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A SURVEY ON SMART SLEEP MONITORING SYSTEM FOR HEALTH CARE CENTRE USING IOT

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ABSTRACT:

Sleep monitoring is an important issue and has drawn considerable attention in medicine and healthcare. Traditional approaches often require subjects to stay overnight at clinics, there has been a need for a low-cost system suitable for long-term sleep monitoring system. Nevertheless, current monitoring methods suffer from several drawbacks, such as obtrusiveness, lack of privacy and high-cost.To overcome the obtrusiveness, lack of privacy and high-cost , a non-contact and cost-effective sleep monitoring, is proposed for continuous recognition of the sleep status, including on bed movement, bed exit, breathing section and heart rate monitoring section. The emergence of internet-of-things technology has provided a promising opportunity to build a reliable sleep quality monitoring system by leveraging the rapid improvement of sensors. These experimental results indicate that it is an effective and promising solution for cost-effective sleep monitoring system..

KEYWORDS:

Evaluation, non-contact sensing, sleep monitoring, cost-effective polysomnography(PSG),ballistocardiogram, photoplethysmography.

INTRODUCTION:

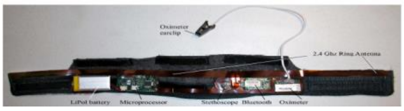
- Quality of sleep has a great impact on human health. There is a growing recognition of the adverse effects from poor sleep quality and sleep disorders. Patients with sleep disorders are prone to suffer from chronic diseases such as obesity, diabetes, and hypertension. Sleep monitoring systems are important to recognize sleeping disorders as early as possible for diagnosis and prompt treatment of disease. They can provide healthcare providers with quantitative data about irregularity in sleeping periods and durations.
- They can also provide detailed sleeping profiles that depict periods of restlessness and interruptions such as bed exits and entries due to visiting the bathroom. This information helps find trends that correlate to certain diseases. Moreover, it enables monitoring effectiveness of treatments to sleep-related diseases. Many studies are focused on finding results.
  - Correlations between body positions during sleep to various breathing problems (e.g., sleep apnea). So, if a sleep monitoring system can provide fine grained information about body positions during sleep, it would help such studies.

- To date, there are several methods to perform sleep monitoring such as polysomnography(PSG), ballistocardiogram, photoplethysmography (PPG) and actigraphy. The PSG is still the primary and the most objective sleep assessment method in clinical use, such as insomnia diagnosis. The PSG can provide fine-grained information for sleep monitoring, thus offering more accurate sleep assessment
- Another common alternative sleeping estimation method is actigraphy, including an accelerometer and a memory storage chip, which can provide information on movements during sleep. Several commercial off-the-shelf (COTS) actigraphy based products, such as Sleep Tracker, Fit bit, and Sleep Cycle, are publicly available. The competitive advantage of this method is that it is convenient to deploy and inexpensive.
- The generated high-resolution pressure maps can be further utilized for sleep monitoring. Nevertheless, current monitoring methods suffer from several drawbacks, such as obtrusiveness, lack of privacy and high-cost. These limitations prevent people from using current sleep monitoring systems on a daily basis.

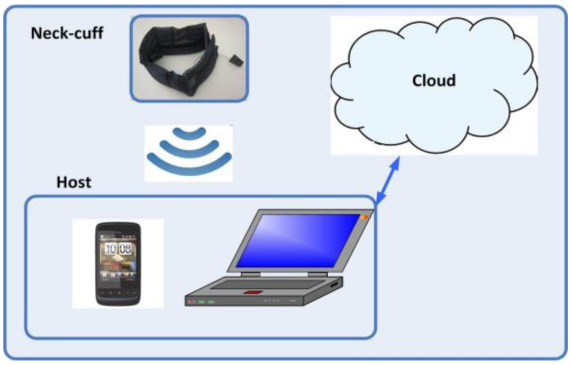
EXISTING MODEL:

REAL TIME SLEEP MONITORING USING WEARABLE NECK-CUFF SYSTEM

A non-invasive, wearable neck-cuff System is capable of real-time monitoring and visualization of physiological signals. These signals are generated from various sensors housed in a soft neck worn collar and sent via Bluetooth to a cellphone which stores the data.With this system we are able to monitor the patients sleep continuously.



