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VIRTUAL PEN

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Abstract: The basic idea of virtual pen is to develop a interface or the connection between the user and computer screen human interaction with the computer is not just bounded to keyboard , there are many other means like gesture,speech, expressions etc. Virtual pen is a system that serves on arduino and machine learning process. This virtual pen is the model where ,user can enter text on the screen by the holding the device in the hand which is a constituent of arduino and accelerometer, Thus making a motion or moving it in specific direction in air is read and displayed on the screen with

Keywords: Arduino, Accelerometer, Button switch, Vector machine algorithm, pyGARL.

I. INTRODUCTION

The keyboard plays an vital role in the computer system to enter the data via typing or pressing number of keys. Nowadays screen touch keyboards are often used and gesture keyboards are used in cases for physically challenged people or for the special use. There are numerous of varieties in design of the physical keyboard such as AZERTY, QWERTY, Dvorak Colemak, Maltron, and JCUKEN. [1], Not only the virtual keyboard gets illustrious and in this era of mobile and networking technology devices generally people use voice to text technology ,but under most of the cases the output is not much accurate.

Virtual pen is one of the electronic devices based on machine learning algorithms and organized by python programming language. It is a system that transforms gesture movement into text defined by the accelerometer in the air. It is being deliberate to help the user for entering text without using a standard or specific design. This model will also be suitable for multi linguistics operations or functionality so the user doesn't need to use the certain kinds of keyboard for entering data. It is similar to writing in a notebook using a pen where a remote act as a pen and notebook will be a text editor. The advantage of this project is users don't need any specific conditions for using the device. and also doesn't need to use various functional keys for different languages. One of the important procedure for designing this system is to create the motion tracking device that is based on 3 major components such as accelerometer, Arduino and switches. The Arduino serial monitor is configured and set the baud rate to 38400 at Arduino IDE, now the overall module will work on sci-kit learn's a library that converts signals into letters through accelerometer and every single character and digit will store in data set. When the data set is ready it will train the module through a machine learning algorithm.

The keyboard isn't a new device in the matrix of computer, as time evolves computer and its supportable or related devices also changes. User comes from the typewriting system to touch screen keyboard and not only these, but keyboard operation or its functionalities also change based on the customer requirements such as design, technology, and also some special case. The screen touch keyboard is a device by which typing on any available surface is possible. It is a wearable device that enables us to type on any surface. The device has incorporated five extensions for each finger and a sensor attached which is used to sense the value through the motion of the finger. At the first stage, the user will be provided with the typology application. From this application, the user will be able to learn all the required values for typing. Once a user is familiar with the typology, then a user will be able to use the device effectively. This device is also flexible which is to say that the user can fix the values according to individual requirments. Movement plays an vibrant role in this device as the values or the readings are to be gathered by sensors via the motion of fingers. This will enable the user to type on any surface. Hence this provides ease and comfortable for the user to use this device. [2]

A air mouse model is wireless device manufactured by protokart, and been worked by a rechargeable lithium battery. This model can easily be connected by Personal Computers, televisions, and also smartphones through Wi-Fi and USB. This is a non-direction device which uses an anti-shake algorithm, it provides accurate and smooth mouse experience along with supporting motion gestures. It can also be used as a remote for playing games. This model has built-in physical keyboard which can be easily be connected to TV, smartphone, and PCs for data or text input. The working distance from the screen is approximately ranged within 5meters. It is compatible with MAC, OS, Windows, Android, and Linux. [3]

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II. LITERATURE SURVEY

The work[1] has a device with which the user can control the pointer of a mouse with the tip of his finger and do the tasks which can be done using a traditional pointer of a mouse. the basis for this system is Beagle board-XM, video camera, camcorder, several bands of different colours with the porting to a pc device. In the work mentioned, the colour bands are differentiated by the end user wears a device on his thumb and index finger to differentiate the coloured bands[2]. The beagle board is used to process the stream of the camcorder device which scans the end user gesture. the processed bits are sent to the pc device which takes the necessary actions as per the processed gestures. The software which is developed for this system uses the algorithm known as "Binary Crystal Growth Algorithm " as well the OpenCV, libraries of V4L. The system is not however as efficient as the traditional mouse device. the long running application was not easy to implement as compared to its basic functions.

