

A Review on Haptic Technology

SALONI SONI¹, AJMEET SINGH²

^{1,2}Dept. of Electronics & Communication Engineering, Poornima College of Engineering, Jaipur

Abstract -- Software engineering finds an extensive variety of uses in an assortment of fields. In this advanced world, the utilization of various human faculties in the field of PCs is ending up increasingly normal and the feeling of touch is no exemption. In this paper, we have given an outline of haptic innovation, which is altogether identified with the feeling of touch. Haptic innovation is a field which is yet to be totally investigated. Individuals are unconscious that they are a piece of the haptics worldview and that they are utilizing haptics in their everyday life. We have clarified to sum things up how haptics capacities and how it is actualized in different fields of study. We have additionally attempted to reveal insight into the future utilizations of haptics and a couple of constraints which have raised in the advancement of haptics.

Indexed Terms -- Haptics, Phantom, 3d modelling, haptic applications.

I. INTRODUCTION

"Haptics" originates from a Greek word haptikos implies relating to feeling of touch and Greek verb "haptesthai" which means to contact or to touch. It manages manual detecting and control of surroundings through touch. The touching procedure can be made by people, machines, or a blend of both. This association may likewise incorporate tangible modalities like vision. Haptics has brought biomechanics, brain research, neurology, designing and PC together in investigation of human touch and power criticism. Touch is bidirectional vitality and data stream between genuine, or virtual, condition and the end client.

Such a sort of touch is called dynamic touch. To see and create mental picture of a question, we have to get a handle on and control the protest. The reliance amongst detecting and control manages how people see and afterward collaborate with the physical world .In short haptic innovation manages material criticism which reproduces feeling of touch by applying power ,vibrations ,or movement to the client .Using mechanical reproduction virtual protests in PC can be made and can likewise be utilized to convey tele

robotics .It improves the situation the feeling of touch what designs has improved the situation vision .Haptic input additionally gives measure of power applied by the client on an interface.

Thus it gives a pivotal understanding to how human feeling of touch functions. Human haptics is detecting and control through material and sensation. On touching a protest cooperation powers are forced on skin. These powers pass on the data and prompt view of the physical world. Because of recognition, the mind enacts the muscles which thusly, result in development. Consequently, human haptics relate to this shut circle amongst people and the physical condition and all perspectives identified with feeling of touch.The human haptic framework is comprised of mechanical, tactile, engine and intellectual segments.The mechanical segments incorporate the body parts which fill in according to the mind reaction.The psychological segments incorporate the mind which dissects and sees the passed on data and after that initiates engine segments subsequently finishing the circle.Machine haptics incorporates the mechanical gadgets that are put into physical contact with people for trading data.

II. VIRTUAL REALITY CONCEPTS

Haptic innovation has indicated mixed potential outcomes of workmanship and science for making programming calculation that combine PC created powers and material incitement to be displayed to client for the discernment and control of virtual articles by means of touch as appeared in Figure 3. Virtual situations (VE) or regularly mainstream as virtual the truth is a PC produced manufactured condition which can cooperate with a human client to perform perceptual and engine assignments, for example, pressing an orange, getting a handle on a container and cutting a roll. Specifically, a man

moving his submit virtual condition for grasping or touching a question as though nature is genuine.

