Wireless Data Logger for Logging of EMG Signal Using LabVIEW

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Abstract: **The data logger is a device which is used to store data. It may be temperature, voltage, current etc. Depending upon the type of data to be measured size and cost of the data logger is also varied. A data logger for the measurement of the EMG signal has been proposed in this paper. It has been designed using LabVIEW. With the help of low cost, compact NI USB-6008, EMG signals have been captured. For long distance transmission of EMG signal satellite communication has been used. Advantage of satellite communication has been used as a key feature to design the data logger using LabVIEW. An experiment has been done on the two subjects for their eight movements of the right hand. It has been found that data logger built with satellite transmission has more reliability, less power consumption, and has a high level of context awareness. This proposed data logger has reduced the burden of long program writing in acquiring to log the data like other data logger.**

1. INTRODUCTION

In its most basic form, data logging is the measurement and recording of parameters over a period of time. The parameter can be anything such as: temperature, light, pressure, voltage, current, resistance, power or any of a wide range of other parameters. But whatever it may be, it is called 'data' as it contains information. And data-logging is nothing but storing this information for future usages and reference. In this paper, EMG signals have been logged from a remote patient with the help of satellite communication. The resultant EMG signal can be used for further analysis. Since, EMG signals are very important in the field of diagnostics, neuromuscular disorder, prosthesis control, ergonomics, etc. [1]. So, it's become important to transmit them with minimum loss. The quality of an EMG signals depend upon several factors such as amount of timing and intensity of muscle contraction, distance of the electrodes from the area of interest of muscles, properties of the tissue overlying the muscle, skin thickness, and fatty tissue [2]. There are two types of noise present in the EMG signal these are power line interference noise and baseline wander [3]. Dogan Ibrahim [4] designed a microcontroller based GPS data logger device with secure data card storage and Google map mapping interface. The device collects the user coordinates in a file on an SD card and then the Google map software is used to draw the track of the user on a street level map. In this paper, the author used, an error correction technique named wide area augmentation system. With the help of this technique GPS receiver receives correction signals and calculates their positions with an accuracy of around 3-5 meters. A limitation of this is high power consumption; the data collection algorithm is poor and data collection interval needs improvement.

Dejan Raskovic et.al [5] designed and implemented an ultra-low power embedded GPS receiver node to use in remote monitoring situations where battery life is of the most important. It consists of a standard SiRF Trickle Mode available on some of the latest chipsets switches between the full power and a single fixed duty cycle. If the fixed duty cycle is set too low, Trickle Mode causes too much signal drops; if set too high, consumes too much energy. Even though determining whether an object is moving or not seems like an easy task, a significant amount of signal processing is required to confirm that the object is stationary. When the signal coming from the accelerometer is plotted, it is relatively easy for a human to characterize different patterns of motion. The microcontroller, however, has to do the same task in real time, using very limited computational resources. Some types of motion produce similar signal outputs from the accelerometer. It does not give the exact location and real time clock information from the network of wireless sensors.

2. MATERIALS & METHODS

2.1 Subjects and Signal Acquisition

In this paper, two subjects have been used for EMG signal analysis for their eight different movements of the right hand. Each person belongs to an age from 20 to 26. A NI LabVIEW USB-6008 has been used to interface with the EMG trainer kit [6]. A low cost EMG trainer kit ST2358 has been used [7]. Satellite transmitter and receiver system made from Falcon Pvt. Ltd. The block diagram of whole system has been shown below in figure 2.1.

