Result Analysis of Gesture Recognition of Hand Written Digit using Android Mobile

Mr. Swapnil D. Awachar[1], Dr. D. T. Ingole[2], Prof. Ms Manik D. Ingole[3]

[1]PG Research-Scholar, Dept. of Digital Electronics, Prof. Ram Meghe Institute of Technology & Research, Badnera, Amravati India
[2,3] Professor in Dept. of Electronics & Telecommunication, Prof. Ram Meghe Institute of Technology & Research, Badnera, Amravati India

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Abstract - *As there is rapid development in computer technology, the interaction between human and computer is become a topic of research. Using Android mobile phones for human activity recognition has a wide range of applications including healthcare and anomalous situations alerting. This study focuses on human activity recognition based on android mobile phone embedded sensors. The proposed human activity recognition system recognizes different activities. We can use mobile devices for data mining applications as mobile devices are user friendly and incorporates with many powerful sensors. In this project we describe the uses of android mobile accelerometers and computer for gestures recognition for hand written digit by human. In this task we performed activities for different alphanumeric digit by using smart phone and record to build our data set. In computer, digit are recognized by trajectory recognition algorithm with the help of MATLAB is takes place. In trajectory recognition algorithm firstly signal preprocessing is done then feature vector are generated from processed acceleration signal and recognize handwritten numeric digit where we use KNN classifier technique for the best accuracy purpose*

Key Words: **GPS, Activity recognition, supervised learning, sensors, KNN**

1. INTRODUCTION

Due to the tremendous progress in pattern recognition technology, handwriting-based human-computer-interaction has become an indispensable component in our daily life. According to input signals, handwritten character recognition can be divided into online and offline recognition. Online recognition recognizes the stroke trajectories of handwritten characters, while offline recognition identifies the images of handwritten characters. Many groups have developed sensor recording and processing devices, such as the e-Watch, a wearable sensor that is intended for use of monitoring elderly and sick, identify non-responsiveness and keep taps on their position. Different methods have been proposed for acquiring information necessary for recognition gestures system. Some methods used additional hardware devices such as MEMS accelerometer sensor, RF transmitter receiver, microcontroller, data glove devices and color markers to easily extract gesture features. Other methods based on the appearance of the hand using the skin color to segment the hand and extract necessary features, these methods considered easy and less cost comparing with methods mentioned before. Some reviews explained gesture recognition system applications and its growing importance in our life especially for Human computer Interaction HCI, Robot control, games, and surveillance, using different tools and algorithms. In this work we demonstrates the advancement of the gesture recognition systems, with the discussion of different stages required to build a complete system with good accuracy and with low cost using different algorithms.

Android smart phone based gesture recognition systems can tell us different kinds of human activities in real time using machine learning techniques. In addition, using smart phones for human activity recognition has a wide range of applications including anomalous situation alerting, personal biometric signature identification, the interaction between computer and human being is easy with the help of smart phones devices. Smart phones in the market have embedded sensors, and the advanced MEMS (micro-electromechanical systems) design has enabled low-power and high-quality sensors for mobile sensing. The best-known MEMS sensors in smart phones are accelerometer and gyroscope, but there are a lot more MEMS sensors in today's mobile device like electronic compass, GPS sensors, audio sensors, image sensors, light sensors, temperature sensors, direction sensors and acceleration sensors.

2. LITERATURE SURVEY

This chapter describes brief about literature survey, the field of gesture recognition has been extensively studied in the past.

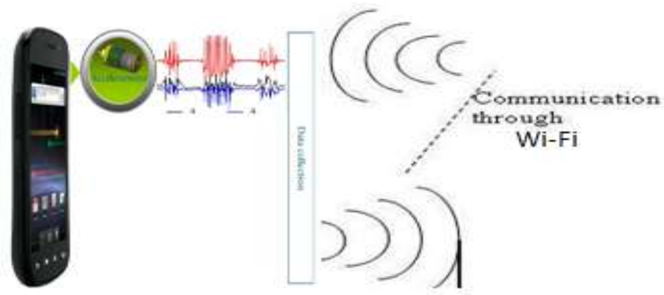
Geethavinothini, V. Vishnu Prasath [1] presented a technique in which an accelerometer-based digital pen for handwritten digit and gesture trajectory recognition applications. The digital pen consists of a tri-axial accelerometer, a microcontroller, and a Zigbee wireless transmission module for sensing 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.

Yufei chen and chao shen [4] presented a systematic performance analysis of motion-sensor behavior for human activity recognition via smart phones. Sensory data sequences are collected via smart phones, when participants perform typical and daily human activities. A cycle detection algorithm is applied to segment the data sequence for obtaining the activity unit, which is then characterized by time-, frequency-, and wavelet-domain features. Then both personalized and generalized model using diverse classification algorithms are developed and implemented to perform activity recognition

Anjali Garg, Antara Datta, Gaurav Singh, Shrikant Pawar [5] presented a technique in which Controlling our personal omputers via hand movements from a distance can elicit great freedom in terms of position and convenience. The proposed system aims to achieve that by putting to use the built in 3-axis accelerometer in mobile phones. The accelerometer determines the phone's motion and orientation in terms of X, Y and Z axis. Thus, it can sense the tilt, movement and speed being applied to the phone. The various gesture patterns made in the air while holding the phone can be used to manipulate the controls on our personal computers. This system uses the Dynamic Time Warping technique for measuring the similarity between two temporal sequences which vary in time and speed.

