

Innovations Utilizing Haptic Technology in Industry 4.0 Era

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Abstract – Haptic refers to technology that uses touch to control and interact with computers. A user may apply a sense of touch through vibrations, motion or force. Haptic technology is used in creating virtual objects, controlling virtual objects or in the improvement of the remote control of machines and devices.

Impact of haptic based technologies in Industry 4.0 is going to have ripple effect. In the world of world wide web (www) humans virtually live in virtual world for literally eight to ten hours on a daily basis. The question which this article tends to address is the future of innovations and specially innovations based on haptic technology in years to come and the impact of the haptic technologies on humanity in Industry 4.0 era.

Haptic technology has opened up a myriad of possibilities from vibrating cell phones, to smart watches, wristbands, virtual reality training simulators, and implantable devices. It is being utilized for precision surgeries. The haptic technology might be the solution to the growing accident rates globally.

Keywords: Industry 4.0, Haptic technology, Virtual reality, Vehicle safety, Wearable device, Robotics

I. INTRODUCTION

THE word “Haptic” in normal understanding relates to the ability of humans to perceive action like seeing, hearing, or becoming aware of something that result from any form of interaction involving touch or the sense of touch. In innovation world, any technology that uses touch to control and interact with computers is termed as haptic technology. The person using the haptic technology is able to apply a sense of touch through vibrations, motion or force.

Haptics (pronounced HAP-tiks) is the science of applying touch (tactile) sensation and control to interaction with computer applications. The word derives from the Greek haptain meaning “to fasten.” Haptics offers an additional dimension to a virtual reality or 3-D environment and is essential to the immersiveness of those environments.

By using special input/output devices (joysticks, data gloves or other devices), users can receive feedback from computer applications in the form of felt sensations in the hand or other

parts of the body. In combination with a visual display, haptics technology can be used to train people for tasks requiring hand-eye coordination, such as surgery and space ship maneuvers. It can also be used for games in which you feel as well as see your interactions with images.

Haptic technology is often associated with the buzzes and clicks of our smartphone alerts, notifications, and the subtle way they give us feedback as we interact with the device.

Haptics aren’t a new technology. Manufacturers have been using them in electronics since the late 1990’s, from video game systems like Nintendo 64 rumble pack, to early mobile phones. Haptics are also used widely in medical and automotive applications.

Author has been a big admirer of Nicolas Tesla. The crux of his extended research has always focussed on three main issues: *energy, frequency and vibrations*. Every innovator over the years in some way or the other has been influenced by his research and learned the art of deduction of vibrations. A number of innovations have solved massive problems by using vibrations, motion or force to attain certain results.

In recent years, with the aim to recreate the sense of touch via a handheld haptic device, haptic technology has opened up a myriad of possibilities from vibrating cell phones that alert you to an incoming message or call, to smart watches, wristbands, virtual reality training simulators, and implantable devices that produce tactile feedback. Further, the haptic technology is being utilized for precision surgeries and has been deployed in performing robotic surgeries.

II. WHAT IS A HAPTIC DEVICE?

Generally, a Haptic device incorporates micro-controllers, drivers, actuators or motors, as well as software for multimodal experiences that improve the usability by engaging touch, sound and sight [1]. The new term gaining importance in recent years is virtual reality (VR) applications and haptic based devices are being utilised for so many important applications from the point of view of achieving precision. Humans love change and

change is inevitable aspect of being more human. Human mind is craving for more content in the online web world.

The virtual reality (VR) applications are going to provide the users a greater sense of realism and create a 3D environment. How the human neurons and lobes are going to perceive this technology only time will tell in future.

Currently, the haptic technology is being extensively utilised in smartphones, computer and video games to get the users hooked on to the internet for long hours. Recently, a number of patents were filed for the utilization of haptic technology in healthcare sector and especially robotics and vehicle transportation. One of the haptic based technologies relates to a vehicle performance control device conceived to autonomously determine a safe, economic and eco-sustainable driving behaviour to reduce the mechanical stress, the wear and the maintenance cost of vehicles.

