

An Accelerometer Based Digital Pen

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ABSTRACT: Due to marvellous development of computer technology, Human computer interaction (HCI) techniques have become an indispensable component in our daily life. HCI for static authentication with better password protection. we have developed a prototype of a MEMS based digital writing instrument which makes use of a micro inertial measurement units. we have proposed accelerometer 3D input digital pen for hand written digit and recognition which works on tri-axial accelerometer to sense hand movement, a microcontroller and an RF wireless transmission model for sensing and collecting acceleration of hand writing and trajectories. From this, the acceleration signals measured by this transmitter are transmitted to the computer by using wireless module. In this project we are using the algorithm known as trajectory recognition algorithm, because it gives the better recognition performance.

KEYWORDS: MEMS Accelerometer, A/D converter, handwritten recognition, Atmel Microcontroller.

I. INTRODUCTION

From the growth of scientific technology and development, the main aim of the technology is to reduce the dimension and weight of the consumer's electronic products. In this, the Digital pen are the new instrument that may completely replace the computer keyboard, which is still the preferred alphanumeric Human to Computer input device. This method may provide an accelerometer based digital pen for handwritten digit and trajectory recognition applications. By this process we can do human computer interaction and thus made them more useful and convenient. Now a days, an attractive devices known as an embedded device with an inertial sensors, has been expected to sense and to recognize the activities of individual and to imprison their motion trajectory information from accelerations for handwriting recognition. One of the important features of inertial sensors is used for wide ranging motion sensor in which it can be operating without any external reference and constraint in operating conditions. On the other hand, motion recognition is slightly hard for different users since each user may have different speeds and styles to generate their motion trajectories. Thus, due to some difficulties many researchers have involved to avoid the problem field and to increase the accuracy of handwriting recognition system. During this process an Accelerometer known as a Tri-axial accelerometer with MEMS sensor is introduced based on this, it is mainly used for recognize four hand trajectory motions will be recognized in digital format. MEMS are termed as Micro Electro Mechanical System it is generally based on silicon. It uses the technology known as micro-fabrication technology in which it may consist of holes, cavity, channels, cantilevers, membranes and in addition initiates mechanical parts. The Main advantage of MEMS is small in size, low cost, highly applicable as an accelerometer. By reducing the cost of the system and make straightforward algorithms, many search effort has been dedicated to extract significant features from time-series inertial signals. This paper may describes about the particulars of the hardware device, the accelerometer based digital pen for handwriting operation, microcontroller and zigbee transmission in detail, parallel human computer interaction application respectively. Finally the conclusion is given in the last section.

II.SYSTEM OVERVIEW

This system in which the schematic diagram may describes about the gloves system to represent the handwriting digits. Here we will develop the gloves – type portable device and a trajectory recognition algorithm. This gloves type portable device may consist of hardware's like accelerometer, microcontroller and an RF wireless transmission module. From this , the moment of acceleration signals measured from the tri-axial accelerometer are transmitted to the computer through the RF wireless transmission system. Users can use this gloves to write digits and thus make the hand moments at a normal speed. The recognition procedure may consist of acceleration acquisition, feature generation, feature selection, feature extraction and signal pre-processing. The process of signal pre-processing procedure may consists of a moving average filter, high pass filter, calibration and normalization.

The main objectives of the feature selection and feature extraction methods is not only to eradicate the burden of the computational load but also to increase the accuracy of classification. By this process, the reduced features may be generally used as the input of the classifiers. The main aim of this paper includes the following (1) the development of portable device with the trajectory recognition algorithm it may generally give the information about the hardware module and it can give desired commands by hand motions to control the electronics devices anywhere without space limitations (2) an effective trajectory recognition algorithm used to select the significant features from the time and frequency domains of acceleration signals and produce their feature space into a smaller feature dimension to recognize the motion with high recognition accuracy.

HARDWARE DESCRIPTION

In this paper, the hardware parts may include the MEMS accelerometer, ATMEL microcontroller, power supply and an RF wireless transmission module.

BLOCK DIAGRAM TRANSMITTER

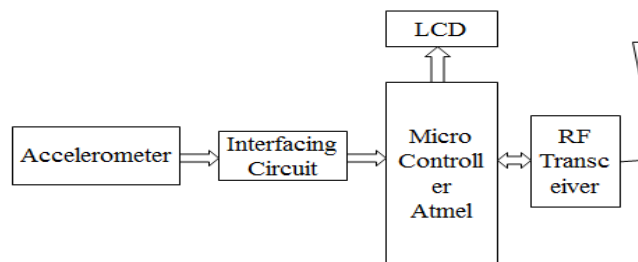


Figure:1 The block diagram of transmitter is showed in this figure.



Figure 2: Experimental setup of Digital pen transmitter

**BLOCK DIAGRAM
RECEIVER**

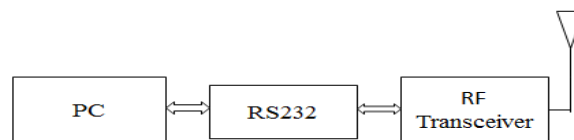


Figure 3: The block diagram of receiver is showed in this figure.



