ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

FPGA Based Real Time Implementation of Gesture Recognition System

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Abstract:

Gesture recognition pertains to recognizing meaning- ful expressions of motion by a human, involving the hands, arms, face, head, and/or body. It is of utmost importance in designing an intelligent and efficient human–computer interface. The applications of gesture recognition are manifold, ranging from sign language through medical rehabilitation to virtual reality. In this paper we implement a control of a Robot using Hand Gesture Motion on FPGA.

Keyword:

Gesture Recognition, Robot, FPGA.

Introduction:

IN THE PRESENT day framework of interactive, intelligent computing, an efficient human–computer interaction is assuming utmost importance in our daily lives. Gesture recog- nition can be termed as an approach in this direction. It is the process by which the gestures made by the user are recognized by the receiver.Gestures are expressive, meaningful body motions involving physical movements of the fingers, hands, arms, head, face, or body with the intent of: 1) conveying meaningful information or 2) interacting with the environment. They constitute one in- teresting small subspace of possible human motion. A gesture may also be perceived by the environment as a compression technique for the information to be transmitted elsewhere and subsequently reconstructed by the receiver. Gesture recognition has wide-ranging applications [1] such as the following:

•developing aids for the hearing impaired;
•enabling very young children to interact with computers;
•designing techniques for forensic identification;
•recognizing sign language;
•medically monitoring patients' emotional states or stress levels;
•lie detection;
•navigating and/or manipulating in virtual environments;
•communicating in video conferencing;
•distance learning/tele-teaching assistance;
•monitoring automobile drivers' alertness/drowsiness levels, etc.

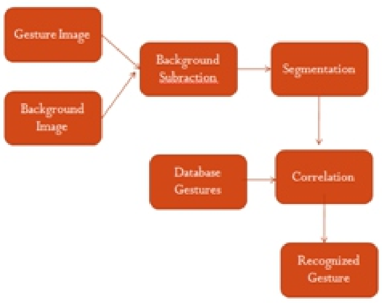
Facial expressions involve extracting sensitive features (re- lated to emotional state) from facial landmarks such as regions surrounding the mouth, nose, and eyes of a normalized image. Often dynamic image frames of these regions are tracked to generate suitable features. The location, intensity, and dynam- ics of the facial actions are important for recognizing an ex- pression. Moreover, the intensity measurement of spontaneous facial expressions is often more difficult than that of posed fa- cial expressions. More subtle cues such as hand tension, overall muscle tension, locations of self-contact, and pupil dilation are sometimes used.In order to determine all these aspects, the human body po- sition, configuration (angles and rotations), and movement (ve- locities) need to be sensed. This can be done either by using sensing devices attached to the user. Those may be magnetic field trackers, instrumented (data) gloves, and body suits, or by using cameras and computer vision techniques.Each sensing technology varies along several dimensions, including accuracy, resolution, latency, range of motion, user comfort, and cost. Glove-based gestural interfaces typically re- quire the user to wear a cumbersome device and carry a load of cables connecting the device to a computer. This hinders the ease and naturalness of the user's interaction with the computer. Vision-based techniques, while overcoming this, need to con- tend with other problems related to occlusion of parts of the user's body. While tracking devices can detect fast and sub- tle movements of the fingers when the user's hand is moving, a vision-based system will at best get a general sense of the type of finger motion.

Again, vision-based devices can han- dle properties such as texture and color for analyzing a gesture, while tracking devices cannot. Vision-based techniques can also vary among themselves in:

1) the number of cameras used;
2) their speed and latency;
3) the structure of environment (re- strictions such as lighting or speed of movement);
4) any user requirements (whether user must wear anything special);
5) the low-level features used (edges, regions, silhouettes, moments, histograms);
6) whether 2-D or 3-D representation is used; and
7) whether time is represented.

There is, however, an inherent loss in information whenever a 3-D image is projected to a 2-D plane. Again, elaborate 3-D models involve prohibitive high- dimensional parameter spaces. A tracker also needs to handle changing shapes and sizes of the gesture-generating object (that varies between individuals), other moving objects in the back- ground, and noise. Good review on human motion analysis is available in literature [5], [6].

Proposed Algorithm:



Background Subtraction:

Background subtraction is a commonly used class of techniques for segmenting out objects of interest in a scene for applications such as surveillance. It compares an observed image with an estimate of the image if it contained no objects of interest. The areas of the image plane where there is a significant difference between the observed and estimated images indicate the location of the objects of interest . The name “background subtraction” comes from the simple technique of subtracting the observed image from the estimated image and thresholding the result to generate the objects of interest.