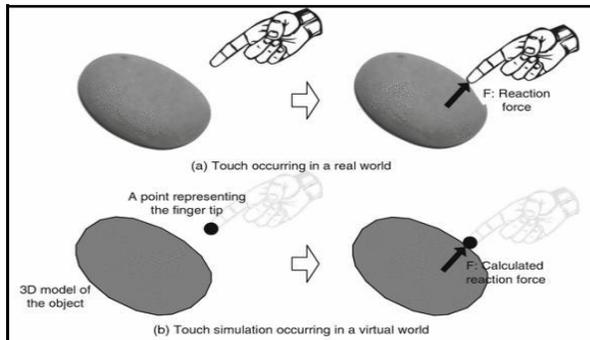


Fig. 1: - Concept of touch in real and virtual world

When's at the tip of clients' finger cooperates with that protest, it applies a response drive against the finger to turn away it from infiltrating the question. Alongside this, clients will detect impact alongside the question's surface, going through muscle and mechanoreceptors. The capable receptors control particular question in situations, with help for seeing or/and hearing them, offers a convincing occasion and leaving clients inundated in the outlined environment with marvelous fulfillment. It is likely that stunning background in VE can be accomplished by a basic haptic interface with implanted visual and sound-related show to make mind boggling sensation to the clients in spite of the fact that by evident full touch reproduction. Analysts in [2] and [12] has talked about that, a genuine question can be made in a virtual world by produced show in PC, making from work library and calculation database in specific programming. Regularly, at the tip of client's finger or hand motions can be spoken to as a point called a 'symbol'. A run of the mill VE comprises of a PC show or a format that can extend PC created synthetics conditions or visual pictures to the standpoint course and an extraordinary glove or scaled down gadget whereby the clients can charge the PC to respond.

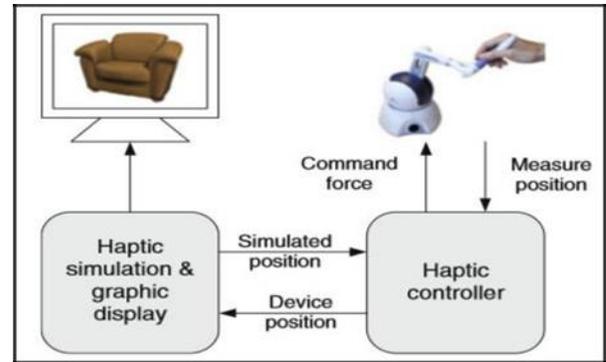


Fig. 2: - Force representation in a virtual world

In logical comprehension, the fundamental standard to influence protests in the virtual condition to stipulate data on the geometry, surface, slippage and encompassing temperature of thing's surface. Having the capacity to follow, understanding and touchable is much basic. At the point when beginning feeling of contact from a man's hand associates with a protest, the nerve receptors in the skin invigorates and energize. Whereby, the receptors give material data of touched items to the mind. At the point when the hand applies drive, sensation data (compel input) becomes an integral factor by giving physical data about the position and movement of the hand with respect to the question. By applying this science idea into virtual reality haptics, after human client controls the bland test (best known as end-effector) of the haptic gadget, position sensors of the instruments will transfer its end position to the PC. In each interim period, PC that controls the end-effector will check for grinding or conflict between the mimicked stylus and the virtual articles situated in virtual condition.

III. WORKING OF HAPTICS

To understand the basic working of haptics, consider the following diagram:

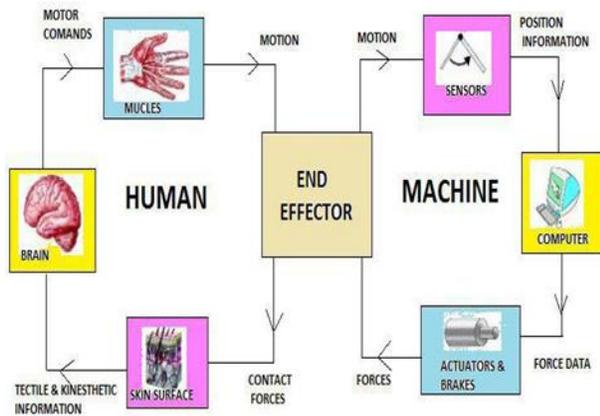


Fig. 3: - Block Diagram of Haptic Technology

The key components which are utilized to interface with PC are sensors, actuators, continuous calculation, and application programming interface. Haptic data given by the framework will be the blend of material data and sensation data.