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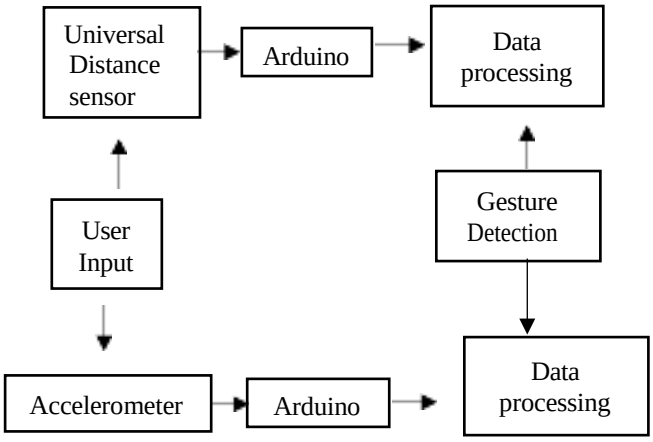

Figure 1: Architecture of [3]

The proposed system[4] is based on a device which can be worn by a end user and named as the Magic Ring System on the fingers such as the index finger. MR was actually previously developed with the inclusion of accelerometer which is a processor for sensing and some of the communications sensors which were wireless. The proposed work is fully based on the use of accelerometer for gesture recognition or sensing processor. When the end user is wearing this device the accelerometer picks up the value of acceleration on different axis namely x and y and this particular value is stored in the computer device which takes the necessary actions as per the processed gestures based on the request of the end user. The gesture is processed based on the pull push action, action of sliding of fingers, rotation of fingers and movements which are need not be mentioned.

[5]The algorithms used for recognition of gestures uses the Distance and Warping Time algorithm proposed by Euclid(DTW). The main setback of this device which is interface for human and computer is confusing. The constant wearing of this device is troublesome during a longer course of time.

In the work[6], it contains parts of two. There is front end and a back end. The system in the back end has three modules namely the module for camera, module for Detection, as well as an module for Interfacing. The module for camera is solely answerable for connection and capture of the diverse types of data of images as input and to make sure these reach to the module for detection in the refined form called as an frame. The refined frame format is output is made to pass through diverse techniques of processing of images namely conversion of colour, removal of the noise, threshold limitation and finally extracts the contour in the module for detection. If it contains any defectors, there is a gesture library for defected gestures. [7]The classification of cascade Haar for image detection. In the end the module for interface is liable for detected mapping of gestures made by the hand in the actions associated with it. The processed action is then converted into credible tasks for the functioning of a system which has a different application altogether.
The work[8] developed here consists of a device which is in the shape of an ring. The end user can wear this device. the ring shaped allows the device to be worn with atmost comfort for the end user. This device can be connected and can be

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used to communicate with plentitude devices. The pattern can be drawn by the end user which can be a symbol or an alphanumeric character in the free air medium and on any smart devices which supports a camcorder and be conditioned with software which is custom built for that particular device. This is then used to realize the moving trail of gestures drawn by the hand and can be further programmed to achieve tasks in a application-suited environment and execute it to utmost perfection.

The design of the keyboard was multifaceted in the proposed system[9] and had the ability to identify the action of typing the keys. The layout of the keyboard design was polished to the need of the end-user and the character recognition was based on the tapping action of the keys. Those type of gestures was done with the index as well as the thumb fingers.

