Gesture recognition has proved to be an important field in recent years. Since an early age, communication through gestures has not only been used by physically challenged persons but is now used for many other applications. Interacting with the physical world using expressive body movements is much easier and more effective than just speaking. As most of the hand is used to perform gestures, Hand Gesture Recognition has been widely accepted for a wide range of applications, such as human-computer interactions, robotics, sign language recognition, etc. With the help of depth information, depth-based methods have improved performance, but depth cameras are not as widely used and affordable as color cameras. Enhancing low-resolution images has always been a key focus in the processing of digital images. Images with a resolution as low as [50×50 pixels] shall also be considered for recognition. The gestures under consideration here are the number of fingers raised by the person (one, two, three, four or five). Low-resolution gesture images captured from web cameras, mobile phones, or low-cost cameras are systematically processed to generate the number of fingers raised. Hand Gesture recognition techniques are essentially divided into vision-based and sensor-based techniques. Initially, the hand region is segmented by applying the skin color model to the YCbCr color space. In the next stage, otsu thresholds are applied to separate foreground and background. The template-based matching technique is finally developed using the Principal Component Analysis (PCA) for recognition. In our project, we are going to use such methods for gesture recognition so that even the disabled people can use it at ease.

Since everyone is trying to recognize hand gestures through HCI, we are trying to build a system for disabled people by recognizing simple gestures at various conditions. In other projects, everyone is trying just to recognize gestures for fun facts used or for smartphone features or for movement in AR but we intensely want it to be used for disabled people. Initially, we will be trying to recognize hand gestures with any camera like a raspberry pi camera for simplicity but In future, more updates of our system will be more capable in recognizing hand gestures with any situation, at any angle with any camera module most importantly with low cost. Any person more likely in rural areas mostly needs this kind of system can easily bear the cost. We will be trying to make it simple so that anyone can use it intensely. With more updates, the accuracy level will be accrued in a level to recognize hand gestures in its fullest more likely in minimal sign. It is important to use for disabilities as everyone is focusing on just modern stuff but we think it should be used in a more proper way. After all, if the technology is not helping someone, it is not required.

1. **Background:**
   1. **Title*:* Gesture Recognition A Survey**

**SUMMARY:** This paper is basically a survey on gesture recognition on hand gestures and facial expressions. Here the applications contain hidden Markov models, particle ﬁltering and condensation, ﬁnite-state machines, optical ﬂow, skin color, and connectionist models.

**HOW IT IS SUPPORTING OUR PROJECT:** Here is a survey on gesture recognition which is our key task in this project. Besides this paper, there are also some benefits and limitations which will help us during the implementation of the whole project.

* 1. **Title: Super Pixel-Based Hand Gesture Recognition with Kinect Depth Camera**

**SUMMARY:** This paper represents detecting hand gestures using novel superpixel earth mover’s distance metric, together with Kinect depth camera. The main function is a compact representation in the form of superpixels, which efﬁciently captures the shape, texture and depth features of the gestures. Based on this representation, a novel distance metric, superpixel earth mover's distance (SP-EMD), is proposed as the dissimilarity measurement for gesture recognition. The key partial matching issue is addressed by introducing the concept of virtual superpixels, which serves to model the folded ﬁngers.

**HOW IT IS SUPPORTING OUR PROJECT:** In this paper, they are using superpixels earth mover’s distance metric and Kinect depth camera to detect hand gesture. The major part of our project is to detect hand gestures this will assist us a lot.

* 1. **Title: An Overview of Hand Gestures Recognition System**

**SUMMARY:** Mankind tries to incorporate humangestures into modern technology by searching and finding a replacement of multi-touchtechnology that does not require any touching movement on-screen. This paper uses several methods to realize hand gesture recognition by using three main modules:camera and segmentation module, detection module and feature extraction module. Using a wide YCbCr threshold mainly converted skin extraction A robust hand and finger gesture tracking recognition system isviable to be used in human-computer interaction systems.

**HOW IT IS SUPPORTING OUR PROJECT:** The hardware part of our project we are using this type of concept and also using this type of module.

