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SENSORS APPLICATION OF DIGITAL SIGNAL PROCESSING

M. F. Abdullah[1], N. M. Z. Hashim[2], N. M. Saad[3]
N. A. A. Hadi[4], A. Salleh[5], A. S. Ja'afar[6]

[1, 2, 3, 4, 5, 6] Centre for Telecommunication Research and Innovation (CeTRI)
Faculty of Electronic and Computer Engineering
Universiti Teknikal Malaysia Melaka
76100 Hang Tuah Jaya, Durian Tunggal, Melaka, Malaysia.
[1]*fazril_abd@yahoo.com*, [2]*nikzarifie@utem.edu.my*

Abstract: *Many people claim that current technology causing pollution and destroyed nature. However there are a lot of advantage that occur after the rising of the technology. Digital signal processing is example of the famous rising technology nowadays. This paper is about current sensors that can be use in digital signal processing also to find out how can sensors giving so much advantages in human life. To find out how each sensors work in different ways and also to find out why are so many sensor created. The scope of this article only explain about the uses of sensors, type of sensors, and how the sensors works. To make this articles interesting and informative for the readers with multiple information, it's have been categorizes according to their characteristic for every sensors. On the other hand to give effective information to readers about nowadays technology especially sensor in digital signal processing.*

Keywords: *Digital Signal Processing, use of sensor in digital signal processing, type of sensors.*

1. INTRODUCTION

One of the rising issue of technology is Digital signal processing (DSP). DSP is a branch of information science and technology, specifically on the methods and techniques for processing digital signals. The signals processed in two ways which in time and in magnitude, and therefore fit for computer manipulations. Sensor is a device that responds to a physical stimulus and transmits a resulting impulse. Sensor can be in different type such as heat, light, sound, pressure, magnetism, or a particular motion.

2. LITERATURE REVIEW

a. Surface Electromyography Signal Processing and Application: A Review [1]

This paper study about human muscle function and how electrical activity produced from human muscle. The muscle activity convert into signal form associate with muscle contraction. The basic techniques of EMG signal recording are by using surface and wire electrode where the latter is usually used for interest in deep muscle. During experiment process, several problems had to be solved such as noise, motion artifact and signal instability. Therefore, lots of signal processing techniques had been implemented to produce a reliable signal for analysis.

From this articles, readers can understand how EMG become important thing in medical and clinical application. This article also explain how amplification process of EMG signal and Noise sources and removal. High-pass filtering using Butterworth filter is probably the efficient technique for ECG artifact removal from SEMG signal. The article also run the analysis u sing three method that is amplitude, frequency and time-frequency analysis.

The application of surface electromyography are:

(i). Estimation of Muscle Fiber Conduction Velocity(MFCV)
(ii). Diagnosis and clinical application with new electrode design
(iii). Study on Parkinson Disease patient
(iv). Biomechanics and Motion Analysis
(v). Prosthetic device
(vi). Speech recognition

Surface Electromyography (SEMG) is very complex because its involve design of electrodes, recording techniques, analysis methods and application for various purposes.

b. Application of Compressive Sensing To the Design of Wideband Signal Acquisition Receivers [2]

This article is about the reduction the number of measurement for digital acquisition by using compressing sensing (CS). The reduction include theory, power consumption, weight, size and monetary cost of both signal. The input signal from environment was taken sparse combination which is the unknown frequencies that appear in a broad spectral band.

Two methods were used which are using a set of computer simulation and using applicable CS theory to look at the consequences performance of the CS receiver. The objectives is to detecting the presence of signals, characterizing them and extracting a specific signal. The result this paper is designing of high-performance RF signal should be able to reduce the system.

The most important technical specifications in this experiment is instantaneous bandwidth, instantaneous dynamic range,

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SNR degradation, and maximum signal bandwidth. The bandwidth available for communicating to other assets or a central processing facility what the receiver has discovered.

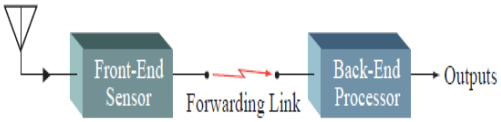

Figure 1: A wideband signal acquisition receiver

c. Low Power Digital Signal Processor Architecture For Wireless Sensor Nodes By Using Parallel Prefix Technique [3]

Wireless sensor network (WSN) applications are industrial inspection, medical field, environment sensing, and military surveillance. WSN node has three parts. They are sensors, radio, and micro controller. These three parts are combined with a limited power supply. Since radio transmissions are very expensive in terms of energy. The ratio of communication to computation energy cost range from 100 to 3000. So data communication must be traded for on the node processing which in turn can convert the many sensor readings into a few useful data values.

Two key requirements are used to the Related Requirements For Processing is minimize memory access, Combine Data and Control Flow Principles. The existing method used in this experimental is binary tree and the disadvantages of this method is at a time only one node act as root nodes, other node act as leaves. So at a time only one data is send. Hence the power as well as energy is increased.