From fig.2.1 it can be seen that electrodes are placed first on the human body then attached to the low cost EMG trainer kit from which EMG signals are transmitted using satellite transmitter then these are transmitted using emulator which works transponder of a satellite and receiver receives these

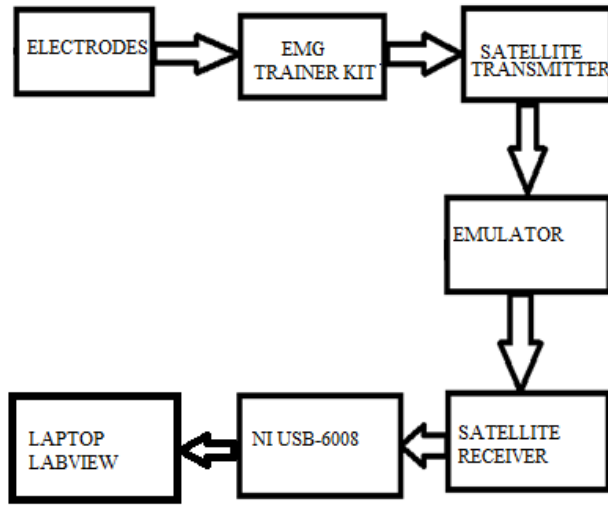signals and transfer them to NI USB-6008. NI USB-6008 has universal connectivity to the computer.

Figure 2.1. Block Diagram of Data Logger Using Satellite Communication

2.2 EMG Preprocessing

Preprocessing of EMG signal is very important in the analysis of EMG signal. It has been done with the help of NI USB-6008. It has capability of amplifying, digitizes, filtering etc. of the EMG signal. It is a low cost, compact DAQ supplied by National Instruments.

At the end EMG signals can be seen on the computer as shown in figure below. From figure 2.2 represents the EMG signals. Along x-axis, number of samples has been shown and along y-axis, amplitude has been shown in millivolt. Since, EMG Signal has low amplitude in millivolts the obtained EMG signal has been shown in figure 2.2.
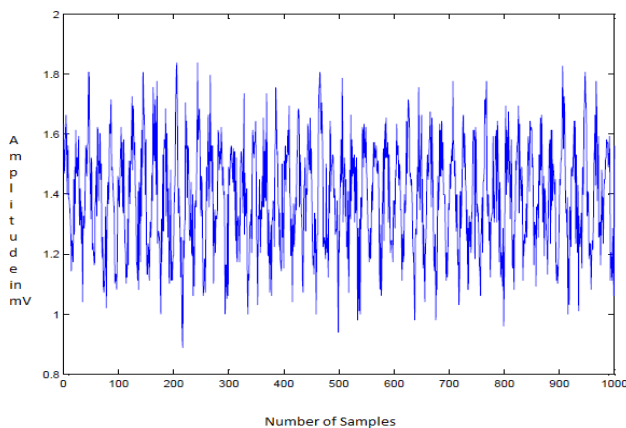

Figure 2.2. Captured EMG Signal Using Data Logger

3. THEORY

A data logger can be formed with the help of NI LabVIEW in a cost effective approach, universal connectivity with computers.

Figure 3.1. Complete Hardware Set up for a Wireless Data Logger Using Satellite Communication System.

In figure 3.1 it has been the complete hardware circuitry needed to design a data logger. In this figure, it has been shown that satellite transmitter to the left at which electrodes are placed. Emulator has been working as transmitter and receiver between satellite transmitter and receiver at the end it can be seen a small, low cost compact NI USB-6008DAQ has been used. Satellite transmitter a satellite is made from falcon India. Satellite transmission and reception consists mainly baseband signal, QPSK transmitter and receiver [8]. The emulator has been working similarly like a transponder. It has one uplink frequency and downlink frequency. Both should be different so that minimum interference would occur. Mostly, the uplink frequency is higher than the downlink frequency.

Since, NI USB-6008 has universal connectivity to the computers. With recent bandwidth improvements and new innovations from National Instruments, USB has evolved into a core base of choice for measurement applications. The NI USB-6008 is a low-cost DAQ device with easy screw connectivity and a small form factor. So, it can be transportable to other computers as well as. To obtain an EMG signal noninvasive electrodes of AgCl have been connected to the right hand of the subjects.