It monitor people's sleep continuously in a non-invasive and low cost method while at the same time collect a large database for sleep data which may benefit future advances.



Fig(a)Neck-cuff outside view (b)overview

It is composed of several sensor nodes, a microprocessor and a Bluetooth transceiver arranged in a neck-cuff together with a cell phone or a desktop machine.The data from the cell phone or a laptop can be uploaded to a cloud, for data aggregation.

I-SLEEP MONITORING SYSTEM THROUGH SMART PHONES

iSleep monitoring system provides a practical approach of monitoring individual patient's sleep quality using off-the-shelf smartphones. Here it uses a built-in microphone which is present in the smart phone in order to detect the events that are closely related to sleep quality, including body movement, couch and snore, and infers quantitative measures of sleep quality It adopts a light-weight decision-tree-based algorithm to classify various events based on carefully selected acoustics features.

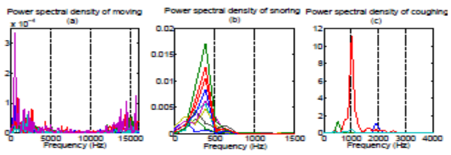


Figure 1: (a), (b) and (c) show the power spectral density of typical moving, snoring and coughing events respectively.

In the above figure, it is classified into 3 categories of which each specify the power spectral density of the patient's movement, snoring, and coughing. It expressed in terms of frequency(HZ). As unobstrusive, portable tool for in-place sleep monitoring system iSleep has a potential in helping the users to improve their sleep quality. iSleep derives both short-term (one-night) and long-term sleep quality from sleep-related events according to two well-established sleep scoring criteria: actigraphy and Pittsburgh Sleep Quality index(PSQI).

EVALUATION OF SLEEP DISORDERS USING ACTIGRAPHY

The growing use of activity-based monitoring (actigraphy) in sleep medicine and sleep research has enriched and challenged traditional sleep-monitoring techniques. It summarises the empirical data on the validity of actigraphy in assessing sleep-wake patterns and assessing clinical and control groups ranging in age from infancy to elderly. Actigraphy provides useful measures of sleep-wake schedule and sleep quality. Actigraphy has been used in research studies assessing the effects of drugs, including the effects of stimulant, antidepressant , antipsychotic and hypnotic medications .

Phenomenon	Reference number
Sleep schedule	3–8, 11–13
Sleep efficiency	3–8, 11–13
Sleep states (in infants)	13
Circadian rhythms	18, 19, 24
Respiratory disturbances	6, 31, 32
Daytime sleepiness	—[b]
PLMD	—[b]
Clinical syndromes	
Insomnia	6, 7, 8, 24, 26
Sleep apnea	6, 31, 32
Schedule disorders	33, 34, 36–39, 42
Narcolepsy	29, 30
Parasomnias	—[b]
Treatment studies	
Behavioral	26, 27, 28
Medication	34, 60–75

Fig: Based on the above table the sleep schedule is specified with reference number.

The role of actigraphy in the assessment of sleep disorders: empirical studies demonstrating validity or anticipated results.

MONITORING SLEEP USING TEXTILE RECORDING SYSTEM

The main idea of this project is that we present a home device for the continuous monitoring of sleep and investigate its reliability regarding sleep evaluation. The signal used for sleep evaluation is the HRV derived from the ECG recorded by means of a sheet and a pillow. Patients in a sleep lab and healthy subjects at home were monitored during sleep with the textile system, After frequency analysis, the spectral parameters used for sleep staging was derived at the same time from standard and textile ECG signals were compared. The trends along the night are very similar.

Fig.1 Recording system integrated into a normal bed

The ECG is fixed in the pillow and the bedcover,through which the sleep of the patients is monitored. The system is not obtrusive and can be used every night without impeding sleep in itself and therefore without interfering with the normal way of life.

PROPOSED SYSTEM:

INTRODUCTION:

Sleep plays an important role on human health. Having inadequate and irregular sleeping pattern causes serious impact on our health. To overcome the sleeping disorders a sleep monitoring system is important to recognize the disorders for early diagnosis. A non-contactable sleep monitoring system is used to monitor the patients. This system measures their movement in sleeping time by using accelerometer sensor and also calculates their breathing rate by using air flow sensor. That people cardiac rate also measured by using heart rate sensor.

