

## Основні відомості

- Місцезнаходження:
  - ≻кімн. 4, корп. 14 (1й поверх)

- Керівник лабораторії:
  - ≻д.т.н. Сулема Є.С.

# <mark>І</mark>нформація про керівника (1/4)

- **/ Е**ксперт в галузі мультимедіа та мульсемедіа:
  - Запрошений доповідач (Invited Speaker), 29th IEEE International Conference on Systems, Signals and Image Processing IWSSIP2022, доповідь "Digital Twins Technology: What Is the Future?", Софія, Болгарія (онлайн), 1 червня 2022.
  - Співорганізатор міжнародного семінару Data retrieval, presentation and analysis of taste and flavour data конференції Experiment@ International Conference expatWS'21, Португалія (онлайн), 24 листопада 2021.
  - Запрошений експерт, International Workshop on Cross Reality, Artificial Intelligence, and Online Learning, 18th International Conference on Remote Engineering and Virtual Instrumentation (REV2021), Китай (online), 24 лютого 2021.

# <mark>І</mark>нформація про керівника (2/4)

- **// Е**ксперт в галузі мультимедіа та мульсемедіа:
  - Запрошений лектор, **Британський університет у Єгипті**, лекція "Synergy of Digital Twins, Mulsemedia, and Neural Networks: is there any future for it?", Каїр, Єгипет (онлайн), 5 грудня 2020.
  - Запрошений доповідач (Invited Speaker), 9-та міжнародна конференція Interactive Collaborative and Blended Learning ICBL2020, доповідь "Digital Twins Technology for Education 4.0", McMaster University, Гамілтон, Канада (онлайн), 14 жовтня 2020.
  - Організатор та керівник секції **Mixed Reality Applications for Industry and Education (MIRINDE)** міжнародної конференції **Interactive Mobile Communication, Technologies and Learning IMCL2019,** Салоніки, Греція.

# <mark>І</mark>нформація про керівника (3/4)

- Експерт в галузі мультимедіа та мульсемедіа:
  - Організатор та керівник секції Augmented Reality and Immersive Applications (ARIA) міжнародної конференції Interactive Mobile Communication, Technologies and Learning IMCL2017, Салоніки, Греція
  - Запрошений доповідач (Invited Speaker) міжнародної конференції
     Systems, Signals and Image Processing, IWSSIP 2016, Братислава,
     Словаччина
  - Організатор та керівник секції Immersive Technologies for Effective Learning (ITEL) міжнародної конференції Interactive Mobile Communication, Technologies and Learning IMCL2015, Салоніки, Греція

# <mark>І</mark>нформація про керівника (4/4)

- Експерт в галузі мультимедіа та мульсемедіа:
  - Запрошений лектор (Visiting Professor):
    - Mälardalen University, Västerås, Sweden, 2020
    - University of Malta, Msida, Malta, 2018
    - Lappeenranta University of Technology, Lappeenranta, Finland, 2018
    - Cyprus University of Technology, Limassol, Cyprus, 2017
    - Slovak University of Technology, Bratislava, Slovak Republic, 2016
    - University of Lorraine, Nancy, France, 2016
    - University of Lisbon, Portugal, 2016
    - University of Luxembourg, Luxembourg, 2015
  - Понад 150 наукових публікацій.



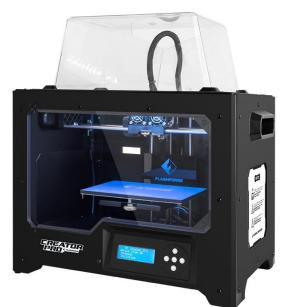
# Список обладнання (1/5)

Пристрої для візуалізації 3D зображень



3D сканер







# Список обладнання (2/5)

**У** Контролер Kinect 2.0



• Контролер LEAP

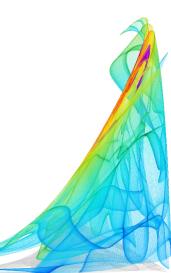


• Рукавичка віртуальної реальності 5DT

• Анагліфні окуляри







# Список обладнання

(3/5)

Інтерактивна дошка SMART BOARD







# Список обладнання (4/5)

Хромакей (1.8х2,7м) з тримачем фона

• Набір постійного світла Deep

• Окуляри доповненої реальності Epson Moveri





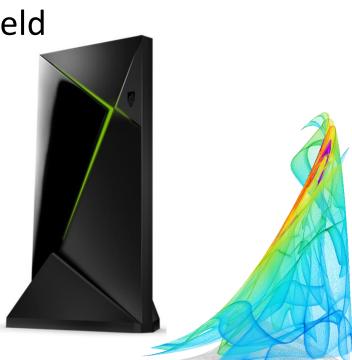
# Список обладнання (5/5)

