

Purpose

This application note describes potential application of Plessey Semiconductor's Electric Potential Integrated Circuit (EPIC) sensor to movement detection, position sensing and gesture recognition of the human body.

Introduction

EPIC is a very high impedance sensor which can measure small changes in the ambient Electric field (E-field). This allows it to detect changes in local E-field due to the movement of dielectric objects such as a human body.

When a person moves, he disturbs the electric field around himself. The EPIC sensors can be configured to detect this change in the E-field and produce a proportional signal which can be used to estimate various information related to position, motion and possibly gesture. The advantage of EPIC sensor technology lies in its ability to operate completely passively. Objects can be detected moving against the Earth's static field or as stationary targets within an existent AC field.

It is sometimes also possible to operate them in covert mode, behind say a non-conductive wall.

Position, movement and gesture applications

The sensor data can be used to calculate a multitude of information including position, movement, velocity and possibly even gestures.

Since the sensor can respond to the changes in the ambient E-field, a number of configurations are possible. The sensors can be positioned in different spatial arrangements to realise various spatial measurements

A simple setup, as shown in figure 1, can be achieved by using just a pair of sensors in a differential mode. Each of the sensors can measure the existing mains frequency (50 Hz/ 60 Hz). When a dielectric object such as a finger, is placed between the two sensors, the level of the mains signal detected by the sensor is changed and this

can be displayed as a relative position within the range of the pair of the sensors.

Sensors may be placed at the corners of a room to triangulate the position of the person moving in the room with some signal processing. Figure 2 shows a possible arrangement for this.

While simple position and movement tracking using relatively small number of sensors and simple signal processing are currently possible, potential future development may lead to the following:

- It may be possible to set up multiple sensors in various spatial arrangements in two and three dimensions to measure and visualise the position and gesture of the body within the confines of the sensor boundaries. By increasing the number of sensors in arrays, the resolution of the detection can be increased opening up the possibility of determining complex gestures.
- It is possible to desensitize the quasi DC response of the EPIC sensor which may make it possible to conduct measurements in the presence of large static objects such as non-conducting walls. This enables the use of the sensor for security applications involving hidden movement detection.

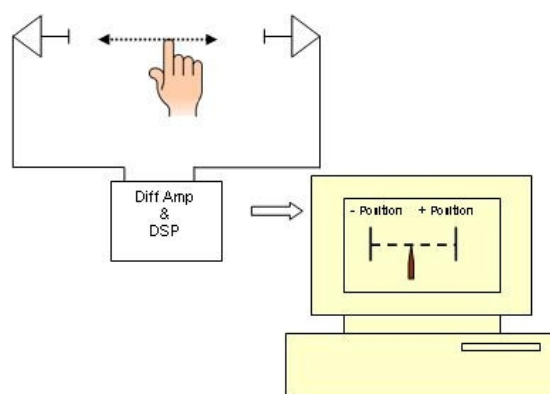


Figure 1- Finger tracking in 1-dimension, using a pair of sensor being displayed on a computer as a relative position

The exact position and gesture related information is extracted via some suitable algorithmic processing, based on sensor data after appropriate signal processing. The complexity of signal processing required depends on the target to be resolved in terms of the spatial precision required and the complexity of the movement and gesture.

Sensor data processing

The signal from the sensors can be easily digitized by using suitable A-to-D with reasonable resolution and sampling rate. The bandwidth of sensor necessary for this type of application can typically be <1 Hz to >200 Hz which can be easily digitized by a 1K Sample/s digitizer.

Digitizers with programmable gain amplifiers in the analogue channels are available which can be useful in restoring the signal to noise ratio from different sources. Obviously, additional gain and filtering can be incorporated prior to feeding the analogue signals through digitizers. Microprocessors with onboard A-to-D can be employed to do this and also perform the necessary algorithms to calculating the position, and movement. A visual interface can be incorporated to display the results.

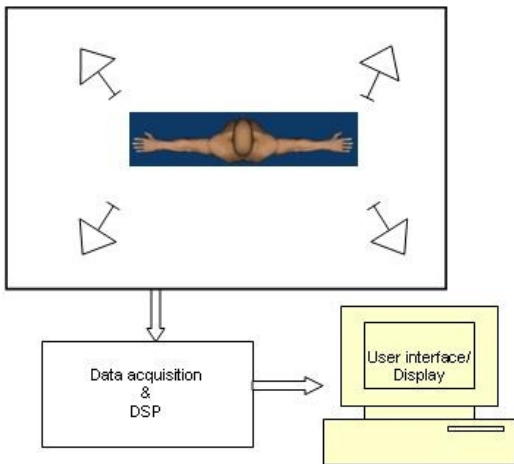


Figure 2 - Movement detection of an ambulatory human subject by four sensors at the corner of a room.

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