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AN ACCELEROMETER BASED DIGITAL PEN WITH A TRAJECTORY RECOGNITION ALGORITHIM FOR HANDWRITTEN DIGIT AND GESTURE RECOGNITION

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***ABSTRACT*-Now a day, the growth of miniaturization technologies in electronic circuits and components has greatly decreased the dimension and weight of consumer electronic products, such as smart phones and handheld computers, and thus made them more handy and convenient. This paper presents an accelerometer-based digital pen for handwritten digit and gesture trajectory recognition applications. The digital pen consists of a tri-axial accelerometer, a microcontroller, and an Zigbee wireless transmission module for sensing and collecting accelerations of handwriting and gesture trajectories. Using this project we can do human computer interaction.**

Users can use the pen to write digits or make hand gestures, and the accelerations of hand motions measured by the accelerometer are wirelessly transmitted to a computer for online trajectory recognition. So, by changing the position of MEMS (micro electro mechanical systems) we can able to show the alphabetical characters in the PC. The acceleration signals measured from the tri-axial accelerometer are transmitted to a computer via the wireless module

I INTRODUCTION

EXPLOSIVE growth of miniaturization technologies in electronic circuits and components has greatly decreased the dimension and weight of consumer electronic products, such as smart phones and handheld computers, and thus made them more handy and convenient. Due to the rapid development of computer technology, human–computer interaction (HCI) techniques have become an indispensable component in our daily life. Recently, an attractive alternative, a portable device embedded with inertial sensors, has been proposed to sense the activities of human and to capture his/her motion trajectory information from accelerations for recognizing gestures or handwriting. A significant advantage of inertial sensors for general motion sensing is that they can be operated without any external reference and limitation in working conditions. However, motion trajectory recognition is relatively complicated because different users have different speeds and styles to generate various motion trajectories. Thus, many researchers have tried to narrow down the problem domain for increasing the accuracy of handwriting recognition systems. Recently, some researchers have concentrated on reducing the error of handwriting trajectory reconstruction by manipulating acceleration signals and angular velocities of inertial sensors. However, the reconstructed trajectories suffer from various intrinsic errors of inertial sensors. Hence, many researchers have focused on developing effective algorithms for error compensation of inertial sensors to improve the recognition accuracy. To name a few, Yang et al.proposed a pen type input device to track trajectories in 3-D space by using accelerometers and gyroscopes. An efficient acceleration error compensation algorithm based on zero velocity compensation was developed to reduce acceleration errors for acquiring accurate constructed trajectory.

In order to reduce the cost of systems and simplify the algorithms, much research effort has been devoted to extract important features from time-series inertial signals. To name a few, Lim et al.computed correlation coefficients of the absolute value of acceleration and the absolute value of the first and second derivatives of acceleration to form feature vectors. They then applied principal component analyis (PCA) and Fisher linear discriminant to reduce the dimension of the feature vectors. With the reduced features, a time-lagged feed forward network was trained to recognize 2-D handwriting gestures and the best performance with an overall accuracy of 95%. In, the acceleration, velocity, and position features were generated from raw acceleration signals, and then, the PCA was utilized to reduce the feature dimension size. They successfully employed a hidden Markov model (HMM) with dynamic time warping algorithms to recognize 3-D handwriting digits with a recognition rate of 90%. Krishnan et al. calculated the time- and frequency-domain features (such as mean, variance (VAR), correlation, spectral entropy, and spectral energy) of the acceleration signals measured from the accelerometers worn simultaneously on different positions of a participant's hand. Subsequently, the AdaBoost, HMM, and k-NN classifiers were utilized to classify hand motions, and the AdaBoost classifier achieved the best performance with an overall accuracy of 86%.

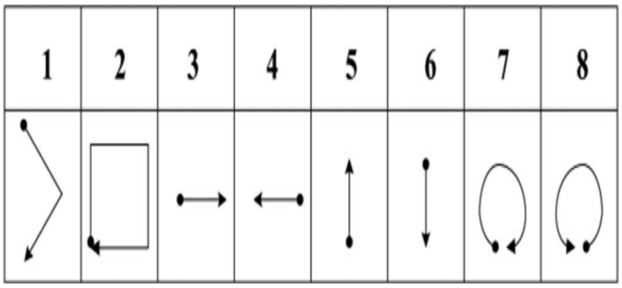
II. RELATED WORK

Recently, some studies have focused on the development of digital pens for trajectory recognition and HCI applications. For instance, an alternative method of conventional tabletbased handwriting recognition has been proposed by Milner. In his system, two dual-axis accelerometers are mounted on the side of a pen to generate time-varying x- and y-axis acceleration for handwriting motion. The author employed an HMM with a band pass filtering and a down-sampling procedure for classification of seven handwritten words. The best recognition rate is 96.2% when the number of states of the HMM is equal to 60. Oh et al. presented a wand like input device embedding a triaxial accelerometer and a triaxial gyroscope for online 3-D character gesture recognition.