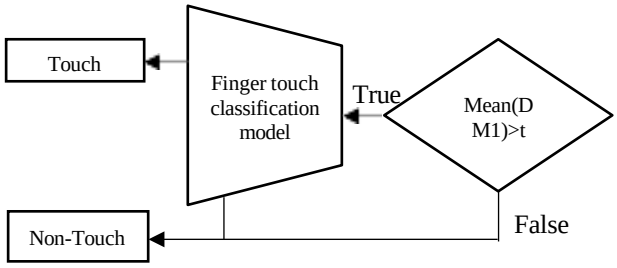

Figure 2 : Architecture of [9]

Many systems which were reviewed had detected the pose of the hand estimation to the landmark hand tracking. The landmark movement of the tip of the finger and the position of the hand in the area of the keys used in traditional keyboards were used to determine and trigger the action. Tip of the finger pressing[10], action of the index[11], clamping the fists and tip of the finger which used to come in contact of the finger were used[12]. Some of the system used additional information such as time consumed for the clicking action[13] and gestures with the complete use of hands[14].

Some of the systems used the RGB camera for the recognition of the gestures and the concept of human- computer interaction (SCI)[15]. They used the estimation of hand pose and equipment which was acquired externally.

Figure 3 : Estimation of pose of hand

The refined frame format is output is made to pass through diverse techniques of processing of images namely conversion of colour, removal of the noise, threshold limitation and finally extracts the contour in the module for detection. If it contains any defectors, there is a gesture library for defected gestures[17]. Recent trends in computer-mediated communications (CMC) have seen messaging with richer media not only in images and videos, but in visual communication markers (VCM) such as emoticons, emojis, and stickers. VCMs could prevent a potential loss of subtle emotional conversation in CMC, which is delivered by nonverbal cues that convey affective and emotional information[18]. Human– computer interaction (HCI) has great potential for applications in many fields. The diversity of interaction habits and low recognition rate are main factors to limit its development. In this paper, a framework of multi- modality-based HCI is constructed. The interactive target can be determined by different modalities including

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gaze, hand pointing and speech in a non-contact and non- wearable way[19] computer vision is used in creating an Optical mouse and keyboard using hand gestures. The camera of the computer will read the image of different gestures performed by a person's hand and according to the movement of the gestures the Mouse of the computer will move, even perform right and left clicks using different gestures. [20,22]. Some of the system used additional information such as time consumed for the clicking action[13] and gestures with the complete use of hands[23].In the work[24] The model discussed in this paper had a capacitive touch screen with character recognition wherein users were able to use their fingertip to draw on the screen. It is a re-imagination of the conventional key striking-based keyboard The paradigm have been also known as shorthand-aided rapid keyboarding[27]

The system[26] uses Sixth Sense technology is a gesture based wearable interface that links the digital information around us with the physical world and it allows us to use our natural hand gestures to communicate information. The approaches were done in which involved the concept of Image Processing and Image Acquisition. According to the study, the motto is to make a virtual mouse which is mainly useful for saving manual work.

The future modification can use complex mouse workings using this simple image processing technique. By this concept real world is interacting and getting well with the digital world using the concept of this technology known to be as Sixth Sense[28] Many works are done using Sixth sense technology some even uses IOT interaction with it as the use of RFID tags and image processing for potholes detection to overcome accidents that's a main problem in many parts of the world.

Another work that is done in the similar domain is that train autonomous cars using block chain methods for faster and safer experience, the autonomous cars can use a review or ratting system which can help them to stack up which road is safe and shortest, this way a healthy route can be created for the autonomous industry be it cars or other autonomous vehicles.Image base one time password is also a factor nowadays to enhance the security of One Time Passwords it also includes machine learning algorithms for detection of image OTP's . Smart Image attendance based systems are also in use now a days which makes the attendance system more error free and less time consuming image processing tools and algorithm are used for student face detection [29].

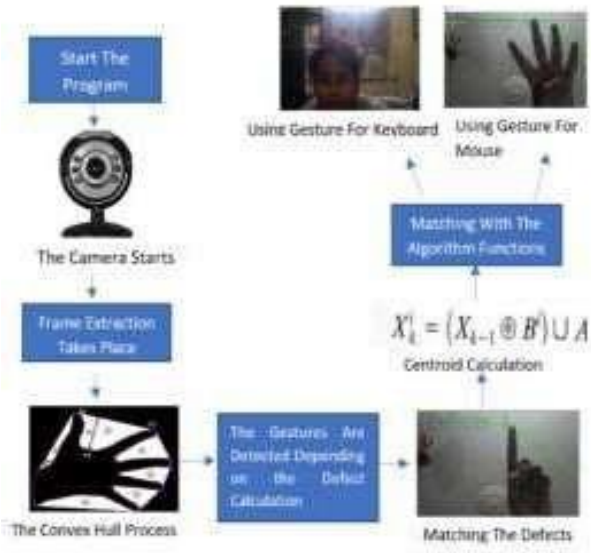

Figure 4: Flow diagram of[26]

