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Controlling the Drone with Hand Gestures by using LEAP Motion Controller

Ms. Tingare B.A.
Mrs. Kolhe V. L.
Department of Computer Engineering
Department of Computer Engineering
D. Y. Patil College of Engineering
D. Y. Patil College of Engineering
bhagyashreetingare@gmail.com
vlkolhe@gmail.com

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Abstract

Abstract-The field of robotics is currently experiencing a revolution. Gestures are an vital perspective in interpersonally and in the context of man-machine interfaces of human interaction. Gesture recognition helps to make simpler vocal commands and are a compact means of communicating geometric information. Gesture recognition is efficacious in applications involving interaction of human/robot for many reasons and it provides a redundant variety of communication between the user and therefore the robot. In this paper, we have presented a implementation of controlling Drone utilizing An Motion controller through simple human gestures. We've got utilized Leap as a motion controller and therefore the Syma X5SC 2.4G headless Quadcopter to the current execution. This Syma Drone will be with ground station i. e. hardware unit via remote sensors. Leap is connected to the personal computer via USB port. In existing

work, Hand recognition by conventional methods using 2-D cameras suffer from instability due to lighting and skin color variations. The upcoming depth sensors overcome the limitations of the conventional cameras. A Leap Motion controller helps to get descriptive data for hand gestures. It tracks the hand furthermore finger movements for digital format and provides for few key points associated with each gesture. These key points are utilized for training and recognition. The paper illustrates the utilization for Leap Motion controller to hand gesture recognition of Drone controlling signs utilizing similarity measures namely Euclidean distance measure and cosine similarity. LEAP motion controller is employed to capture these gestures, and so these gestures are transmitted so as to manage the motion of the Syma Drone via these gestures.

***Key Words*:**Depth sensors, Hand gesture recognition, Leap Motion controller.

1 INTRODUCTION

In recent years, with the large development within the field of machine learning, issues like understanding human voice, language, movement, posture become additional and additional well-liked, hand gesture recognition in concert of the these fields has attracted several researcher's interest[1]. As compared to the additional body elements, hand is that foremost natural and convenient thanks to specific our feelings. Hand gestures are ready to represents ideas and actions with different hand shapes, which might be identified by the gesture recognition system. These are then taken to recognize the sign constructs and provides an interface to the computer system. The objective for this method is conversion of the hand gestures of sign Language into with some meaningful actions. Dumb individuals can easily use the new technology within the type of controlling Drone they can easily access it for their need. The implemented system can be used to help normal people to understand the language of dumb people. Different modes of gestures such as lip movements, facial expression, eye brow movements and hand gestures are considered by Sign language [2]. Researchers have started exploiting Leap Motion device which can be used to

develop efficient algorithms that can be used for several applications such as gaming [3,4],security[5], upper limb rehabilitation[6], human computer interface [7, 8], air- writing [9]. Drones nowadays are widely used around the world for a variety of purposes. Those purposes includes aerial videography, photography, surveillance etc. In many cases, skilled pilot is required to perform these tasks using the Drone which proves to be exorbitant. This type of system i.e. a simple gesture controller can make the task of piloting much easier. Gesture includes any bodily motion or states particularly any hand motion or face motion [10]. In our system implementation, recognition of gestures will be done by using the Leap Motion Controller. Those gestures will be motion of the hand, and as a result, we can access the Drone by using simple gestures from the human hand.

2 REVIEW OF LITERATURE

Guanglong Du, Ping Zhang, and Xin Liu proposed a novel markerless humanrobot interface in [11], thatcomes from the concept that the manipulator copies the movements of human hands . With this technique, in a contactless and markerless environment one operator could manage dual robots through both his or her hands. So as to get the position and orientation of human hands in real time, a sensor called leap motion (LM) is used. However, as a result of tracking errors and noises of the sensor, the measurement errors increase with time. Therefore, interval Kalman filter (IKF) and improved particle filter (IPF) are used to assess the position and the orientation of the human hands, respectively[11].Bing-Yuh Lu, Chin-Yuan Lin, Shu-Kuang Chang, Yi- Yen Lin, Chun-Hsiang Huang, Hai-Wu Lee, Ying-Pyng Lin presented a Leap Motion somatosensory controlled switches in [11]. The relays have implemented the switches. The open or short of the switching circuit were controlled by the sensing of the Leap Motion somatosensory module[12]. In the pattern recognition and computer vision communities Dynamic hand gesture recognition is a crucial but challenging task. Wei Lu, Zheng Tong, and Jinghui Chu have proposed a novel feature vector in [13] which is suitable for representing dynamic hand gestures, and presents a satisfactory solution to recognizing dynamic hand gestures with a Leap Motion

