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— *as to the identity of the inventor (Rule 4.17(i))*

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

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(54) **Title**: HANDHELD BIOMETRIC SENSOR FOR MOBILE DEVICES

(57) **Abstract**: A system and method comprises structure for receiving in a handheld device biometric or environmental data from the vicinity of the handheld device. The system may include a handheld mobile device such as a cellular telephone, or that device and a separate mechanical housing configured be held in a hand of a user and to clamp to or contain the handheld device. The system may include a specialized radar unit and be designed to analyze radar signals to provide a signal indicative of time varying arterial blood pressure. The mechanical housing may include a receiver designed to receive a biometric or environmental signal and to wirelessly transmit a corresponding signal to the handheld device when clamped to the handheld device.

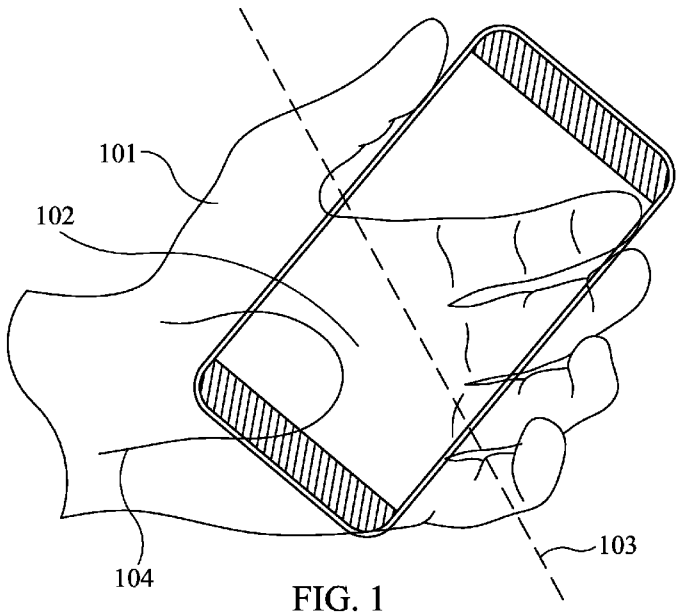


FIG. 1

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AMENDED CLAIMS
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CLAIMS

1. A system for determining arterial blood pressure of a user as a function of time, comprising:

a handheld structure comprising at least one of: (1) a handheld device configured to be held in one hand of a person comprising a cellular telephone transceiver and human interface; and (2) a handheld mechanical housing configured to be held in one hand of the person, and designed to removably mechanically attach or clamp onto a handheld device;

a frequency controlled oscillator to generate Radio Frequency (RF) signals;

at least one antenna configured to transmit the RF signals generated by the frequency controlled oscillator and configured to receive RF signals which are reflections of the transmitted RF signals;

a mixer configured to mix at least one of the transmitted RF signals with at least one of the reflected RF signals to generate a modified signal;

an analog-to-digital converter configured to convert the modified signal into digital data thereby providing a digital representation of said modified signal;

at least one processor for processing digital data;

wherein said handheld structure contains said frequency controlled oscillator; said at least one antenna; said mixer; said analog-to-digital converter; and said at least one processor;

wherein said system is configured to use said digital representation of said modified signal and a model relating said modified signal to arterial blood pressure, to generate an arterial blood pressure signal indicating arterial blood pressure of the user as a function of time;

wherein said system is designed to generate the transmitted RF signals at a repetition rate above the heart rate of a person to result in the received RF signals having the repetition rate;

wherein said system is designed to function in a subband of at least 500 MHZ in a frequency range between 3.1 to 10.6 GHz;

wherein said at least one antenna comprises an ultra-wideband microwave signal antenna, said ultra-wideband microwave signal antenna comprises a dielectric sheet, and said ultra-wideband microwave signal antenna defines a slot;

a feed line coupling to said ultra-wideband microwave signal antenna, wherein said feed line comprising a conductive layer; and

wherein said system is designed to generate peak power between 1uW and 100mW, and to have an average power from 1uW to 10 mW.

2. The system of claim 1 wherein said handheld device contains said frequency controlled oscillator; said at least one antenna; and said mixer; said analog-to-digital converter; and said at least one processor.

3. The system of claim 1, wherein said oscillator is configured to generate signals having a bandwidth of at least 3 GHz in a frequency range between 3.0 GHz to 10.7 GHz.

4. The system of claim 1, wherein a single mixer is coupled the frequency controlled oscillator and said at least one antenna.

