Sensing motion in a mobile phone and limiting functionality of moving phones

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Abstract

A system for detecting motion of a cell phone and disabling the use of the cell phone while moving or driving. The system includes: a cell phone; a sensor to detect motion of the cell phone; software in the cell phone to disable the use of the cell phone when motion is detected. In a preferred embodiment, the system also recognizes the near proximity of an automobile and disables the use of the cell phone in this near proximity.

Background

There is a need for a method to disable the use of a cell phone while driving. Many large cities or States have enacted prohibitions against driving while using a cell phone or, at least, a hand held cell phone. Cell phone related accidents have become a plague of epidemic proportions. It is estimated that roughly 50,000 Americans die each year in traffic related deaths with many times that number of non-fatal injuries. A growing percentage of these deaths and accidents are in some way related to cell phone use. Driving novices such as teenagers are acutely at risk because they are uniquely familiar with cell phones and lacking sufficiently in driving skills. In fact it has recently been reported that teens using cell phones drive in the same manner as the elderly. Unfortunately, at present there is no solution to the problem except through legislation and it is questionable whether such laws are actually effective.

Summary

The system and method are for disabling a cell phone while moving. The method includes: a cell phone; a motion detecting sensor in the cell phone, such as an accelerometer or GPS receiver; or a short range wireless connection that detects an enabled car and software which disables communications features of the cell phone when motion is detected. Optionally 911 and other pre-approved calls such as phone calls to parent's phone numbers could be made at all times and would not be disabled by motion detection. Calls would be allowed while in motion if the phone detected insertion into a hands-free docking station. To deactivate communication, preferably the detected speed would have to exceed a threshold such that the phone could still be used while walking, running, etc. and such that positional "noise" from the motion detector does not cause false deactivations.

Cell phone manufacturers and service providers have developed a number of schemes for determining the location of a cell phone, at least to within a few hundred feet, but only after pressure from the government in furtherance of 911 emergency services. In some cases, service providers have gone on to use this information to provide geographically targeted advertising or features. While such positional information has not been used to limit operation of a cell

phone under unsafe conditions, with appropriate conditioning such information could be employed in certain embodiments of the present invention to achieve motion detection.

The system includes: a cell phone; an array of cell towers with communications between themselves; software in the service provider's system which tracks a cell phone's location based either on time-of-flight and/or relative signal strengths to determine a cell phone velocity; and a system for preventing operation of a cell phone when a velocity threshold is exceeded. Ideally the tower based motion detecting software would have a speed threshold greater than that which is usually associated with jitter as to avoid false detection of movement.

The method includes: a cell phone; a cell phone based communications link such as Blue Tooth; a car mounted transmitter configured for communication with the cell phone; and software which disables communications features of the cell phone when an in-operation signal is received from the car mounted transmitter. This system could disable the cell phone anytime the phone is in the owner's car with the car running. Further, such a system does not require additional hardware within the cell phone, since many cell phones are presently Blue Tooth enabled, or require local service provider cooperation.

Description

Typically, a cell phone is used by a person to make telephone calls in much the same way as a wire-based telephone. With a cell phone, however, the phone communicates wirelessly with a cell site, such as on a tower. In practice, an area with cell phone coverage is divided into cells, each cell being serviced by a single tower. As a subscriber moves around, the service provider automatically switches the user to the tower with the highest quality signal.

Subscription-based wireless phones have taken on a number of different names, including: cell phones, PCS phones, CDMA phones, TDMA phones, analog phones, GSM phones, digital phones, etc. Any wireless mobile phone is referred to herein simply as a "cell phone" and the present invention is suitable for use with any type of such phone.

Regardless of the phone technology employed, a typical cell phone includes: a microphone for receiving acoustic information from a user; a speaker or headphone for outputting audio to the user; an audio system comprising at least an amplifier for the signal from microphone, an amplifier for speaker, and possibly anti-aliasing filtering for the incoming audio signal for digital cell phones; processor for managing operation of the phone; a radio ("RF") system for wireless communication with the service provider; and a user interface for interaction with user.

In this system, the cell phone further includes a motion detection system, which may comprise either a GPS receiver along with its accompanying antenna, an inertial system, or a combination thereof. GPS receivers are well known and, in fact, an ever increasing number of cell phones already include an embedded GPS receiver. Generally speaking, GPS receivers receive timing information from a plurality of GPS satellites. Presently there are 24 active satellites in the GPS constellation but a GPS receiver only needs to be able to receive signals from three or more satellites to provide a position fix in two dimensions. Velocity of the GPS receiver can easily be determined by finding the change in position with respect to time (the first order differential). A

determination of motion using this GPS technique would then disable the calling and receiving capability of a phone with motion detection capabilities, likewise the absence of position change would re-enable the calling and receiving capability of the cell phone.

An alternative design employs a cell phone with an inertial system, the determination of motion using an integrated accelerometer, or similar motion detector, would then disable the phone's calling and receiving capability. Likewise the absence of position change would re-enable the calling and receiving capability of the cell phone if it had motion detecting capabilities.

Cell phones have a variety of functions and hardware such Blue Tooth, wireless headsets, e-mail, and ring programmability which could be used or disabled if motion is detected. Blue Tooth is a very short range, rarely more than 20 feet, radio communications scheme that is largely used in communicating with wireless headsets. Newer uses for cell phone based Blue Tooth and other wireless schemes such as Ultra-wideband are being touted as automatic commerce or communication with vending machines, ATMs, gas pumps, and door locks.

