

IOT Based Gesture Recognition for Smart Controlling



Ketki P. Kshirsagar, Rajeshree Rokade, Dhanapal Kamble

Abstract: Internet of things (IOT) analyzing network things embedded with software, sensors, n/w etc. IOT extend to internet connectivity with flexible devices. IOT makes life easier and makes smart with improving networks and power of data correlations. Major fundamental component of IOT systems are sensors, connectivity, data processing, active engagement and user interface. User interface make comfort between computer and human interaction. Human interaction as consider in form of command and computer interpret that commands. This paper presents user interface with internet of things (IOT) more effectively with comparing different techniques on recent review base.

Keywords: Internet of things, Gesture Recognition, human machine interaction, smart interaction.

I. INTRODUCTION

The American word Gesture means to express movements through body part like hand, head, facial emotions or any information. Gesture conveys state of mind and intentions. Gesture referred to convey non verbal communication. Gesture recognition is a type to interpret computer and human gesture command. Gesture recognition provides ability to human machine interaction. General steps to gesture recognition:

- Camera captures images or video. Camera scene motions or any physical activity through any sensor.
- For captured images/video or sensing activity initiated by preprocessing software.
- Design post processing software recognizes particular meaningful activity.
- Once get meaningful gesture then used for appropriate application.

Internet of things provide flexible platform to control gesture intentions. Researchers developed individual systems like hand gesture system, facial gesture system, head movement systems,

emotions system but no one focused complete package of IOT based gesture recognition system. This paper provides background to design IOT based gesture recognition system. Most popular IOT based gesture controlled applications are to control home appliances, smart cities, arm robot control, lab equipment control, medical equipment control,

health monitoring, smart environment, IOT services, Digital art, Surveillance robots, Gaming , Energy efficient industry appliances, deaf communication. IOT based system is used to design next industrial revolution, so it's called digitally-connected things. IOT based system provide automatically control inter human or human machine interaction. IOT more advantages' in terms of communication, automation and control , information, monitor, time, money, efficient and saved time and better quality of life.

The rest of paper is organized as follows: section 2 introduces related recent work; section 3 provides proposed interactive iot based gesture recognition for smart controlling system, section 4 discussed comparative results and section 5 provide conclusion and future scope.

II. RELATED WORK

Lei Jing et. al proposed one-for-all gesture based remote control system[1]. This system provides natural unified approach to control home appliances. System used magic ring and electrical appliances (EA) node are two fundamental devices, which is solving effective problem selection and function navigation. They provide comparative study between magic ring (MR) based method and traditional remote control (RC) based method. These methods follow star network topology for add or remove additional nodes. One-for-all control consist target selection and function selection, which one to one map between command and control target.

IOT based smart lighting system proposed by Syed Ali Raza Zaidi et. al [2]. System was focus on a wireless network with gesture recognition. System was kept in room/building and network controller matches with wireless network. Room network controller (RNC) was control light control actuator, Ambience sensor, user with smart phone and group of lights. RNC is center point for automation.

V.Padmanabhan and M.Sornalatha proposed artificial mouth between dumb people and normal people [3]. Dumb people have meaningful motions, which action of motion get sense by sensor and message provided to microcontroller. Microcontroller matches database and motions and produce meaningful speech signal. Speech signal/ voice signals, which understand normal people i.e. called artificial mouth.

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For understanding current market scenario, HCL technology provides solution of gesture recognition by reducing time and efforts. Their solution is act as glue between device and application. Devices such as camera, sensors and processors and applications are healthcare and industrial [4].

Xiao Han proposed, voice and gesture controlled by IOT [5]. The proposed system focused on two parts: control station and application station. The control station includes development board, camera/microphone, voice recognition module, LCD screen and ZigBee module. Application station includes relays, ZigBee module and specific application. The system detect signal and track user hand and after recognition of hand gesture control various applications. Hand and voice commands are also used for controlling different applications.

Andy Wong [6], discussed regarding gesture recognition system with 3D image sensor chip. 3D image sensor chips require a high level of integration including the photosensitive pixel array, sophisticated control logic, digital interfaces with ADCs and digital output. This 3D image sensor of high level integration design provides very compact and accurate system for IOT based gesture recognition application.

