WIRELESS EEG

Nagashree Bhatawadekar[1],Varsha Thorat[2], Priyanka Mathuria[3]

[1,2,3]Electronics Engineering, D.Y.Patil Institute of Engg.& Technology Pimpri, (India)

ABSTRACT

Electroencephalogram signals commonly known as EEG is a representative signal containing information about the condition of the brain. The device used to measure these signals is restricted to one room. This project aims to increase the distance and make the EEG accessible within a building making patient monitoring comfortable for doctor.Also this project deals with a comparative study of the PSD achieved from normal, epileptic EEG signals.Currently analysis of electroencephalogram (EEG) remains a challenge owing to limited understanding of the signal origin which leads to the complication of developing evaluation techniques. We are using the VB software in our PC for the user interface with the system.

Keywords: Artifacts, Distance, EEG, RF, Wireless EEG

I.INTRODUCTION

The conventional wired EEG systems are limited to distance, are large and stationary that require the patient to be tethered to the system via a wired connection. Measurement of EEG is simple but patient have to wait till the doctor arrives at the room, to the patient. Also the wired transmissions always cause inconvenience in mobilization.

The methods in examining brain diseases are improving continuously in recent years. Due to the advantages of non-invasive measurement and the capability of long term monitoring of the EEG signal, the electroencephalograph machine plays an important role in brain examination and study.Especially, in the diagnosis of brain disease such as epilepsy, sleeping disorder and abnormal behavior, this machine is used most commonly.

The approach is to make the EEG compact, portable and more accurate. The main purpose is to increase the distance through which data travels from patient to doctor. Use of wireless technology will help to make the system portable and reach to the end easily.
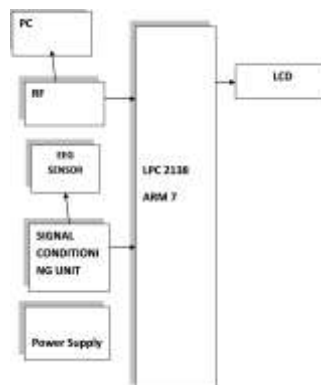
II BLOCK DIAGRAM

Fig 1. Block Diagram of Wireless EEG

III. SYSTEM DESCRIPTION

3.1 Arm 7

It is a versatile processor designed for mobile devices and other low power electronics. This processor architecture is capable of up to 130 MIPS on a typical 0.13 µm process. The ARM7TDMI processor core implements ARM architecture v4T. The processor supports both 32-bit and 16-bit instructions via the ARM and Thumb instruction sets.ARM series is a series of low-cost, power-efficient, 32-bit   microprocessors. Theseprovide the maximum performance amount and place a lower importance on minimizing power consumption and cost. Another major distinguishing feature of a microprocessor is that the chip itself consists only of a processing unit. The microprocessor must be programmed to communicate with peripherals, such as analog and digital I/O, external to the chip.

3.2 Signal Conditioning

Since the scalp EEG signal is very weak, typically with an amplitude in range of 10~100uV, thereby requiring conditioning prior to any signal processing. Furthermore, the human skin typically provides source impedance on the order of 1~5Mohm. To acquire the signal effectively,the amplifier must match or have greater input impedancethan the source impedance.

3.3 Transmission Module

Transmission module reduces the need of connecting wires.This project uses RF module as a wireless medium to increase the transmission distance. Transmission module makes the conventional EEG more compact and portable. RF will be fitted both in the transmission section as well as receiver section. The recorded readings will travel from signal conditioning circuit from the transmitter to the RF module of the receiver and to the PC.

3.4 PC

The PC and RF receiver can be interfaced with the help of the data cable DKU-50.We are using the VB software in our PC for the user interface with the system. With the help of this VB software any user can easily make the use of the system.This VB software provides the notice typing and editing facility. Also we can copy the same content as received through mobile in the editing window and call it as a notice.Hence the PC/VB software provides the typing, editing and formatting options to the user.

IV. MATHEMATICAL MODEL

The Burg's method for AR spectral estimation is based on minimizing the forward and backward prediction errors at the same time fulfilling the Levinson-Durbin recursion. On the contrary to other AR estimation techniques, the Burg's method refrains from calculating the autocorrelation function but estimates the reflection coefficients directly. The primary advantages of the Burg's method are resolving closely spaced sinusoids in signals with low noise levels, and estimating short data records, in which case the AR power spectral density estimates are very close to the true values. In addition, the Burg's method ensures a stable AR model and is computationally efficient. The accuracy of the Burg's method is lower for high-order models, long data records, and high signal-to-noise ratios (which can cause line splitting, or the generation of extraneous peaks in the spectrum estimate).

