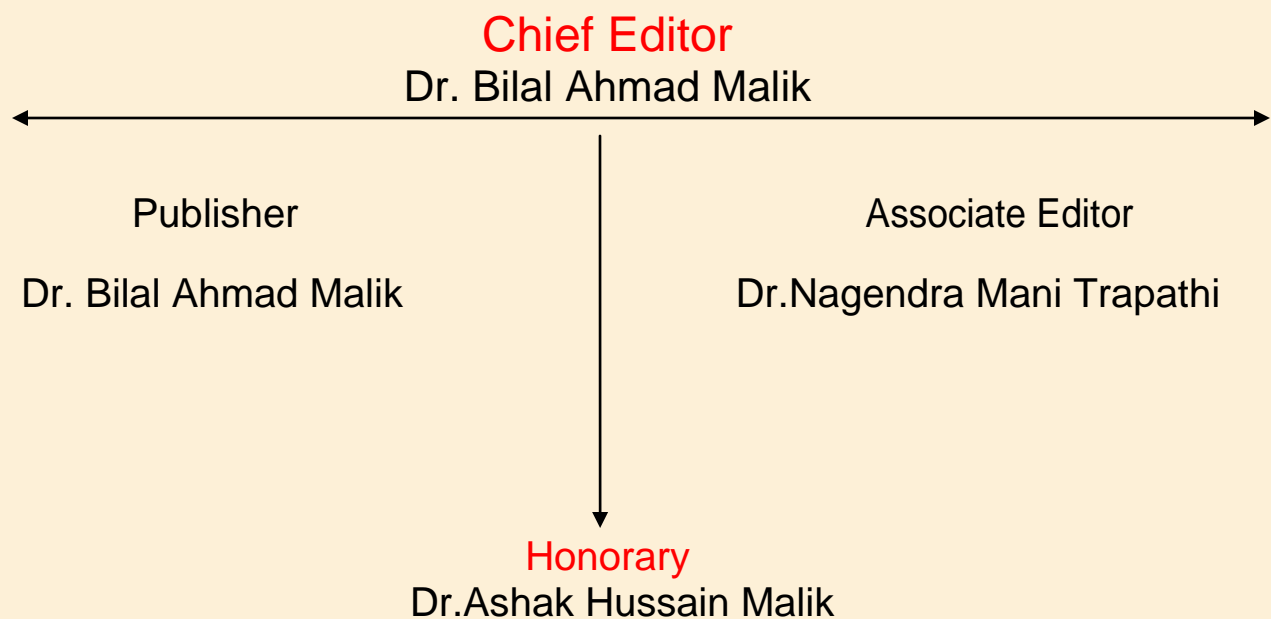


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VIRTUAL DRUM: AN INTERACTIVE MUSIC APPLICATION FOR AUTISM CHILDREN

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ABSTRACT

The air drumming provides the same level of satisfaction to the user as drumming on a physical drum set does. Project has intention of implementing a gesture controlled virtual drum set. It provides a simple and fun way for people those who wish to learn drumming or just to enjoy drumming. The application focuses on a game for autism children. It is a music game. Autism Spectrum Disorder (ASD) involves impairment of communication. It also has limited imagination, etc. Music provides helpful interaction with child. A web camera is used to recognize the signs of user and then the signs are converted to drum beats. The system simulates an 'e-drum'. The e-drum maps different arm actions to different drum beats. Visual interface uses input from camera based system. Then it gives visual and audio feedback.

Keywords: Autism, gesture recognition, sign language.

I. INTRODUCTION

Mental abilities have been a vast topic for research in last few years. As we discover disabilities, we run behind its cure and precautions. One of such disability that is mainly notice in first three years of child's birth is 'Autism'. The fact that there is not any cures for autism, in many cases children's have recovered. According to survey, each year the graph of children affected with autism is increasing and probably almost 5 times more in boys than girls. The Autism Spectrum Disorder (ASD) can be due to generic and environment factors. Children with autism mostly like to live alone. The word autism itself means 'self'. These children are mainly interested in music, calendar calculations and mathematics. We have selected music as a treatment as not only children are attracted to music but adults also. This will be easy for their parents also to involve children in it. It does not need any extra training for parents to teach the children as like mathematics and calendar calculation, the parents first have to learn it and then teach children. The application would have set of drums on the desktop and the children

or user has just to tap their hands in front of the desktop. If tapped appropriate, the specific drum will be played. We can also prepare a music tone from continuous tapping the drums. We can also play a song's tone by tapping drums in proper sequence and frequency. Frequency matters in output level of sound, Greater the frequency of tapping, high the sound level and lower the frequency of tapping, low the sound level. Each drum will produce a different sound. Children would attract to this as it produces sounds and also visual effect on drum tapped. The screen would also show which drum has tapped by visual effects like blinking the drum or by shivering the drum. This would be a game and entertainment too. This will generate a proper hands tapping skill in children. After a lot training, we can also give them a music tone and tell to play that by tapping. This would improve their memory skills. Music lovers can also use it. People who wish to learn drum but cannot afford the real drum set can learn it by this application. It will be useful for them. Also the physical space limitation problem does not arrive. Real drum kit needs a lot of space. But this application needs no physical space.

1.1. Related work:

The main part is gesture in this application. The 'Real-Time Hand Gesture Recognition Using Range Cameras' used a Swiss Ranger SR4000 camera. The underlying principle is that there shouldn't be any object between the camera and the hand. To extract hand information, range threshold was used. Another paper 'Exploring Motion-based Touchless Games' defined 5 games for autism children. Through this, children develop their skills. The 'Virtual Drum Set' uses a video and audio module. Video module does the gesture recognition part. It locates the hand position. The audio module is responsible of determining which drum to play.