LabVIEW can be used as an effective tool for the signal acquisition and analysis [9]. Now, to acquire the EMG signal a program has been written using NI LabVIEW software. First of all take DAQ input assistant from tools. Then double click on this the automation and explorer option has been used to select the channel on which electrodes are placed. Now, to minimize the offset in the EMG signal differential configuration of electrode attachment has been used using

LabVIEW as well as areas of interest. Since, this device has very low cost in comparison to the Bio-Opac instruments. A bio-Opac instrument has also complex circuitry and more weight in comparison with EMG trainer kit ST2354 [11]. The operation of DAQ has been shown below in figure 3.2.
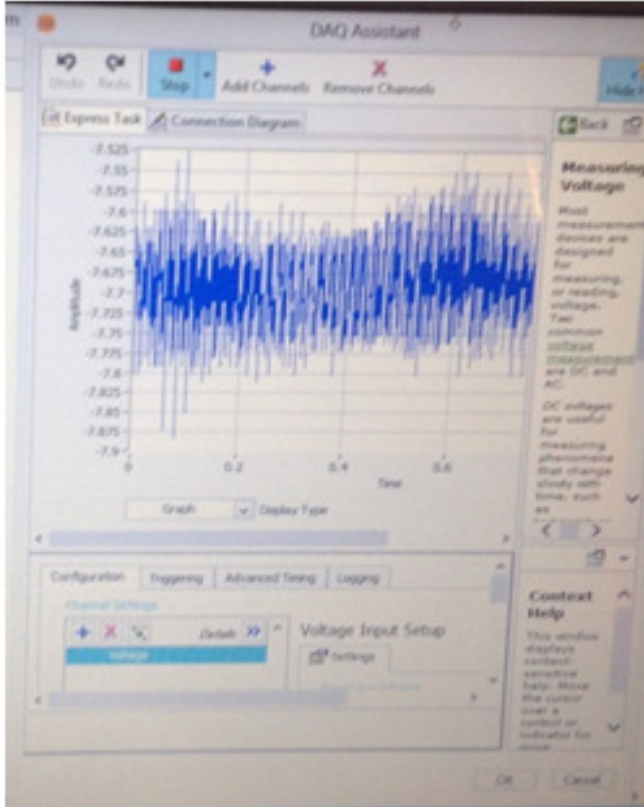

Figure 3.2. DAQ Assistant Operation

A data logger can be used to log EMG signal. A model of data logger has been proposed using LabVIEW. It has been shown as below:
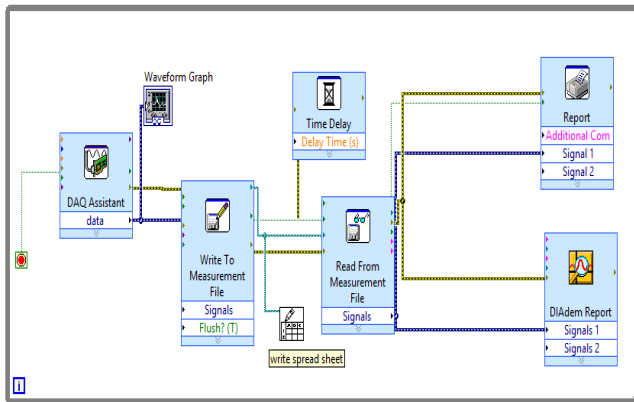

Figure 3.3. A Data Logger Using LabVIEW

After complete set up of electrodes, configuration of NI USB-6008 and satellite transmitter and receiver circuitry, DAQ opens an output signal. This signal can be write to a measurement file using write to measurement file but in this data can be stored in text file or measurement file. It has disadvantage like patient name, report time and the operator name has not been written using this. With the help of this program written using NI LabVIEW, we can store data continuously for a long time. The data is stored in spreadsheet format or in the form of a report.In early, this task of recording has been done by using a strip chart recorder, voyage recorder, etc. which were slow and had a complex circuitry. With the advancement in technology a method has been proposed to record real time data for remote patient as shown in figure 3.3.

