Title: METHOD FOR RADIO PHYSIOLOGICAL SIGNAL BIOMETRIC AND RADIO PHYSIOLOGICAL SIGNAL SYSTEM USING THE SAME

Abstract: A radio biosignal measurement method and system is provided. The radio biosignal measurement method, including: dividing an original signal, generated from an oscillator, via a coupler, and generating a transmission signal and a local oscillator (LO) signal, the transmission signal being transmitted to an antenna, and the LO signal being transmitted to a mixer; transmitting the transmission signal to a subject, and receiving a measurement signal reflected from the subject; amplifying the measurement signal, received via the antenna, in a low-noise amplifier (LNA) and generating the amplified measurement signal; removing a leakage component of the original signal using the LO signal, and extracting only a measurement signal component; converting the measurement signal component into a digital signal and transmitting the digital signal to an analysis server via a transmission module; bandpass filtering the digital signal and dividing the bandpass filtered digital signal; and outputting a biosignal measurement result.
METHOD FOR RADIO PHYSIOLOGICAL SIGNAL BIOMETRIC AND RADIO PHYSIOLOGICAL SIGNAL SYSTEM USING THE SAME

Technical Field

The present invention relates to a radio biosignal measurement method, and more particularly, to a radio biosignal measurement method and system which measures a biosignal using an electric wave without using an electrode placement method.

Background Art

In the Ubiquitous society, Ubiquitous-HealthCare (hereinafter, U-HealthCare) has recently been in the spotlight. U-HealthCare enables patients to check their health conditions and receive medical attention at any time and place using portable terminals or computers. U-HealthCare aims at providing human-friendly high-tech medical welfare services based on information technology (IT)-biotechnology (BT) convergence. Much research on new medical technologies such as telemedicine has been carried out in developed countries.

Currently, Ubiquitous technology has become commercialized and an aging society is approaching. Also, people's interest in health increases, and thus the cost of health care increases. In Korea, the cost of health care is greater than 7% of its gross domestic product (GDP).

Also, as a death rate due to chronic diseases, sudden death, and the like, increases, an interest in a health care system able to check an individual's health in everyday life increases. A sudden death means an unexpected death that occurs instantaneously. A sudden death may occur in an individual who appeared healthy immediately before dying. Cardiac disorders such as an angina pectoris, myocardial infarction, cardiomegaly, valvular disease, and the like, are the cause of over 50% of sudden deaths. In particular, among those over 40 years of age, the usual cause of sudden death is a sudden arrhythmia syndrome due to an acute myocardial infarction and subarachnoid bleeding.

Such diseases are required to be immediately treated while continuously checking for any changes in a patient's autonomic nervous system. Specifically, continuous monitoring of biosignals with respect to heart beat and respiration is
A biosignal measurement method in a conventional art is a method of attaching an electrode to a human body. That is, an electrode pad for measurement is attached to a patient's body to measure biosignals. In this instance, performance of the electrode pad may vary depending on how securely the electrode pad is attached to a human body. Accordingly, only when the electrode pad is attached using a special gel or artificial perspiration may an accuracy of biosignal measurement be improved.

Also, the method of attaching an electrode to a human body affects an autonomic nervous system, that is, causes an overall change of the autonomic nervous system, since stress is generated by attaching an electrode to a human body for a long period of time. Accordingly, the measurement may not be performed accurately and stably. Also, disadvantages such as a restriction on patient's movement, side effects due to an electrode pad attachment such as burns and dermatosis, waste of resource due to a use of disposable electrodes, and the like may occur.

Also, a medical machine for measuring biosignals is generally large-sized, and may be used by only experts, and thus ordinary people or patients may not measure biosignals on their own in daily life. Also, biosignals measured by the medical machine may be interpreted by only experts, and thus patients may not check their health condition by themselves.

Disclosure of Invention

Technical Goals

The present invention provides a radio biosignal measurement method and system which measures biosignals using an electric wave without using an electrode placement method to measure biosignals with respect to a patient's body, and thereby may measure biosignals more easily and accurately.