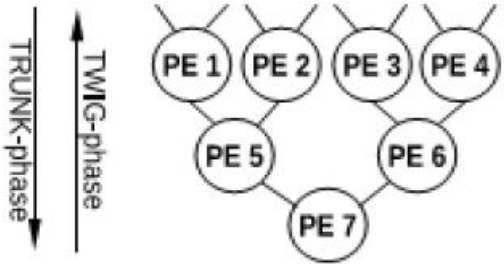

Figure 2: Binary Tree Method

Flexibility energy can be saved by limiting the data set by preprocessing with parallel prefix operations and the reuse of the binary tree as a folded tree.

d. Robots and DSP methods: History and Perspectives [4]

This article research about robot operate and sense their environment. There are three main part of the sensor that are used in this articles which is passive and active sensor, infrared sensor and a logical sensor.

Passive sensor rely on the environment to provide the medium for observation.to observe the environment it requires a certain amount of ambient light to produce a usable picture while active sensor put out energy in the environment to either change the energy or enhance it. A sonar sends out sound, receives the echo, and measures the time of flight.

A logical sensor is a unit of sensing or module that supplies a particular percept. It consists of the signal processing from the physical sensor and the software processing needed to extract the percept. It is the functional building block for perception

Infrared sensors are another type of active proximity sensor. They emit near infrared energy and measure whether any significant amount of the IR light is returned. IR sensors have a range of centimeters to meters, depending on what frequency of light is used and the sensitivity of the receiver.

e. State of the Art in Sensors, Signals and Signal Processing [5]

This articles is about the specification of the bio signal sensor. The research focus on sensors and physiological signals for

(i). Electroenzephalogram (EEG)
(ii). Electrocardiogram (ECG)
(iii). Respiration
(iv). Electromyogram (EMG)
(v). Electrooculogram (EOG)

Table below represents a first overview of sensors for bio signal measurements together with some important features.

Table 1 Overview Of Sensors For Bio Signal Measurements

Bio signals	Sensor type	Sensor location
EEG signals	AgCI electrodes	Scalp
Pulse (Heart rate)	Photoelectric	Finger, earlobe
ECG (Heart rate)	Disposal electrode	e.g. Einthoven I/II, Wilson recording
Electro dermal activity	Finger electrode	Hand, foot, forehead
Respiration	Belt/nose flow sensor	Thorax, abdominal
Facial EMG	Disposal electrode	Face
EMG	Disposal electrode	Hand, leg
EOC	AgCI electrodes	Vertical/ horizontal/ diagonal eye

In conclusion different types of sensors and signals and different method of signal processing has been discussed. As this field is quite huge, the presented signals is just a sketch of what is available and ready for use in biomedical research and applications. Based on the state of the art sensors will be

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further established and signal processing algorithms will be additional improved in order to improve the output of biomedical research and to the usability for medical diagnosis.

f. Sensor Applications of Digital Signal Processing [6]

This article is about the origins and scope of the digital signal processing include the heritage of numerical analysis and computing also heritage of statistical analysis and heritage of signal and systems theory

Other than that, from this article readers also can know about basic models of DSP and their generalizations and interdisciplinary nature of DSP. DSP applications not just involve in technology and science but also in mathematical modeling.

The specification for the mathematical modeling is basic concepts, General Scheme of Model Identification, Inadequacy and Inaccuracy of the Model, Epistemological Considerations and Examples of Mathematical Modeling of Sensors and Sensor Data.

The most important information in this article is its provide the example of problem and solution in digital signal processing.

g. Digital Signal Processing by Virtual Instrumentation of a MEMS Magnetic Field Sensor for Biomedical Applications [7]

This article is about signal processing system with virtual instrumentation of a MEMS sensor to detect magnetic flux density for biomedical applications. This system contains of a magnetic field sensor, electronic mechanisms implemented on a printed circuit board (PCB), a data acquisition (DAQ) card, and a virtual instrument.

The MEMS sensor operates with the Lorentz force, which is produced by the collaboration of a magnetic flux density and a sinusoidal excitation current through an aluminum loop. The Lorentz force is amplified when the resonant structure works at its first resonant frequency. It causes a longitudinal strain in the two piezo resistors located on the bending beams, which changes their initial resistances. It produces a variation in the output voltage of the Wheatstone bridge.

