REAL TIME FETAL HEART RATE MONITORING SYSTEM

C.K. WALGAMPAYA [1], D.D.B. ELKADUWE[2], K.S. WALGAMA[1*],
J.V. WIJAYAKULASOORIYA[3]

[1]*Department of Engineering Mathematics, Faculty of Engineering, University of Peradeniya, Peradeniya*

[2]*Department of Computer Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya*

[3]*Department of Electrical and Electronic Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya*

The World Health Organization (WHO) reports that, even in developed countries one out of every two hundred pregnancies ends in late fetal loss. This figure is much higher in developing countries. For an unborn baby, monitoring the heart rate is one of the few things that could be done to diagnose fetal well being. Techniques to monitor the fetus heart rate during pregnancy have been developed to provide sufficient information to medical practitioners to diagnose any critical situations. Unfortunately these systems are too expensive for a developing country to adopt throughout its entire community. Our aim is to develop a low cost fetal monitoring system, replacing the expensive sensor hardware items found in the available systems, with low cost sensors and high computing power.

An automated stethoscope and an automated pinard are used to acquire the mother's and mother's + fetus' heart beat signals separately. A condenser microphone is attached to the head of an ordinary stethoscope via which the mother's heart beat is taken into the system. Similarly a condenser microphone is fixed in the position where you normally place your ear when using the pinard alone. Digitized signals are separately taken into the system via specially designed hardware. Accurate sample rate, which is critical for heart rate calculations, is achieved using the real time operating system known as RTLinux 3.2 kernel, which runs on top of normal 2.4.4 Linux kernel.

The fetus' heartbeat signal, which is weak, is corrupted by the dominant mother's heartbeat. Since separate measurements are taken for both signals an Adaptive Inference Canceling (AIC) technique can be used to remove the mother's heart beat from the fetus'+ mother's signal. Hence an adaptive filter, which uses Least Mean Square algorithm, is used as the AIC method.

The sensor hardware and the data acquisition system work satisfactorily. The system is tested with artificially generated data which are similar to the actual data patterns of the fetus' and mother's heart beat signals. The new fetal monitoring system is yet to be tested with patients once the medical ethical clearance certificate is obtained. The new system is more flexible than the existing systems, because the user has more control over the parameters such as sampling frequency and sample size. The system can further be improved to monitor multiple mothers, which is not available in current systems.