In operation, the vehicle performance control device is positioned between the vehicle's Pedal Interface (PI) and the vehicle's Electronic Control Unit (ECU). The vehicle's Pedal Interface (PI) includes the cruise control, the speed limitation and the speed control systems, or a combination of these as illustrated in Figure 1.

The vehicle performance control device autonomously and dynamically acts on the functional status of the cruise control, the speed limitation or the speed control system to modulate the vehicle's performance. The performance of the vehicle is tuned depending on the current vehicle's position, speed, acceleration, inclination and pose respect to the ground.

For example, the vehicle's max speed can be limited in specific geographic areas or during specific time intervals when the driver is supposed to drive improperly, excessively were off the vehicle, or parts of it, or stress the mechanics [2].

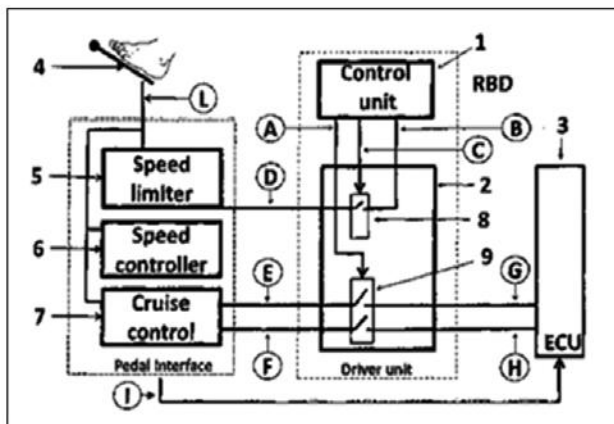


Figure 1. Vehicle control system.

For example, the engine performance will be not limited if the vehicle gets in an uphill over a certain inclination threshold to

avoid stops due to torque outages. The control device embeds a communication unit able to connect to the internet, exchange data with personal computers, diagnostic tools or personal devices such as smartphones and tablets.

The control device provides all the useful information for the estimation of the vehicle's status, the driver's behaviour and the induced mechanical stress and wear off. Imagine the big data being generated around this technology. The communication unit is intended to exchange data for the monitoring of the vehicle's status, its performance and for the tuning of the control unit's strategy. The communication can be automatically scheduled by the system itself, attempted by the remote fleet's managers or the fleet's management systems, or performed by humans operators or the connected remote devices on requests.

A human machine interface provides visual, acoustic or haptic feedbacks, or a combination of these, to the driver on the status of the control device, the estimated level of wear or mechanical stress induced on the vehicle or part of the vehicle, the drive safety, efficiency and the eco-sustainability.

The current innovative Right Behaviour Driver (RBD) innovative system is providing an adaptive and reconfigurable apparatus to be deployed in the vehicle. The haptic technology might be the solution to the growing accident rates globally and the present innovation is capable of autonomously and actively control the vehicle's performance to determine a safe, efficient and effective drive.

Music is spice of life and the frequency of music is able to calm the mind. Numerous innovations are being protected by way of filing patents. Patents is a type of Intellectual Property Right. Patent right is granted to the innovator for a period of 20 years from the first day of filing the patent information before the patent office. Patent is technological creativity which can be protected and patent is used to grant license to interested third party. The intellectual property ecosystem is very conducive to learn and develop unicorn business model in industry 4 era.

“Reach high, for stars lie hidden in you. Dream deep, for every dream precedes the goal.” — Rabindranath Tagore.

The goal of innovation is to harness the potential of technology to solve problems encountered in life. Recently, a wearable vest has been designed [3] to enable a hearing impaired person to experience sounds as illustrated in figure 2. Sound can be in the form of music, alarms, and speech. The wearable vest deploys vibratory motors to generate a haptic language for music that is integrated into wearable technology. The wearable sound vest acts an assistive device for the hearing impaired person. The hearing impaired person is able to experience sounds such as music or other auditory input. The input is the sound or music and the input is transformed to haptic signals. The

generated haptic signals provide the person the experience of their favourite music in a unique way to provide enjoyable life.