Mitangi Patel et. al proposed home automation controlled by gestures [7]. Author provides survey between different algorithms benefits and limitations. The algorithms are support vector machine (SVM), feed forward neural network (FNN), Dynamic time warping (DTW) and Hidden Markov model (HMM). SVM can handle unknown gesture data but it limits size of learning and testing phase. FNN algorithm was work faster and easier to adopt data but it less efficient for over fitting and imbalanced data. DTW was used to measure time and speed but data/ video of number of frames are increased, then operation time will increased. HMM algorithm shows best gesture recognition accuracy but difficult to convert multidirectional data to one dimensional data. Ketki kshirsagar and doye [8], proposed better gesture recognition efficiency using Dynamic time warping than the finite state machine technique.

Darshan Iyer et. al. [9] proposed inertial measurement unit sensor based hand gesture recognition system. The system proposed to spotting gestures and reduces false positives using sensor based system.

Gesture driven robotic arm control using Intel real sense was proposed by Rupam Das et.al [10]. Intel real sense is impressive technique to track hand, head and gesture recognition. This proposed method shows impressive interaction between robotic arm and gesture control, so this method called Gesture-Robotic simulator (GeroSim). This simulator controlled by IOT and Gero script language. All movements of robotic arm was commanded by Gero script through gestures.

Assad Mohammed et.al., proposed evolution lighting and gesture controlled [11]. The proposed system consist cloth wristband, which integrates to long sleeved sweatshirt it involves sensors and microcontrollers, which has been designed for wearable computing. This method of gesture processing to control lights over wireless IOT n/w.

Ayaka Hatori et. al. [12] proposed osne method to solve wearable devices for recognizing arm motion. Gesture

acceleration commonly have inertia sensor used for getting arm motion. For data analyzing they used accelerometer in smart phone for measuring motion data. For finding out feature vectors SVM recognition method was used.

Divya Sree .V [13] design a system used to reduce communication gap between mute and normal people. MATLAB and visual basic is used to detect gestures with good accuracy. Python language used for IOT integration and MATLAB and VB are interface with python language.

Hand gesture detection and recognition to generate gesture command for controlling, this system proposed by Anna YANG et. al [14]. System recognizes, gesture based on contour mapping by using Bezier curve. Recognized gesture mapped with predefined commands and used for controlling. P.Gnanasundari et. al. [15] proposed system for handicapped, dumb and deaf people communicate with normal world. IOT based system consist of accelerometer, ADC converter, Rasberry PI, mobile phone. Through mobile/ smart phone they control devices without any struggle and delay.

Jung-Hwa et. al, proposed watch & Do interactive system [16]. This system control simple gestures with IOT device by gazing. This system involves object detection, gaze estimation; hand gesture recognition and IOT based control using deep learning estimation. Watch & Do IOT based proposed system watches patient monitoring inside the room and it was used to install around patient to detect hand gestures. This system watch module detect opposite side of user and it's head position and do module capture hand gestures. Watch module work gaze estimation with deep learning framework and do module work on cloud based IOT platform. Talal Noor proposed hand gesture recognition system based on hand fingertip trajectory using a HMM [17]. Proposed system consist of three stages: first stage to find color map and hand contour, second stage to calculate dynamic features using k-mean clustering techniques and final stage to recognize gesture using viterbi algorithm. Experiment provide efficient recognition rate for training and testing database. Jun Xu et. al. proposed high security and smart interactive hand gesture recognition for IOT. The system model consists of camera, fingertip, and eye and computer cursor. 2D Camera capture with specific size of images of hand with fingertip, fingertip interacts with eye and eye interacts with computer cursor highlighted black circles for controlling devices [18]. Nidhi Patel [19] proposed IOT system for converting handwritten text to editable format. For extracting text from hand written images used deep machine learning algorithm with Rasberry PI. White board Written message converted and that will be display on computer/laptop screen.

Vasileios Sideridis et. al. proposed gesture keeper automatic hand gesture identification system on accelerometer. Classify hand using support vector machine technique. Recognition means accuracy extended up to 94.44% [20]. Gyroscope based continuous hand gesture recognition for wearable device for HMI proposed by Hobeom Han [21]. SVM threshold technique was used for hand recognition. Six hand gestures are selected for user convenience and three axis gyroscope used instead of accelerometer.

So accuracy increased up to 99%. This system is required less computational load, so this system operates in real time. Chong Tan proposed feature fusion SVM based gesture classify and identification gesture [22]. SVM technique combines HOG features and Hu invariant movement. For identification HOG features are used and global feature is Hu invariant movement. Hu moment used to find geometric shape of image and calculate speed.

