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Hand Gesture Recognition for the Paralysed

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Abstract: Paralysis is a condition where control over the body is either partially or completely lost. The individuals who have this condition find it difficult to move around or even perform any other actions. This makes them mentally weak as they have to completely rely on others. This paper shows different popular methods developed to help these individuals to become self sufficient to a certain extent. Disadvantages of these methods have also been discussed. Also, proposed gesture recognition technique is explained.

Keywords: Marker; Gesture; Human Computer Interaction; HCI, IoT; Fingertips; Embedded Systems

I. INTRODUCTION

One of the most important issues in a contemporary society is disability, due to which individuals experience limitations in the scope of exercising their daily routines, skills, expanding their knowledge and the ability to use the opportunities to their fullest potential. In this modern era of technological advancement disability can no longer be a hinderance to both the personal growth of the individual and also the social development. In recent years, the human computer interface with the main focus of easing the lives of human have employed many methods such as sign language interpretation and also many other applications contributing to human welfare [1].

One such development is the invention of wheelchair. Although wheelchair provides the disabled with independent movement from one place to another, it is a challenge to the person to turn the wheels manually if he has only limited movements. However, in many other cases, such people only possess the ability to move very light loads with the help of their hands and there are even worst cases where these person can only make smaller movements of their fingers on a small area which gives instructions for the movement towards the intended direction. The real time detection of such hand or finger movements, in other words detection of such gestures accurately can help assist them in controlling the wheelchair movements, also other flexible parts of the bed for bed ridden patients. The idea in this approach is to capture real time finger movements which can be further interpreted for the control of devices.

Over the last few years, there have been several approaches adopted to design applications that can recognize finger movements precisely, amongst them are techniques which work on specially designed gloves for the collection of inputs image that is reported in [2] or use of input from marker gloves or marked hands proposed in [3]. The marker-based systems that use human computer interfaces are unsuitable for regular use due to its discomfort and inconvenience. Another approach reported in [4]-[5] presents extrapolation of complex representation of hand shapes. The use of complex computations makes it unsuitable for wireless and real time applications.

Segmentation of fingers and hand based on color was reported in [6], but the presence of external object with similar color degrades its performance. The approach in [7] is a curvature space which requires extensive off-line testing and is computationally extremely demanding. The approach reported in [8], uses a multisystem camera which helps in locating the fingertips as the farthest points from center of gravity of hand. This approach fails to perform efficiently in the presence of noise and with the variating of external condition. In [9] a special camera is utilized to extract the depth information. In [10]-[11] some other methods have used principal component analysis, [12] is proposed based on histograms, [13] is based on neural network and [14] is reported to use vector machine. However, generally it is seen that the implementation of these approaches becomes difficult in real time robust application where computation time constraints are present. This urges the need of a user-friendly approach which is easily implemented and also provides a hassle tree

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interaction of human machine which is still in greater demand especially to the users who are physically challenged.

II. LITERATURE SURVEY

Alrashdi et al. [15] propose that to help those suffering with mobility impairment, the electric powered two-wheeled wheelchairs are designed. Demand for these wheelchairs are growing rapidly because they don't require help from others. The main motto of this approach is to design an electrical wheelchair for controlling the movements of the wheels. The drawback is that smart phones makes the approach expensive and people from all generation are not able to operate smart phones easily. Smartphones are not secure as anybody can access it.

According to Yingda et al. [16] the two problems for the disabled people are travel and independent life. Brainwave detection technology can solve this problem. Electrical signals emitted by brain are used in Brainwave control technology. Human machine interface technology controls the external object with the help of software application, the interaction of mind and force control can be detected. The drawback is that as brainwave are used emotions and the thinking capability of a person may lead to some disaster.

According to Mirin et al [17], a touch controlled and voice recognition based smart wheelchair system is developed using embedded system. An android application is developed and installed on smartphone. This is divided into voice mode and touch mode. For voice mode physically disabled people will command the voice input. For touch mode, the screen of the android is used by handicapped people to control the wheelchair.The drawback is that the use of android smart phone gives rise to security issues as it can be accessed by anybody and can be taken disadvantage of easily.

Nsengumuremyi et al [18] say that the main motto is to focus on people who are not able to move and people who are handicapped. The proposed method uses manual joystick and an android phone-controlled wheelchair. With the help of joystick handicapped people can control the movement of the wheelchair. At different levels of control user is allowed to interact with wheelchair using android phone. This approach uses IOT which is not cost effective and also has security issues of being hacked.