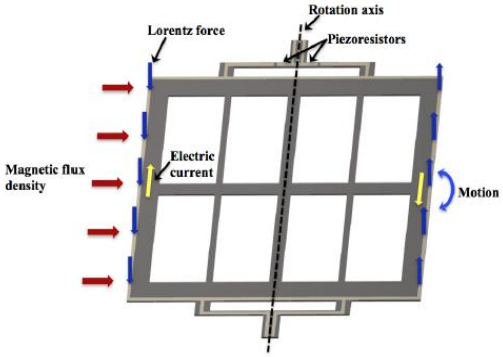

Figure 3: Operation Principle of a MEMS Magnetic Field Sensor

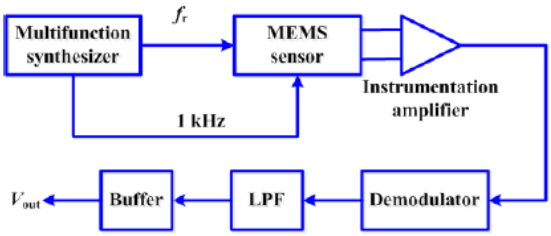

Figure 4: Signal Conditioning Stages Of The MEMS Magnetic Field Sensor

The block diagram of the signal conditioning system executed in a printed circuit board (PCB) for a MEMS magnetic field sensor. It is wrapped using a DIP-8 (eight-pin dual inline package). A sensor with related characteristics was reported, which presented an experimental sensitivity and resolution of 4 V·T−1 and 1 μT, respectively.

h. An Energy- driven Design Methodology for Distributing DSP Applications across Wireless Sensor Networks [8]

This article present a design methodology for modeling and implementing DSP applications applied to wireless sensor networks. Dataflow models of computation are widely used for modeling DSP applications. The number of data values produced and consumed by each graph vertex is fixed and known at compile time.

As a result of this restriction, graphs can be scheduled statically based on the repetition vector, which is a vector that is indexed by the actors in the graph, and gives the number of times that each actor needs to be appealed in a static schedule for the graph.

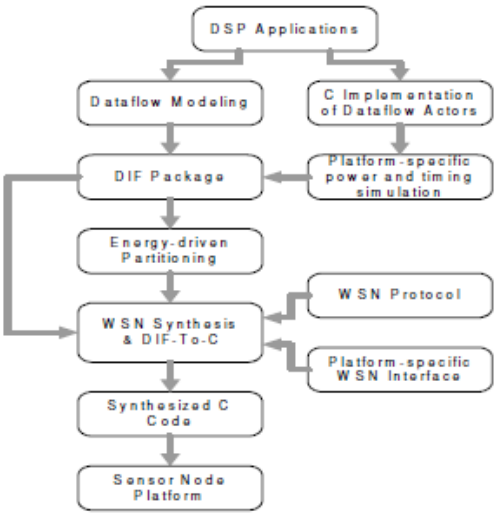

Figure 5: Overall Design Flow

This article have presented a novel algorithm, and associated design methodology for allocating DSP applications across master/slave WSN systems in an energy efficient fashion. This

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methodology participates high-level application modeling, task and network-level energy and latency modeling to systematically optimize system performance. Results on synthetic benchmarks and on three practical applications demonstrate the utility of our proposed methods.

i. A Wireless Sensor Node Architecture for Exploring Distributed Sensor Network Applications [9]

This article research about the examination of problems where multipoint sensor measurements are bonded to make complex decision on the detection and characterization of circulated phenomena. The design of the XYZ node based on commercial off-the shelf components struggles to attain a middle-ground between a small form factor, low power device and the current needs for experimental evaluation of sensor network systems.

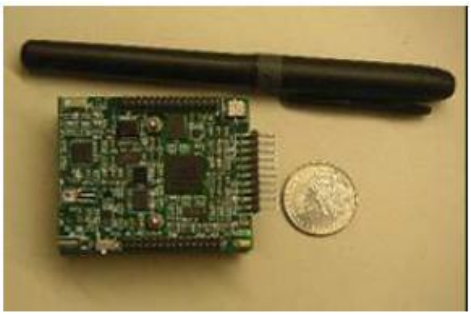

Figure 6: The *XYZ* sensor node

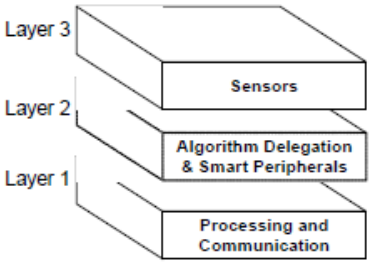

Figure 7: Sensor node hardware stack

Users will be able to apply these procedures to produce application specific ultra-low cost sensor network applications. This article also envision that the *X*YZ architecture will assist as the enabler for these applications. Researcher plan to use the *X*YZ node as a generic wireless communication interface that delegates more complex tasks to an external FPGA that will act as the development platform for IP core implementation as shown.

j. Temperature Sensors [10]

This article research about applications of temperature sensors in monitoring, compensation and control. The application in monitoring divided into four which are

(i). Portable Equipment
(ii). CPU Temperature
(iii). Battery Temperature
(iv). Ambient Temperature

Two method for compensation application is Oscillator Drift in Cellular Phones and Thermocouple Cold-Junction Compensation while another two method for control application is Battery Charging and Process Control.

3. CONCLUSION

From all the article that have been simplify and explain in literature review, we know that there are lot of sensors that were used in different application due to various function of the sensors. The rising of nowadays technology is faster than we expected. Even a lot of sensors that include in this article, but there still a lot of sensors that are not mentioned in this articles. From the result in this article, we know that how sensors work and giving so much advantages in our life because works getting easier to human.

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