There are existing methods to determine the location of a cell phone in accordance with E911 requirements. The E911 requirements were enacted to provide the location of a cell phone to emergency workers when a cell phone user dials "911". The primary approaches of these methods rely on either a Global Positioning System (GPS), signal strength between cell towers, or "time of flight". GPS location systems are well known and determine a cell phone's position within about 5 meters. GPS provides one of the best, but also expensive, options requiring a special phone with a GPS engine inside. The GPS engine is usually off to save power and is turned on only when the 911 feature is activated or by the cell phone user to determine a location when lost.

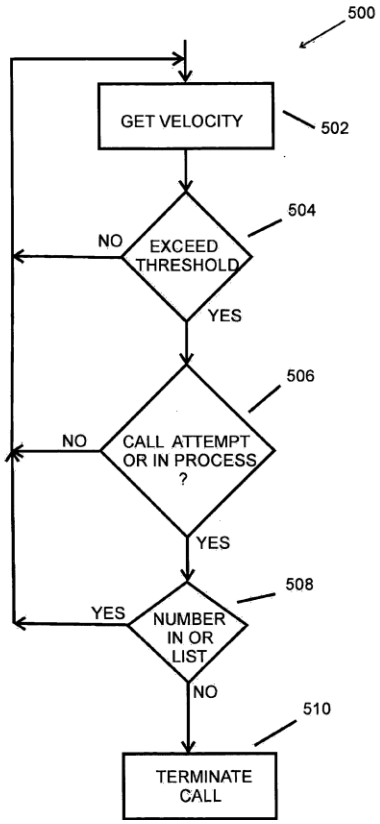
A different method using, "received signal strength indication" (RSSI), is well known. This system can only provide an estimate of a cell phone location, typically within about 1000 feet, but is widely favored in older installations as it generally only requires a cell-site software upgrade. Each cell tower communicates with adjacent towers regarding which of the directional antennae it is using and the corresponding RSSI signal from a single cell phone. From the collected information, the system approximates the cell phone's location. This is the least desirable location method because large buildings and structures can block signals to a nearby cell tower while the view to a further tower is unobstructed, which combined yield a false location.

In another design, the apparent location provided by RSSI could be tracked by the cell phone service provider and velocity of the cell phone can easily be determined by finding the change in position with respect to time (the first order differential). A determination that the cell phone was moving would result in a condition that would allow the provider to disable the cell phone's service or send a signal to the cell phone which would disable the phone's calling and receiving capability. Likewise the absence of position change would re-enable the calling and receiving capability of the cell phone.

"Time of flight" (ToF) systems determine how long it takes a radio signal to travel from the cell phone in a car to the closest towers. This information is used in a timed triangulation scheme to

determine location. Because radio signals travel at the speed of light and the distance of flight is relatively short, this ToF method requires special and expensive hardware at the cell sites but not special cell phones. The ToF system works around and under tall buildings where GPS might not work but isn't quite as accurate as GPS in practice.

The apparent location provided by a ToF system could be tracked by the cell phone service provider and velocity of the cell phone can easily be determined by finding the change in position with respect to time (the first order differential). A determination that the cell phone was moving would result in a condition that would allow the provider to disable the cell phone's service or send a signal to the cell phone which would disable the phone's calling and receiving capability. Likewise the absence of position change would re-enable the calling and receiving capability of the cell phone.



One method 500 for practicing the present invention is shown in the flow chart. A loop for monitoring the motion status of a cell phone starts at step 502 wherein the velocity of the cell phone is obtained. As will be apparent from the discussion hereinabove, such velocity may be calculated internally at the cell phone through, for example, integrated accelerometers, the output of a GPS receiver, or the like; or by the service provider through time of flight, relative RSSI, or the like. For the purposes of this invention, how the velocity is obtained is unimportant, only that an approximate value of the velocity is obtained.

At step 504, the velocity retrieved in step 502 is compared to a threshold, or limit, to see if the cell phone is in motion at a velocity which is indicative of use in an automobile. If the velocity is below the threshold, the process returns to monitor the speed at step 502. If the speed of the cell phone exceeds the threshold, at step 506 it is determined if: the user is attempting a call; or a call is already in progress. If neither condition exists, the process returns to step 502 to monitor the speed of the cell phone. If a call is in progress or being attempted, the phone number is compared against a list of allowed telephone numbers at step 508. It should be noted that it is unimportant whether the call is inbound or outbound, the phone, or service provider, obviously has an outbound number available as entered by the subscriber and has inbound numbers available through caller ID.

At step 508, if the number is not in the list of allowed numbers, the call is terminated at step 510. If the number is in the list, the call is allowed and the system returns to monitor the speed of the cell phone. Associated with the call termination of 510 there may be an aural warning and/or a visual warning provided to the subscriber to indicate that the call was disallowed. It should also be noted that after the call is terminated, control preferably returns to step 502 to resume monitoring of the cell phone speed.

While velocity is typically a vector having a magnitude and direction and speed is typically a scalar quantity providing a magnitude without direction, the present invention can use either such quantity to provide the inventive function. Since either velocity or speed provides the information necessary to practice the present invention, for purposes of this invention the terms are used interchangeably.

A subscriber's vehicle may provide the functions of steps 502 and 504 and communicate either the speed or a binary determination of the exceeded threshold to the cell phone. For example, it could be assumed that if the ignition is on, or other indicator that the car is under the control of a driver, it can be assumed that the threshold is exceeded and a disallowed call thus prohibited.

In one design, the cell phone further includes a local wireless interface. A similar interface mounted in a car would be activated when the car was turned on. The car's interface would communicate with the cell phone's interface. The connection of this communication would be the signal to disable the cell phone's calling and receiving capabilities. The absence of the wireless communication between the car and the phone would re-enable the cell phone's calling and receiving capabilities. This would allow the phone to be used in other vehicles or while moving but not in the owner's vehicle.