S.Madhumitha1, Neeraja S. Sathya2, Pravya Pinto3, Riyan John Stephan [7] presented a "Sign language interpreter" is an electronic device that translates the sign language into speech by the use of gesture mapping thereby bridging the communication gap between the vocally challenged community and normal community, facilitating efficient communication. This system recognizes the hand gestures with the help of specially designed gloves fitted with flex sensors along the length of finger and an accelerometer. These recognized hand gestures are converted into speech by software so that normal people can understand their expressions. In this gesture recognition system a single gesture is translated to a complete message, rather than a couple of gestures forming a word as in the existing systems. This makes the communication process much simpler and effective rendering a human interpreter dispensable. The system can be customized by the user according to his needs as the messages are derived from a database developed after predictive analysis.

3. SYSTEM IMPLEMENTATION



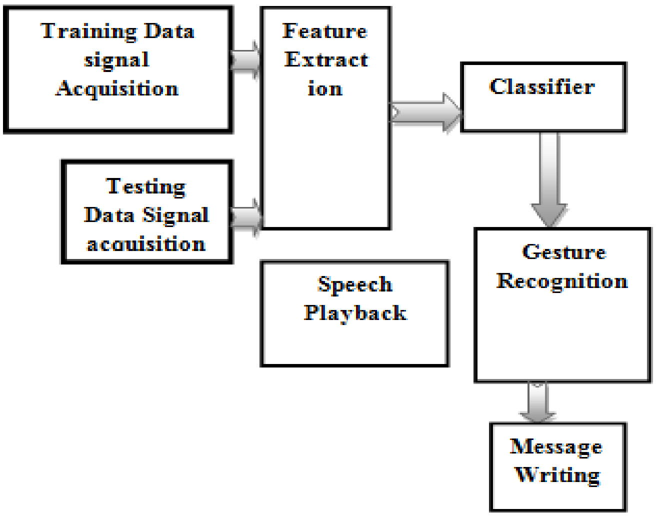


Figure 1 Block diagram of for gesture recognition system

Our technology enables devices to interpret human gestures using smart phone sensors, whose data is then processed using algorithms. The system is built to identify specific human gestures, and then use them to convey information by converting in to voice signal. The gestures used have to be intuitive, simple and universally acceptable to ensure they are easily adopted by users. Gesture recognition makes computers more accessible for the physically-challenged and also makes interaction more natural in the 3D virtual world or in gaming. In today's world, gesture recognition is an evolving technology that can be seen all around us. The latest phones, computers, gaming consoles, and even TVs now feature it. The human body's movements are read by an imaging sensor like an accelerometer, which then sends that data to a computer. The computer uses the gestures captured as inputs, processes this input to understand what was gestured, and these recognized hand gestures are converted into speech by software so that normal people can understand their expressions. In this gesture recognition system a single gesture is translated to a complete message, rather than a couple of gestures forming a word as in the existing systems. This makes the communication process much simpler and effective rendering a human interpreter dispensable. The system can be customized by the user according to his needs as the messages are derived from a database developed after predictive analysis. There are a number of sensing technologies that can be considered, but we'll stick to the popular ones here. *Accelerometers* **also** known as inertial or acceleration sensors, these are used to detect the changes in force resulting from the fall, motion, tilt, shock, positioning or vibration of the body they are connected to, with respect to time.

A trajectory reconstruction algorithm has been developed to perform the trajectory reconstruction of motions or movements using the signals measured by the inertial sensors embedded in the smart phone. The block diagram of the proposed trajectory recognition algorithm consisting of acceleration acquisition, feature extraction, classification, speech signal generation and message generation according to gestures as shown in figure 1.

4. EXPERIMENT AND EVALUATION

Features Generation 62 subjects completed the total 5 kinds of hand gestures under the supervision of researcher. In this experiment, the user was asked to hold the mobile device to write numbers and digits, without any ambit restriction in a 3-D space. From the extracted the gestures signals, various features can be generated both in time domain and frequency domain as described in last section.

In our case, time-domain features of each axis are calculated including mean, standard deviation, energy, entropy, correlation of any two axes. Each feature in the set consists of three elements in X, Y, and Z axis. For obtaining an objective evaluation results, here we select Nearest Neighbor (NN) classifier of machine learning. First, each one in the candidate feature set is tested by Nearest Neighbor (NN) classifier, the evaluation results are ranged in a descending order as shown in Table 1.