- Плата NVIDIA Jetson
- Система на кристалі NVIDIA Tegra



- Потоковий медіаплеєр NVIDIA Shield
- Стерео-камера ZED
- •





## Актуальна тематика (1/2)

 Вдосконалення компілятора мови оброблення мульсемедійних даних ASAMPL







# Актуальна тематика (2/2)

 Розроблення програмного забезпечення для цифрового оброблення смаків







# Приклад проєкту









# Міжнародні публікації студентів







## Haptic Interaction in 3D World with Use of Data Glove and Web-Camera

Yevgeniya Sulema, Vladyslav Zaichuk, Denys Chernykh National Technical University of Ukraine "Kviv Polytechnic Institute" (sulema@pzks.fpm.kpi.ua)

Haptic interaction is an effective element of human-co Higgic interaction in an effective element of human-computer interaction Higgic devices can be devices with sensory inecladars interaction Higgic devices can be devices with sensory inecladars creation of a feeling of real interaction of the user with the object in the integration. They can be used only for manipulation with higgir regions. They can be used only for manipulation with which objects in the 30 virsal world in antural way by Taleing, "moving," and 'manipulation," the object with much it can be considered as an appropriate solation for many 30 virsal world considered as an appropriate solation for many 30 virsal world

considered as an appropriate source to many 3D visual vento applications.

The data giove (Figure 1) is a happic device, which has a special controller with at least fire sensors – by one sensor on each finger (Figure 2) – that register fingers movement, transform it into a signal to be analyzed by special software and transformed into both fingers movement of a hand model on a screen and internal commands for





However, the majority of data glove types does not allow to obtain data about the position of the user's hand with the glove on it in the 3D space. As the result the interaction with the virtual object can be fulfilled. To enable manipulation with objects in the 3D scene a movement racker is required. At the same time the use of additional movement tracker is required. At the same time the use of additional hardware (tracker) raises the price of the application. In this paper we propose the technique of using a usual web-camera for obtaining data about the user's hand position in the 30 scene instead of using a movement tracker. This approach enables the development of cost-flective applications for transplusation objects in 30 virtual worlds.

## II. WORK WITH DATA GLOVE

In the research presented in this paper the 5DT Data Glove 5 Ultra [1, 2] with 5 sensors and wire connection via USB port was used. This data glove does not allow to obtain data about a position of the user's hand with the data glove on it in the 3D scene and therefore the correct manipulation with objects in the 3D scene is impossible. To solve this issue a usual web-camera was used.

To solve this issue a usual web-camera was used. The development of mee applications to the 50T data given is sent to the 50T data given in the second of th

Attentatively, we can use a callback handler, which calls the method for receiving actual data from the senore.

The next task is to visualize the 3D model of a hand that represents movements of the real hand of the user while he or she is manipulating the virtual object in the 3D scene. The Tae Framework [4] library was used for visualization of the hand model in the 3D scene in this research. This library enables OpenGJ, features for JAET platform.

The hand model exported from the 3D editor MilkShape3D [5] in text The hand model exported from the 3D editor Milk:Shape.3D [5] in text format was chosen for this purpose. End format means that the 3D editor exports data, which describes the mesh of the hand model represented as a bifle. This file contains a description of the hand model including vertices, triangles, UV coordinates, texture mame, ct. Since the file Framework desert support badings user models, the parser has been developed. The result of the hand model visualization is shown in Figure 3.





## III. WORK WITH WEB-CAMERA

III. WORK WITH WEB-CAMERA
To define the proper position of the hand noted in the 3D scene we need to delet the position of the use of hand with the day give on read to delet the position of the user's hand with the day give on the contract of the position of the user's hand. A picker section of generated the give of the user's hand. A picker section of generated from the hand give on the user's hand. A picker section of generated from the hand give on the section of the position of the pos



Figure 4. The giptin end to motive

Figure 5. Descript generals are giptin and to motive

The processing of the sighty images received from the week-camera includes four stapes: image preprocessing, glypts search, typical complication described. To recognition, and glypts in celeration described. To recognition and glypts in celeration described. To recognition and great convert every found glypts-like object to the black-and withle image and disked the limitings as it is aboven in Figure 5. After the division or calculated the ratio between the color of the glypts of the process of the glypts of the process of the glypts of the great in the towardly and black picels inside this cell (boundary posels should not be taken) into account because or cell editation can again in the boundary in the processing of the glypts of the great in the boundary posels inside that is out of the threat the great in the boundary posels inside that is out of the threat color of the great in the boundary posels of the great in the boundary posels of the great in the boundary of the great in the posels of t

11th International Workshop on Multimedia and Signal Processing May 191, 2017 Busiless, Sinokia









## Smart Room Software Based on Microsoft Kinect and Speech Synthesizing

National Technical University of Ukraine "Igor Sikorsky Kylv Polytechnic Institute", sulema@pzks.fpm.kpi.ua

## I. Introduction

I. Introduction
Face destiction is complete technology that identifies human faces in digital images. A face recognition is a computer technology in the complete technology in the complete technology in the complete technology in the complete of the face of the ways to 6 this by comparation general content is caused in security systems and can be compared to deet hosteric such as fingepoint yeters and can be compared to deet hosteric such as fingepoint increasingly popular "smart homes," marketing, estimation with the complete comparation of the complete complete comparation of the complete complete complete comparation of the complete comple





II. FACE DETECTION, WORK WITH

KINECT
Kinec 17 was released with Xbox One on November 22, 2013 by Microreh. Microrof released the Kineck software development the s. In was decided to develop the software with C il programming and the second of the control of the

## III. FACE RECOGNITION, WORK WITH

The problem of lacial recognition is the subset of machine learning problems. The software developed for this paper uses the most problems. The software developed for this paper uses the most learning can be split but two steps.