* 1. **Title: Python-based Raspberry Pi for Hand Gesture Recognition**

**SUMMARY:** A real-time vision-based system is proposed tomonitor objects (hand fingers). It is built based on theRaspberry Pi with a camera module and programmed withPython programming Language supported by Open SourceComputer Vision (OpenCV) library. The essential aim of the hand gesturerecognition system is to establish communication betweenhuman and computerized systems for the sake of control. The recognized gestures are used to control the motion of a mobile robot in real-time. The system Architecture mainly uses frames capture, Blur Frame, Frame Segmentation, Draw Contours. The database whichused for human hand gesture recognition is supported withfive types of gestures for five movements controlled with hand and The database whichused for human hand gesture recognition is supported withfive types of gestures for five movements controlled withhand

**HOW IT IS SUPPORTING OUR PROJECT:** The hardware and software both are related to our project. In the hardware part, this paper Raspberry Pi with a camera module and the shake control system maintains the motion of a mobile robot in real-time.

* 1. **Title: Real-time robust vision-based hand gesture recognition using stereo images.**

**SUMMARY:** This paper presents a real-time and robustapproach to recognize two types of gestures consisting ofseven emotional gestures and six finger spelling gestures. It incorporates several existing computationally efficient techniques and introduces a rule-based approach to merge theinformation from a pair of stereo images leading to improved hand detection compared to using single images. a real-time and robust approach to handgesture recognition based on a pair of stereo images hasbeen introduced. It has been shown that by merging theinformation from the left and right images of a stereoimage pair, robust hand detection is achieved leading tohigh recognition rates for two types of hand gestures

**HOW IT IS SUPPORTING OUR PROJECT:** The main concept this paper the seven motional and six finger spelling gestures are marge the storage image

* 1. **Title: A Real-time Hand Gesture Recognition Approach Based on Motion Features of Feature Points.**

**SUMMARY:** This paper presents a precise tracing of feature points including palm center, fingertips, and joints by using Kinect. A novel recognition method based on precise motion features of these feature points is also presented. Having been tested with a series of applications, our method is proved to be robust and effective, and suitable for further application in real-time HCI systems. Kinect SDK is used for hand position detection by detecting the skeleton of the human body in most Kinect-based applications. This approach combines skeletal-based and appearance-based gesture recognition methodologies, processes hand gestures based on color and depth images, tracks hands movement and classifies hand gestures in real-time. Here they apply the naïve Bayesian algorithm and forward feedback neural network algorithm (take FFNN for short).

**HOW IT IS SUPPORTING OUR PROJECT:** Implementation of hand gestures based on color and depth images and naïve Bayesian algorithm and forward feedback neural network algorithm to recognize hand gestures.

* 1. **Title: Real-Time Hand Gesture Recognition Using Random Forest and Linear Discriminant Analysis**

**SUMMARY:** The proposed method consists of three steps - detection, validation, and recognition. In the detection stage, several areas, estimated to contain handshapes are detected by random forest hand detector over the whole image. The next steps are the validation and recognition stages. In order to check whether each area contains hand or not, they used Linear Discriminant Analysis. There was no choice but to use a color filter which can pass only a specific range of color intensity. In order to deal with various sizes of hands, various sizes of templates are required. This can be used as a signal to control electronic devices and home appliances. Speed is important to the practical real-time interface. With the combination of random forest and NPD features proposed in, they achieved more than 30 FPS. Invalidation and recognition stage, they used the Linear Discriminant Analysis to classify hand samples and negative (background) samples.

**HOW IT IS SUPPORTING OUR PROJECT:** To recognize hand gesture, Linear Discriminant Analysis to classify hand samples and negative background by random forest hand detector.