- Tactile data alludes to the attention to incitement to the external surface of the body.
- Kinesthetic data alludes to the attention to appendages position and minute and additionally muscles pressure. Haptics can be subdivided into three zones:

a) Human Haptics:

Human haptics is the investigation of human detecting and control through touch. Human haptic framework comprises of two subsystems: engine subsystem and tactile subsystem. Both the frameworks are unequivocally connected with each other. Human use to various types of haptic investigation: dynamic and uninvolved. Dynamic haptic investigation is utilized when client controls its activity and aloof haptic investigation is utilized when someone else guides the hand or fingers of the client.

b) Computer Haptics:

Computer haptics is a calculation and programming related with creating and rendering the touch and feel of virtual articles. PC haptics is a quickly developing zone of research that is worry with the methods and the procedure related with producing and showing the touch and feel of virtual articles to a human administrator through a power reflecting gadget. It incorporates programming engineering required for

haptics communication and synchronization with visual and other show modalities.

c) Machine Haptics:

Machine haptics alludes to outline, development and utilization of machine to supplant or expand human touch. Haptic interfaces are gadgets the made out of mechanical parts in physical contact with the human body to exchange data with the human sensory system. Interface, the human client passes on wanted engine activities by physically controlling the interface, which in turns shows tangible tactile data to client by fittingly fortifying his or her material and kinesthetic tactile frameworks.

IV. HAPTICS RENDERING

Haptic rendering is the way toward creating and registering powers in light of the client's collaboration with the virtual protest. The way toward interfacing with the virtual protest has been of awesome enthusiasm to numerous scientists around the world. Rendering alludes to a procedure by which wanted jolts are forced on a client to pass on the data about the virtual protest. New innovation dependably flabbergasts individuals and similarly as the general population were stunned to see the PCs a couple of decades back, individuals are astounded to feel the virtual protests today. Haptic rendering is a standout amongst the most essential piece of the haptic interfaces as, better the haptic rendering better the virtual feel. To improve the haptic rendering different rendering calculations are actualized. In this area we will think about the approach of outlining and executing a haptic rendering calculation.

1) Tactile data: This alludes to the data gained by the sensors associated with the client's body.

2) Kinesthetic data: This alludes to the data gained by the sensors in the joints.

Haptics additionally acquaints us with the idea of virtual reality. Virtual Reality enables a client to cooperate with a PC recreated condition [3]. Clients collaborate with VR either through information gadgets or through multimodal gadgets. Such a

reenacted domain can either be like or unique in relation to reality. Virtual the truth is utilized to portray a wide assortment of utilizations. Notwithstanding, it is extremely hard to make a high constancy virtual reality encounter because of specialized impediments.