In the proposed system[28], computer vision is used in creating an Optical mouse and keyboard using hand gestures. The camera of the computer will read the image of different gestures performed by a person's hand and according to the movement of the gestures the Mouse of the computer will move, even perform right and left clicks using different gestures.

The paper [30] describes the design, implementation and evaluation of a text input system for HMDs (head mount display) called Air Typing, which requires only a standard camera and is shown to be comparable in effectiveness to single-hand text input on tablet computers in a lab setting.

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III. METHODOLOGY

The button switch will basically turns on the accelerometer. Accelerometer is a motion tracking device which is used to detect the motion. Arduino provides the power to the entire circuit. The button switch, Arduino and accelerometer together we call it as pen. The communication between the pen and the monitor is wireless communication through Bluetooth. When the user press the button switch accelerometer detects the motion and support vector machine algorithm compares the written alphanumerical is in the pygarl framework or not if the particular alphanumerical is present then it is displayed on the monitor.

ALGORITHM:

1. Accelerometer detects the motion.
2. Motion is recognized and analysed by pygarl.
3. Scikit learns compares the motion with the data
4. If the data matches then it is printed on the screen.

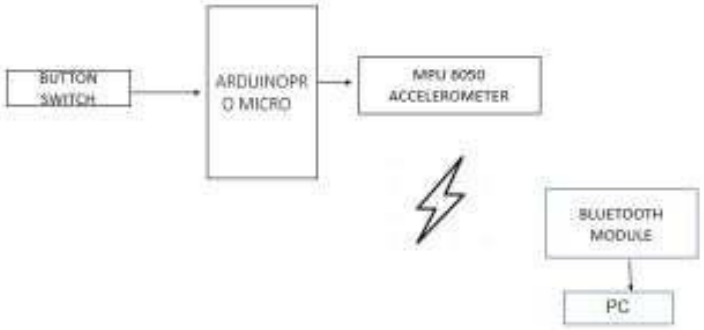

Figure 5: Block diagram of Virtual Pen

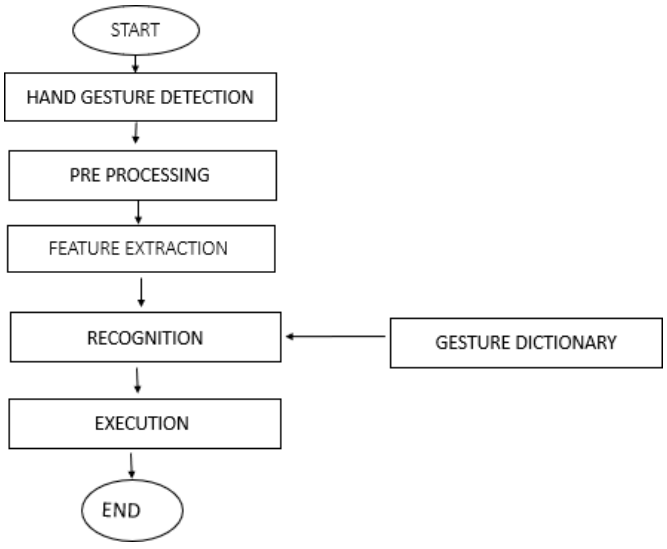

Figure 6: Flowchart of Virtual Pen WORKING

Gesture control keyboards that use PyGarl, scikit-learn, SVM, and an accelerometer work by capturing the user's hand movements and converting them into input commands. Here's how they work: Sensor technology: These keyboards use an accelerometer sensor, which is a type of motion sensor that measures the acceleration of the user's hand movements. The accelerometer sensor captures the motion of the user's hand and converts it into digital signals that can be processed by the software Data collection: The digital signals from the accelerometer sensor are collected by PyGarl, an open-source platform for collecting and processing sensor data. PyGarl collects data from the accelerometer and stores it in a dataset for analysis.

