Knowledge Management System Through Haptic Technology

Mrs. P. Sagaya Aurelia, Mr. P. F. Xavier Patrick Kishore, Mr. Khamis Faraj Alarabi.

Department of Computer Science,
Faculty of Education,
Baniwalid, Libya
psagaya.aurelia@gmail.com, patrick.kishore@gmail.com.,Kf_alarabi@yahoo.com

***Abstract*:Haptics is the science of applying touch (tactile) sensation and control to interact with computer applications. The word is derived from the Greek word "haptein" meaning "to fasten."Organizations worldwide are using techniques and technologies to better manage their knowledge. Their objectiveis to improve the quality of knowledge sharing by exploiting tacit and explicit knowledge of successes and failures.Haptic technology is like exploring the virtual world with a stick. The computer communicates sensations through a haptic interface –a stick, scalpel, racket or pen that is connected to a force-exerting motor. In this paper we explicate knowledge management, dynamic use of haptic technology as learning tool, how haptic technology works and its significance. Then, we move on to its advantages and disadvantage a few applications of Haptic Technology. Finally we conclude by mentioning a few future developments.**

KEYWORDS: Knowledge management, haptic technology

I. Introduction

"KM [Knowledge Management] involves blending a company's internal and external information and turning it into actionable knowledge via a technology platform."Susan DiMattia and Norman Oder in *Library Journal*, September 15, 1997.

Knowledge management is simply the practice of capturing, storing and sharing knowledge so that we can learn lessons from the past and apply them in the future. "Knowledge management is concerned with the exploitation and development of the knowledge assets of an organization with a view to furthering the organization's objectives. From an organizational context, it has become Knowledge management increases the ability to learn from its environment and to incorporate knowledge into the business processes by adapting to new tools and technologies (Liautaud and Hammond, 2001). Knowledge gained from positive or negative experiences has to be managed well and is one of the important sources of knowledge today. Davenport defines knowledge as "information combined with experience context interpretation and reflection". Good knowledge management can support organizations in promoting continuous learning where new knowledge can be practiced and used whenever it is needed. There is an increase of interest towards KM in organizations and academia.

Haptic technology, or **haptics**, is a tactile feedback technology that takes advantage of a user's sense of touch by applying forces, vibrations, or motions to the user. It has been described as "doing for the sense of touch what computer graphics does for vision". Although haptic devices are capable of measuring bulk or reactive forces that are applied by the user, they- should not be confused with touch or tactilesensors that measure the pressure or force exerted by the user to the interface.

Haptic technology has made it possible to investigate in detail how the human sense of touch works by allowing the creation of carefully controlled haptic virtual objects. These objects are used to systematically probe human haptic capabilities, which would otherwise be difficult to achieve. These new research tools contribute to the understanding of how touch and its underlying brain functions work. Table 1 shows the basic characteristics of data, information and knowledge.

II. Knowledge Management an Overview

"Knowledge Management is the collection of processes that govern the creation, dissemination, and utilization of knowledge"

A knowledge management system (KMS)is an organized collection of people, procedures, software, databases, and devices used to create, store, share, and use the organization's knowledge and experience.

A KMS can involve explicit and tacit knowledge. Explicit knowledge is objective and can be measured and documented in reports and rules. Determining if a person qualifies for a bank loan based on the company's rules is an example of explicit knowledge. Tacit knowledge is harder to measure and document and is typically not objective or formalized. Knowing the best way to negotiate a complex labour dispute would utilize tacit knowledge. Many organizations attempt to convert tacit knowledge to explicit knowledge to make the knowledge easier to measure, document, and share with others through knowledge management systems.

IBM's Lotus Notes/Domino and Microsoft's Digital Dashboard are examples of software designed to support knowledge management. In addition to software tools, artificial intelligence and special-purpose technologies and tools can be used in a knowledge management system.