* 1. **Title: Hand Gesture Recognition in Low-Intensity Environment Using Depth Images**

**SUMMARY:** In this paper, a method is proposed for the recognition of hand gestures using depth image postures. It supports a vision-based gesture recognition driven system capable of recognition in low-intensity environments based on real-time hand tracking and gesture recognition from extracted hand features using depth images and contour extraction. The algorithm processes video in real-time and generates instantaneous output in the system. Firstly, they obtain depth images, generate disparity maps and perform masking. Secondly, nearest contour extraction is performed followed by polygon approximation. Further, convexity defects for counting fingers are obtained. The program has been scripted in Python, using the OpenCV and Open Kinect Libraries and synchronized through Linux with Kinect. When lights are ON, both RGB and IR cameras are in play. When lights are OFF, only the IR bitstream is active. They have achieved satisfactory accuracy levels of above 90% with real-time processing. They have optimized the algorithm for appropriate distances. In the vision-based hand gesture recognition system, the movement of the hand is recorded by Kinect video camera and IR camera. The system’s performance evaluation results have shown that this efficient interface can be used by users with ease and accuracy in all lighting conditions.

**HOW IT IS SUPPORTING OUR PROJECT:** It helps analyzereal-time hand tracking and gesture recognition from extracted hand features using depth images and contour extraction and processes video in real-time by the algorithms.

* 1. **TITLE: Real-Time Hand Gesture Recognition System for Android Devices**

**SUMMARY:** They have proposed a system based on SVM for recognizing various hand gestures. The system consists of four steps: hand segmentation, smoothing, feature extraction, and classification. The idea here is to allow the smartphone to perform all necessary steps to recognize gestures without the need to connect to a computer in which a database is located to perform the training process. With this system, all steps can be done by the smartphone. In this paper, for image acquisition, the frontal camera of the smartphone is used. After that frames are gotten from the video, the color sampling is done which is followed by making a binary representation of the hand, and then contours representing the hand were described with convex polygons to get information about fingertips and finally the input gesture was recognized using a proper classifier. Here, they have used the OpenCV library for Android for image processing, and the Tegra Android Development pack as a software tool and hardware used is Intel® Core i3® CPU, Windows 7 Home basic (64 bit), 2GB RAM and an Android 4.4 Smartphone with 2 MP camera. In this paper, the steps that they have used for recognizing different hand gestures are ColorBased Hand Segmentation, Median filter for smoothing, and finally, Support Vector Machine as a proper classifier. Thus, an accurate result was obtained. This system can be used to control the smartphone without the need to touch it.

**HOW IT IS SUPPORTING OUR PROJECT:** SVM for recognizing various hand gestures by four steps hand segmentation, smoothing, feature extraction and classification. It can improve smartphone support.

* 1. **Title: Real-Time Dynamic Hand Gesture Recognition**

**SUMMARY:** A real-time dynamic hand gesture recognition system is performed in this paper. The dynamic images are caught by a dynamic video. They use the YCbCr color space transformation to detect the skin color and to find the hand contour from the complex background. Convex defect character points of the hand contour are defined, and the finger angles and fingertip positions are calculated to recognize the hand gestures. OpenCV is used to perform our research. Ten tested users produce 330 cases to recognize eleven hand gestures, and each hand gesture has three different poses of hand gestures. The accurate recognition rate is **95.1%.** The three convex defect character points of the hand contour are defined to calculate the angles between the fingers, and the fingertip positions calculated to recognize the hand gestures. Ten tested users produce 330 cases to recognize hand gestures. The eleven hand gestures representing the number from one to nine have been recognized. The accurate recognition rate achieved more than 95.1%and each picture spends processing time is about 55 ms.

**HOW IT IS SUPPORTING OUR PROJECT:** It helps analyze gestures through dynamic video. To work in any complex background it motivates an idea through YCbCr color space transformation to detect the skin color and to find the hand contour.

* 1. **Title: Hand Gesture Recognition using an Android Device**

**SUMMARY:** The recognition approach used in this paper is artificial neural network among back Propagation algorithm. This approach can be adapted to the real-time system very easily. In this paper for image acquisition android camera is used, after that frames are sent to the server and edge detection of the video is done which is followed by thinning that reduces the noise, tokens are being created from thinning images after tokens are fetched. The paper briefly describes the schemes of capturing the image from an android device, image detection, processing the image to recognize the gestures as well as few results. The backpropagation algorithm is used in layered feed-forward ANNs. This means that the artificial neurons are organized in layers, and send their signals forward, and then the errors are propagated backward. In this application, it is done by using the IPWebCam android application. The system database has sign gestures of the size of 176X144 pixels so that it takes less time and memory space during pattern recognition. The recognition rate of all gestures is between 70-80% which is an acceptable range. The overall accuracy of this system is 77% (approx).