By using this data logger, a medical expert can monitor the health status of patients even from remote areas. The report of a patient can be analyzed in real time as well as offline when he would be free. During busy hours like, when medical expert would be in operation theatre the EMG signal has been stored in the spreadsheet, text or in the pdf form. He can communicate with the patient if his data would have been found to be serious. The data has been stored in the format like.

Report title specifies the title of the report. It means that title can be given according to the EMG, EEG or ECG signals of a patient. Patient's name specifies the name of the patient on the report. Operator name specifies the name of the operator who has generated the data for the report. Report print date includes the date of the report. Report print time includes the time of the report. Page number includes the current page number of the report. Total pages include the total number of pages of the report. Further, the report can be written as a TEXT file, a PDF file or HTML file with the help of this device.

4.   RESULTS AND DISCUSSION

From figure below it has been seen the report generated by Raman Dev for EMG signal analysis is of patients. The EMG signal has been shown below belongs to patient 'a'. Thus, a data logger has been built with the combination OF satellite communication system and compact NI USB-6008 to log EMG signal from remote area patients.

It has advantages over AM and FM which have been used only for short distance. For long distance transmission of EMG signal, Satellite communication system has been used [11]. It reduced the burden of complexity like in strip chart recorder, Voyage recorder, etc. With the help of LabVIEW a data logger has been designed which gives accurate information. It has also reduced the cost of requirement of cathode ray oscilloscope or digital storage oscilloscope. Since, EMG signals have been used in many areas like in neuromuscular disorder, prosthesis control, ergonomics,

clinical purposes etc.. So, a data logger for EMG signal can be good idea for all above problems.
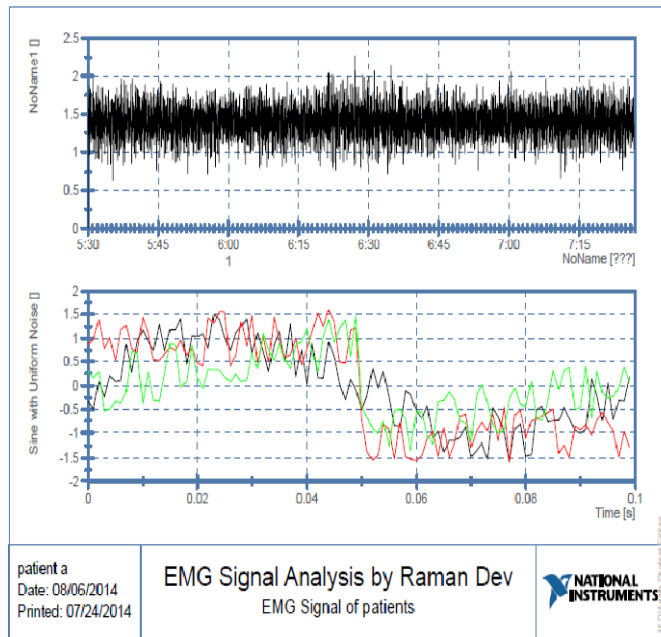

Figure 4.1. EMG Signal Report Generated by Data logger

5. CONCLUSION

With the advancement in technology, a data logger with combination of Satellite communication system and NI USB-6008 can be a good choice for EMG data logging. Since, EMG has vast applications in the area of neuromuscular disorder, prosthesis control, ergonomics etc. A data logger has been proposed here is useful to get EMG data from the patient belongs to remote areas, where it is impossible to transmit data using AM or FM. Thus, data logger has been built using NI USB-6008, EMG trainer kit; satellite communication system can be used by the medical specialist to monitor the EMG signal in real time as well as in offline time also. Thus, a reliable system has been built with the help of LabVIEW. The system has high context awareness in order to correctly analyze the collected information.

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