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Wireless Digital Writing Human Computer Interaction Device

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Abstract **– This paper presents the wireless digital writing device. It is human computer interaction device to interact the user with computer. Nowadays Human Computer Interaction i.e. HCI techniques has extended rapidly and increasingly for three decades and so catch the attention of professionals from many other disciplines and incorporating diverse concepts and approaches. Human Computer Interaction (HCI) techniques have turn into an essential part of our day to day life. To get better the interactions between users and computers by making computers more usable and friendly to users need is the aim of HCI. This device is composed of motion processing unit sensor, PIC microcontroller, RF wireless communication module. Users can hold this device, to write digits, alphabets at normal speed. This device is portable and convenient. For this HCI device, there is no need of any external device for writing purpose like digitizer tablet. We can write it on any hard surface. Thus this writing device can give efficient output with great accuracy.**

Keywords **– MPU Sensor, PIC, Handwritten Digit Recognition, RF Wireless Communication Module.**

I. INTRODUCTION

Pen based computing as a field broadly includes computers and applications in which a pen is the main input device. This field carry on, to draw a lot of attention from researcher side because there are number of applications where the pen is the most convenient form of input. Nowadays Human Computer Interaction i.e. HCI techniques has extended rapidly and increasingly for three decades and so catch the attention of professionals from many other disciplines and incorporating diverse concepts and approaches. Due to tremendous progress in advent technology in electronic circuits and components has greatly reduced the size, dimension and weight of computers and personal digital assistants, thus making them extremely powerful, portable, and suitable and efficient. Based on human behaviour, many researchers have focused on developing novel HCI methods [8], [7], [3],[5].

The novel idea of pen-based computers was that they would bring the benefits of physical paper and pen to computer interaction and allowing people to interact more naturally with the computer. Due to motion tracking systems have been researched on various indoor applications such as manufacturing human computer interaction, different inertial motion sensors are used. Recently, pen-based input devices embedded with inertial sensors, which have been proposed to intellect the motion of human and to capture the motion trajectory information from accelerations for recognizing handwriting. There is one important advantage of inertial sensors for general motion sensing is that they can be operated without any external reference and limitation in working conditions such as friction, wind, directions or dimensions. Pen based input devices embedded with inertial sensors have been provided for hand gesture or handwriting [1], [2], [4], [6], [15].

The idea of creation of input devices using accelerometers and gyroscopes consisting of inertial measurement unit (IMU) has long been investigated. Since the inertial measurements are not affected by outside or external signal jamming or magnetic field and there is no need of external reference sources. At the earliest stage of the research, the acceleration measurement was mainly used for signature verification.

The suggestion of pen as writing instrument is given by Robert baron. He developed instrumented pen for signature verification and handwriting analysis by taking the acceleration measurement [2]. Acceleration measurement generated by pen movements while one is signing, it provide useful information for handwriting analysis research for application like signature verification.

A system for real time estimation of human hand motions is developed by Z. Dong, G. Zha ng, C. C. Tsang, G. Shi, W. J. Li, P. H. W. Leong, and M. Y. Wong [6]. He presented the latest improvement based on software algorithm for the calculation of the acceleration by optical tracking. By using the multiple camera calibration, the OTS (Optical tracking System) was developed for the following two goals first obtain accelerations of the proposed ubiquitous digital writing instrument (UDWI) by calibrating 2-D trajectories and second to obtain the accurate attitude angles. However, in order to recognize or reconstruct motion trajectories accurately, the aforementioned approaches introduce other sensors such as gyroscopes or magnetometers to obtain precise orientation.

The inertial-measurement-unit based pen with trajectory reconstruction algorithm and its application is presented by J.Wang [16]. In this, quaternion based orientation

estimation and MAD switch for position estimation is used. Using this instrument user can write numerals at normal speed. W. C. Bang, W. Chang, K. H. Kang, E. S. Choi, A. Potanin, and D. Y. Kim[1] developed a pen shaped input device for wearable computers, which reproduce and recognize three-dimensional hand motions with no external reference device. C. Tsang, P. H. W. Leong, G. Zhang, C. F. Chung, Z. Dong, G. Shi, and W. J. Li [11] developed a digital writing instrument system based on micro inertial measurement unit which is used to record and recognize human handwriting motion in large writing area i.e. a large whiteboard or screen.