A closer look at these models allows the distinction between tacit and explicit knowledge as well as present a list in which each of these concepts appears associatedwith a set of keywords (see Table 1).

Data	Information	Knowledge
Explicit	Interpretable	Tacitus / embedded
Exploitable	Explored	Created
Usable	Built	Reconstructed
Acceptance	Confirmed	Deformed
Based on previous models	Amendment of previous models	Develop new models
Without learning	Single-step learning	Several steps of learning
Directorate	Communication	Based on the sense
Prescriptive	Adaptable	Seminal
Efficient	Effective	Innovation / redundancy
Predetermined	Restricted	Flexible
Without context	With context	Within the context
Technical systems	Socio-technical systems	Social networks

Source: Adapted from Galliers and Newell (2001)

[1] TABLE 1- BASIC CHARACTERISTICS OF DATA, INFORMATION AND KNOWLEDGE

Knowledge management and organizational learning clearly involve the search for technical excellence and productivity. Knowledge Management (KM) encompasses a wide range of tools and methods that are at the heart of the information and communication society and provide solutions that rely as much on organization as on technology.Figure 1 shows the starting framework of knowledge management system.

- Knowledge management system (KMS)
  - Organized collection of people, procedures, software, databases, and devices
  - Used to create, store, share, and use the organization's knowledge and experience

Technology to Support Knowledge Management

- Effective KMS
  - Is based on learning new knowledge and changing procedures and approaches as a result

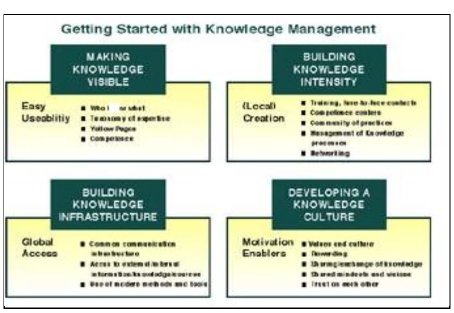

Figure 1 Getting started Knowledge management system [2]

Figure1. Getting started Knowledge management system [2]

III. TECHNOLOGY ENABLES NEW KNOWLEDGEBEHAVIORS

- Technology shapes how we live (radio, television, computer, biotechnology)
- Pushes KM, doesn't drive it
- Facilitates flow of knowledge. Figure 2 shows the integration of IT and knowledge management
  - One look, one feel
  - Easy access
  - Easy dissemination (push-pull)
  - Different storage (from paper to digits)

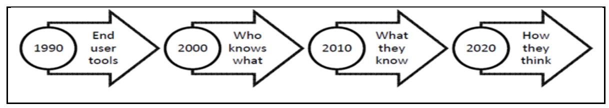

Figure 2 Integration of IT and knowledge management [1]

IV. THE DDYNAMIC USE OF HAPTIC TECHNOLOGY AS A LEARNING TOOL

The Active way of learning procedure is to gain knowledge by participating, investigating the physical scene and manipulating its elements. One of the first active ways of Learning Procedure has been the experiments performed at school, providing students with the ability to acquire practical knowledge that plays a great deal in cognition of science. In the last years several multimedia and on-line applications have been released allowing children to study scientific issues. There are commercial applications concerning Physics and Chemistry, containing images, sounds, videos and animations that describe several phenomena and allow children to participate, interact and play with the content while gaining knowledge. In the Active way of learning, students experience the principles that rule nature in a more focused way and it becomes apparent almost instantly whether they have understood the theory that describes the Physic world correctly or erroneously. [6]

V. THE SCIENCE OF HAPTICS

Haptic is the "science of applying tactile sensation t human interaction with computers".

