew as a part of their criteria Additionall the discuss performance in terms of CP memor and power usage which we approach from the low resource consumption point of iew

Arg riou et al 2016 discuss a out the challenges of designing I in mi ed 360- ideo and game en ironment using Google V SDK and nit 3D Though the do not concentrate on creating choosing criteria of different SDKs the are interested a out user interaction which is also taken into account in our criteria

3 CRITERIA FOR CHOOSING 360-DEGREE VIDEO SDK

e present a criteria a out the factors software de elopers need to concider when choosing a 360-degree ideo SDK The criteria is ased on scientific literature an inter iew with a 360-degree ideo application de eloper from industr with se en ears of 360-degree ideo application de elopment e perience our own e periences si months with Google V SDK for Android okia SDK and nit 3D The inter iew with an e pert was helpful especiall from the we de elopment perspecti e Additional ackground for the criteria comes from our discussions with industr partners that ha e made us interested in some particular use cases such as user logging and user interaction

3.1 Platforms, Domains and SDKs

As Ta le 1 presents there are multiple platform alternati es for 360-degree ideo applications er SDK can not support e er platform ut for e ample we rowser applications can e run in different kind of en ironments and Card oard Da dream applications can e run on different mo ile de ices Android and i S There are also man fields for 360-degree ideo applications such as education entertainment industr and research which can ha e an effect on the desired characteristics of an SDK Further Ta le 2 lists different 360-degree ideo SDKs e might e missing some SDKs ut the list works as an e ample of different alternati es and it reflects the difficult of choosing the est one for de elopment work from man options

Ta le 1 ample platforms for 360- ideo applications

Platform
e rowser
Card oard Da dream
indows
inu
mac S
TC Vi e
Gear V
culus ift

3.2 Features and Characteristics of SDKs

The com ination of different features and characteristics of SDK can e the most important reason for choosing one Ta le 3 lists the features and characteristic that are ased on our own de elopment e perience knowledge gained from an inter iew with an e pert from industr and aspects found from the research literature There are naturall other features and characteristics as well ut either we ha e e perience or we ha e found scientific ackground for the chosen ones The features and characteristics in the list are ela orated in the following paragraphs

User interaction For immersi e e perience a con enient wa to implement user interaction for e ample adding an em edded I on top of 360-degree ideo can e an important factor Pro a l the de elopment of I re uires some kind of graphical API owe er not e er SDK offers a possi ilit to add user interaction points easil

Minimal limitations The usage of an SDK should not e restricted onl to the read -made features A skillful programmer should e a le to e tend the functionalit if needed

Performance hile e en modern mo ile de ices are powerful enough for showing 360-degree ideos the performance re uirements can increase for high resolution ideos with a high refresh rate including other computation An SDK should pro ide sufficient performance for comforta le immersi e e perience Some SDKs include performance monitors ut it is pro a l not the most essential feature for a 360-degree ideo SDK if the de elopment en ironment otherwise includes a performance monitor

VR hardware support MDs can e integrated to different kinds of de ices that help for e ample with na igation and user interaction For e ample Google Da dream supports a decicated controller that can e used for pointing and clicking

Low-level API In addition to high-le el interface an SDK can offer a low-le el interface ith low-le el source code the de elopers can make applications that perform faster or use less resources For e ample Google V SDK for Android comes with a nati e de eloper kit DK that is less restricted than the a a SDK ut re uires knowledge a out C and C n the other hand de elopment work s a straction le el can e e en increased for e ample with nit 3D integration

Programming language The programming language of an SDK can ha e an effect on the usage decision Some programmers are more familliar with some languages or the platform can re uire a certain language For e ample a high-le el language can support cross-platform de elopment etter or a ascript can e needed for we de elopment

Multiple platforms ften creating a application for a single platform is not enough ut it the implementation is needed for other platforms as well An e ample of multiple platform support is Google V en ironment that is pro ided for Android and i S in addition to integration with nit 3D and nreal game engines and support for we applications

Low resource usage Pla ing 360-degree ideos

Ta le 2 ample 360-degree ideo SDKs

SDK	Developer	Platform
Google V SDK	Google	Android i S nit 3D nreal e
pla er SDK	okia	Android i S culus Mo ile SteamV
penV SDK SteamV SDK	Val e	Multiple endors
SV SDK	pen source	pen Source V headset
V ne SDK	eiss	V ne
krpano	krpano	e
Pano2V	Garden Gnome Software	e Card oard
Mar ipano	pen source	e
culus SDKs	culus V	ift Gear V nit 3D nreal e PC

Ta le 3 Different characteristics or features of 360-degree ideo SDKs with ackground

