ABSTRACT

The presently available methods of reducing motion sickness include a series of process like deactivating the neural activity by medication of ointment packs so that the sensory organs such as skin senses get diminished and so on. This causes uneasiness and side effects. As a part of the study, analysis is being done for the development of a system for reducing the motion sickness caused by kinetosis. Kinetosis is the medical condition of a person subjected to impulsive events that occur at low frequency i.e. entry and exit from curves for road vehicles, vertical acceleration and deceleration in case of aircrafts and lifts or roll on wave motions. The detailed study involves the application of vibrations on stressed points such that the motion sickness will be reduced by the system being developed.

Keywords---- Motion, Sickness, Diagnostics

I. INTRODUCTION

1. Motion Sickness

Motion sickness or kinetosis, also known as travel sickness, is a condition in which a disagreement exists between visually perceived movement and the vestibular system's sense of movement. Depending on the cause, it can also be referred to as sea sickness, car sickness, simulation sickness or air sickness. Dizziness, fatigue, and nausea are the most common symptoms of motion sickness. "Sopite syndrome", in which a person feels fatigue or tiredness, is also associated with motion sickness. "Nausea" in Greek means sea sickness (naus means ship). If the motion causing nausea is not resolved, the sufferer will usually vomit. Vomiting often will not relieve the feeling of weakness and nausea, which means the person could vomit until the cause of the nausea is treated.

2. Causes of Motion Sickness

The most common hypothesis for the cause of motion sickness is that it functions as a psychological defense mechanism against neurotoxins. The area postrema in the brain is responsible for inducing vomiting when poisons are detected, and for resolving conflicts between vision and balance. When feeling motion but not seeing it (for example, in a ship with no windows), the inner ear transmits to the brain that it senses motion, but the eyes tell the brain that everything is still. As a result of the discordance, the brain will come to the conclusion that the individual is hallucinating and further conclude that the hallucination is due to poison ingestion. The brain responds by inducing vomiting, to clear the supposed toxin.

Types of Motion Sickness

Motion sickness can be divided into three categories. They are enumerated as below:
(a) Motion sickness caused by motion that is felt but not seen;
(b) Motion sickness caused by motion that is seen but not felt; and
(c) Motion sickness caused when both systems detect motion but they do not correspond.

Motion is felt but not seen

In these cases, motion is sensed by the vestibular system and hence the motion is felt, but no motion or little motion is detected by the visual system.

i) Car sickness

A specific form of motion sickness, car sickness is quite common and often evidenced by the inability to read a map or book during travel. Car sickness results from the sensory conflict arising in the brain from differing sensory inputs. The eyes mostly see the interior of the car which is motionless while the vestibular system of the inner ear senses motion as the vehicle goes around corners or over hills and even small bumps. Therefore the...
Sea sickness is a form of motion sickness characterized by a feeling of nausea and, in extreme cases, vertigo experienced after spending time on a craft on water. It is essentially the same as car sickness, though the motion of a watercraft tends to be more constant. It is typically brought on by the rocking motion of the craft or movement while immersed in water. As with airsickness, it can be difficult to visually detect motion even if one looks outside of the boat as water does not offer fixed points with which to visually judge motion. Poor visibility conditions, such as fog, may worsen sea sickness. Some sufferers of car sickness are resistant to sea sickness and vice versa.

ii) Sea sickness

Sea sickness is a form of motion sickness characterized by a feeling of nausea and, in extreme cases, vertigo experienced after spending time on a craft on water. It is essentially the same as car sickness, though the motion of a watercraft tends to be more constant. It is typically brought on by the rocking motion of the craft or movement while immersed in water. As with airsickness, it can be difficult to visually detect motion even if one looks outside of the boat as water does not offer fixed points with which to visually judge motion. Poor visibility conditions, such as fog, may worsen sea sickness. Some sufferers of car sickness are resistant to sea sickness and vice versa.

iii) Dizziness due to spinning

When one spins and stops suddenly, fluid in the inner ear continues to rotate causing a sense of continued spinning while one's visual system no longer detects motion.