MONITORING BODY MOVEMENT

The sleep status of a person is based on bed-movement and bed exit of a patient. These status can be monitored by accelerometer sensor. An accelerometer sensor is used measure the physical movement of the object due to inertial forces or due to mechanical excitation. The accelerometer which is attached to the chest can detect the movement accurately. Hence the sensor monitor the patient and store the information in the server.

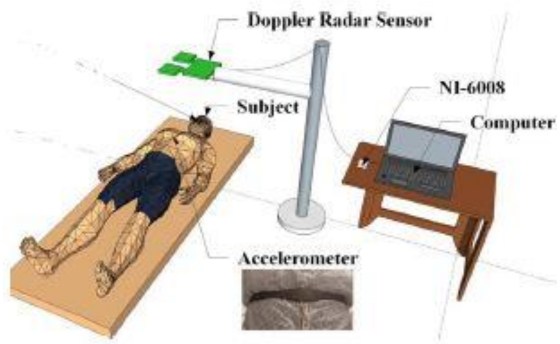


Fig: Represents the patient, being monitored by the sensors and data is stored in the server through Iot.

BREATHING RATE RECOGNITION

The breathing rate of the patient can be detected by the airflow sensor. The airflow sensor which is attached to the nostril area monitors the breathing signal because nostril area changes when the patient inhales and exhales. The breathing signal from the airflow sensor consisted as the demodulated signal. The demodulated signal which is send has a data to the server. The breathing signal during sleep can be considered as ground truth signal.

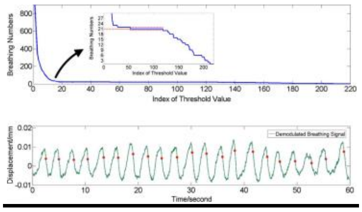


Fig. Represents the breathing signal and the ground truth signal

HEART RATE ESTIMATION

The recognition of heart rate is difficult process than the breathing rate and bed movement. Because estimating respiratory rate since pulse related motions have smaller amplitude which has to be monitored each and every second. The heart rate should be monitored for the sudden fluctuations also. The heart rate at ground truth is obtained during sleep. The heart rate sensor collects the patient’s information and send to the server.

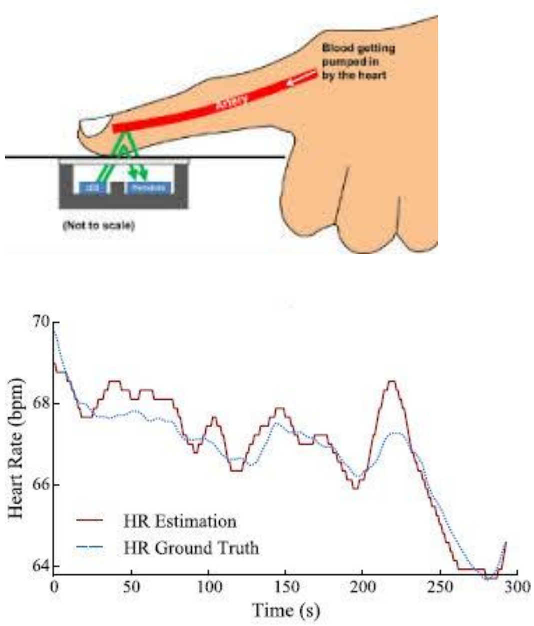
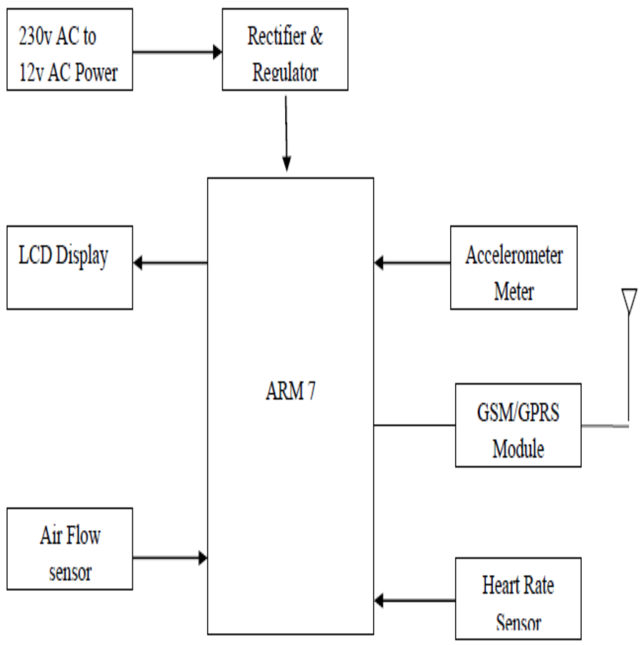
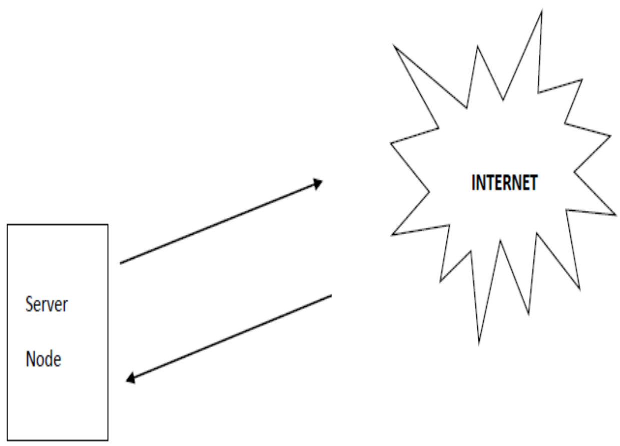