The present invention also provides a radio biosignal measurement method and system which analyzes a measurement signal, divides the measurement signal into at least two biosignals, outputs a biosignal measurement result according to a predetermined output cycle, and provide the biosignal measurement result in real time.

Technical solutions
According to an aspect of the present invention, there is provided a radio biosignal measurement method, including: dividing an original signal, generated from an oscillator, via a coupler, and generating a transmission signal and a local oscillator (LO) signal, the transmission signal being transmitted to an antenna, and the LO signal being transmitted to a mixer; transmitting the transmission signal to a subject via the antenna, and receiving a measurement signal which is reflected from the subject; amplifying the measurement signal, received via the antenna, in a low-noise amplifier (LNA) and generating the amplified measurement signal; removing a leakage component of the original signal using the LO signal transmitted to the mixer, and extracting only a measurement signal component, the leakage component of the original signal being included in the amplified measurement signal; converting the measurement signal component into a digital signal and transmitting the digital signal to an analysis server via a transmission module; bandpass filtering the digital signal transmitted to the analysis server and dividing the bandpass filtered digital signal into at least two biosignals; and outputting a biosignal measurement result using the divided biosignals.

According to another aspect of the present invention, there is provided a radio biosignal measurement system, including: a subject measurement signal receiving unit which divides an original signal, generated from an oscillator, via a coupler, generates a transmission signal and an LO signal, transmits the transmission signal to a subject via the antenna, and receives a measurement signal which is reflected from the subject, the transmission signal being transmitted to an antenna, and the LO signal being transmitted to a mixer; an LNA which amplifies the measurement signal, received via the antenna, and generates the amplified measurement signal; a mixer which removes a leakage component of the original signal using the transmitted LO signal, and extracts only a measurement signal component, the leakage component of the original signal being included in the amplified measurement signal; an analog to digital conversion (ADC) module which converts the measurement signal component into a digital signal; a transmission module which transmits the digital signal to an analysis server; a bandpass filter which bandpass filters the digital signal transmitted to the analysis server and divides the bandpass filtered digital signal into at least two biosignals; and a biosignal measurement result output unit which outputs a biosignal measurement result using the divided biosignals.
Brief Description of Drawings

FIG. 1 is a flowchart illustrating a radio biosignal measurement method according to an embodiment of the present invention;

FIG. 2 is a diagram illustrating an example of a radio biosignal measurement result according to an embodiment of the present invention; and

FIG. 3 is a diagram illustrating a radio biosignal measurement system according to an embodiment of the present invention.

Best Mode for Carrying Out the Invention

Hereinafter, a radio biosignal measurement method and system according to an embodiment of the present invention is described in detail by referring to the figures.

According to an embodiment of the present invention, a radio biosignal measurement method uses a Doppler effect, and measures biosignals, generated in a human body, using an electric wave without using an electrode placement method.
measurement signal, received via the antenna, in a low-noise amplifier (LNA) and
generates the amplified measurement signal. That is, since an amplitude of the
measurement signal, received via the antenna, is less than that of the transmission signal,
the radio biosignal measurement method may amplify the measurement signal via the
LNA and thereby may generate the amplified measurement signal having an amplitude
suitable for demodulating.

In operation S160, the radio biosignal measurement method removes a leakage
component of the original signal using the LO signal transmitted to the mixer, and
extracts only a measurement signal component. The leakage component of the
original signal is included in the amplified measurement signal. According to an
embodiment of the present invention, a phase difference between the LO signal and the
leakage component is 180 degrees. That is, the leakage component of the original
signal is included in the amplified measurement signal when the measurement signal is
received by the antenna and transmitted to the mixer. Accordingly, the radio biosignal
measurement method cancels out the leakage component included in the measurement
signal using the LO signal having the phase difference of 180 degrees, and thereby may
extract only the measurement signal component.

In operation S170, the radio biosignal measurement method converts the
measurement signal component into a digital signal and transmits the digital signal to an
analysis server via a transmission module.