Motion that is seen but not felt

In these cases, motion is detected by the visual system and hence the motion is seen, but no motion or little motion is sensed by the vestibular system. Motion sickness arising from such situations has been referred to as "visually induced motion sickness" (VIMS)

a) Motion sickness due to films and other video

This type of sickness is particularly prevalent when susceptible people are watching films on large screens such as IMAX but may also occur in regular format theatres or even when watching TV. For the sake of novelty, IMAX and other panoramic type theatres often show dramatic motions such as flying over a landscape or riding a roller coaster. This type of motion sickness can be prevented by closing one's eyes during such scenes. Home movies, often filmed with a hand-held camera, also tend to cause motion sickness in those that view them. The cameraman rarely notices this during filming since their sense of motion matches the motion seen through the camera's viewfinder. Those who view the film afterwards only see the movement, which may be considerable, without any sense of movement. Using the zoom function seems to contribute to motion sickness as well as zooming is not a normal function of the eye. The use of a tripod or a camcorder with image stabilization technology while filming can minimize this effect.

Motion sickness due to virtual reality

Motion sickness due to virtual reality is very similar to simulation sickness and motion sickness due to films. In virtual reality, however, the effect is made more acute as all external reference points are blocked from vision, the simulated images are three-dimensional and in some cases stereo sound that may also give a sense of motion.

The NADS-1, a simulator located at the National Advanced Driving Simulator, is capable of accurately stimulating the vestibular system with a 360-degree horizontal field of view and 13 degree of freedom motion base. Studies have shown that exposure to rotational motions in a virtual environment can cause significant increases in nausea and other symptoms of motion sickness.

Motions that are seen and felt do not correspond

When moving within a rotating reference frame such as in a centrifuge or environment where gravity is simulated with centrifugal force, the coriolis effect causes a sense of motion in the vestibular system that does not match the motion that is seen. Sometimes when riding a vehicle for a long time on a badly maintained road at a very slow (10-20 km/h) speed, the two senses fail to correspond. Due to the poor road quality the vehicle will jerk too much giving a sense of severe motion to the inner ear, but due to the slow speed, the eye doesn't sense a proportional amount of motion.

II. LITERATURE REVIEW

Graybiel et.al [1] presented a new diagnostic criteria for grading the severity of acute motion sickness. It was more suited to clinical application as empirical evaluations than for precise measurement of physiological functions. Oman et.al [2] discusses a model that postulates a major dynamic functional role for sensory conflict signals in movement control as well as in sensory-motor adaptation. It accounts for the role of active movement in creating motion sickness symptoms in some experimental circumstances and in alleviating them in others. The relationship between motion sickness produced by "sensory rearrangement" and that resulting from external motion disturbances is explicitly defined. A nonlinear conflict averaging model is proposed that describes dynamic aspects of experimentally observed subjective discomfort sensation and suggests resulting behaviors. Since the occurrence of vomiting as a response to motion is both widespread and apparently disadvantageous, it presents a problem for evolutionary theory.

M Treisman et.al[3] proposed an hypothesis that motion sickness is triggered by difficulties which arise in the programming of movements of the eyes or head when the relations between the spatial frameworks defined by the visual, vestibular, or proprioceptive inputs are repeatedly and unpredictably perturbed. Such perturbations may be produced by certain types of motion, or by disturbances in sensory input or motor control produced by ingested toxins. The last would be the important cause in nature, the main function of the emesis being to rid the individual of ingested neurotoxins. Its occurrence in response to motion would be an accidental byproduct of this system.
III. PROBLEM DEFINITION

The present paper illustrates a method developed by the team members to design and fabricate a model that helps to reduce the motion sickness as defined by KINETOSIS (low frequency motions).

The various methods that can be adopted for alleviating motion sickness are:
1. Acupuncturing for Zusanli.
2. View shortening.
3. Plugging for Vestibular system.