Feature or characteristic
ser interaction Arg riou et al 2016
Minimal limitations ier aum and ust 1 8
Performance ier aum and ust 1 8
V hardware support ier aum and ust 1 8
ow-le el API ier aum and ust 1 8
Programming language ier aum and ust 1 8
Multiple platforms Dalmasso et al 2013
ow resource usage Dalmasso et al 2013
Content management Inter iew
e support Inter iew
Access to sensor data aValle et al 2014
Viewport tracking aValle et al 2014
Multiple 360 ideo formats wn e perience
360 ideo format detection wn e perience
D M protection support wn e perience
Free pen source license Palme et al 2010
ase of implementation Palme et al 2010
Market situation Palme et al 2010

can re uire relati el much computing power for mo- ile de ices ith low resource usage we mean the SDK s a ilit to keep CP memor and power usage on minimal le el for e ample for sa ing atter resources

Content management Some 360-degree ideo use cases are related to content management For e ample a 360-degree ideo can e a part of an educational we page managed with a content management s stem Thus SDKs could support em edding 360-degree ideos in ar ing content en ironments n the other hand content management inside 360-degree ideos can e important as well For e ample sometimes it would e useful to add te t on top a ideo or highlight a part of the it according to associated metadata

Web support hile man 360-degree ideo applications are made for mo ile de ices a support for we applications can e more important in the future when 360-degree ideos ecome more popular in we

Access to sensor data An SDK can support different wa s to access sensor data for head tracking For e ample the the head orientation can e retrie ed in man formats such as euler angles uaternions or matri data In addition accessing accelerometer can e needed

Viewport tracking ith iewport tracking we mean the ideo pla er s a ilit to automaticall adapt to user s head orientation For MD usage this is asicall a re uired a ilit ut for we applications it can e prefera le to na igate with mouse dragging

Multiple 360 video formats 360-degree ideos come in multiple formats so an SDK should support as man as possi le The can e monoscopic each frame is monocular e uirectangular panorama or stereoscopic two erticall -stacked e uirectangular panoramas or the ideo e can stream MP G-4 we m etc

360 video format detection In addition to e a le to pla different 360-degree ideos it would e helpful for an SDK to detect the ideo format For e ample when using the class V VideoView of Google V SDK for Android it is re uired to set the ideo format monoscopic or steroscopic in the program code ecause the pla er can not detect the ideo format itself

DRM protection support As traditional ideos 360-degree ideos can e protected with digital rights management D M techni ues ot all SDKs offer pla ack for D M protected ideos

Free / Open source license The license of an SDK can affect the usage decision For e ample an indi idual de eloper getting familiar with eld might want to start with a completel free SDK while a compan might want to pa for non-restricted usage

Ease of implementation hen choosing tools for software de elopment work the ease of implementation can e an important aspect ase of implementation includes things such as good documentation familliar technologies the ualit of an API etc e include the easiness of integration with other components such as S s and game engines under this categor

Market situation Market situation can ha e an effect on the SDK usage decision For e ample new de ices can ha e new features that ha e the charm of no elt In addition the organi ation s strateg can determine the used platform

4 DISCUSSION

hen starting to work with 360-degree ideo de elopment we reali ed that choosing an SDK for 360-degree ideo application de elopment is not an eas task Additionall we could not find a proper scientific criteria for choosing an SDK Since 360-degree ideos are a growing phenomena a criteria for choosing the tools for the de elopment work is eneficial for multiple parties

To e aluate our criteria we plan to conduct a sur e e chose the method ecause it is ine pensi e we hope to reach a large respondent group and the responses are anon mous Disad antages in using sur e s include the infle i ilit of the sur e form and the lack of human interaction Piloting the sur e eforehand is important

e plan to make an online sur e with Google Forms Primaril we will call for participants from an association called Virtual ealit Finland that supports the de elopment of the V and A ecos stem in Finland The sur e is planned to e lightweighted and not re uiring much time to answer 10-15 minutes According to plan the sur e has 10 uestions di ided to four sections e multiple choise uestions four open field uestions and one grid uestion with a 5-step answer scale e aim to keep the uestions short and simple

A good sur e should e clear eas to follow and pro ide enough information for respondents There is a danger that some respondents do not understand what we mean with the uestions Answering to the open te t uestions can e more difficult for some respondents so is it possi le that the will lea e the open field empt e en though open te t answers could gi e the most interesting insight for us

ur own de elopment e perience was limited to working with Google V SDK for Android okia SDK and nit 3D with simple applications For that reason we wanted to inter iew e perts from the industr owe er we onl managed to conduct one inter iew ecause it turned out to e difficult to get inter iews from industr e perts That is one of the reasons we tr to reach for a larger respondent group with an online sur e

The group of sur e respondents can e e pected to e uite e clusi e since onl de elopers with e perience a out 360-degree ideo SDKs are a le to answer ot an software de eloper can gi e proper insight on the topic Therefore getting a large enough response set for making meaningful research is not an eas task