5. A system for determining arterial blood pressure of a user as a function of time, comprising:

a handheld structure comprising at least one of: (1) a handheld device configured to be held in one hand of a person comprising a cellular telephone transceiver and human interface; and (2) a handheld mechanical housing configured to be held in one hand of the person, and designed to removably mechanically attach or clamp onto a handheld device;

a frequency controlled oscillator to generate Radio Frequency (RF) signals;

at least one antenna configured to transmit the RF signals generated by the frequency controlled oscillator and configured to receive RF signals which are reflections of the transmitted RF signals;

a mixer configured to mix at least one of the transmitted RF signals with at least one of the reflected RF signals to generate a modified signal;

an analog-to-digital converter configured to convert the modified signal into digital data thereby providing a digital representation of said modified signal;

at least one processor for processing digital data;

wherein said handheld structure contains said frequency controlled oscillator; said at least one antenna; said mixer; said analog-to-digital converter; and said at least one processor; and

wherein said system is configured to use said digital representation of said modified signal and a model relating said modified signal to arterial blood pressure, to generate an

arterial blood pressure signal indicating arterial blood pressure of the user as a function of time;

wherein said at least one antenna comprises a first antenna and a second antenna, said first antenna is located in said handheld structure relative to an artery in a left hand of the user so that it senses arterial diameter when said system is held in the left hand of said user, and said second antenna is located in said handheld structure relative to an artery in a right hand of the user so that it senses arterial diameter when said system is held in the right hand of said user.

6. The system of claim 1 wherein said system is configured to transmit said arterial blood pressure signal indicating arterial blood pressure of the user as a function of time over a cellular network.

7. The system of claim 1 further comprising a heart rate determination algorithm designed to determine heart rate of a user, wherein said heart rate determination algorithm is designed to determine heart rate of a user from said digital representation of said modified signal and at least one model function for heart rate, wherein said algorithm is implemented in at least one of software and hardware.

8. The system of claim 1 comprising said handheld mechanical housing and wherein said handheld mechanical housing contains said frequency controlled oscillator; said at least one antenna; and said mixer, and a transceiver designed to wirelessly communicate with said handheld device.

9. The system of claim 8 comprising both said handheld mechanical housing and said handheld device; and

wherein said handheld mechanical housing contains said frequency controlled oscillator, said at least one antenna, said mixer, and a low power transceiver designed to wirelessly communicate with said handheld device.

10. The system of claim 9 wherein said low power transceiver is designed to transmit in at least one of the following frequency bands: 6.765 to 6.795 MHZ; 13.553 to 13.567 MHZ; 26.957 to 27.283 MHZ; 40.660 to 40.700 MHZ; 433.050 to 434.790 MHZ; 902.000 to 928.000 MHZ; 2.400 to 2.500 GHz; 5.725 to 5.875 GHz; 24.000 to 24.250 GHz; 61.000 to 61.500 GHz; 122.000 to 123.000 GHz; and 244.000 to 246.000 GHz.

11. The system of claim 9 wherein said low power transceiver is configured to transmit either said modified signal or said digital representation of said modified signal to said handheld device, when said handheld device is removably mechanically clamped or latched onto or contained in said handheld mechanical housing.

12. A method for determining arterial blood pressure of a user as a function of time, comprising:

powering with a battery, a handheld structure comprising at least one of: (1) a handheld device configured to be held in one hand of a person comprising a cellular telephone transceiver and human interface; and (2) a handheld mechanical housing configured to be held in one hand of the person, and designed to removably mechanically clamp or latch onto a handheld device; a frequency controlled oscillator to generate RF signals; at least one antenna configured to transmit the RF signals generated by the frequency controlled oscillator and configured to receive RF signals which are reflections of the transmitted RF signals; a mixer configured to mix at least one of the transmitted RF signals with at least one of the reflected RF signals to generate a modified signal; an analog-to-digital converter configured to convert the modified signal into digital data thereby providing a digital representation of said modified signal; at least one processor for processing digital data; wherein said handheld structure contains said frequency controlled oscillator; said at least one antenna; and said mixer; said analog-to-digital converter; and said at least one processor;

using said digital representation of said modified signal and a model relating said modified signal to arterial blood pressure, to generate an arterial blood pressure signal indicating arterial blood pressure of the user as a function of time;

wherein said system is designed to generate the transmitted RF signals at a repetition rate above the heart rate of a person to result in the received RF signals having the repetition rate;

wherein said system is designed to function in a subband of at least 500 MHZ in a frequency range between 3.1 to 10.6 GHz; and

wherein said system is designed to generate peak power between 1uW and 100mW, and to have an average power from 1uW to 10 mW.