1. Acupuncturing for Zusanli

Acupuncturing for Zusanli reduces the motion sickness which is a continuous process to be done at the nodes of low frequency vibrations when these are generated according to the problem statement defined.

2. View shortening

In the present study, we examined the effects of the time lag between visual scene and the head movement in the virtual reality (VR) world on motion sickness and its control in healthy volunteers. The visual-vestibular conflict induced slight motion sickness. In order to reduce the visionary mismatch sickness, a flap like device is introduced in front of the eyes. This reduces the visionary mismatch by shortening the view of the passenger or by projecting a preprocessed static image with which the viewer is comfortable for viewing.

3. Plugging for Vestibular System

The plugging of ears is another controlling technique to reduce motion sickness caused while taking a turn or during banking. The plugging of the ear is done by a cam operated system, which is under the control of MCU.

The experimental setup is designed in such a way that it can be employed for various parts of the body by methods like acupuncturing, visual view shortening and proposed vestibular plugging system. These procedures may reduce the motion sickness to an extent in the passenger according to the low frequency vibration generated as the cause for the kinetosis (a tech name for motion sickness). This is in accordance with that described by Claudia Braccesi & Filippo Cianetti in their publication of ASME journal "Development methodology For the Evaluation of Motion sickness incidence in railways". These methods of reduction will be applied according to the type of motion being taken by the passenger in the automobile. The action to reduce motion sickness is being generated by the output of the Micro Controller setup.

IV. EXPERIMENTAL SETUP

Working Model

The automated micro controller setup controls the devices attached to the respective body parts. The pre-programmed micro controller setup operates the servo motors. The servo motors are mechanically linked to the devices which are used to reduce motion sickness. The devices adopted depends on the cause of motion sickness. For example if the motion sickness is due to a mismatch between the visual observation and the head movement, the flaps are activated by the servomotor to shorten the view of the passenger. If the motion sickness is due to a sudden turn taken by the vehicle, the ear plugging system gets automatically activated. The automated control set up is as shown in the figure1.

![Fig1: Automated control unit setup along with the accelerometer and Micro controller](image)

The types of methodologies being followed are:

a. Acupuncturing,
b. Shortening of vision field,
c. Vestibular Plugging.

a. Acupuncturing for Zusanli

Zusanli (figure-2) is one of the most frequently used of all acupuncture points and is certainly the most intensively studied single point treatment. The indications for use of this acupuncture point are many, and the claimed benefits are substantial.

![Fig 2: Location of Zusanli point](image)
Mechanism of Zusanli

Acupuncture treatment stimulates the nerves at a point by small electrical pulses. These pulses are transferred along nerve pathways and yield the ultimate therapeutic effect. The locations on the body where acupuncture is initiated are as shown in figure-2.

Fig 3: View shortening or pre image protecting device

b. Shortening of vision field

In the present study, we examined the effects of the time lag between visual scene and the head movement in the virtual reality (VR) world on motion sickness and its control in healthy volunteers. The visual-vestibular conflict induced slight motion sickness in experimental subjects. This is controlled by the shortening of vision field. The device used for view shortening is shown in figure-3.

c. Vestibular Plugging

This is a new approach to reduce motion sickness. Vesti-Plug is a new mechanism that can help to eliminate Motion Sickness caused when a person is exposed to rectilinear acceleration or to "rotating linear acceleration vectors" (RLAV). Such a motion sickness symptom is medically termed as nystagmus.

The evidences considered in the evocation of nystagmus are:
1. Rectilinear acceleration
2. Constant angular velocity when rotated about the co-planar earth horizontal-axis
3. A rotating linear angular acceleration in the absence of angular motion.

V. CONCLUSIONS

The system designed and fabricated to reduce nausea or motion sickness was practically experimented to check its usage in real-time situations. The system response was found to be beneficial to reduce motion sickness. However it has to be modified further to make it user friendly.

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