In operation S180, the radio biosignal measurement method bandpass filters the
digital signal transmitted to the analysis server and divides the bandpass filtered digital
signal into at least two biosignals. According to an embodiment of the present
invention, the at least two biosignals may include a cardiac signal and respiratory signal.

Generally, based on a male adult, a heart beat is approximately 60 ~ 73 times
per minute, and a breathing rate is approximately 16 ~ 20 times per minute. When
considering a frequency, the cardiac signal is in a range of 1 ~ 3 Hz, and the respiratory
signal is in a range of 0.3 ~ 0.8 Hz. Using such features, the radio biosignal
measurement method may bandpass filter the digital signal to correspond to each band
range and divide the cardiac signal and respiratory signal.

In operation S190, the radio biosignal measurement method outputs a biosignal
measurement result using the divided biosignals.
FIG. 2 is a diagram illustrating an example of a radio biosignal measurement result according to an embodiment of the present invention.

Referring to FIG. 2, the radio biosignal measurement method may display the radio biosignal measurement result with respect to the measurement signal 210, the cardiac signal 220, and the respiratory signal 230 on a graphic user interface (GUI) screen. The cardiac signal 220 and the respiratory signal 230 are obtained by filtering the measurement signal in the analysis server and dividing the measurement signal.

Also, according to an embodiment of the present invention, the radio biosignal measurement method may set a predetermined output cycle with respect to the at least two biosignals, and output the biosignal measurement result using each of the at least two biosignals divided according to the set output cycle. For example, the radio biosignal measurement method may set the output cycle with respect to the at least two biosignals as a single minute, and output the biosignal measurement result using each of the at least two biosignals each minute.

FIG. 3 is a diagram illustrating a radio biosignal measurement system according to an embodiment of the present invention.

Referring to FIG. 3, the radio biosignal measurement system 300 includes a subject measurement signal receiving unit 310, an LNA 320, a mixer 330, an analog-to-digital conversion (ADC) module 340, a transmission module 350, a bandpass filter 360, and a biosignal measurement result output unit 370.

The subject measurement signal receiving unit 310 includes an oscillator 311, a coupler 312, and an antenna 313. The subject measurement signal receiving unit 310 divides an original signal, generated from the oscillator 311, via the coupler 312. Also, the subject measurement signal receiving unit 310 generates a transmission signal and an LO signal, transmits the transmission signal to a subject via the antenna 313, and receives a measurement signal which is reflected from the subject. In this instance, the transmission signal is transmitted to the antenna 313, and the LO signal is transmitted to the mixer 330.

The LNA 320 amplifies the measurement signal, received via the antenna 313, and generates the amplified measurement signal.

The mixer 330 removes a leakage component of the original signal using the transmitted LO signal, and extracts only a measurement signal component. The
leakage component of the original signal is included in the amplified measurement signal. According to an embodiment of the present invention, a phase difference between the LO signal transmitted to the mixer 330 and the leakage component may be 180 degrees. That is, according to an embodiment of the present invention, the leakage component of the original signal is included in the amplified measurement signal when the measurement signal is received by the antenna 313 and transmitted to the mixer 330.

The ADC module 340 analog-to-digital converts the measurement signal component into a digital signal. The transmission module 350 transmits the digital signal to the analysis server.

The analysis server includes the bandpass filter 360 and the biosignal measurement result output unit 370. The bandpass filter 360 bandpass filters the digital signal transmitted to the analysis server and divides the bandpass filtered digital signal into at least two biosignals.

According to an embodiment of the present invention, the at least two biosignals include a cardiac signal and respiratory signal.

The biosignal measurement result output unit 370 outputs a biosignal measurement result using the divided biosignals.

According to an embodiment of the present invention, the biosignal measurement result output unit 370 may set a predetermined output cycle with respect to the at least two biosignals, and output the biosignal measurement result using each of the at least two biosignals divided according to the set output cycle.