Web based gesture recognition system controlling heterogeneous IOT devices using deep learning proposed by Nikhil Jangamreddy et. al [23]. Web based gesture recognition system control multiple devices such as smart watch, lock, fridge, geo tag, micro-owen, camera, and lighting. This system worked in two phases, training phase and testing phase. In training phase, gestures are trained for controlling IOT devices and in testing phase, gesture recognized using kNN classifier with closed prediction score. Web interface was interface between gesture and corresponding action usig HTTP request. For finding particular gesture use deep learning algorithm called MobileNet.

III. PROPOSED IOT BASED GESTURE RECOGNITION SYSTEM FOR SMART CONTROLLING

The proposed IOT based gesture recognition system shown in figure 1, which controls various appliances or devices.

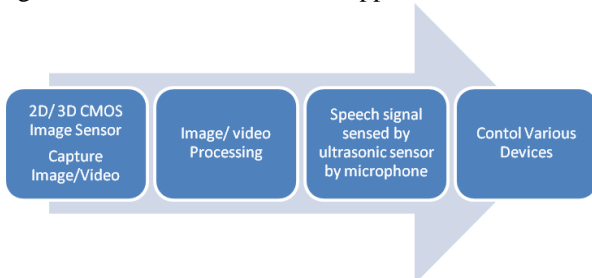


Fig 1: Proposed IOT based gesture Recognition for smart controlling

Image /video captured by 2D CMOS image sensor. NanEye 2D CMOS/ ARO430 COMS image sensor is used for capturing the image/video. Image processing diagram is shown in figure 2. Next step to segment image [24] and after segmentation extract features with gesture recognition and classify the images[25]. Classify images distributed in terms of words and sentence. Words/sentence converted to speech signal using arduino Uno. Microphone/ speaker speech signal sensed through ultrasonic sensor. Ultrasonic sensors are used as proximity sensor for object detection and ranging measurement for distance calculations. Sensor HC-SR04 is calculated distance and control different devices like medical, health care or home appliances.

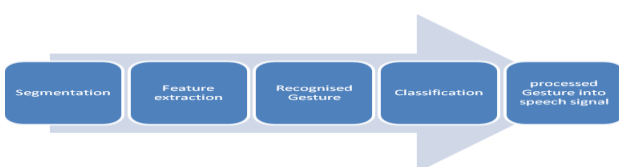


Fig 2: Image/ video processing

IV. COMPARATIVE RESULTS

Experimental result shows in Table 1, less static database and fewer devices used for controlling purpose. Previous experimentation shows less clarity for dynamic gesture recognition and controlling. Proposed system work on these lacunas and improve control efficiency with time consumed system.

Table 1: Experimental Comparative Results

Technique	Accuracy	Database with controlling devices
MR and EA node	43% to 65%	19 Lamp, TV, radio
Artificial mouth, Gesture robot simulator	-	-
Inertial Measurement Unit sensor based	92%	52 unique objects and 8 field objects Smart phone
Support vector machine	82.5%	Hot, freeze, cold, humid
MATLAB and VB with python	M ATLAB -98% VB-100%	Hi, more, yes, "Hi, I am Divya", "AN IoT INTEGRATED GESTURE RECOGNITION USING IMAGE PROCESSING FOR SPEECH IMPAIRED PEOPLE
Bézier curve		28 images Listing defence, ok, number signs, Degree of rotation
HMM, k-mean clustering	98.61% & 93.06%	720+360 images Car, TV, Washing machine, freeze
Deep learning	90%	3,065 Images Fan , AC,RC, Washer, Cleaner, TV, Door
Euclidean distance	Average speed 131 ms per frame D= 3cm or 6cm	15 images
Support vector machine Accelerometer rate 40Hz	96%	15 subjects-900 images Up, Clock-wise , Counter Clock-wise ,down, left, right, Z trajectory, push, pull, wave trajectory
Support vector machine threshold , Gyroscopy rate 20Hz	93-99%	Up, Down, left, right, clockwise
Feature fusion SVM	97.8%	1000 sample Scale, rotation, light condition, alphabet, number images.
Deep learning	100%	30 to 100 samples Gesture A,B,C,D from left to right

V. CONCLUSION AND FUTURE SCOPE

In this paper, we represent smart capturing images/videos and pre image processing with segmentation, feature extraction; recognition and classification. And IOT environment used for smart controlling. Proposed system is more efficient for patient monitoring, dumb people communication, controlling home appliances for patient, emotion recognitions and controlling appliances. This system is time efficient, less hardware is required.



As further work, we are going to developing a system to accommodate for real time applications.

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