CLAIMS

1. A processor implemented method for real time unobtrusive monitoring of physiological signals pertaining to a subject confined to a bed, the method comprising the steps of:

obtaining periodically, by one or more hardware processors, a motion data signal pertaining to the physiological signals including heartbeat rate and breathing rate from the subject, from a pseudo I (in-phase) channel and a pseudo Q (in quadrature) channel of three pseudo IQ radars, wherein the three pseudo IQ radars are positioned in a predetermined configuration around the subject and wherein each of the three pseudo IQ radars comprise a pair of single channel continuous wave (CW) radars placed at a calibrated distance from each other such that optimum points of one CW radar in the pair spatially overlaps null points of the other CW radar in the pair, a baseband signal from the CW radars constituting the pair serving as the pseudo I channel and the pseudo Q channel respectively;

processing, by the one or more hardware processors, the motion data signal from each of the three pseudo IQ radars, to discard the motion data signal having motion artifacts;

determining, by the one or more hardware processors, Quality of Information (QoI) based on Signal to Noise Ratio (SNR) and frequency spectrum associated with the motion data signal from each of the three pseudo IQ radars having no motion artifacts, wherein the QoI is indicative of the pseudo IQ radar from the three pseudo IQ radars to be considered for each lying position of the subject such that readings corresponding to the motion data signal have maximum SNR and minimum harmonic content;

recalibrating, by the one or more hardware processors, one or more of the three pseudo IQ radars if the readings corresponding to the motion data signal having no motion artifacts deviate from an empirically determined threshold, wherein the threshold is indicative of number of times anomalous

readings are received from the pseudo I channel and the pseudo Q channel; and

evaluating, by the one or more hardware processors, the heartbeat rate and breathing rate by applying a Supervised Complex Signal Demodulation (SCSD) method on the motion signal data received from the one or more of the three pseudo IQ radars based on the QoI, wherein the SCSD method is configured to suppress amplitude and DC imbalance by assigning weights to the pseudo I channel and the pseudo Q channel, the weights being determined using a simulated trained weighted K-Nearest Neighbor (KNN) model configured to identify reliability of the pseudo I channel and the pseudo Q channel based on Fast Fourier Transform (FFT) pattern thereof in the range of the heartbeat rate and breathing rate, the reliability being indicative of harmonic content in the motion signal data.

2. The processor implemented method of claim 1, wherein the predetermined configuration provides maximum beam coverage of the bed and comprises two of the three pseudo IQ radars positioned over the subject and one of the three pseudo IQ radars positioned below the bed such that the three pseudo IQ radars form an isosceles triangle for obtaining the motion data signal unobtrusively regardless of the lying position of the subject on the bed.

3. The processor implemented method of claim 1, wherein the calibrated distance is based on wavelength of the CW radars comprising the three pseudo IQ radars.

4. The processor implemented method of claim 3, wherein the calibrated distance is an integer (n) multiple of one eighth of the wavelength ($\lambda/8$) of the CW radars comprising the three pseudo IQ radars.

5. The processor implemented method of claim 1, wherein the presence of motion artifacts is detected when dominant frequency in the motion signal data is beyond 2 Hz.

6. The processor implemented method of claim 1, wherein the step of recalibrating one or more of the three pseudo IQ radars comprises suppressing phase imbalance between the pseudo I channel and the pseudo Q channel by fine adjustment of the calibrated distance between the CW radars constituting the pair.

7. The processor implemented method of claim 1, wherein the simulated trained weighted K-Nearest Neighbor (KNN) model is trained using training data simulated by:

dividing the calibrated distance into a plurality of bins including points ranging from the optimum points to the null points;

further dividing each of the plurality of bins into five classes including null class, better null class, middle class, better optimum class and optimum class having a distinct frequency spectrum therein;

identifying a frequency band of operation corresponding to the physiological signal being monitored;

simulating for each of the five classes comprised in each of the plurality of bins, the baseband signal for incremental steps of all frequencies in the frequency band of operation and incremental distances corresponding to each of the five classes;

generating features including location of peaks and peak to peak ratio from frequency plots using the simulated baseband signal for each of the five classes comprised in each of the plurality of bins; and

training the weighted KNN model using the generated features for each of the five classes comprised in each of the plurality of bins.