controller (LMC) only. To recognize dynamic hand gestures the feature vector with depth information is computed and fed into the Hidden Conditional Neural Field (HCNF) classifier. The systematic framework of the proposed technique includes two main steps: feature extraction and classification. These steps are used with the HCNF classifier. The proposed methtechniqueod[13] is evaluated on two dynamic hand gesture datasets with frames acquired with a LMC[13]. Federico Manuri, Giovanni Piumatti have presented some preliminary results in the design and development of a hybrid interface for hand-free augmented reality applications. The paper [14] presents a framework to interact with AR applications through a speech and gesture recognitionbased interface[14]. Giulio Marin, Fabio Dominio, Pietro Zanuttigh have proposed a novel hand gesture recognition scheme [15] explicitly targeted to Leap Motion data. An ad-hoc feature set based on the positions and orientation of the fingertips is computed and fed into a multi-class SVM classifier in order to recognize the performed gestures. A set of features is also extracted from the depth computed from the Kinect and combined with the Leap Motion ones in order to improve the recognition performance[15].Fan Zhang, Shaowei Chu, Ruifang Pan, Naye Ji, Lian Xi have presented a double hand-gesture interaction (DHGI)method[16] for walkthrough in VR environment with an Oculus Rift headset and Leap Motion function[16].

3 SYSTEM ARCHITECTURE

In the proposed system, an input gesture is acquired using a Leap Motion sensor. It tracks hands and fingers movements in 3-D digital format. A mapping of the gesture in terms of feature points is given by Leap motion controller. The extracted fingertip positions of each gesture are stored in the database. The distance between them is used as feature vector. While testing, again gestures are captured and the positions of the finger points are extracted. Distances are calculated by Euclidean distance method for current gesture and all gestures stored in the database. For recognition, the feature vectors are compared using the four similarity measures viz. Cosine similarity and Euclidean distance measure. The one with maximum similarity is returned as the detected gesture. As shown in fig. 1,

Drone is connected to the ground station i.e. hardware unit via remote sensors. Hardware unit includes Remote unit, Digital to analog converter (DAC) and controller. Leap is connected to the personal computer via USB port. A Leap Motion controller helps to obtain descriptive information of hand gestures. It tracks the hand and finger movements in digital format and gives few key points associated with each gesture. These key points are used for training and recognition. Fig. 2 It consists (a)Data Acquisition (b)

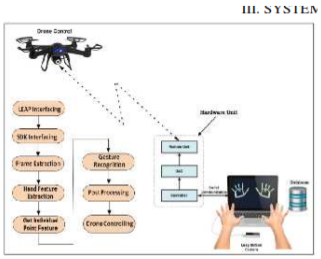

Fig. 1. System Overview

Feature Extraction (c) Recognition. A set of tracking data is represented by the frame data represents for hands and fingers detected in a single frame. The gestures captured by the Leap controller yields a few keypoints corresponding to each hand gesture. The extracted keypoints are coordinates of finger positions from the input gesture. The points are, the center of the palm(say A), tips of thumb(say B), index finger(say C), middle finger(say D), ring finger(say E), pinky finger(say F) for

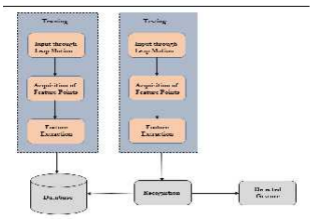

Fig. 2. Detailed structure of proposed system

each hand. The coordinates be, A(x_1; y_1; z_1);B(x_2; y_2; z_2);C(x_3;y_3; z_3);D(x_4; y_4; z_4); E(x_5; y_5,z_5); F(x_6; y_6;z_6)

for each hand. The extracted points are stored in a database file. During testing, a current gesture is captured and key points are extracted from that gesture. At the run time, distances are calculated from the extracted feature points using Euclidean distance formula.

