METU, Department Of Computer Engineering Graduation Project Proposal Form

Project Information

Title

3D Modeling from 2D images using Leap Motion

Target

Public []

Restricted [x]

Proposer Information

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IP (Intellectual Property) Information

None	

Project Description and Background Information

Description

The Leap Motion controller is a small USB peripheral device which is designed to be placed on a physical desktop, facing upward. It captures the movement of your hands and fingers so you can interact with your computer in a natural and 3D way. We will use this interaction in extracting 3D models/shapes from a photograph.

Users will be able to define each dimension of the component with hand/finger movements and gestures to extract 3D models of objects in a natural way. These 3D movements and gestures will give control over the thickness/depth of the object that is being extracted from the image. This technique will be supported by edge detection algorithm to enhance experience of the user.

Viewing of extracted 3D models will be controlled with predefined hand and finger gestures. This will provide simple and natural controls for viewing. For demonstration, constructed 3D models will be printed using a 3D printer.

Similar Products/Projects

[1] **3-Sweep: Extracting Editable Objects from a Single Photo:** Interactive technique for manipulating simple 3D shapes based on extracting them from a single photograph. Such extraction requires understanding of the components of the shape, their projections, and relations. Technique provides the user the means to quickly create editable 3D parts. Three strokes are used to generate a 3D component that snaps to the shape's outline in the photograph, where each stroke defines one dimension of the component. The computer reshapes the component to fit the image of the object in the photograph as well as to satisfy various inferred geometric constraints imposed by its global 3D structure. Once the 3D object has been extracted, it can be quickly edited and placed back into photos or 3D scenes, permitting object-driven photo editing tasks.

[2] **Artefact Leap Motion 3D Modeling Application**: Two designers of ArtefactGroup decided to see what Leap could do with parametric CAD application Pro Engineer.

Justification of the proposal

The purpose of the project is to achieve simple user interaction using Leap Motion technology in 3D modelling and solving the similar projects' [1] flaws. We aim to provide an exciting and smooth way in 3D modelling to individuals who are interested in 3D Modeling, even for those without any experience.

(Why is there a need to develop the project you are proposing?)

Currently, we are interacting with computer in a very unnatural sort of 2D way and trying to model a 3D object by using tools that are based on this unnatural interaction. We see this as a limiting issue for human beings especially for designers. It will accelerate the modelling process.

(Which basic problems does your project aims to solve?)

Project 3-Sweep's algorithm fails on generating 3D models with images that contains shadows on edges. We aim to solve this problem by providing a 3D interaction using Leap Motion Controller. It also fails in some objects which require a sense of depth while modeling.

Contributions, Innovation and Originality Aspects of the Project

(State innovation and originality aspects as well as contributions planned in the project.) We will design gestures, set of hand movements, for Leap Motion to make it easy for users to model 3D object out of a 2D image.

We will provide an interface for users to use Leap Motion in which we are planning to show location of hands on image as well as a model being built up by the movements of hands.

(If there exists any developed products or existing projects similar to yours that target the same problem area of your proposal, how will your targeted product be different, possibly be better than those existing ones?) Project 3-Sweep has good accuracy on overall but it fails on images that has shadows on edges. It also fails on images that have discontinuous geometrical shape because of the assumption of uniformly scaled profile such as toothpaste tube. We aim to solve these issues.

(What will be the advantages and distinctive characteristics of your targeted product?) The main advantage is that users will interact with a 2D image with 3D interface provided by Leap Motion Controller. This will provide more natural interaction compared to current interaction methods that involve unnatural 2D interactions.

We as humans can detect the depth of an image but computers cannot. We need to give this information to computer by using tools that are designed for that purpose. Current methods does not provide a sense of depth. For example, the tools we have, tablet/pen/touchscreen, they all fail to deliver a sense of depth since they are tools designed to be used as 2D interaction. They are not suitable for extracting a 3D object out of an image since depth requires 3D interaction. However, with Leap Motion Controller, we can provide the depth information to computer naturally. We can configure hand movements to deliver depth as well as delivering height and width.

Another advantage over similar products is that similar products can not detect the object if there is an obstacle in front of the object because of the failure of the edge detection, but our product can overcome this difficulty with the help of Leap Motion. We are capable of imagining the shape of an object even it is not visible due to obstacles in front. Leap Motion overcomes this problem by giving us a better interaction with the computer so that we can transfer this capability to computers.

(What are the contributions of your project to technological development at national and international levels?) Leap/motion based controls are new and emerging technologies in designing and modeling areas. Our project will be one of the earliest examples in this area.

(Does your project have any potential to initiate further research and/or development activities in the same or different technological areas?)

Companies such as Autodesk and Blender Foundation try to develop tools/plugins for their own products. Our project can be integrated to softwares such as AutoCAD, Maya, Blender of these companies. Our project have a potential usage in VR technologies which require hand/finger motion based controls.

Technical Aspects of the Project

We will define special gestures by using Leap Motion SDK. These gestures will be simple to learn by any user and provide smooth controls.

Modeling phase will be controlled by these predefined gestures and shown to users in an OpenGL window. This modelling phase will be enhanced using edge detection algorithms provided by OpenCV.

After modeling phase, users will be able to examine generated models by zooming in/out or rotating objects with hand/finger motions and gestures.

Extracted models can be printed using a 3D printer for real-life demonstration.

Targeted Output, Targeted User/Domain Profile

End-product can be used by wide range of users via user-friendly interface and natural controls provided by Leap Motion. Our product will accelerate the modeling phase significantly.

Correctness of the final 3D model is one of the success measures. How effectively and accurately Leap Motion is used is another success measure. learning curve, easy to use, casual user

Targeted user profile ranges from amateurs such as high school students, who are interested in 3D Models but sceptical to 3D Modeling due to complexity of the tools, to professionals.

Project Development Environment

Project will be developed as a cross platform application with JetBrains CLion IDE using CMake. Core programming language of the project is C++. For GUI development we may consider other languages such as JavaScript with Electron framework. Electron allows building cross platform desktop GUI with JavaScript, HTML, and CSS.

Leap Motion V2 Desktop C++ SDK for Leap Motion Controller OpenGL C++ SDK, GLUT/GLFW for 3D modelling OpenCV for edge detection

External Support

External hardware requirement: Leap Motion Controller, 3D Printer

References

[1] https://www.youtube.com/watch?v=Oie1ZXWceqM&feature=youtu.be , https://www.researchgate.net/publication/262425949_3-Sweep_Extracting_Editable_Objects_from_a_Single_ Photo