Fisher discriminant analysis was adopted, and different combinations of sensor signals were used to test the recognition performance of their device. When all six axes raw signals were used as inputs of the recognition system, the recognition rate was 93.23%. In addition, they proposed an ensemble recognizer consisting of three sub recognizers with the following signals as inputs: acceleration, angular velocity, and estimated handwriting trajectory. The recognition rate of the recognizer was 95.04%. Similarly, a gesture recognition system consisting of a gesture input device, a trajectory estimation algorithm, and a recognition algorithm in 3-D space was proposed by Cho et al. The trajectory estimation algorithm based on an inertial navigation system was developed to reconstruct the trajectories of numerical digits and three hand gestures, and then, a Bayesian network was trained to recognize the reconstructed trajectories. The average recognition rate was 99.2%. Zhou et al. proposed a μIMU for 2-D handwriting applications. They extracted the discrete cosine transform features from x- and y-axis acceleration signals and one angular velocity and used an unsupervised self-organizing map to classify 26 English alphabets and ten numerical digits. The recognition rate of 26 English alphabets and ten numerical digits achieved 64.38% and 80.8%, respectively.

III TRAJECTORY RECOGNITION ALGORITHM

The block diagram of the proposed trajectory recognition algorithm consisting of acceleration acquisition, signal preprocessing, feature generation, feature selection, and feature extraction is shown. In this paper, the motions for recognition include Arabic numerals and eight hand gestures. The acceleration signals of the hand motions are measured by a triaxial accelerometer and then preprocessed by filtering and normalization. Consequently, the features are extracted from the preprocessed data to represent the characteristics of different motion signals, and the feature selection process based on KBCS picks p features out of the original 24 extracted features. To reduce the computational load and increase the recognition accuracy of the classifier, we utilize LDA to reduce the dimension of the selected features. The reduced feature vectors are fed into a PNN classifier to recognize the motion to which the feature vector belongs. We now introduce the detailed procedure of the proposed trajectory recognition algorithm as follows.



A. Existing system

- ❖ Shorter distance between PC and Pen section
- ❖ Some board is required for writing

B. Proposed System

It consists of the following

- ❖ Longer distance is possible by using Zigbee communication
- ❖ By varying the position of MEMS we can display the characters in PC

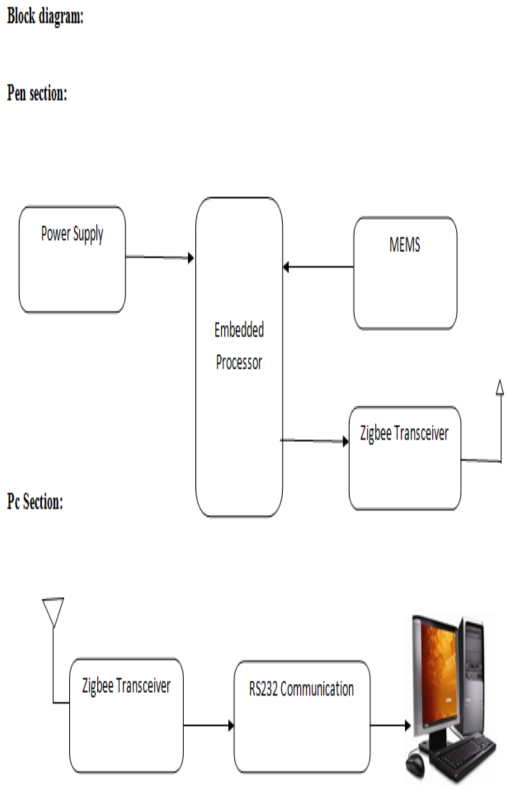


Fig. 1 Block Diagram

IV RESULT &DISCUSSIONS

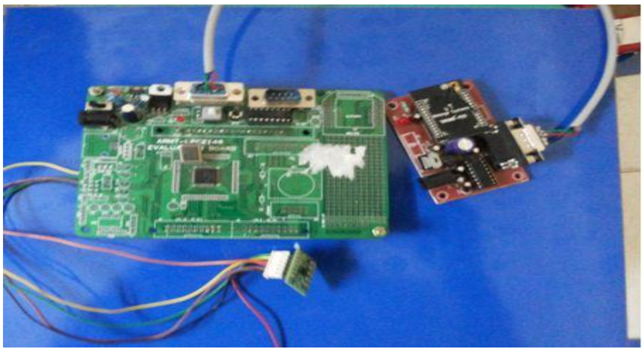


Fig: 2 Transmitting section

Fig:3 receiving section

Vehicle section:

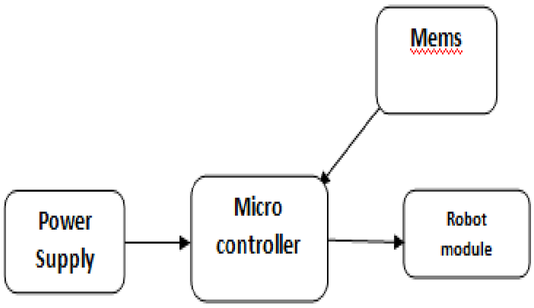


Fig. 4 Vehicle Section

V FUTURE SCOPE

In future we can use this project for security purpose,we know that people do forgery of sign but if we use the extension of this project it is impossible to forgery because no one can have same acceleration of signature which can be known by this project. We can use extension of this project for controlling wheel chair. And it can also be used to send secret code which will be the best application for ARMY.

VI CONCLUSION

Users can use the pen to write digits or make hand gestures, and the accelerations of hand motions measured by the accelerometer are wirelessly transmitted to a computer for online trajectory recognition. So, by changing the position of MEMS (micro electro mechanical systems) we can able to show the alphabetical characters in the PC. The acceleration signals measured from the tri-axial accelerometer are transmitted to a computer via the wireless module.

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