Haptics is a term derived from the *Greek* word which is based on the sense of touch haptic technologies provide force feedback to users about the physical properties and movements of virtual objects represented by a computer. Haptic is the newest technology to arrive in the world of computer interface devices -- promises to bring profound changes to the way humans interact with information and communicate ideas. Recent advances in computer interface technology now permit us to touch and manipulate imaginary computer-generated objects in a way that evokes a compelling sense of tactile "realness."With this technology we can now sit down at a computer terminal and touch objects that exist only in the "mind" of the computer. These interactions might be as simple as touching a virtual wall or button, or as complex as performing a critical procedure in a surgical simulator. The term "haptics" has been used for years by researchers in human psychophysics who study how people use their hands to sense and manipulate objects. Recently the term "haptic interfaces" has begun to be used by human interface technologists to describe devices that measure the motions of, and stimulate the sensory capabilities within, our hands. Figure 3 shown a example how haptic technology is implemented.

Figure 3 Implementation of haptic technology

Haptics can enhance the user experience through:

Improved Usability: By restoring the sense of touch to otherwise flat, cold surfaces, haptics creates fulfilling multi-modal experiences that improve usability by engaging touch, sight and sound. From the confidence a user receives through touch confirmation when selecting a virtual button to the contextual awareness they receive through haptics in a first person shooter game, haptics improves usability by more fully engaging the user's senses.

Enhanced Realism: Haptics inject a sense of realism into user experiences by exciting the senses and allowing the user to feel the action and nuance of the application. This isparticularly relevant in applications like games or simulations that rely on only visual and audio inputs. The inclusion of tactile feedback provides additional context that translatesinto a sense of realism for the user.

Restoration of Mechanical Feel: Today's touchscreen driven devices lack the physical feedback that humans frequently need to fully understand the context of theirinteractions. By providing users with intuitive and unmistakable tactile confirmation, haptics can create a more confident user experience and can also improve safety byovercoming distractions. This is especially important when audio or visual confirmation is insufficient, such as industrial applications, or applications that involve distractions, suchas automotive navigation. The potential for haptics in computer interface design goes beyond using touch to simulate forces found in nature. Haptics can be used to develop a tactile language that consistently delivers touch cues to reinforce typical interactions. A simple example of this, in wide use today, is the delivery of different vibrations to signal incoming calls, incoming text messages, etc., on a mobile device. In this course we will explore a sample application, Bouncing Ball that uses tactile feedback to provide dimension to a library of visual objects. [5].Figure 4 shown how haptic technology works.

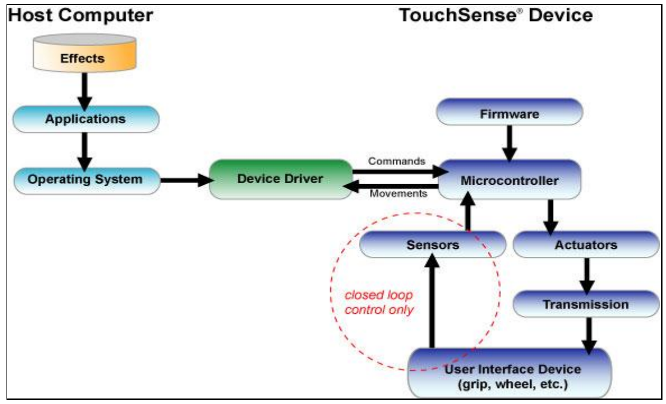

Figure 4Working of Haptics

VI. WHY HAPTICS ?

- Touch is the **first sense to develop** when we are born and the **last sense used** before death.
- It is **20 times faster** than vision.
- **No need of continuous user interaction** with the mobile device.
- **Need not be a map expert** to understand the way haptic feedback works.
- Humans are **highly sensitive to vibrations** up to1000Hz (most sensitive at 250Hz)
- The user can **interact with the real environment** and people around rather than the mobile device.
- in training and other applications, haptic interfaces are vital.
- It also reduces the energy consumption and the magnitudes of contact forces used in a teleoperation situation.