The spectral density estimate computed by the Burg's method is also susceptible to frequency shifts (relative to the true frequency) resulting from the initial phase of noisy sinusoidal signals. This effect is magnified when analyzing short data sequences. Burg's method is capable of resolving close spaced sinusoids in signal with low noise levels. Hence this method is selected to analyze EEG in this project.

$$P_{xx}^{BU}(f) = \frac{\hat{E}_p}{\left| 1 + \sum_{k=1}^{p} \hat{a}_p(k) e^{-j2\pi fk} \right|^2} \tag{1}$$

$\hat{a}_p(k)$ = estimates of the AR parameters obtained from Levinson-Durbin recursion

$\hat{E}_p$ = reflection coefficients in an equivalent lattice structure (chosen to attain total least square error)

V. CONCLUSION

The designing of wireless EEG recording system is studied in this paper. The device is compact and portable using which remote monitoring can be possible. Also the system is more efficient than conventional EEG and easy to use.

This can be used for Neurological defect estimation, determination of the mental state of an individual, in video gaming and to control various mobile apps.

The wireless transmission mechanism eliminates wire-line connections. Also, the signal filtering and digitization in the system reduce the possible noise interference. In contrast with the current EEG recording systems, such improvements make this EEG signal measuring system more applicable to studying on non-consecutive brain diseases. The primary improvements that this design exemplifies are its portability and adaptability. In addition to this Wireless EEG will allow the remote observation of relevant EEG data. The adaptability of the system will allow a variety of end application users.

REFERENCES

[1] "Design and implementation of wireless multi-channel EEG recording system and study of EEG clustering method" byRobert Lin, Ren-gueyLee,Chwan-Lu Tseng, Yan Fa Wu, Joe-Air JianBiomedical Engineering Applications ,Basis & Communications.

[2] A low-power, wireless, 8-channel EEG monitoring headset by Lindsay Brown, Jef van de Molengraft, RefetFiratYazicioglu, Tom Torfs, JulienPenders, Chris Van Hoof In 32nd Annual International Conference of the IEEE EMB Buenos Aires, Argentina, Publication Year- 2010 , Page(s)4197-4200, ISSN 1557-170X

[3] Design of a Wireless EEG System for Point-of-Care Applications by WenyanJia, Yicheng Bai1, Mingui Sun, In 2013 39th Annual Northeast Bioengineering Conference Publication Year-2013, Page(s)-78-79, ISSN-2160-7001

[4] Bluetooth Enabled Electroencephalograph (EEG) Platform by Joseph A. Lovelace, Tyler S. Witt, and Fred R. Beyette, Jr.In Circuits and systems (MWSCAS), 2013 IEEE 56th International Midwest Symposium Publication Year- 2013, Page(s)-1172-1175, ISSN- 1548-3746

[5] The Implementation of a Wireless Electroencephalogram Information System using WLAN byHaifeng Chen and Jungtae Lee In IJCSNS International Journal of Computer Science and Network Security VOL.8 No.2, Publication Year-February 2008

[6] A Wearable UHF RFID-Based EEG System by ArtemDementyev, Joshua R. Smith   In IEEE RFID 2013 Technical Program University of Washington (US)

[7] Remote monitoring of EEG signals through wireless sensor networks by AnkitBhutani, Zachary McGarvey, John Frye, Jonathan Finamore Daniel F. Pontillo, In Multi-Disciplinary Engineering Design Conference, Kate Gleason College of Engineering, Rochester Institute of Technology, New York

[8] Biomedical instrumentation and measurements-Leslie Cromwell

[9] Handbook of biomedical instrumentation-R.S.Khandpur

[10] Application and design of medical instruments-John G. Webster

BIOGRAPHICAL NOTES

NagashreeBhatawadekar is presently pursuing B.E. final year in Electronics Engineering Department from D.Y.Patil college of Engineering, Pimpri, Pune, India.

VarshaThorat is presently pursuing B.E. final year in Electronics Engineering Department from D.Y.Patil college of Engineering, Pimpri, Pune, India.

PriyankaMathuria is presently pursuing B.E. final year in Electronics Engineering Department from D.Y.Patil college of Engineering, Pimpri, Pune, India.