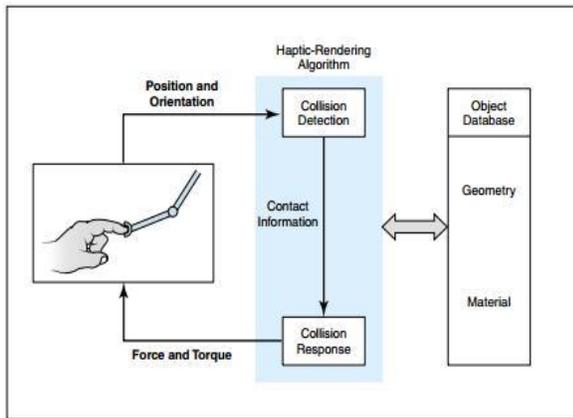


Fig. 4: - Haptic Rendering

As appeared in the above figure, the haptic rendering calculation frames the most imperative vital piece of the haptic system. The haptic rendering calculation by and large comprises of two sub - calculations, impact identification calculation and crash reaction calculation. As the client changes his position or the power input (appeared in Fig 2-a fingertip) the adjustment in position or introduction is obtained and the Collision Detection calculation distinguishes the crash between the fingertip and the virtual condition. On the off chance that an impact is recognized, at that point the Collision Response calculation figures the power of association between the client and the virtual condition and after that educates the reaction gadget to produce the required power, in this manner creating the real portrayal of the virtual question. The refresh rate of the haptic input circle must be no less than 1KHz, with a specific end goal to keep up the vibe of the virtual question. The Object Database ought to be kept up with the goal that all the physical properties of the protest can be recreated effectively in the virtual condition. In addition, estimation of the contact powers is similarly critical than simply figuring the impacts. Hence, better the haptic rendering calculation, better the impersonation of the genuine condition. Promote we will see the uses of haptic interfaces which constitute the rendering calculations to give precise outcomes for the separate application.

V. APPLICATIONS OF HAPTICS

a) Use of Haptic Feedbacks in Graphical User Interfaces:

Graphical User Interface (GUI) frames a necessary piece of any electronic framework if human cooperation is included. GUI enables the client to collaborate with the framework through graphical symbols, visual signs on the screen, content based interfaces and so on. In the event that a third measurement is added to the graphical UI, the association of the client with the electronic framework can be more practical. This third measurement that can be added to a GUI is haptics. The client cooperates with the PC as sound or content information sources. The reproduction motor mimics the contributions from the framework, forms it and exchanges the outcomes to the haptic media. The haptic equipment offers yields to the client in different arrangements, for example, touch sensations, drive inputs, vibrations and so on. This will improve the client's involvement of working the framework and will bring about more productivity in performing different capacities. Ongoing encounters can be given to the client in a GUI enlarging haptic criticism.

b) Haptics for Medical and Visual Disabilities:

Haptic interfaces for restorative reproduction have demonstrated extremely helpful. Touch and kinesthesia are unobtrusive, easy faculties which are imperative for quick, exact association with our condition. These end up being exceptionally vital for negligible obtrusive techniques. These incorporate laparoscopy, interventional radiology and remote surgery. In open surgery, specialists depend intensely on touch to recognize sound tissue from sickness tainted tissue. The upside of utilizing haptics system is that specialists can perform substantial number of comparative activity with less weariness

c) Haptics in Teleoperation:

Teleoperation implies task of a machine arranged at a separation .It is fundamentally the same as a remote control however is typically found in explore ,scholastics ,and specialized condition .In spite of the fact that it is normally connected with apply autonomy and versatile robots, it can at present be connected to a machine or a gadget which a man is working from a

separation .The cause of teleportation can be followed back to the start of radio correspondence and Nikola Tesla .He built up the basic rule and framework for teleportation in 1880's. Normally scenes are seen by 3D vision .Hence visual methodology is a prevalent wellspring of recognition, however material and surface attributes are likewise essential. Henceforth haptic investigation is required. Also in tele robotics control is required. Manipulation requires shut human – condition association. Thus, investigation and control are fundamental for tele robotics.

d) Data Visualization:

Utilization of designs and liveliness to break down or take care of issues is information perception .They are utilized as a part of logical examination and furthermore for outwardly weakened individuals .Using haptics a high caliber and precise information representation is conceivable .For instance SC Irun is logical information perception for critical thinking .Scientific information representation is likewise utilized for liquid stream show ,atomic association ,constrain field investigation .For outwardly impeded individuals touch is utilized as a channel to give data .Using graphical model produced using haptic input, even a genuine city can be investigated for the visually impaired individuals.

VI. LIMITATIONS

There are some of confinements related with haptics, which, if overcome, can cause haptics to achieve an unrest. Some of the restrictions are:

- a) Haptics being another innovation requires a high introductory venture and henceforth is expensive.
- b) The haptic gadgets are normally cumbersome. These gadgets are extensive in estimate and more prominent in weight which turn into a major issue in the event of wearable haptic gadgets.
- c) Haptic interfaces apply powers with restricted size and not similarly well every which way.
- d) Haptic rendering calculation which gives the virtual condition work in discrete time though the ongoing clients work in consistent time.
- e) Bandwidth impediment is a noteworthy issue related with haptics. Data transmission has restricted transfer speed.