The answers will e anal ed statisticall pen answers naturall re uire more preparation for anal sis ut at first we intend to categori e them for further uantitati e anal sis e also hope to get enough material for ualitati e anal sis

ur criteria reflects our own interests to some e tent e are most interested in some particular use cases like user logging and user interaction owe er we did not want to restrict the criteria onl to those topics ut we wanted to gain more wide iew on the field and we found support from the literature for man aspects n the other hand we assume that some interesting and important aspects were not included Therefore we hope that the planned open uestions in the sur e will gi e insight on those factors

hile the criteria and the sur e is not the main goal of our research pro ect it is an important first step to gain knowledge a out the field e reali e that there is a gap in current research not pro iding enough knowledge a out de eloper e perience in 360-degree ideo de elopment Stud ing software de elopers is important ecause for e ample ucel and dgell 2015 state that software de elopers in ent uses for de ices popular in future and the act as earl adopters of technolog so their preferences can ha e effects on earl market ad antages

5 CONCLUSIONS

In this position paper we presented a preliminar criteria for choosing a 360-degree ideo SDK The criteria is ased on research literature our own e periences and an inter iew with an e pert on the domain To e aluate our criteria we plan to conduct an online sur e for software de elopers working in the field of 360-degree ideos ur e entual goal is to find out on which criteria software de elopers choose 360-degree ideo SDKs and what features are e pected from them

The moti ation for the work comes from the need to sort out the field for further de elopment of 360-degree ideo applications e need to choose a proper SDK for our use cases which include user interaction and user logging In addition we hope that we can identif functionalit gaps in the current SDKs

The upcoming sur e will e significant ecause 360-degree ideos are gaining popularit among consumers the de elopers are earl adopters of technolog and there are relati el few scientific pu lications a out choosing 360-degree ideo SDKs

This work is an initial stud for a research pro ect called 360 Video Intelligence The purpose of the pro ect is to create a 360-degree ideo platform which pro ides an eas wa to run different kinds of anal sis for e ample o ect detection algorithms on 360-degree ideos The ideos with added metadata will e then pla ed on 360-degree ideo pla er application owe er the pla er will not onl pla the ideo with isuali ed metadata ut it will also gather user log for further anal sis Practical use cases for user logging include iew port prediction that can e used for e ample on pro iding etter ideo resolution onl to the field of iew similarl to work presented in chi et al 2014 e will also need some kind of I elements for isuali ing the added metadata on 360-degree ideos ith the knowledge gained from de eloping our criteria and the following sur e we can ha e a etter understanding a out de eloping such applications

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REFERENCES

Alface P Mac -F and Ver i p 2011 aluation of andwidth performance for interacti e spherical ideo In *Multimedia and Expo (ICME), 2011 IEEE International Conference on* pages 1 6 I

Arg riou conomou D ouki V and Doumanis I 2016 ngaging immersi e ideo consumers Challenges regarding 360-degree gami ed ideo applications In *Ubiquitous Computing and Communications and 2016 International Symposium on Cyberspace and Security (IUCC-CSS), International Conference on* pages 145 152 I

ier aum A and ust C 1 8 Software tools for irtual realit application de elopment *Course Notes for SIGGRAPH* 8

Dalmasso I Datta S K onnet C and ikaein 2013 Sur e comparison and e aluation of cross platform mo ile application de elopment tools In *Wireless Communications and Mobile Computing Conference (IWCMC), 2013 9th International* pages 323 328 I

Fagerholm F and Munch 2012 De eloper e perience Concept and definition In *Software and System Process (ICSSP), 2012 International Conference on* pages 73 77 I

aValle S M ersho a A Katse M and Antono M 2014 ead tracking for the oculus rift In *Robotics and Automation (ICRA), 2014 IEEE International Conference on* pages 187 1 4 I

inowes and Schoen M 2016 *Cardboard VR Projects for Android* Packt Pu lishing td

ka a Messinger oehme F orman C Mace M and Gordon M 2002 hat programmers reall want results of a needs assessment for sdk documentation In *Proceedings of the 20th annual international conference on Computer documentation* pages 133 141 ACM

chi D Kunita Fu ii K Ko ima A Iwaki S and irose 2014 md iewing spherical ideo streaming s stem In *Proceedings of the 22nd ACM international conference on Multimedia* pages 763 764 ACM

Palme Tan C - Sutanto and Phang C 2010 Choosing the smart phone operating s stem for de eloping mo ile applications In *Proceedings of the 12th International Conference on Electronic Commerce: Roadmap for the Future of Electronic Business* pages 146 152 ACM

Shi ata T 2002 ead mounted displa *Displays* 23 1 57 64

ucel I and dgell A 2015 Conceptuali ing factors of adoption for head mounted displa s Toward an integrated multi-perspecti e framework *Journal For Virtual Worlds Research* 8 2