A. ALGORITHM

Point extraction	Feature extraction	Normalization	Feature Comparison and Recognition

Input: Hand Gesture
Output: Hand Points.
- Initialization of Leap camera
- for each hand h:
- hT=read_handtype
if(It is right hand)
mid_x=Read_palm_position_x()
mid y=Read_palm_position_y()
mid z =Read_palm_position_z()
for each finger in right hand f
if(f==Thumb/Index/Mid/Ring/Pinky)
(x,y,z)=Read_xyz()
	Input: Hand Gesture
	Output: Features.
	Let M(6)(3) be the hands point with (x,y,z)value.
	Calculate feature value:
	for (y = zero to all point)
	distance = compare each point with other()
	Update distance in feature Array F
	Continue the procedural for all.
	Compare two points($P_1(x_1; y_1; z_1)$; $P2(x_2; y_2; z_2)$)
	$D = \sqrt{(x_1+x_2)^2(y_1+y_2)^2(z_1+z_2)^2}$
	return distance
		Input: Extracted Points
		Output: Normalized Points.
		Let F be the distance array
		for (y = star to all feature of F)
		Normalization = (F [y]/600)
			Input: Hand Gesture performed
			Output: Action corresponding to the hand gesture
			comparison(current_F)
			- Let DB be the set of all gestures
			for (y=start gesture to all gesture)
			cosine=compare(y,F')
			find_max_cosin_value
			Display_most_relevant_gestures

4 RESULTS

Performance Analysis:

For performance evaluation, a set of gestures are used to test the drone controlling system. The result shows that the average percentage of accuracy of hand gestures using 3d Camera i.e. LAEP Motion controller is 95.6% and the average percentage of accuracy of hand gestures using 2d Camera 80.4%. as shown in below graphs.

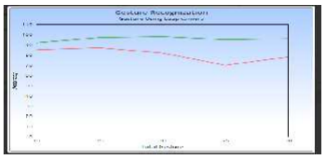

Fig 3: Accuracy Graph for 3D and 2D camera for sample 5 gestures

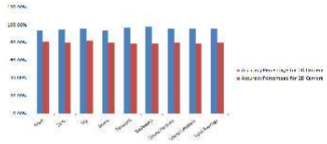

Fig 4: Accuracy Graph for 3D and 2D camera for all for stored gestures

The Drone moves as per the instructions. Instructions are in the form of hand gesture. Instructions are in the form of hand gesture. Instruction are start,stop,Forward,Backward,Up,Down,,speed increase,decrease and Halt.

Table I: Co-ordinate value of both hand for various gestures

Gesture		Left Hand			Right Hand		
		x	y	z	x	y	z
THREE	CENTER	200	289	328	600	186	600
	TYPE_THUMB	0	57	0	300	143	300
	TYPE_INDEX	-93	10	55	300	157	300
	TYPE_MIDDLE	-55	7	66	300	150	300
	TYPE_RING	-18	24	102	300	165	300
	TYPE_PINKY	34	57	-5	300	111	300
FIVE	CENTER	600	215	600	321	263	333
	TYPE_THUMB	300	161	254	85	-6	-33
	TYPE_INDEX	288	219	201	74	-3	77
	TYPE_MIDDLE	256	230	206	57	-8	104
	TYPE_RING	233	221	229	6	-22	103
	TYPE_PINKY	211	226	271	-32	-18	87

Table II: Agerage Co-ordinate value of both hand for various

Gesture	Left Hand	Right Hand
One	237.7120	95.7121
Two	37.2231	291.1111
Three	59.7223	285.1122
Four	331.8110	51.7111
Five	285.1111	77.1112
Nice	47.2778	317.1110
All The Best	114.5611	44.4111

gestures

Likewise we can get the co-ordinates value for all stored gestures.The following Table and graph shows the average co-ordinate values for all stored gestures.

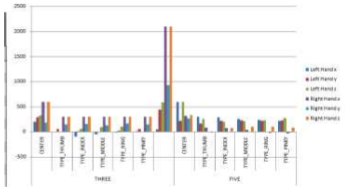

Fig 5: Co-ordinate value of both hand for various gestures Graph

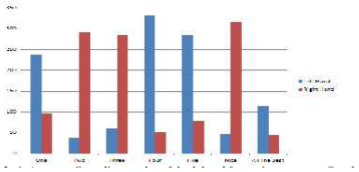

Fig 6: Agerage Co-ordinate value of both hand for various gestures Graph

5 CONCLUSION

The gesture recognition system with the LEAP Motion controller will be used to control the Drone. The user can store the various gestures with labeling as per their convenience. The LEAP Motion Controller detects hand points automatically with great accuracy. The gestures features are retrieved with calculation of distance between any two detected points. The controller has more intuitive 3D interface for motion detection which helps to make API more user friendly and attractive. Motion detecting algorithm is secret in the controller i.e. automatic motion detection. It provides great accuracy and responsiveness. This system can be used with various applications as per need like Drone controlling, robot controlling, etc.

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