VII. FUTURE APPLICATIONS

a) Holographic Interaction:

Research is carried on by adding haptic criticism to holographic projection. Using this input, the client gets material reaction from holograph as though it were a genuine question. It depends on utilizing ultrasound waves along these lines making acoustic radiation weight. It is through material reaction that client perceives the protest.

b) Biometric Haptics:

Haptics can likewise be utilized for biometric .Conventional biometrics require a one of a kind ID and secret word .These can be dull to recall and thus are badly arranged .Further these passwords are less secure .These can be hacked without being known and subsequently are not exceptionally sheltered and dependable .The haptic based biometric measure the position ,speed and power .After these estimations utilizing calculations ,remarkable physical examples can be created which can be utilized for recognizable proof.

c) E-Commerce:

Utilizing haptic input in electronic trade empowers buyers to physically interface with the item. The item can be felt by touching and properties, for example, surface, unpleasantness can be resolved. Consumers generally get a kick out of the chance to feel and touch the protest before purchasing. For instance: while purchasing a texture, the harshness, contact and delicate quality can be really felt by the client and consequently helps in their basic leadership.

VIII. CONCLUSION

Haptics is still in its beginning stage. It can possibly realize extraordinary upgrades in our communications with the virtual world. In any case, it has a couple of impediments in equipment, improvementcost, and its usage. Step by step, the cost of innovation is diminishing. Haptics is discovering applications in each conceivable field, for example, training, stimulation, workmanship, restorative, teleoperation. Haptics has a substantial future extension in each conceivable field. With an expansion in interests as far as cash, time, devotion and space haptics will undoubtedly upset the world. It is concluded that

Haptic Technology is the only solution which provides high range of interaction that cannot be provided by virtual reality. The touch access technology is important till now. But, haptic technology has totally changed this trend. This technology makes the future world as a sensible one. Haptic Technology enables users to simulate touch and utilize a new input as well as output technology Large potential for applications in critical fields as well as for leisurely pleasures. Haptic devices must be miniaturized so that they are lighter, simpler and easier to use.

REFERENCES

- [1] M. Mihelj and J. Podobnik, "Haptics for Virtual Reality and Teleoperation: Human Haptic System," in *Intelligent Systems, Control and Automation: Science and Engineering*, vol. 64. Netherlands: Springer Science and Business Media, 2012, pp.41-55.
- [2] N. Enayati, E. De Momi and G. Ferrigno, "Haptics in Robot-Assisted Surgery: Challenges and Benefits," in *IEEE Reviews in Biomedical Engineering*, vol. 9, pp. 49-65, 2016.
- [3] T. Hoshi, D. Abe and H. Shinoda, "Adding material response to 3D image," *RO-MAN 2009 - The eighteenth IEEE International Symposium on Robot and Human Interactive Communication*, Toyama, 2009, pp. 7-11.
- [4] Guido Böttcher, Dennis Allerkamp and Franz-Erich Wolter, "Virtual reality frameworks displaying haptic two-finger contact with deformable physical surfaces", *IEEE Trans. On Cyberworld*, 2007.
- [5] Volkov, S. what's more, J. Vance, Effectiveness of Haptic Sensation for the Evaluation of Virtual Prototypes. *Diary of Computing and Information Science in Engineering*, 2001.
- [6] Lien L.L, Chen Y.H. "Haptic Surgical Simulation: An Application to Virtual Suture", *Computer-Aided Design and Applications*, Vol. 3, Nos. 1-4, IEEE 2006, pp 203-210.
- [7] Cagatay Basdogan, Suvranu De, Jung Kim, Manivannan Muniyandi, Hyun Kim, and Mandayam A. Srinivasan, "Haptic in Minimally Invasive Surgical Stimulation and Training", *IEEE Computer Graphic and Applications*, March/April 2004.