Extracted Feature wise recognition in Off-line Mode

Table 1 : The results of single feature evaluation

Sr. No.	Extracted Feature for Recognition	% Accuracy for Digit Recognition (A-Z)	% Accuracy for Number Recognition (0-9)
1.	Max & Min	53.84%	90%
2.	Entropy	7.69%	50%
3.	Mean	19.23%	60%
4.	Variance	42.30%	90%
5.	Std Deviation	50%	80%
6.	Power	26.92%	70%
7.	Power Spectral Density	34.61%	80%

Second, selecting the optimal feature from the Table 1 and combining with other features, the combinations will be recomputed based on the models. The results are shown in Table 2.

Table 2: The evaluation results by combining all features

Sr. No.	Combination of Extracted Feature for Recognition	% Accuracy for Digit Recognition (A-Z)	% Accuracy for Number Recognition (0-9)
1.	Max & Min + Std Deviation	76.92%	80%
2.	Max & Min + St.dev + PSD	84.61%	80%
3.	Max & Min + St.dev + PSD + Ent	88.46%	90%
4.	Max & Min + St.dev + PSD + Ent + Mean	92.30%	90%
5.	Max & Min + St.dev + PSD + Ent + Mean + Power	96.15%	100%

The average classification accuracy of combining all features is 98%. The evaluation results shows with the increasing of the number of features, the classification accuracy will increase. However, when feature combination reaches to some extent, the accuracy has no obvious change. That indicates not the more features are, the better classification accuracy is. Even under certain circumstance, large number of features will reduce the accuracy, which is the peaking phenomenon occurring for larger features. The best classification result is about 98%. To improve the classification, other features are considered to add into the candidate set.

On-line Mode

Gesture Recognition rate in on-line Mode for 10 testing Samples

Table 3: Recognition matrix for 5 kinds of hand gestures based on the selected feature subset.

Classified as	1	2	3	4	5	6	7	8	9	10	% Avg. Accuracy
B=BREAKFAST	B	B	B	3	B	B	3	B	B	B	80%
D=DINNER	D	D	0	D	D	D	O	D	D	O	70%
L=LUNCH	L	L	L	L	L	L	L	L	L	L	100%
M=MEDICINE	M	M	m	M	M	N	m	M	M	M	90%
W=WATER	W	W	W	M	W	W	w	m	W	W	80%

The overall user dependent and user-independent recognition rates were 90.6% and 84.8%, respectively. The user-independent confusion matrix for 3D handwritten digit recognition using the accelerometer-based mobile device with the proposed automatic recognition algorithm.

5. CONCLUSION

In the recognition task, features are of paramount importance. In the paper, we focus on the research of feature analysis and selection, which includes how to generate the candidate feature set based on the sensing information, how to evaluate each feature and their combinations, and how to select the optimal feature subset. Feature generation process need to observe the activity signal and initially select some features and neglect insignificant one. Based on the candidate feature set, forward selection algorithm of stepwise regression is adopted to evaluate each feature and their combinations. The final combination with good classification significance is selected as feature subset for gesture recognition. Experiment result indicates the process of feature analysis and selection is feasible to most of activity recognition research. In the future, we plan to use our method to evaluate other kinds of sensing device and activity data.

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BIOGRAPHIES

Swapnil D. Awachar Student of ME (Digital Electronics) of Prof. Ram Meghe Institute of Technology & Research, Badnera, Amravati INDIA. Done BE in Electronics & Telecommunication.

Dr.D.T.Ingole had completed engineering graduation B.E. in electrical engineering from the Govt. College of Engineering, Karad, India, in 1983; M.E.in Electrical Power System from the Govt. College of Engineering, Amravati, India and Ph.D. degrees in Electronics Engineering from the Visvesvaraya National Institute of Technology (VNIT), Nagpur, India..

In 1986, he joined the Department of Electronics & Telecomm Engineering, Prof Ram Meghe Institute of Technology & Research, Badnera, Amravati, as a Lecturer, and subsequently became a Professor. He was the Principal of the same institute from 2012-2014. His current research interests include biomedical signal processing, image processing, electrical machine and drives. Dr. D.T.Ingole is a Fellow of the Institution of Engineers (India); Fellow of the Institution of Electronics and Telecommunication Engineers (IETE), member of IEEE, life member of The *Biomedical Engineering Society* of India (BMESI). He is a Life Member of the Indian Society for Technical Education (ISTE). He was the General Chair of the various national and international conferences. He has filed the

patent.
He is a Director of Innovation, Incubation & Linkages in Sant Gadge Baba Amravati University, Amravati INDIA.

Prof. Ms. M.D. Ingole is affiliated to Sant Gadge Baba Amravati University, Amravati INDIA and currently working as a Professor in Dept. of Electronics & Telecommunication at Prof. Ram Meghe Institute of Technology & Research, Badnera, Amravati INDIA. Her areas of interest include Microprocessor and Microcontroller.