**HOW IT IS SUPPORTING OUR PROJECT:** It helps analyze the backpropagation algorithm used in layered feed-forward ANNs with a smartphone to use further.

* 1. **Deep Dynamic Neural Networks for Multimodal Gesture Segmentation and Recognition**

**SUMMARY:** This paper describes a novel method called Deep Dynamic Neural Networks (DDNN) for multimodal gesture recognition. Besides that, a semi-supervised hierarchical dynamic framework based on a Hidden Markov Model (HMM) is also proposed for gesture segmentation and recognition where skeleton joint information, depth, and RGB images, are the multimodal input observations. Unlike others, the main approach of this paper is learning high-level spatiotemporal representations using deep neural networks suited to the input modality: a Gaussian-Bernoulli Deep Belief Network (DBN) to handle skeletal dynamics, and a 3D Convolutional Neural Network (3DCNN) to manage and fuse batches of depth and RGB images.

**HOW IT IS SUPPORTING OUR PROJECT:** In this paper, they are using Dynamic Neural Networks (DDNN) for multimodal gesture recognition which can be a way that we can use to detect hand gestures and implement our project.

* 1. **Real-Time Hand Detection & Tracking for Dynamic Gesture Recognition**

**SUMMARY:** In recent years gesture recognition has become the most intuitive and effective communication technique for human interaction with machines. In this paper, we are going to work on hand gesture recognition and interpret the meaning of it from video sequences. Our work takes place in the following three phases: 1. Hand Detection & Tracking 2. Feature extraction 3. Gesture recognition. Hidden Markov Model is basically a powerful statistical tool to model generative sequences. With proposed methodology gives better recognition results compared with the traditional approaches such as PCA, ANN, SVM, DTW and many more. The whole implementation is done by taking the most interactive features of the hand. With the help of these features, we are able to give the best result in gesture recognition.

**HOW IT IS SUPPORTING OUR PROJECT:** the hardware part tracking to connect video for hand detection and using many methodologies for feature extraction.

* 1. **An Overview of Hand Gestures Recognition System Techniques**

**SUMMARY:** The hand gesture recognition system has evolved tremendously in the recent few years because of its ability to interact with machines efficiently. Mankind tries to incorporate human gestures into modern technology by searching and finding a replacement of multi-touch technology which does not require any touching movement on-screen. This paper presents an overview of several methods to realize hand gesture recognition by using three main modules: camera and segmentation module, detection module and feature extraction module. There are many methods that can be used to get the respective results depending on its advantages. Summary of previous research and results of hand gesture methods as well as the comparison between gesture recognition are also given in this paper**.** three main steps of hand gesture which are camera module, a detection module, and featureextraction module are discussed. A robust hand and finger gesture tracking recognition system isviable to be used in the human-computer interaction system.

**HOW IT IS SUPPORTING OUR PROJECT:** The System components and framework such as camera module, detection module and featureextraction module related to our project.

**1.15:** **An Efficient Approach for the Recognition of Hand Gestures from Very Low-Resolution Images**

**SUMMARY:** This paper suggests a simple and effective method for identifying hand gestures from photographs with very low resolution. Images with a resolution as low as[ 50×50 pixels] shall also be considered for recognition. Low-resolution gesture images captured from web cameras, mobile phones or low-cost cameras are systematically processed to generate the number of fingers raised. The current approach extracts the hand gesture directly from the low-resolution image to a high-resolution image or the use of any classifier without the need for reconstruction.

**HOW IT IS SUPPORTING OUR PROJECT:** Using this method can help us to detect gestures in a low-resolution image. So, we can use a webcam or any low definition cam easily.

**1.16: A NEW TECHNIQUE FOR HAND GESTURE RECOGNITION**

**SUMMARY:** In this paper, An advanced Self-Growing and Self-Organized Neural Gas (SONG) network are being introduced as a new method for hand gesture recognition. Initially, a color segmentation technique that depends on a map of skin-color distribution is used to detect the region of the hand. then applied to the segmented hand, in order to approach its topology. Finally, recognition of the hand gesture is accomplished through a classification method based on probability.