- Teaching that classifier (creating decision-making criteria based on training data).

- Classification, or face recognition (companing a face in the frame against the set of classes defined in the model).

gainst the set of classes defined in the model).

kyBiometry is a state of the art Face recognition & Face detection oud biometrics API. This resource has the following advantages:

It can detect multiple faces in a photo simultaneously:

It allows to make 100 requests per hour for free;
It enables easy classifier training;
It is able to recognize people both with and without glasses.

SkyBiometry is used for both training and recognition processes. In order to learn, the service has to be supplied with the photo of the person and the information about who that is (this is called labelling) person and the information about who that is (this is called liabelling) is a recommended to use the photon made by the same device that will be used to recognize faces later (Cinect V2 in this case). Since encognition is also establishing, the photo should be taken recognition in a beginning to the lighting, the photo should be taken will be used. Alternatively, if the lighting properties can vary, multiple photos with verying lighting can be used. The size of trianglat affects the precision of the recognition process: the higher the number of photos is. the quarter precision is During the development of the software. It was determined that a minimum of 10 photos with verying the contraction of the process of the pr





IV. SOFTWARE DEVELOPMENT

## FEATURES

All the described modules are executed in a sequence, that can be described as follows:

described as follows:

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-- If recensary, the system can be modified by astending the chain
-- If the chain of the system of the chain
-- Useffiscopized on the chain
-- Useffiscopized
-- Usef B. Vocal greeting
The user can be greeted by synthesizing a greeting by using a stored user's name . NET has a default N-System Speech Synthesis

namespace, which contains classes for initializing and configuring a speech synthesis engine, for creating prompts, for generating speech, for responding to events, and for modifying voice characteristics. Since the greetings options list is stored in a CSV file, it can be effortlessly modified: greetings can be added, modified or deleted. The downside of this approach is that .NET Framework does

System allows simultaneous execution of arbitrary applications and playing selected music for the user entering the room. It is possible to devise a new approach of executing applications for groups of

## V. Conclusion

Face detection and face recognition are currently widespread technologies. They have found a wide application in 'smart home' technology. The proposed approach allows to develop cost-effective face recognition applications by using minimal number of specialized hardware – only a Kinect controller is necessary. This approach is cost-effective and easy to use.

## ·──Redžúr 2018





## Fast Approximated Subsurface Scattering

Yevgeniya Sulema, Constantine Rudenko Igor Sikorsky Kyiv Polytechnic Institute (sulema@pzks.fpm.kpi.ua)

## I. Introduction

surface beyond the point where direction of the light is perpendicular to the surface normal (Fig. 1, Fig. 2).





g wrap coefficient w which limits the extent of 
$$i = \left(\frac{\cos(\phi) + w}{1 + w}\right)^{p}$$
(2)

A more accurate but compensationary expensive approach is not excellent to the coefficient of the coefficien estimate the distance sign has trained introdupt the object clotter escaping its surface. In order to do this, a depth may rendered from light perspective is used By subtracting the depth rendered from the properties of the distance between light source and given point them the actual distance between light source and given point the distance that light has traveled through the distance has been proportioned from the object can be approximated from the object can be approximated from the distance that light has traveled through the distance that the object can be approximated from the object can be







## II. Proposed Approach

The general local register for simulating subsurface scattering in real-time. The general local of the proposed approximation is demonstrated in include ways lighting, settlending light absorption using opinh map.

Fig. 5. The vector L, the the object directly along the surface anomal letterings proposed in this paper is a highly obbecen first to many control of the design and off thus, does not mentioned techniques. The substance assurface vindous using one of the surface normal and thus, does not exceed techniques. The surface is the surface anomal results of the surface normal and thus, does not mentioned techniques and the length of the parties of the surface normal techniques in the surface of the surface is the surface of the surface and the length of the parties of the surface normal.

$$l = cos(\alpha) \cdot 2r$$
 (3)  
ength of subsurface path,  $\alpha$  is the angle between light  
rface normal and  $r$  is the radius of approximated

where / is the length of subsurface path,  $\alpha$  is the angle between light vector and surface normal and r is the radius of approximated circular cross-section which is equal to local thickness.

## III. Light Distribution Model

Figure 1 Companions
Figure 2 Committee or may prove provide continuous formula allows sure to determine the statement continuous provides and committee or to determine the statement continuous provides and committee or to determine the statement continuous provides and committee or to determine the statement provides and continuous management provides and continuous management

The proposed model provides a quick approximation for subsurface scattering while allowing to set subsurface color separately from surface color, providing a physically meaningful way of adjusting the scattering depth and abding the energy conservation law. The results of applying proposed model are demonstrated in Fig. 7.





V Conclusion