VII. UNIQUENESS OF THE TECHNOLOGY

Haptic is generally enabled by actuators which provide the required mechanical motion upon application of an electrical stimulus. This results in the application of a force to the end

user's skin so as to provide touch feedback. Certai conventional designs of Haptic feedback use electromagnetic motors to provide feedback. These motors need to operate at resonance and also have limited range of sensations. Next generation Haptic actuator technologies, such as electroactive polymers and piezoelectric actuation, have emerged in recent years, however these technologies make use of discrete actuators to provide the required motion. Electroactive polymer actuator technology makes use of shape-shifting technology in which a voltage is applied across two thin elastic film electrodes which are separated by an elastic dielectric polymer. This voltage difference causes the oppositely charged electrodes to attract each other resulting in pressure upon polymer material available in between the electrodes. The products based on this technology include motors, actuators, pumps, generators and transducers/sensors. However, the dependence on such discrete actuators necessitates the use of a separate frame or holder to couple the actuator to the touch screen. The battery life is also impacted based on the type and the frequency at which feedback is provided to the end user. In the case of gaming applications, this impact is expected to be more significant owing to the high usage and long durations at which feedback is provided. It also adds to the overall cost and complexity involved in the manufacture of the product.[3]

VIII. HAPTIC DEVICES

Haptic devices (or haptic interfaces) are mechanical devices that mediate communication between the user and the computer. Haptic devices allow users to touch, feel and manipulate three-dimensional objects in virtual environments and tele-operated systems. Haptic devices are input-output devices, meaning that they track a user's physical manipulations (input) and provide realistic touch sensations coordinated with on-screen events (output). Examples of haptic devices include consumer peripheral devices equipped with special motors and sensors (e.g., force feedback joysticks and steering wheels) and more sophisticated devices designed for industrial, medical or scientific applications (e.g., PHANTOM)

Other Low-cost Haptic Devices: [4]

1. Haptic Paddles
2. Haptic knobs
3. Novint Falcon
4. Force Feedback Gaming Joysticks
5. SensAble's Omni Phantom

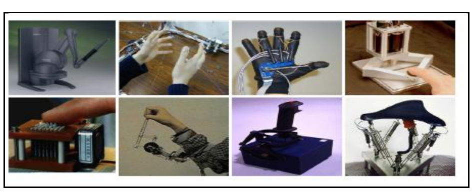

Figure 4 Haptic devices

IX. ADVANTAGES

- Communication is centered through touch and the digital world can behave like the real world.
- Working time is reduced since objects can be captured, manipulated, modified and rescaled digitally.
- Touch sensations make navigating software user interfaces easier by assisting with hand-eye coordination and confirming completed tasks.
- Sensations, such as unique vibrating effects, assist in identifying callers without the use of sound.
- Touch sensations can replace or complement graphical cues to diminish problems with screen glare or when looking at the screen is inconvenient, such as receiving an alert during a call.
- Surveys show a clear and measurable preference for haptic-enabled applications:
- 90% of respondents indicated a preference for haptics in their next phone.
- 95% of users surveyed perceived next-generation, haptic-enabled applications to be ofhigh value.[5]

X. DISADVANTAGE

- The precision of touch requires a lot of advance design. With only a sense of touch, haptic interfaces cannot deliver warnings.
- Haptics applications can be extremely complex, requiring highly specialized hardware and considerable processing power.
- The complexity also means that many haptics projects rely on fixed installations of equipment and are not easily portable.
- Debugging issues—these are complicated since they involve real-time data analysis.
- As the objects being manipulated in haptics are virtual, a compelling interaction with the device requires that all of the physical properties and forces involved be programmed into the applica-tion. As a result, costs for haptics projects can be considerable.

XI. APPLICATIONS OF HAPTIC TECHNOLOGY

Graphical user interfaces, like those that define Windows and Mac operating environments, will also benefit greatly from haptic interactions.Although several companies are joining Novint and Nokia in the push to incorporate haptic interfaces into mainstream products, cost is still an obstacle.. Aircraft mechanics can work with complex parts and service procedures, touching everything that they see on the computer screen. And soldiers can prepare for battle in a variety of ways, from learning how to defuse a bomb to operating a helicopter, tank or fighter jet in virtual combat scenarios.