**HOW IT IS SUPPORTING OUR PROJECT:** Neural network is a vast open field for machine learning and image processing. If we can follow the trail of the neural network-based system, this project will be much more efficient.

**1.17: AN IMPROVED HAND GESTURE RECOGNITION WITH TWO-STAGE CONVOLUTION NEURAL NETWORKS USING A HAND COLOR IMAGE AND ITS PSEUDO-DEPTH IMAGE**

**SUMMARY:** In this paper, the author discussed robust hand gestures With the help of depth information, depth-based methods have improved performance, but depth cameras are not as widely used and affordable as color cameras. Therefore, in this paper, they propose a two-stage deep convolutional neural network (CNN) architecture for accurate color-based hand gesture recognition.

**HOW IT IS SUPPORTING OUR PROJECT:** Neural network is an unknown field for most of us, but if we can use this on this project, we can detect hand gestures at ease.

**1.18: Image Processing Algorithms for Gesture Recognition using MATLAB**

**SUMMARY:** The purpose of this paper is to identify hand postures and to establish an interaction between man and machine. It detects the hand region in the image and determines the number of active fingers. The color image is converted and preprocessed into a binary image, and the number of fingers is counted using the MATLAB scanning method. This is an approach that is simple yet efficient.

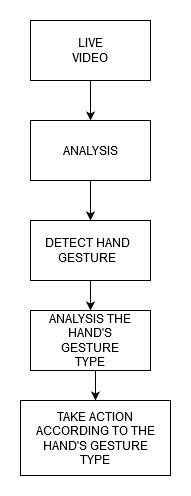
**HOW IT IS SUPPORTING OUR PROJECT:** Determining the active fingers in an image is the fundamental target of our project. We can follow this technique and convert the color image into a binary image for better detection.

**1.19: Static Vision-Based Hand Gesture Recognition Using Principal Component Analysis**

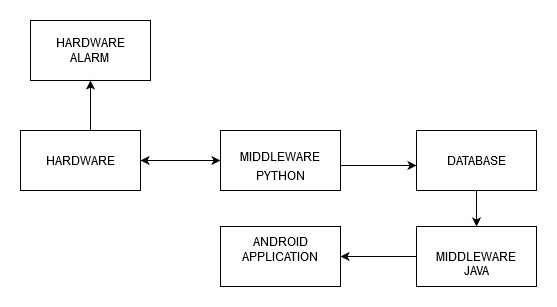
**SUMMARY:** This paper relies on a vision-based hand gesture recognition system by proposing a scheme that uses a database-driven hand gesture recognition based on the skin color model approach and thresholding approach together with an effective PCA matching template. Initially, the region of the hand is segmented by applying a model of skin color in color space YCbCr. To separate the foreground and background is applied in the next stage otsu thresholding. Lastly, a template-based matching technique is developed for recognition using the Principal Component Analysis (PCA).

**HOW IT IS SUPPORTING OUR PROJECT:** YCbCr or Y'CBCR, is a family of color spaces used on video and digital photography systems as part of the color image process. It will help us to process the color image from the video we are going to use.

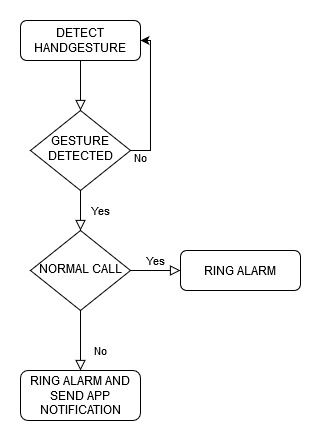
1. **Design Possibility:** 
   1. **Block Diagram:**

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* 1. **Component Diagram:**

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* 1. **Flow Chart:**

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1. **Design Approach:**

To complete this project we are going to use some hardware and software and we will use some specific language to perform some specific task. The list of all the required things is given below.