Figure 4: Experimental setup of Digital pen Receiver

Accelerometer

In this project, an accelerometer used which is known as MEMS accelerometer (Tri-axial accelerometer). It is generally used to detect and to measure the vibrations of the hand moment. The force caused by vibration or a change in motion (acceleration) causes the mass to “squeeze” the piezoelectric material which produces an electrical charge that is proportional to the force exerted upon it. Since the charge is proportional to the force, and the mass is a constant, then the charge is also proportional to the acceleration.

Table: Accelerometer specifications

Features	Specifications
Selectable Sensitivity	1.5g / 2g / 4g / 6g
Low Current Consumption	500 μ A
Sleep Mode	3 μ A
Low Voltage Operation	2.2V-3.6V

Microcontroller (ATMEL)

The Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications. The AT89S52 is a low-power, high –performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel’s high-density non-volatile memory technology and is compatible with the industry- Standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory

programmer. In addition, the AT89S52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port, and interrupt system to continue functioning. The Power-down mode saves the RAM contents but freezes the oscillator, disabling all other chip functions until the next interrupt or hardware reset.

Table: Atmel specifications

Features	Specification
Operating Range	4.0V to 5.5V
Static Operation	0Hz to 33Hz
Internal RAM	256×8-bit
Timer/Counters	Three 16-bit

Pin Diagram

(T2) P1.0	1	40	VCC
(T2 EX) P1.1	2	39	P0.0 (AD0)
P1.2	3	38	P0.1 (AD1)
P1.3	4	37	P0.2 (AD2)
P1.4	5	36	P0.3 (AD3)
(MOSI) P1.5	6	35	P0.4 (AD4)
(MISO) P1.6	7	34	P0.5 (AD5)
(SCK) P1.7	8	33	P0.6 (AD6)
RST	9	32	P0.7 (AD7)
(RXD) P3.0	10	31	EA/VPP
(TXD) P3.1	11	30	ALE/PROG
(INT0) P3.2	12	29	PSEN
(INT1) P3.3	13	28	P2.7 (A15)
(T0) P3.4	14	27	P2.6 (A14)
(T1) P3.5	15	26	P2.5 (A13)
(WR) P3.6	16	25	P2.4 (A12)
(RD) P3.7	17	24	P2.3 (A11)
XTAL2	18	23	P2.2 (A10)
XTAL1	19	22	P2.1 (A9)
GND	20	21	P2.0 (A8)

LCD

LCD (Liquid Crystal Display) have materials which combine the properties of both liquids and crystals. It is an electronic display module and find a wide range of applications. A 16×2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi-segments LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters, animations and so on. A 16×2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5×7 pixel matrix. This LCD has two registers namely, Command and Data.

Table: LCD Specifications

Features	Specifications
Power supply	+5V (Also Available for +3V)
Dots	5×8 dots with cursor
Duty Cycle	1/16

RF Transceiver

CC2500 is wireless transmitter receiver developed by Texas instruments which is used in 2400-2483.5 MHz ISM/SRD band systems. This project shows how to configure registers of CC2500, how to give commands to CC2500

and how to activate transmission or receiver mode of CC2500 via SPI interfacing with avr microcontroller. The CC2500 RF module is a low cost 2.4 GHz transceiver used in very low power wireless applications. The RF transceiver is integrated with a highly configurable baseband modem. It supports OOK, 2-FSK, GFSK and MSK modulations. It works in voltage range of 1.8-3.6v. Two AA batteries are enough to power it. It has 30m range with on board antenna. It is always used with microcontroller which supports SPI communication.

Table :RF Transceiver Specifications

Features	Specification
Operating temperature range	-40 ~ +85
Operating Voltage	1.8 ~3.6 volts
Hi sensitivity	-101dbm@10kbps

RS232

In communications, RS-232 is a standard for serial binary data interconnection between a DTE(Data terminal Equipment) and a DCE(Data Circuit-terminating Equipment). It is commonly used in computer serial ports. It defines the purpose and signal timing for each of the 25 lines; however, many applications use less than a dozen. RS232 transmits positive voltage for a 0 bit, negative voltage for a 1. This interface is the Electronic Industries Association(EIA) standard for the interchange of serial binary data between two devices. In this, the signal transmission is bipolar, requiring two voltages, from 5 to 25 volts, of opposite polarity.

Table: RS232 Specifications

Features	Specification
High speed	460kbps
Appear	COM ports
Bus powered	No external power is required

OVERVIEW OF ALGORITHM

The entire process is explained below in step by step method.

Step 1: The motion of accelerometer in any direction is send to Atmel microcontroller in the form of signal through wire connection

Step 2: These values may be pass through the process of calibration and the values moving averaging filter to make average values.

Step 3: The High Pass Filter process this data and then pass through the process of Normalization.

Step 4: After this feature extraction is done here we use serial to USB communication for fast response.

Step 5: Using Visual Basics Software PC will display the Motion in terms of characters.

III.EXPERIMENT RESULT

In this part, the proposed of using digital pen is validated by the following two experiments they are generally (1) Hand Written alphabetic recognition (2) motion recognition. The proposed recognition algorithm consists of acceleration acquisition, signal preprocessing. Here, we collected the acceleration signal in laboratory environment and displayed in the personal computer.

IV.CONCLUSION

This paper represents an accelerometer based digital pen for hand writing digits by recognition applications. In this, the digital pen consists of a triaxial accelerometer, Atmel microcontroller, RF wireless transmission module for sensing

and receiving the signal of accelerations of hand writing. By this technology we can display the characters without using the keyboard for applying the human interaction to the computer.

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