An alternative method of conventional tablet-based handwriting recognition is proposed by Milner [12]. In that, he introduced two dual-axis accelerometers are mounted on the one side of a pen to generate time-varying x- and y-axis acceleration for handwriting motion. He used an HMM with a band-pass filtering and a down-sampling procedure for classification handwritten data. A μIMU for 2-D handwriting applications was prsene by S.Zhou[15]. In that he, 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.

G.Zang [14] introduced an useful algorithm- an error compensation method, called zero velocity compensation, to compensate the acceleration signals. To improve the handwritten recognition accuracy, W.C.Bang[1] illustrated that the Kalman filter is proficient technique to reduce noise of inertial sensors. Y.Luo [9] also proposed one helpful algorithm- an extended Kalman filter based on a micro inertial measurement unit with magnetometers for real-time attitude compensation. This is used to compensate the orientation of the proposed writing device.

II. Block Diagram of System

Figure 1 shows block diagram of digital writing device. The block diagram of system composed of two modules :
1) Writing device module
2) Receiver module, which receives

The writing device composed of sensor (MPU 6050), PIC microcontroller (18F14K22), and an RF wireless transmission module at the transmitter side. And at receiver side it includes receiver module, RS232 and personal computer. The accelerometer sensor is used to measure the acceleration signal. The accelerometer plays a role in detecting the acceleration, velocity, and position of hand motion writing. The output of sensor is transmitted to the PIC microcontroller. For further procedure such as signal processing and analysis it transmitted to computer via RF wireless module. After receiving data, by using RS232 it is given to computer for further processing. The size of the ink-less electro pen is small. And it is portable, convenient and efficient HCI device. Fig.2 shows the hardware digital writing device. Fig.3 shows the hardware of receiver module.

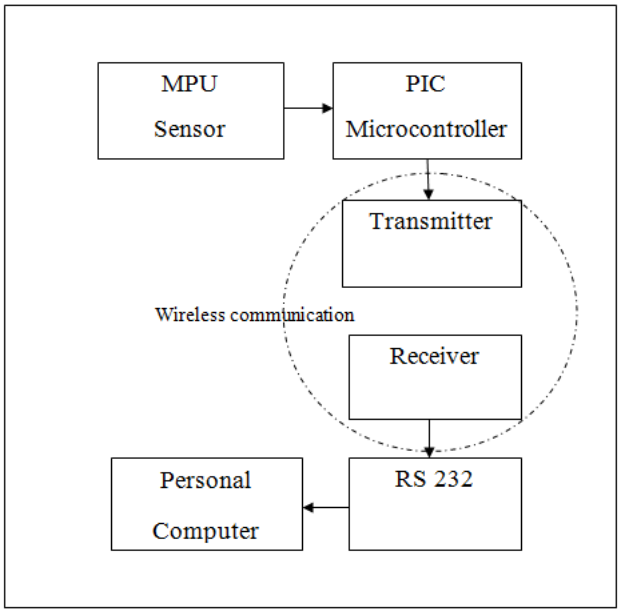

Fig.1. Block Diagram of system device

Fig.2. Hardware of writing device module

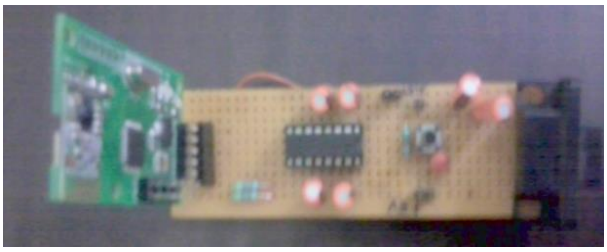

Fig.3. Hardware of Receiver module

Fig 4.shows the working flow of pen module system. On hardware of device module, keypad is used. There are two keys, one indicates the start and another indicates the stop. To begin the writing action, press the start key. Sensor gives the data in terms of X, Y and Z axis. Then this data is transferred wirelessly to PC. By pressing the stop key writing action is completed.

