

tion has been made. The activation software subroutine may also be connected to the emergency vehicle flasher lights, so as to activate these lights, to warn nearby vehicle operators that a hazard condition exists. Or the activation software subroutine could be connected to a recording and loud-speaker within the passenger compartment, which may play a message containing the operator's name and the command "WAKE UP!" The activation software subroutine might instead or in addition be connected to the vehicle horn, so as to cause the horn to honk repeatedly, to alert both the operator 18 and other operators nearby in traffic. An audible alarm of some sort offers the advantage over a merely visible alarm, such as a flashing light, that the operator 18 will not see the flashing light if his/her eyes have closed.

Those familiar with the art will appreciate that the invention may be employed in configurations other than the specific forms disclosed herein, without departing from the essential substance thereof.

For example, and not by way of limitation, although three sensors 10 are used in the preferred embodiment, a number believed sufficient to achieve adequate sensitivity for measurement of operator head motion, the present invention could be employed with different numbers of sensors, provided at least three are used, to allow triangulation.

Although capacitive coupling sensors are used in the preferred embodiment, the present invention is not to be regarded as being limited to the use of this particular form of sensor.

Similarly, although two amplifiers are used in the preferred embodiment, to amplify the signals from the sensors 10, for the reasons given above, the invention is not to be regarded as being limited to the use of two amplifiers; a single amplifier, or three or more amplifiers of varying sensitivity, might be suitable for particular applications.

And, although the preferred embodiment is described as using "wires" to connect various circuit components, the present invention is not to be understood as being limited to forms in which "wires" in the ordinary sense of the word are used, i.e. insulated covered bundles of metal strands. Circuit components may instead be connected and communicate with one another by numerous other means, including, without limitation, conductive traces on circuit boards, or infrared beams, or fiber optic connectors, without departing from the substance of the invention. So the term "wire" is to be understood as referring to a connection means, for connecting different circuit components.

Also, while the preferred embodiment uses a microprocessor for processing various input/output signals and processing information, another form of information processing means such as customized digital logic, neural networks, or other forms of integrated circuits for processing and decision-making, could be employed instead.

And while the preferred embodiment uses a single oscillator frequency for all detectors, another form of the invention could use multiple oscillators operating over a range of frequencies to drive the detectors.

In addition, while the preferred embodiment is designed to detect impairment, and activate alarm means to alert an impaired operator, other forms of the invention could activate other responses to the impairment, such as disengagement of the vehicle power train, or send notification of the operator's impairment to remotely located monitoring systems or personnel; or could include other mechanisms to reduce potential harm to persons or property that might result from the impaired condition.

The scope of the invention is defined by the following claims, including also all subject matter encompassed by the doctrine of equivalents as applicable to the claims.

I claim:

1. Impaired operator detection and warning apparatus, for detecting significant impairment of the operating ability of a transportation vehicle operator, by measurement and analysis of the motion of said operator's head, and for warning of said impairment, comprising:

(a) Sensing means, for sensing the position of said operator's head, and for producing electrical output signals dependent upon said position of said operator's head;

(b) Signal processing, analysis, and alarm activation means, connected to said sensing means, for achieving any needed amplification of said output signals, for any height of said operator within an expected ranges of heights for said operator, and for determining the time profile of the motion of said operator's head by analysis of said output signals, and for comparing said time profile of said motion of said operator's head, with reference profiles characteristic of normal and impaired operator head motion, and for activation of an alarm means, upon a determination, based upon said comparison of said profiles, that said operator is significantly impaired in operating ability; and

(c) said alarm means, connected to said signal processing, analysis and alarm activation means, for alerting said operator to said determination that said operator is significantly impaired.

2. The apparatus of claim 1, wherein said sensing means comprises a plurality of capacitive coupling sensors, and wherein each of said sensors comprises a capacitive coupling detector driven by a driving means, connected to said detector, for electrically driving said detector.

3. The apparatus of claim 2, wherein said capacitive coupling sensors are mounted on the upper surface of a headliner secured to the interior roof of said vehicle above said operator's head.

4. The apparatus of claim 3, wherein said sensing means comprises an array of at least three of said capacitive coupling sensors.

5. The apparatus of claim 1, wherein said signal processing, analysis and alarm activation means includes a plurality of amplifiers of different gains, having gains of suitable values to produce said output signals of suitable amplitudes, for the expected range of heights for said operators who may operate said vehicle.

6. The apparatus of claim 5, wherein said signal processing, analysis and alarm activation means includes two amplifiers.

7. The apparatus of claim 1, wherein said signal processing, analysis and alarm activation means includes a microprocessor, having software means to analyze said output signals from said sensing means and to continuously determine the position of said operator's head, and having an active memory means to store the measured time profile of said operator's head positions at different times, and having a reference memory means containing reference time profiles showing typical operator head motion profiles for normal and impaired operators, and wherein said software means further includes profile comparison means, to compare said measured time profiles of said operator's head positions at different times, with said reference time profiles, and to determine, based upon said comparison, whether said operator is significantly impaired in operating ability, and wherein said microprocessor further comprises said alarm activation means, to activate said alarm means when said determination of operator impairment is made.

8. The apparatus of claim 1, wherein said alarm means comprises at least one bright light in the interior of said