The above-described embodiment of the present invention may be recorded in computer-readable media including program instructions to implement various operations embodied by a computer. The media may also include, alone or in combination with the program instructions, data files, data structures, and the like. The media and program instructions may be those specially designed and constructed for the purposes of the present invention, or they may be of the kind well-known and available to those having skill in the computer software arts. Examples of computer-readable media include magnetic media such as hard disks, floppy disks, and magnetic tape; optical media such as CD ROM disks and DVD; magneto-optical media such as optical disks; and hardware devices that are specially configured to store and perform program
instructions, such as read-only memory (ROM), random access memory (RAM), flash memory, and the like. Examples of program instructions include both machine code, such as produced by a compiler, and files containing higher level code that may be executed by the computer using an interpreter. The described hardware devices may be configured to act as one or more software modules in order to perform the operations of the above-described embodiments of the present invention.

Although a few embodiments of the present invention have been shown and described, the present invention is not limited to the described embodiments. Instead, it would be appreciated by those skilled in the art that changes may be made to these embodiments without departing from the principles and spirit of the invention, the scope of which is defined by the claims and their equivalents.

**Industrial Applicability**

According to the present invention, a radio biosignal measurement method and system measures biosignals using an electric wave without using an electrode placement method to measure biosignals with respect to a patient’s body, and thereby may measure biosignals more easily and accurately.

According to the present invention, a radio biosignal measurement method and system analyzes a measurement signal, divides the measurement signal into at least two biosignals, outputs a biosignal measurement result according to a predetermined output cycle, and provides the biosignal measurement result in real time.
CLAIMS

1. A radio biosignal measurement method, comprising:
   dividing an original signal, generated from an oscillator, via a coupler, and generating a transmission signal and a local oscillator (LO) signal, the transmission signal being transmitted to an antenna, and the LO signal being transmitted to a mixer;
   transmitting the transmission signal to a subject via the antenna, and receiving a measurement signal which is reflected from the subject;
   amplifying the measurement signal, received via the antenna, in a low-noise amplifier (LNA) and generating the amplified measurement signal;
   removing a leakage component of the original signal using the LO signal transmitted to the mixer, and extracting only a measurement signal component, the leakage component of the original signal being included in the amplified measurement signal;
   converting the measurement signal component into a digital signal and transmitting the digital signal to an analysis server via a transmission module;
   bandpass filtering the digital signal transmitted to the analysis server and dividing the bandpass filtered digital signal into at least two biosignals; and
   outputting a biosignal measurement result using the divided biosignals.

2. The radio biosignal measurement method of claim 1, wherein the at least two biosignals include a cardiac signal and respiratory signal.

3. The radio biosignal measurement method of claim 1, wherein a phase difference between the LO signal transmitted to the mixer and the leakage component is 180 degrees.

4. The radio biosignal measurement method of claim 1, wherein the outputting comprises:
   setting a predetermined output cycle with respect to the at least two biosignals;
   and
   outputting the biosignal measurement result using each of the at least two biosignals divided according to the set output cycle.
5. A computer-readable recording medium storing a program for implementing the method according to any one of claims 1 through 4.

6. A radio biosignal measurement system, comprising:
   a subject measurement signal receiving unit which divides an original signal, generated from an oscillator, via a coupler, generates a transmission signal and an LO signal, transmits the transmission signal to a subject via the antenna, and receives a measurement signal which is reflected from the subject, the transmission signal being transmitted to an antenna, and the LO signal being transmitted to a mixer;
   an LNA which amplifies the measurement signal, received via the antenna, and generates the amplified measurement signal;
   a mixer which removes a leakage component of the original signal using the transmitted LO signal, and extracts only a measurement signal component, the leakage component of the original signal being included in the amplified measurement signal;
   a transmission module which converts the measurement signal component into a digital signal and transmits the digital signal to an analysis server;
   a bandpass filter which bandpass filters the digital signal transmitted to the analysis server and divides the bandpass filtered digital signal into at least two biosignals; and
   a biosignal measurement result output unit which outputs a biosignal measurement result using the divided biosignals.