1.2. Motivation:

The reason behind developing virtual drum is not only just for entertainment but also it would be helpful. As noted before, it would be useful by all people, no matter age, career, education level, etc but main purpose for the children affected with ASD. Now-a-days there are many health problems occurring. Physical health problems are related easy to cure as compared to mental problems. For physical problems, there are defined medicines and treatments but for mental problems doctor or person treating the disability have to know the mental condition of patient. The mental condition varies from patient to patient as its cure also. ASD is mainly seen in children below 3 years. So to develop the child's mental ability properly for good future, it is very important to improve its skill from childhood. The verbal skill, interacting skill, language and body sign etc are need to develop in proper age only. Once the age is gone, the child lacks in everything. So it was a need to develop this application. Also the next reason to develop this application is the economics and space problem. People who cannot afford real drum kit due to its cost can use this application or people who are not interested in music and its rule but just want to play drum as a fun can also play drum with this application. One more requirement with real drum kit is the space needed to keep it. It needs a huge space and some can have shortage of space to keep drum kit. But this application needs no physical space just some memory in computer storage.

II. METHODOLOGY

The application is a simple virtual drum which would work same as a real drum kit. This task requires use of both visual information and audio information. Visual information to view the drum and then tap and audio is for hearing the sound produced by the drum.



Figure 1. Virtual Drum

The system has a web camera as an input source and the output is the sound of tapped drum and also effect on drum. Effect on drum can be a blink on drum or shivering of drum. This is to indicate actually which drum has tapped and produces sound. Gesture recognition is main part and output is depending on it. Firstly, we would tap our hands and it would be captured by web camera. This is camera interface. Then from the video, frames will be extracted. The extracted frames would be blurred for removing the noise. Then the initial position of user would be captured called background image registration. This would be the base image in our processing. When the user makes movements, the current image will be compared with base image and difference between the hands position will be calculated. This is called current image subtraction. Then the image would be threshold. The image captured by camera is in RGB format and in threshold; we convert it into grayscale form. This is done by applying threshold algorithm Next step is now to convert the grayscale image into black and white. Blob algorithm does this and separates the necessary part and unnecessary part. The necessary part is hands and we can either make hands black and other background as white or vice-versa. Now the hands position is

detected and specified drum is played. This is gesture estimation. Playing the sound is last step. The sound of drum also can be customized. For single drum, we can select what type of sound we want. This would add creativity in output sound. Camera interface, virtual drum interface and customization window are the modules used.

2.1. Modules:

2.1.1 Camera Interface:

This is important module as all the further processing is dependent on input. The web camera would take the input and give it for processing. Input will be in form of video. The web camera has to be placed at correct location so as correctly capture video of hands. If video of both hands is captured properly then only the output will be generated as expected.

2.1.2. Virtual Drum interface:

This is the gesture recognition part. Here, locations of hand tapped have to be estimated and the drum that is correspondence to that location should be found out. If there is any mistake in calculation of location of hands then the output will also be wrong.

2.1.3. Customization Window:

This section focuses on how the application can be made more interested. It allows user to choose what beats or sound the drum will generate on tapping. Also the effect on drum on tapping can be changed. User can select sound from a list of sounds and then can play the drum. The effects on drums can be changed to blink or shivering. In blink effect, the drum will blink once when tapped and in shivering, the drum will shiver for a fraction of seconds.

2.2. Algorithm:

2.2.1. Blurring algorithm

Blurring algorithm is used to remove noise and eliminate sharp edges from the image. There are many types of noise. Noise can be in form of black and white pixels, random white pixels or random black pixels.

Blurring also reduces the details of image. Blurring the image multiple times is same as blurring it at once but at large blur.

2.2.2. Threshold algorithm

Thresholding is a method of image segmentation. In thresholding, we convert the image into black and white. Black and white image is also called binary image as it uses only two bits. Thresholding is used for extraction of features. The features we want can be kept white and other part black or vice versa.

Steps for thresholding:

- Traverse through entire input image array.
- Read individual pixel color value (24-bit) and convert it into grayscale.

- Calculate the binary output pixel value (black or white) based on current threshold.
- Store the new value at same location in output image.

Short view of thresholding logic can be:

```
gs = (r+g+b) / 3;    // grayscale
if(gs < th)         //th is a threshold value
{
pix = 0; // pure black
}
Else
{
pix = 0xFFFFFFFF; // pure white
}
```

2.2.3. Blob Detection

In blob detection the image is differentiated in black and white. An area with some same features like color, intensity, brightness, etc is called a blob. We need blob detection in our project so as to separate the hands and other part of image. Blob will clearly separate the user's hand and other part so as to easily detect the location of hands.

3. Result:

The output of project is depending on user tapping hands. The user will tap hand in front of screen and then the drum will play. Different sounds will be generated by different drums.

III. CONCLUSION AND FUTURE WORK:

The project has a wide application area. It is related to music but main used for development of autism children. It also gives the knowledge of use of gestures and tapping hands. It also introduces the user about music.

Project is based on web camera but in future we can also implement it using a kinect camera. Web camera uses two coordinates for locating hands but the kinect camera takes into consideration all the three coordinates. More musical instruments can also be added in future. Use of sticks can be done for playing instruments such as disk. Piano can be added which make use of finger position.

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