SURVEY ON FINGER SLEEVE

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Abstract

In this Article we present a novel wearable navigation system along with implicit HCI (iHCI) model, where interaction with technology is dissolved into a day-today activity. In this type of HCI model a computer takes the input and tries to output an action that is a proactive anticipation of next action of a user. Usually, in urban areas people use voice assisted navigation systems or navigation guidelines displayed on a mobile phone. Some navigation systems are already installed on car dashboard, which needs explicit attention in order to make driving decisions.

A navigation system using haptic perception to guide a user throughout a journey is the key contribution of this paper. It does not ask for explicit user attention and demonstrates the indolent form of technological interaction. This wearable device is an index finger sleeve, which consists of vibrator modules, Bluetooth communication module and Microcontroller Unit (MCU). A working prototype has been built and tested.

1. INTRODUCTION

Wearable computing enables human to wear a computational device on body. Wearable devices can be of many types, and each addresses specific use case, such as smart glasses, smart wrist watch, heart monitoring headsets and many more. With the advent and growing popularity of wearable devices like the Google Glass, Fitbit Flex, Nike fuel Band, LG life Band and the Oculus rift, wearable computing is proving to be one of the major technological advancements in the 21st century. These body mounted devices are able to monitor various activities in real-time.

For a wearable navigation device the success factor lies in the accuracy of navigational signalling and unobtrusive interaction. With Implicit Human Computer Interaction model, user need not necessarily be interacting with the computing system. Moreover, interaction with limited visual attention is often emphasized as a design goal for wearable input. Finger Sleeve, a wearable navigation device, works along with the Android Smartphone. Android Operating Systems (OS) based Smartphone covers largest consumer market share, which helps us choose Android Smartphone as a GPS navigator. Here android OS based Smartphone is running a Google Map like application and providing the navigational signals to the Finger Sleeve. The user has to wear Finger Sleeve and pair it with the Smartphone running a navigational application. Finger Sleeve provides easy navigation throughout a journey.

2. LITERATURE SURVEY

Nellcor Puritan Bennett Llc et al [1] says that In many medical applications it is desirable to hold one or more medical sensors in contact with a patient's tissue such that various non-invasive measurements of physiological parameters may be non-invasively monitored. For example, medical sensors may be held in contact with a patient's tissue to non-invasively determine pulse rates, blood pressure, temperature, and/or blood oxygenation levels. Common to many non-invasive medical sensors is the need to properly position the sensor relative to the patient's tissue to ensure proper sensor operation. For example, if a sensor is held too loosely relative to the tissue it may not function; in contrast, if a sensor is held too tightly to the tissue, the sensor itself may interfere with the physiological parameter(s) it is supposed to monitor.

Covedian Lp et al [2] tells that A common technique used to monitor blood oxygen levels is pulse oximetry, which utilizes light signals transmitted through living tissue to determine light attenuation caused by various blood components. In this regard, pulse oximetry sensors generally include one or more light emitters and detectors that are held in contact with the tissue of a patient. Transmittance type pulse oximetry sensors transmit light through a portion of tissue and detect the non-absorbed light passing through that tissue. In this regard, transmittance type sensors require that the light source(s) and detector(s) be held relative to a patient such that an optical path exists through that tissue between the light emitters and light detectors (e.g., through an appendage such as a finger, ear lobe, hand, foot, etc.).

Joseph Coakley et al.[[3] discussed that the emitters and detectors of transmittance type pulse oximetry sensors must both be properly positioned relative to the patient tissue to ensure their proper operation. In this regard, a means for securely positioning the pulse oximetry sensor relative to an appendage of a patient is required. It is especially important in positioning the reusable sensor to provide good conformance between the light emitters/detectors and the patient's tissue as well as securing the light source(s) and detector(s) on opposing appendage surfaces to provide an optical path through the tissue between the light sources and detectors. Further, the sensor holding means should be adapted for ready application and removal from the patient with minimal patient discomfort and ease of use for the applicator.

William H et al. [4] says that In a first aspect of the invention, a sensor holder is provided that contains a patient engaging member that is plastically deformable to allow the sensor holder to be conformed about an appendage of a patient, such as a finger, as well as elastically deformable to provide a retention force. That is, the deformable engaging member may be bent into a first shape to, for example, dispose first and second portions of the sensor holder in an opposing relationship (e.g. U-shaped to engage opposing surfaces of a patient appendage).

Carine Horarau et al. [5] discussed that Once deformed into a desired shape, the plastically deformable member may be elastically deformed to a second shape to provide a retaining force, in the manner of a paper clip, to maintain the sensor holder and a sensor interconnected thereto in contact with a patient appendage. For example, the opposing surfaces of a U-shaped member may be slightly sprung to allow the firm insertion of a patient appendage there between. By utilizing the plastically deformable member, the sensor holder of the present invention may be shaped to conform to a variety of patient appendages while providing a customizable fit for that appendage. Furthermore, by utilizing elastic deformation of the shaped member to provide retention force, the sensor holder may be applied to an appendage without the use of adhesives or other connectors. However, an adhesive material may additionally be provided on a patient contact surface to further enhance the retention/holding force of the sensor holder.

Chin Rhodney et al. [6] says that A medical sensor may be interconnected to the deformable engaging member in any manner so long as the sensor is held in a conformal relation with a patient's tissue upon application of the sensor holder to the appendage. For example, the sensor holder may receive a sensor in a recess, a pocket, or other attachment device for holding the existing sensor relative to the sensor holder. Alternatively, the engaging member may be incorporated into a medical sensor. That is, one or more sensor components (e.g. a light emitter and/or detector for a pulse oximetry sensor) may be permanently mounted directly to the engaging member. As a further alternative, the sensor may be held by friction or pressure. That is, the sensor, along with a patient's appendage, may be compressed between opposing surfaces of the patient engaging member.