8. A system for real time unobtrusive monitoring of physiological signals pertaining to a subject confined to a bed, the system comprising:

an indented radar system comprising three pseudo IQ radars positioned in a predetermined configuration around the subject, wherein each of the three pseudo IQ radars comprises a pair of single channel continuous wave (CW) radars placed at a calibrated distance from each other such that optimum points of one CW radar in the pair spatially overlaps null points of the other CW radar in the pair, a baseband signal from the CW radars constituting the pair serving as a pseudo I (in-phase) channel and a pseudo Q (in quadrature) channel respectively; and

a controller unit in communication with each of the three pseudo IQ radars, wherein the controller unit comprises:

one or more data storage devices configured to store instructions; and

one or more hardware processors operatively coupled to the one or more data storage devices, wherein the one or more hardware processors are configured by the instructions to:

obtaining periodically, a motion data signal pertaining to the physiological signals including heartbeat rate and breathing rate from the subject, from the pseudo I channel and the pseudo Q channel of the three pseudo IQ radars;

processing the motion data signal from each of the three pseudo IQ radars, to discard the motion data signal having motion artifacts;

determining Quality of Information (QoI) based on Signal to Noise Ratio (SNR) and frequency spectrum associated with the motion data signal from each of the three pseudo IQ radars having no motion artifacts, wherein the QoI is indicative of the pseudo IQ radar from the three pseudo IQ radars to be considered for each lying position of the subject

such that readings corresponding to the motion data signal have maximum SNR and minimum harmonic content;

recalibrating one or more of the three pseudo IQ radars if the readings corresponding to the motion data signal having no motion artifacts deviate from an empirically determined threshold, wherein the threshold is indicative of number of times anomalous readings are received from the pseudo I channel and the pseudo Q channel; and

evaluating the heartbeat rate and breathing rate by applying a Supervised Complex Signal Demodulation (SCSD) method on the motion signal data received from the one or more of the three pseudo IQ radars based on the QoI, wherein the SCSD method is configured to suppress amplitude and DC imbalance by assigning weights to the pseudo I channel and the pseudo Q channel, the weights being determined using a simulated trained weighted K-Nearest Neighbor (KNN) model configured to identify reliability of the pseudo I channel and the pseudo Q channel based on Fast Fourier Transform (FFT) pattern thereof in the range of the heartbeat rate and breathing rate, the reliability being indicative of harmonic content in the motion signal data.

9. The system of claim 8, wherein the predetermined configuration provides maximum beam coverage of the bed and comprises two of the three pseudo IQ radars positioned over the subject and one of the three pseudo IQ radars positioned below the bed such that the three pseudo IQ radars form an isosceles triangle for obtaining the motion data signal unobtrusively regardless of the lying position of the subject on the bed.

10. The system of claim 8, wherein the calibrated distance is based on wavelength of the CW radars comprising the three pseudo IQ radars.

11. The system of claim 10, wherein the calibrated distance is an integer (*n*) multiple of one eighth of the wavelength (λ/8) of the CW radars comprising the three pseudo IQ radars.

12. The system of claim 8, wherein the presence of motion artifacts is detected when dominant frequency in the motion signal data is beyond 2Hz.

13. The system of claim 8, wherein the one or more hardware processors are further configured by the instructions to perform recalibrating one or more of the three pseudo IQ radars by suppressing phase imbalance between the pseudo I channel and the pseudo Q channel by fine adjustment of the calibrated distance between the CW radars constituting the pair.

14. The system of claim 8, wherein the one or more hardware processors are further configured by the instructions to perform training of the simulated trained weighted K-Nearest Neighbor (KNN) model using training data simulated by:

dividing the calibrated distance into a plurality of bins including points ranging from the optimum points to the null points;

further dividing each of the plurality of bins into five classes including null class, better null class, middle class, better optimum class and optimum class having a distinct frequency spectrum therein;

identifying a frequency band of operation corresponding to the physiological signal being monitored;

simulating for each of the five classes comprised in each of the plurality of bins, the baseband signal for incremental steps of all frequencies in the frequency band of operation and incremental distances corresponding to each of the five classes;

generating features including location of peaks and peak to peak ratio from frequency plots using the simulated baseband signal for each of the five classes comprised in each of the plurality of bins; and

training the weighted KNN model using the generated features for each of the five classes comprised in each of the plurality of bins.