Fig. (1) Optical heart rate sensor used for all kinds of skin and tissue.(2) The performance of heart rate with ground truth

ARCHITECTURE DIAGRAM:



IOT NODE:



BLOCK DIAGRAM DESCRIPTION:

- In this project, ARM 7 microcontroller is used. This is the 32 bit microcontroller.
- Accelerometer sensor, Heart Rate Sensor, GSM/GPRS module and LCD Display these devices are interface with ARM 7 micro controller. The Accelerometer sensor is used to know their movement in sleeping time.
- Heart Rate Sensor used for measure their heart rate. The air flow sensor is used to calculate their breathing rate.
- GSM/GPRS module is used to send the information to server. Here the sim 900 gprs module is using. This is the most flexible model.
- LCD display is interfaced for displaying the current status.

EXPERIMENTAL RESULTS:

Sleep monitoring system is used to monitor the sleeping status of the patients and also followed by verification of the sampled signal from Sleep Sense using the ground truth signal from the accelerometer sensor and airflow sensor.

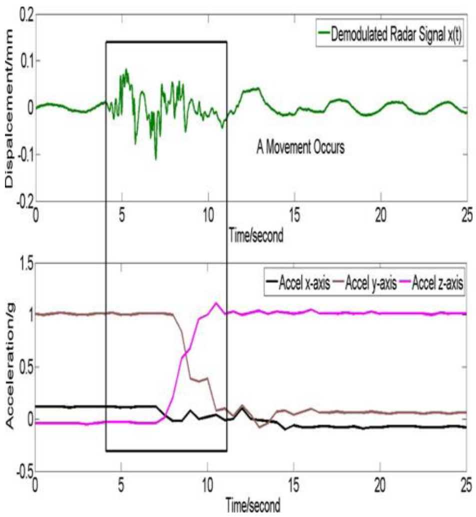


Fig: When a movement occurs, there is a large-magnitude and fast frequency fluctuation in the demodulated signal.

Therefore, the movements are detected along xyz axis respectively and is monitored through sensors.

Predicted / Actual	On-bed movement	Bed exit	Breathing section	Recall
On-bed movement	93	10	5	86.1%
Bed exit	9	21	0	70.0%
Breathing section	3	0	405	99.3%
Precision	88.6%	67.7%	98.8%	

Table: represents a short term study

The above table represents a short term study of actual as well as predicted forms for determining the performance of sleep monitoring system.

CONCLUSION:

A non-contact and cost-effective sleep monitoring system, Sleep Sense, can discriminate various sleep status stages and extract the breathing rate accurately. In the implementation of Sleep Sense, we extract different sleep status, including breathing section, bed exit, and on-bed movement. The breathing rate, then, is calculated using a novel breathing rate extraction algorithm. We also demonstrate the effectiveness of Sleep Sense in the short-term controlled study and the 75-minute real case study. The Sleep Sense can identify the on-bed movement, bed exit, breathing section, and extract the breathing rate with an acceptable accuracy rate and wide usability. By deploying the proposed sleep monitoring system at home, it can help people to assess sleep quality, even diagnose the sleep disorders at the earliest stages.