Devin McCOMBIE et al.[7] tells that Additions and various refinements of the noted features exist, these refinements and additional features may be provided separately or in any combination. For example, the engaging member may be formed of any material that imparts the desired mechanical characteristics to the sensor holder. As used herein, the term “plastically deformable” refers to deformation of a body caused by an applied stress, wherein the deformation remains after the stress is removed. The term "elastically deformable" refers to the deformation of a body caused by an applied stress, wherein the body returns to its original shape after the stress is removed. For any material, an elastic limit (also known as yield strength) is the separation point between elastic and plastic deformation characteristics.

David Rich et al. [8] tells that An applied stress beneath the elastic limit results in elastic deformation, whereas an applied stress above the elastic limit results in plastic deformation (or breakage for brittle materials). In any case, the selected material should have an elastic limit that allows the engaging member to be manipulated (i.e., plastically deformed) by hand from a first shape to a second shape while providing adequate elastic deformation characteristics to allow the engaging member to act as a spring to hold the sensor holder on the patient appendage.

Mayeux Charles et al. [9] discussed that the elastic limit or total yield strength of a member is generally dependant on one or more physical and material factors. These factors include the moment of inertia about the axis which a stress is applied (i.e. which is dependent upon the physical dimensions of that material) as well as the modulus of elasticity for that material. In any case, by varying the dimensions (e.g., cross-sectional size and/or length) of the engaging member as well as the material used to form the engaging member, any of a variety of materials may provide the desired deformation properties. A non-inclusive list of materials includes isotropic materials such as aluminum, plastics, and rubbers, as well as composite materials such as metallic wires immersed in a rubberized matrix, etc. What is important is that the material utilized provides the desired plastic deformation to enable first and second portions of the sensor holder to be disposed on opposing surfaces of an appendage as well as the desired elastic deformation to act as a spring to provide a restraining force once applied to an appendage.

Hon Edward H et al. [10] discussed that A second aspect of the present invention provides a sensor holder that includes: a deformable backing layer that is plastically deformable from a first configuration to a second configuration; a patient interface layer having a first surface interconnected to the deformable backing layer and a second inside surface for interfacing with a patient appendage; and a sensor recess located on the inside surface of the patient interface layer for selectively receiving a sensor. Prior to application to a patient appendage, the sensor holder may be in any first configuration (e.g., planer, an open U-shape, etc) that allows a patient appendage to be disposed relative to the inside surface of the patient interface layer. In order to be applied to a patient appendage, the deformable backing layer of the sensor holder may then be plastically deformed (i.e., bent) into a second configuration to engage opposing surfaces of a patient appendage. In this regard, the sensor holder may be custom-sized for an appendage.

3. DESIGN OF FINGER SLEEVE

In this section, an abstract design of a finger sleeve is discussed. A complete operational system using Finger Sleeve has two major parts –

a) Android OS based Smartphone Application.
b) A Finger sleeve device.

a) High Level Design of Finger Sleeve

A working prototype of Finger sleeve has four modules; every module is responsible to perform a specific operation as described below:

1. HC-05bluetooth module: It is used to send and receive data wirelessly to/from android OS based Smartphone. Another alternative is to use Bluetooth Low Energy (BLE) module.

2. Arduino Nano: It has ATmega168 microcontroller with 16KB memory to store the code. It is responsible to run computational tasks.

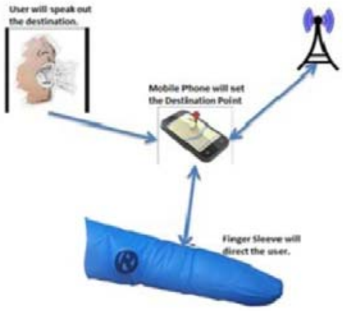
3. Micro Vibrators: Two micro vibrators are used to provide a vibrational indicator of respective direction.

Each vibrator corresponds to particular haptic navigational signal viz. Right or Left. Li-ion Rechargeable Battery Pack: Battery pack is responsible to power the Arduino nano. It is a rechargeable battery capable to maintain 80% capacity after 800 cycles. The smallest size of a battery pack, micro vibrator, Microcontroller

Unit (MCU) and Bluetooth module helps Finger Sleeve to be worn easily.

b) Android OS based Smartphone mobile Application (Covedian LP Medical sensor for reducing signal artifacts**)**

1. Start.
2. Set the destination point on map.
3. Draw a navigational path over a map. (Application will perform this automatically)
4. Signal the finger sleeve.
5. Start sending navigational signals to Finger Sleeve.
6. Detect the change in positions of User's current location.
7. Repeat the steps 5 and 6 until the user arrives at the destination or application is explicitly closed.
8. Stop.



CONCLUSION

In this paper, we have discussed and in depth analysis of the Finger Sleeve prototype for navigation during walking and driving a car tasks.

Finger Sleeve, a wearable navigational assistant, shows the potential of being effective navigational beacon.

Preliminary studies of user reactions and feasibility of using such wearable navigational device suggest that it is an easy to use and apropos for the navigational needs of the user in present era.

Such navigational system stands a base for multiple applications, which can be extended from the basic version, such as –

1. Media controller for a Smartphone.
2. A wearable pointing device.
3. Customizable keys to be used along with the mouse.
4. Finger sleeve can help visually impaired, but it has to be integrated with obstacle detection systems.

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