Ceriani et al [19] suggest that the motto is to develop an autonomous wheelchair with low cost, which is able to avoid obstacles, explore environments with safety. This system is designed to meet disabled people's requirement. There are three different interfaces in this system-brain computer interface (BCI), a joystick, and a Touchscreen. But, the use of joystick makes the approach expensive; touch screen is proven to be taken disadvantage of and BCI system may lead to disasters while exploring the environment.

In [20], a smart, motorized, voice-controlled wheelchair is designed using embedded system. The movements of the wheelchair are controlled by the voice command given by the physically challenged person. Voice command is transferred and converted through the cellular device having bluetooth. For example, with a command 'go' chair will move in forward direction. This system is cost-effective. However, the use of voice-controlled system gives rise to security issues as the voice can be mimicked by anybody and people who are dump cannot use this model.

According to Suresh et al [21] the motto is to develop a wireless wheelchair controlled by brain which helps the disabled and paralyzed people to move freely. To control the movement of the wheelchair, a virtual reality system is connected to the brain computer Interface (BCI) which controls the external device and human brain through muscles. But, as brainwaves are used emotions and the thinking capability of a may lead to some disaster.

According to Ubale et al [22], the motto is to develop a wheelchair which can be controlled by hand gesture or with hand movements using acceleration technology. Hand gestures made by the physically challenged people and wheelchair is controlled by the sensors. If the direction of the wheelchair is changed, the values of the sensor registers are changed, and value are given to microcontroller. This approach uses sensors which may fail to work at a certain situation.

In [23], powered wheelchairs are used with high mobility. The integration of mentally and physically handicapped people is one of the greatest steps in the navigational intelligence. Tetraplegic people and paraplegic people are unable to operate joystick. To overcome this problems Rob Chair system is developed. The drawback is the use of joystick makes the model expensive and people lacking hands cannot use joysticks.

III. PROPOSED SYSTEM

Fig. 1 shows the block diagram of the work.

The camera here first captures the gesturers and sends the live video frames to the video processor that has an algorithm which can understand the gestures. If the gestures given by the user is corresponds to wheelchair motion. This information will be sent to motor control to move the wheelchair while if the gesture corresponds to control home application. Then we use Bluetooth interfaces to send information to the applications.

Steps involved in the air gesture detection for controlling wheelchair are shown in Fig. 2.

A. Image Acquisition

To overcome worst real time condition and to keep this cost-effective, high resolution camera has been avoided a front tech camera of 20MP resolution with night vision. The camera is placed over the white background where the gestures are done to control the wheelchair. Video is

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captured continuously by the camera, which is synchronized with web cam of the PC. Then frames are taken from further processing steps to decode the gesture into corresponding action as required by the user.