Haptic technology is also widely used in teleoperation, or telerobotics. In a telerobotic system, 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 of teleoperation known as telepresence, 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 in telepresence models. It won't be long before astronomers and planet scientists actually hold and manipulate a Martian rock through an advanced hapticsenabled telerobot.

XII. Future Challenges and Opportunities

Although both ground-based and exoskeleton force-reflecting haptic interface devices are available in the market, further improvements in range, resolution, and frequency bandwidth of these devices are needed to match their performance with that of the human user. Ability to reflect torques in addition to forces, enough degrees of freedom to permit grasping and two-handed manipulation of objects is high on the list of desirable improvements. In moving towards realistic haptic displays that mimic direct natural touch, tactile displays are probably the most challenging among the technologies that need to be developed. The emerging field of micro-mechanical systems holds promise for providing very fine arrays of tactile stimulators. Although capable of relatively small forces and deflections, arrays of such actuators integrated with addressing electronics are expected to be inexpensive, lightweight, and compact enough to be worn without significantly impeding user’s actions. In the area of computer haptics, the current models of virtual objects that can be displayed haptically in real-time are quite simplistic compared to the static and dynamic behavior of objects in the real world. Computationally efficient models and interaction techniques that result in real-time haptic displays that match the human perceptual capabilities in accuracy and resolution will continue to be a challenge, even with the current rate of increase in processing speeds. This is because the complexity of the models, such as in detecting collisions of moving multiple objects or in performing a mechanistic analysis of a deformable object in real-time, can be arbitrarily high. Synchronization of the visual, auditory and haptic displays can be problematic, because each modality requires different types of approximations to simulate the same physical phenomenon. Use of multiple processors with shared memory and/or multi-threading seems to be essential. To have haptics across the internet in a manner that is useful to a large number of users, standardized protocols for distributed VEs should include haptics explicitly. Due to inherent hardware limitations, haptic interfaces can only deliver stimuli that approximate our interactions with the real environment. It does not, however, follow that synthesized haptic experiences created through the haptic interfaces necessarily feel unreal to the user. Consider an analogy with the synthesized visual experiences obtained while watching television or playing a video game. While visual stimuli in the real world are continuous in space and time, these visual interfaces project images at the rate of about 30 frames/sec. Yet, we experience a sense of realism and even a sense of telepresence because we are able to exploit the limitations of the human visual apparatus. The hope that the necessary approximations in generating synthesized haptic experiences will be adequate for a particular task is based on the fact that the human haptic system has limitations that can be similarly exploited. To determine the nature of these approximations, or, in other words, to find out what we can get away with in creating synthetic haptic experiences, quantitative human studies that are tightly coupled with technology development are essential to assess which types of stimulation provide the most useful and profound haptic cues for the task at hand. Many of the point-based rendering algorithms have been already incorporated into commercial software products such as the Reachin API, GHOST SDK, and OpenHaptics. [7]

XIII. Conclusions

Development and refining of various kinds of haptic interfaces will continue, providing more and increasingly lifelike interactions with virtual objects and environments. Researchers will continue to investigate possible avenues for haptics to complement real experiences. Advances in hardware will provide opportunities to produce haptic devices in smaller packages, and haptic technology will find its way into increasingly commonplace tools.[4]

Haptic is the future for online computing and e-commerce, it will enhance the shopper experience and help online shoppers to feel the merchandise without leaving their home. Because of the increasing applications of haptics, the cost of the haptic devices will drop in future. This will be one of the major reasons for commercializing haptics. With many new haptic devices being sold to industrial companies, haptics will soon be a part of a person’s normal computer interaction.

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