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Data preprocessing: The collected data is preprocessed using scikit-learn, a popular machine learning library in Python. Scikit-learn is used to filter and normalize the data, removing any noise or outliers that may affect the accuracy of the model. Model training: Once the data is preprocessed, it is used to train a machine learning model using Support Vector Machines (SVM), a popular algorithm for classification and regression tasks. The SVM algorithm learns to recognize specific hand gestures by analyzing the patterns and features in the pre processed data. Gesture recognition: After the model is trained, it can be used to recognize hand gestures in real-time. When the user makes a hand gesture, the accelerometer sensor captures the motion and PyGarl processes the data. The processed data is then fed into the trained SVM model, which predicts the most likely gesture based on the learned patterns and features.

Input commands: Once the gesture has been recognized, it is mapped to a specific input command, such as typing a letter or clicking a button. The command is then sent to the computer or mobile device to perform the desired action. User feedback: Gesture control keyboards may provide feedback to the user to confirm that the gesture has been recognized and the input command has been executed. This can be done through visual or audio cues, such as a sound or animation that plays when the gesture is detected. Overall, gesture control keyboards that use PyGarl, scikit-learn, SVM, and an accelerometer offer a powerful and accurate way to control computers and mobile devices using hand gestures.

They leverage machine learning algorithms to learn and recognize specific gestures, making them more intuitive and natural to use. However, they may require some initial setup and configuration, as well as practice and adjustment to get used to. Data Preprocessing: Once we have collected the data, we need to preprocess it to remove any noise or unwanted signals. This may involve filtering the data, normalizing the data, and segmenting the data into individual gestures. Filtering: The first step in preprocessing the data is to filter out any noise or unwanted signals. This can be done using various techniques, such as low-pass filtering or band-pass filtering.

The choice of filter will depend on the type of noise in the data. Normalization: The next step is to normalize the data. Normalization is the process of scaling the data so that it falls within a specific range. This can be useful for ensuring that the data is comparable across different sensors or users. Segmentation: The final step in preprocessing the data is segmentation. Segmentation is the process of dividing the data into individual gestures. This can be done manually or automatically, depending on the complexity of the data. Feature Extraction: Once the data is preprocessed, the next step is to extract features from the data. Features are mathematical representations of the data that can be used to train a machine learning model. Some common features used in gesture recognition include the mean, standard deviation, and Fourier transforms. PyGarl provides a set of tools for extracting features from the data. These tools include various statistical features, such as mean, standard deviation, and root mean square (RMS), as well as time-domain and frequency-domain features, such as signal energy and spectral entropy. Model Training: The extracted features are used to train an SVM model using scikit-learn.

The SVM model is trained on a set of labeled hand gesture data, with each gesture mapped to a specific keyboard input. In scikit-learn, we can use the SVM class to train an SVM model. The SVM class supports various types of SVM models, including linear SVM, polynomial SVM, and radial basis function (RBF) SVM.

IV. CONCLUSION

The virtual pen is a gesture recognition device that can be seen as a unique idea with huge potential in the coming market where education is further digitalized and for its technical capabilities. This project brings forth a lot of excitement and fun in the field of learning. This is a new way of teaching which will keep the students intrigued and engaged. The amount of interaction between the student and teacher will also increase due to this.

This system not only brings forth recognition of characters but also can bring forth numbers and special characters can also be introduced manually into this system. The main objective of this system is to develop a system that can reduce the use of traditional keyboards where the end user should have to stay in a place to type the characters but can move freely while entering the characters which will solve a plethora of problems.

The users need not learn anything priorly and don't have to remember anything beforehand as well. This system can be made used in wired or wireless methods. Since the gestures of the end users might differ the system accommodates a large variety of font families in it to deal with the problem.

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