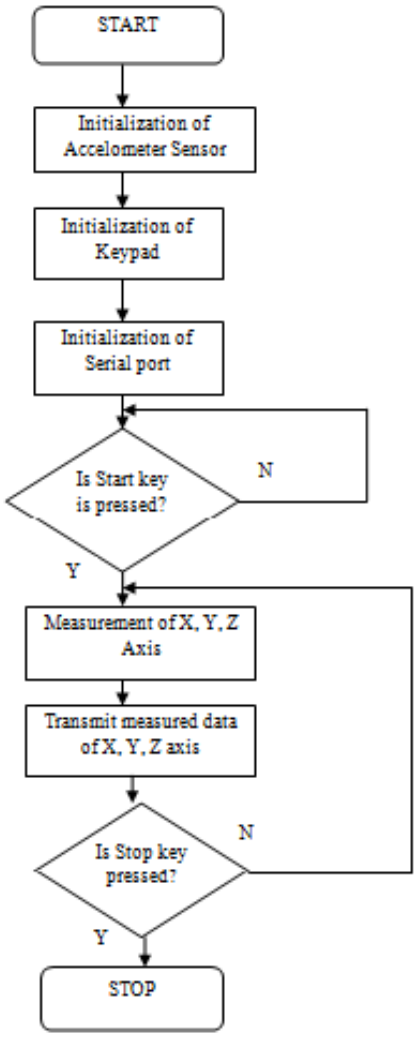

Fig.4. Flowchart of working flow of pen module

III. RESULTS

Alphabets and digits are nothing but the combination of horizontal, vertical, inclined and curve lines. When we write using this pen, the generated data will compare with database which is already store in PC. In database, we will categorize horizontal lines in X-axis, Vertical lines in Y-axis and inclined lines in Z-axis. If we write any alphabet or digit, the generated data will compare with the database. If generated data will match with database then the written alphabet or digit will display on PC.

Figure 4 shows the Data of x-axis, y-axis, z-axis while device is moving randomly. After processing on given generated data we will get the approximate expected output as shown in fig 6.

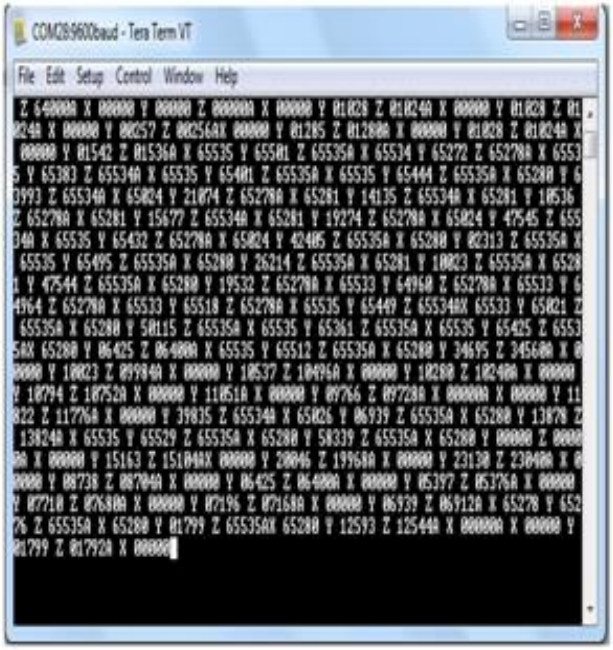

Fig.5. Data of x-y-z axis while pen is moving

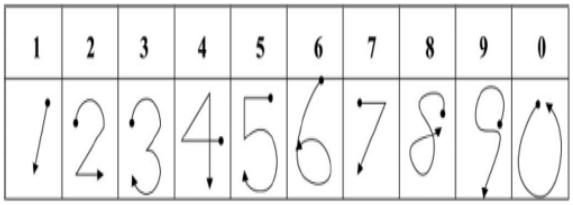

Fig.6. output of digits trajectory

Handwriting recognition gives the user the ability to interface to a computer through the already familiar activity of handwriting, where the user writes on any hard surface and it will display on computer. Most users, especially those without prior knowledge of computing and the main conventional interface that is the keyboard & mouse, initially see this as a very intuitive and attractive human-computer interface that allows them to leverage a skill which has already been acquired and developed. Although as most users will find when they use a pen interface, this is only true to a certain extent because current HWX methods are not completely accurate as characters can be incorrectly recognized, and these recognition errors must be corrected by the user. For handwriting recognition we can use this recognition algorithm and this can be very efficient.

IV. CONCLUSION

The wireless digital writing HCI device is pen like device can used to write the alphabet or digit at normal speed. For this device we used MPU sensor, PIC microcontroller, and RF wireless module. By using this

major component, we made pen module and this is small, compact and efficient. We obtained the data of x, y, z axis from writing device side module. On processing on this data we will get expected output as discussed in result section. Using this technology we can use this pen to write numerals and alphabets and it will display on computer without use of keyboard.

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