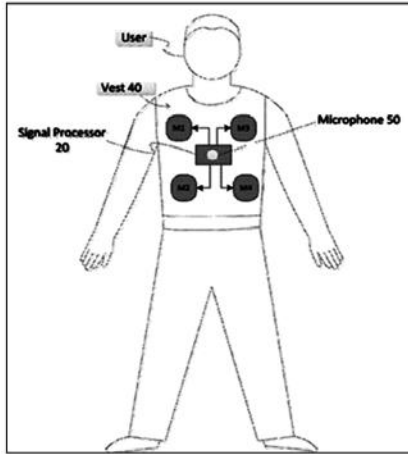


Figure 2 (a). Wearable devices.

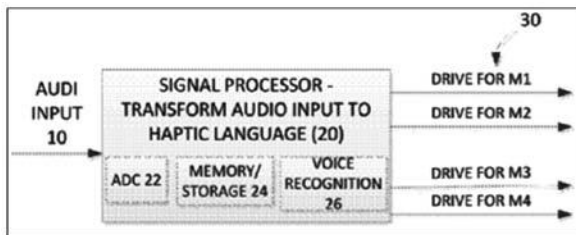


Figure 2 (b). Block schematic for the wearable device.

III. INTERESTING APPLICATIONS

Video game makers have been early adopters of passive haptics, which takes advantage of vibrating joysticks, controllers and steering wheels to reinforce on-screen activity. But future video games will enable players to feel and manipulate virtual solids, fluids, tools and avatars.

Haptic technology is widely used in telerobotics, where a human operator controls the movements of a robot that is located some distance away. Some teleoperated robots are limited to very simple tasks, such as aiming a camera and sending back visual images. In a more sophisticated form, the human operator has a sense of being located in the robot's environment. Haptics now makes it possible to include touch cues in addition to audio and visual cues. It won't be long before astronauts and planet scientists actually hold and manipulate a Martian rock through an advanced haptics-enabled telerobot -- a high-touch version of the Mars Exploration Rover.

Computer scientists in Greece are incorporating haptic technology into touchable maps for the blind. To create a map, researchers shoot video of a real-world location, either an architectural model of a building or a city block. Software evaluates the video frame by frame to determine the shape and location of every object. The data results in a three-dimensional grid of force fields for each structure. Using a haptic interface device, a blind person can feel these forces and, along with

audio cues, get a much better feel of a city's or building's layout.

IV. IMPACT OF HAPTIC TECHNOLOGIES IN INDUSTRY 4.0

The adoption of new technologies in Industry 4.0 era is going to be game changer and is going to have a ripple effect on the way haptic based technologies being perceived by humans. Change is the inevitable aspect to stay ahead in business and adoption of haptic based technologies along with Internet of Things (IoT), cloud computing, and artificial intelligence will be necessary to keep the growth curve exponential and non-linear at the same time.

Automation of technologies is going to solve alpha stage problems and give an opportunity to bypass small challenges to create the next disruptive technology. Many services and business models are going to be affected and in-turn the product lifecycle is going to come down eventually in near future.

With the continued proliferation of gaming, smartphones, and new hardware devices, haptics will continue to be an integral part of bridging the human-device experience.

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Ms. Prity Khastgir (b. 26 Dec. 1984). Obtained B.A.Sc (Hons) in Applied Sciences specialising in Food technology from University of Delhi and M.Sc in Biotechnology and LLB from University of Rajasthan. Did Entrepreneurship course from Indian School of Business (ISB) sponsored by Goldman Sachs 10,000 Women Entrepreneurs Initiative. She is Certified Mediator for Commercial Disputes and Negotiator in India. Currently, she is working towards launching innovation hub in domestic and international level.

She is passionate about technology, law and business on a global scale. Recently, she was invited by China Government for China International Big Data Expo 2018, Guiyang. She is active in international technology arena and recently participated in the 4th Annual Asia Pacific Spectrum Management Conference and in World Summit on the Information Society (WSIS) Forum 2018, Geneva.

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Aligning and facilitating youth to be driven in the industry 4.0 era is her motto to take India's GDP to next level. She is a guest faculty at IMT, Ghaziabad taking lectures on legal aspects of doing business in India and understanding the innovation ethos globally.