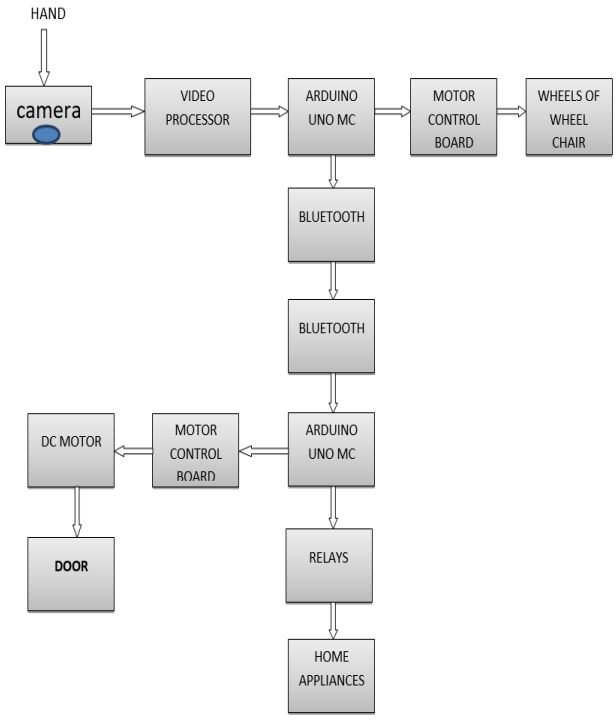

Fig 1. Block Diagram

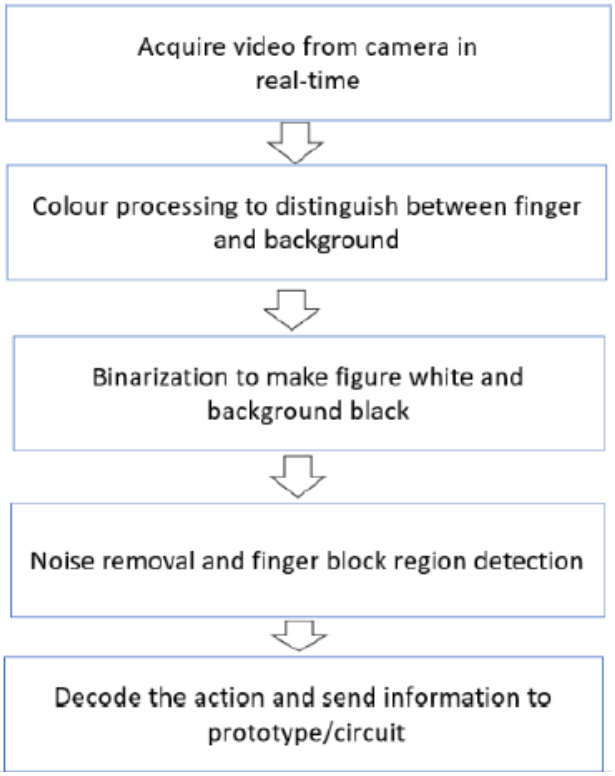

Fig 2. Flowchart

B. Color Normalization:

Color processing is done to distinguish between the finger and background. During image capture, lighting conditions will vary depending on the lighting and surrounding environment to minimize such effects we will convert RGB color model to saturation.

C. Background Subtraction:

Images are captured from the video continuously where obtained images are gray scale image next, memory saved in the background is subtracted. Grayscale image is converted to binary image

D. Morphological operation

The operation used in this proposed method is erosion and dilation. Morphological operation erosion is done using square structuring elements to delete noisy pixels. This dilation operation is done using disk structure elements to fill some points which are detected to fill some points which are detected as black pixel.

E. Decode action

The gesture is decoded using pixel to area analysis and the identified gesture is sent to the hardware associated, i.e., wheelchair and home appliances.

IV. RESULTS

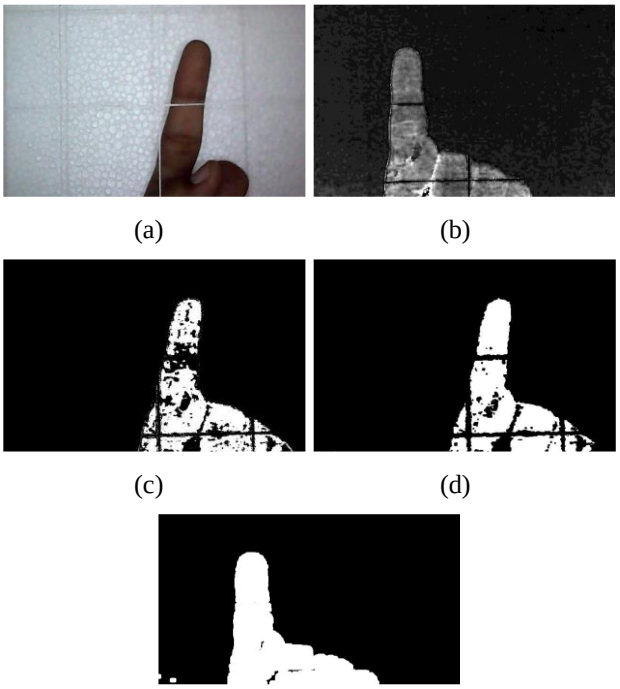

Fig 3. (a) RGB image (b) Saturation (c) Segmented image (d) Eroded image (e) Dilated image

The Fig. 3 shows outputs of every stage explained in the previous section.

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V. CONCLUSION

This paper has shown different methods available for gesture recognition and the drawbacks of the same have also been described. There exists a requirement to that expects minimal interference from the user considering his/her state. A complete camera-based interface is developed, which can help the paralyzed to move around also control his/her home appliances.

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