REFERENCES:

1. Comparison of center estimation algorithms for heart and respiration monitoring with microwave doppler radar", *Sensors Journal IEEE*, vol. 12, no. 3, pp. 627-634, 2012.
2. R.D.Vorona,M.P.Winn,T.W.Babinea, B.P.Eng, H.R.Feldman and J.C.Ware, "Over weight and obese patients in a primary care population report less sleep than patients with a normal body mass index," Archives Intern. Med., vol.165,no.1,pp. 25–30,2005.
3. K.Spiegel, K.Knutson, R.Leproult, E.Tasali and E.VanCauter," Sleeploss: A novel risk factor for insulin resistance and type 2 diabetes," J.Appl.Phys., vol.99,no.5,pp.2008–2019,2005.
4. D.Brooks, R.L.Horner, L.F.Kozar, C.L.Render-Teixeira and E.A.Phillipson "Obstructive sleep apnea as a cause of system in hyper- tension. Evidence from a can in emodel," J.Clin.Invest., vol.99,no.1, pp. 106,1997.
5. M.S.Aloia, J.Arnedt, J.D.Davis, R.L.Riggs andD.Byrd, "Neuropsychological sequelae of obstructive sleep apnea-hypo apnea syndrome: A critical review," J.Int.Neuropsych.Soc., vol.10,no.5,pp.772–785, 2004.
6. J. J. Liu, W. Xu, M.-C. Huang, N. Alshurafa, M. Sarrafzadeh, N. Raut, B. Yadegar, "A dense pressure sensitive bedsheet design for unobtrusive sleep posture monitoring", *Pervasive Computing and Communications (PerCom) 2013 IEEE International Conference*, pp. 207-215, 2013.

7. C. Wang, A. Hunter, N. Gravill, S. Matusiewicz, *Unconstrained video monitoring of breathing behavior and application to diagnosis of sleep apnea, 2014.*
8. Herrmann, J.G.Frey, A.Fernandes, J.M.Vesin, J.P.Thiran and J.M.Tschopp, "Obstructive sleep apnea syndrome: Effect of respiratory events and arousal on pulse wave amplitude measured by photo plethysmography in NREM sleep," Sleep Breath., vol.9,no.2,pp.73–81,2005.
9. S.Ancoli-Israel, R.Cole, C.Alessi, M.Chambers, W.Moorcroft and C. Pollak, "The role of actigraphy in the study of sleep and circadian rhythms. American academy of sleep medicine review paper," Sleep, vol.26,no.3,pp.342–392,2003.
10. M.Sateia, K.Doghramji, P.Hauri and C.Morin, "Evaluation of chronic insomnia," Sleep, vol.23,no.2,pp.243–308,2000.
11. A.Droitcour, V.Lubecke, J.Lin and O.Boric-Lubecke, "A microwave radio for doppler radar sensing of vital signs," in Proc. Dig. IEEE MTT-S Int. Microwave Symp., 2001,vol.1,pp.175–178.
12. B.Lubecke,P.-W.Ong,andV.Lubecke,"10 ghz Doppler radar sensing of respiration and heart movement," in Proc.IEEE28thAnnu.Northeast Bio engineering Conf., 2002,pp.55–56.
13. M.Zakrzewski, H.Raittinen and J.Vanhala, "Comparison of centere stimation algorithms for heart and respiration monitoring with microwave doppler radar," IEEE Sensors J., vol.12,no.3,pp.627–634,2012.
14. N.A.Fox, C.Heneghan, M.Gonzalez, R.B.Shouldice and P.deChazal, "An evaluation of a non-contact bio motion sensor with actimetry," in Proc.29thAnnu.Int.Conf.IEEE Engineering in Medicine and Biology Soc., 2007,pp.2664–2668.
15. P.DeChazal,N.Fox,E.O'Hare,C.Heneghan,A.Zaffaroni,P.Boyle, S. Smith, C.O'Connel and W.T.Mcnicholas, "Sleep/wake measurement using a non-contact bio motion sensor," J.SleepRes., vol.20,no.2, pp. 356–366,2011.