7. The radio biosignal measurement system of claim 6, wherein the at least two biosignals include a cardiac signal and respiratory signal.

8. The radio biosignal measurement system of claim 6, wherein a phase difference between the LO signal transmitted to the mixer and the leakage component is 180 degrees.

9. The radio biosignal measurement system of claim 6, wherein the biosignal measurement result output unit sets a predetermined output cycle with respect to the at
least two biosignals, and outputs the biosignal measurement result using each of the at least two biosignals divided according to the set output cycle.
FIG. 1

START

GENERATE ORIGINAL SIGNAL FROM OSCILLATOR \(\sim S110\)

DIVIDE ORIGINAL SIGNAL VIA COUPLER AND GENERATE TRANSMISSION SIGNAL AND LO SIGNAL \(\sim S120\)

TRANSMIT TRANSMISSION SIGNAL TO SUBJECT VIA ANTENNA \(\sim S130\)

RECEIVE MEASUREMENT SIGNAL WHICH IS REFLECTED FROM SUBJECT \(\sim S140\)

AMPLIFY MEASUREMENT SIGNAL, RECEIVED VIA ANTENNA, AND GENERATE AMPLIFIED MEASUREMENT SIGNAL \(\sim S150\)

REMOVE LEAKAGE COMPONENT OF ORIGINAL SIGNAL USING LO SIGNAL AND EXTRACT ONLY MEASUREMENT SIGNAL COMPONENT \(\sim S160\)

CONVERT MEASUREMENT SIGNAL COMPONENT INTO DIGITAL SIGNAL AND TRANSMIT DIGITAL SIGNAL TO ANALYSIS SERVER \(\sim S170\)

BANDPASS FILTER DIGITAL SIGNAL AND DIVIDE BANDPASS FILTERED DIGITAL SIGNAL INTO AT LEAST TWO BIOSIGNALS \(\sim S180\)

OUTPUT BIOSIGNAL MEASUREMENT RESULT USING DIVIDED BIOSIGNALS \(\sim S190\)

END
FIG. 2

Bio Sign Monitoring System

Button group:
- RF Signal (input signal)
- Heart Axes (ECG)
- Respiration Axes (Respiration)

Panel:
- Signal View
- Heart Beat Number
- Respiration Number

Graphs depicting signal data with axes and numerical values.
FIG. 3

310

311 312 313

CW Rx

330 MIXER

320 LNA

340 ADC MODULE

350 TRANSMISSION MODULE

360 BANDPASS FILTER

370 BIOSIGNAL MEASUREMENT RESULT OUTPUT UNIT
A. **CLASSIFICATION OF SUBJECT MATTER**

A61B 5/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. **FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC8 A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

KR, JP  IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS (KIPO internal) "bio-signal", "radio"

C. **DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 2005/0143667 A1 (PARK, J-M et al) 30 June 2005 See figure 3 and claims</td>
<td>1-9</td>
</tr>
<tr>
<td>A</td>
<td>US 5394882 A (MAWHINNEY D D) 07 March 1995 See abstract and figure 2</td>
<td>1-9</td>
</tr>
<tr>
<td>A</td>
<td>US 3934577 A (ROMANI, E P) 27 January 1976 See abstract and figure 2</td>
<td>1-9</td>
</tr>
</tbody>
</table>

☐ Further documents are listed in the continuation of Box C  ☒ See patent family annex

Category*: Special categories of cited documents

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search: 27 APRIL 2007 (27 04 2007)

Date of mailing of the international search report: 30 APRIL 2007 (30.04.2007)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea

Facsimile No  82-42-472-7140

Authorized officer

PAEK, Jm Wook

Telephone No  82-42-481-8458

Form PCT/ISA/210 (second sheet) (April 2007)
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>US2005143667A1</td>
<td>30.06.2005</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>US05394882</td>
<td>07.03.1995</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>US3934577A</td>
<td>27.01.1976</td>
<td>NONE</td>
<td></td>
</tr>
</tbody>
</table>