* 1. **Hardware:**
     1. **Raspberry Pi 3 B+:** We are going to use Raspberry Pi 3 B+ to capture the live video through a camera module and use it to analyze it for detecting hand gestures and send the data to firebase. Besides, it will also help to ring the alarm when needed.
     2. **Raspberry Pi Camera:** Through this camera, Raspberry Pi will record live video.
     3. **Speaker:** By using this speaker Raspberry Pi will ring an alarm when required after analyzing hand gestures.
     4. **Adapter:** Raspberry Pi 3 B+, Raspberry Pi Camera, and Speaker need a power source to operate.
  2. **Software:**
     1. **Android Studio:** As an android application is required to receive data from the database. That is why we are going to use Android Studio to build a required android application.
     2. **Jupyter Notebook:** We areusing it to create and handle the dataset.The Jupyter Notebook is an open-source web application that we can use to create and share documents that contain live code, equations, visualizations, and text.
     3. **Anaconda:** To handle various libraries and algorithms we are using anaconda. Anaconda is a Python prepackaged distribution of Python which contains a number of Python modules and packages, including Jupyter.
  3. **Language:**
     1. **JAVA:** As we mentioned that we are using android studio for application. The main languages for Android studio are JAVA and KOTLIN. That is why we are using JAVA for developing applications.
     2. **Python:** Here Python is playing a major role. We are operating PI using python. Besides that, we are using python to train the dataset and sending the processed data into the database.
  4. **Library:** 
     1. **OpenCV:** OpenCV is a library of programming functions that mainly target computer vision in real time. Originally developed by Intel, it later received support from Willow Garage then Itseez. The library is cross-platform and is open-source BSD licensed for free use.
  5. **Database:**
     1. **Firebase:** Mainly the database is a bridge between Hardware and Android Application here. After the analysis of video Hardware will send a message to the database and the application will retrieve it from the database and will show it as a push notification. For this, we are going to use the realtime database of Firebase.

1. **Timeline:**

|  |  |  |
| --- | --- | --- |
| **WEEK** | **DATE** | **Expected Progress** |
| Week 1 | 26-JAN-2020 | Project Deciding |
| Week 2 | 2-FEB-2020 | Project Deciding |
| Week 3 | 9-FEB-2020 | Project Deciding |
| Week 4 | 16-FEB-2020 | Project Proposal Submission and Environment Setup |
| Week 5 | 23-FEB-2020 | Start Work on ML and How to Detect Hand Gesture |
| Week 6 | 1-MAR-2020 | Hand Detect and Start Work on Mobile Application |
| Week 7 | 8-MAR-2020 | Mobile Application Stage 1 Ready |
| Week 8 | 15-MAR-2020 | Hand Gesture Detect |
| Week 9 | 22-MAR-2020 | Hand Gesture Detect and Show Conclusion |
| Week 10 | 29-MAR-2020 | Send Hand Gesture Conclusion to the Database and Connect it With App |
| Week 11 | 5-APR-2020 | Project Ready and Start Debug |
| Week 12 | 12-APR-2020 | Final Project and Report Submission |

1. **Estimate Cost:**

|  |  |
| --- | --- |
| **PURPOSE** | **COST** |
| Raspberry Pi 3 B+ | 3300 BDT |
| Raspberry Pi Camera | 700 BDT |
| Speaker | 200 BDT |
| DATABASE | FREE |
| Adapter | 120 BDT |
| TOTAL | 4320 BDT |

1. **Expected Problem:**
   1. Before starting, we need to research raspberry pi, image processing, deep learning, gesture recognition algorithms, required applications environments, and resource and datasets.
   2. The gesture segmentation problem is introduced as the first step towards visual gesture recognition with the detection, analysis, and recognition of gestures from sequences of real images. Our gesture segmentation scheme is composed of two steps: accurate gesture contour tracking in the space domain, and continuous tracking in the time domain. Experimental results and implementation issues are presented.
   3. Recognize hand in complex background.
   4. Recognize hand gesture in any angle
   5. Setting up a software environment is a big task and deploying libraries. ( the action of bringing resources into effective action.)
   6. Setting up the dataset in case of lack datasets
   7. Sometimes it required high end performed computation to train some datasets or trains. For that maybe we need of software lab
   8. Find an appropriate algorithm to acquire accuracy at a satisfactory level.
   9. Real-time image processing can be slower. To make it faster