13. The method of claim 12 further comprising determining heart rate of a user, using a heart rate determination algorithm designed to determine heart rate of a user, wherein said heart rate determination algorithm is designed to determine heart rate of a user from said digital representation of said modified signal and at least one model function for heart rate, wherein said algorithm is implemented in at least one of software and hardware.

14. A system for transmitting data to a handheld device comprising a cellular telephone, comprising:

a handheld structure comprising a handheld mechanical housing configured to be held in one hand of a person, and designed to removably mechanically attach or clamp or latch onto a handheld device comprising a cellular telephone transceiver and a human interface;

wherein said handheld mechanical housing comprises:

a low power transceiver for wirelessly communicating with said handheld device;

a second transceiver for configured to receive an electromagnetic signal in a first frequency band;

a frequency controlled oscillator to generate Radio Frequency (RF) signals;

at least one antenna configured to transmit the RF signals generated by the frequency controlled oscillator and configured to receive RF signals which are reflections of the transmitted RF signals;

a mixer configured to mix at least one of the transmitted RF signals with at least one of the reflected RF signals to generate a modified signal;

an analog-to-digital converter configured to convert the modified signal into digital data thereby providing a digital representation of said modified signal;

at least one processor for processing digital data;

wherein said handheld structure contains said frequency controlled oscillator; said at least one antenna; said mixer; said analog-to-digital converter; and said at least one processor; and

wherein said system is configured to use said digital representation of said modified signal and a model relating said modified signal to arterial blood pressure, to generate an arterial blood pressure signal indicating arterial blood pressure of the user as a function of time;

wherein said at least one antenna comprises a first antenna and a second antenna, said first antenna is located in said handheld structure relative to an artery in a left hand of the user so that it senses arterial diameter when said system is held in the left hand of said user, and said second antenna is located in said handheld structure relative to an artery in a right hand of the user so that it senses arterial diameter when said system is held in the right hand of said user.

15. The system of claim 14 wherein said electromagnetic signal is a biometric signal containing biometric information about a person holding said handheld mechanical housing.

16. The system of claim 14 wherein said electromagnetic signal is an environmental signal containing environmental information about an environment in a vicinity of said handheld mechanical housing.

17. The system of claim 14 further comprising said handheld device, and wherein said handheld mechanical housing is removably mechanically attached or clamped onto said handheld device.

18. The system of claim 1 storing a distance algorithm for using amplitude and phase of reflected signals to estimate distance of at lease one of said at least one antenna from skin.

19. The system of claim 1 configured to use said distance algorithm for compensating for changes in distance of said at least one antenna from skin.

20. The system of claim 5 wherein said handheld device defines a relatively wide and flat surface that defines a relatively long dimension of said handheld device and a relatively short dimension of said handheld device, wherein said handheld device has first relatively long side and second relatively long side which both extend along the relatively long dimension, wherein said first antenna is closer to said first relatively long side than said second antenna and said second antenna is closer to said second relatively long side than said first antennae.

21. The system of claim 5 wherein said handheld mechanical housing defines a relatively wide and flat surface that defines a relatively long dimension of said handheld mechanical housing and a relatively short dimension of said handheld mechanical housing, wherein said handheld mechanical housing has first relatively long side and second relatively long side which both extend along the relatively long dimension, wherein said first antenna is closer to

said first relatively long side than said second antenna and said second antenna is closer to said second relatively long side than said first antennae.

22. The system of claim 21 further comprising a low power transceiver located between said first antennae and said second antennae.

23. The system of claim 5 further comprising a selection switch connected to said mixer, which selection switch switches connection of said mixer between said first antenna and said second antenna.

24. The system of claim 23 wherein said selection switch is controlled by said at least one processor.

25. The system of claim 1 configured to have a data acquisition rate of between 5 and 1000 Hz.

26. The system of claim 1 configured to have a data acquisition rate of between 50 and 1000 Hz.

27. The system of claim 1 configured to have a data acquisition rate of between 50 and 280 Hz.

28. The system of claim 1 wherein said system is designed to be battery operated, and further comprising a battery.

29. The system of claim 1 wherein said system is designed to fit in the palm of a hand of a person.