Segmentation:

In computer vision, image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as superpixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze.Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics

Correlation:

Correlation is the method which identifies the matching content in the images.From the above procedure we identifies the gesture of the user with the database. Once the gesture was identifies then we send a command through the serial port in order to control the Robot movement depend upon the Gesture applied.

Hardware Modules:
RELAY:

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits, the link is magnetic and mechanical. Relays are very simple devices. There are four major parts in every realy. They are

•Electromagnet
•Armature that can be attracted by the electromagnet
•Spring
•Set of electrical contacts

WORKING:

When a current flows through the coil, the resulting magnetic field attracts an armature that is mechanically linked to a moving contact.

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The movement either makes or breaks a connection with a fixed contact. When the current to the coil is switched off, the armature is returned by a force approximately half as strong as the magnetic force to its relaxed position. Usually this is a spring, but gravity is also used commonly in industrial motor starters. Most relays are manufactured to operate quickly. In a low voltage application, this is to reduce noise. In a high voltage or high current application, this is to reduce arcing.

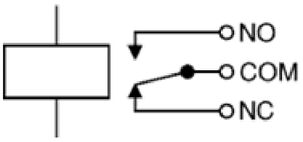

Fig 8.1 Circuit symbol of a relay

The relay's switch connections are usually labeled COM, NC and NO:

•COM = Common, always connect to this, it is the moving part of the switch.
•NC = Normally Closed, COM is connected to this when the relay coil is off.
•NO = Normally Open, COM is connected to this when the relay coil is on.

NOTE:

Connect to COM and NO if you want the switched circuit to be on when the relay coil is on. Connect to COM and NC if you want the switched circuit to be on when the relay coil is off.

ADVANTAGES OF RELAYS:

Like relays, transistors can be used as an electrically operated switch. For switching small DC currents (< 1A) at low voltage they are usually a better choice than a relay. However transistors cannot switch AC or high voltages (such as mains electricity) and they are not usually a good choice for switching large currents (> 5A). In these cases a relay will be needed. Advantages of relays compared to other switching devices are:

•The complete electrical isolation improves safety by ensuring that high voltages and currents cannot appear where they should not be.
•Relays can switch many contacts at once. Relays come in all shapes and sizes for different applications and they have various switch contact configurations. Double Pole Double Throw (DPDT) relays are common and even 4-pole types are available. You can therefore control several circuits with one relay or use one relay to control the direction of a motor.
•Relays can switch AC and DC, transistors can only switch DC.
•Relays can switch high voltages, transistors cannot.
•Relays are a better choice for switching large currents (> 5A).

DRIVE CIRCUIT AND PROTECTION DIODES FOR RELAYS:

The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Hence a CB amplifier is used to achieve the current rating of the relay.Transistors and ICs must be protected from the brief high voltage produced when a relay coil is switched off. The diagram shows how a signal diode (e.g. 1N4148) is connected 'backwards' across the relay coil to provide this protection. Current flowing through a relay coil creates a magnetic field which collapses suddenly when the current is switched off. The sudden collapse of the magnetic field induces a brief high voltage across the relay coil which is very likely to damage transistors and ICs. The protection diode allows the induced voltage to drive a brief current through the coil (and diode) so the magnetic field dies away quickly rather than instantly. This prevents the induced voltage becoming high enough to cause damage to transistors and ICs.

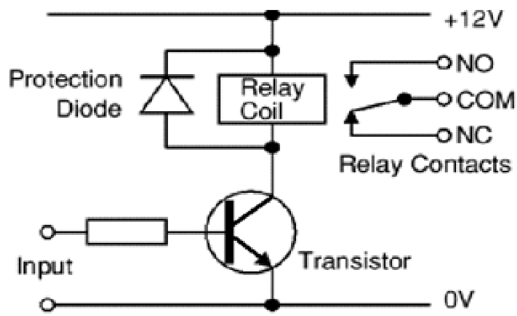

Fig 8.2 Drive circuit and protection diodes for relays

CHOOSING A RELAY:

One needs to consider several features when choosing a relay:
1.Physical size and pin arrangement: If you are choosing a relay for an existing PCB you will need to ensure that its dimensions and pin arrangement are suitable. You should

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find this information in the supplier's catalogue.
2.Coil voltage: The relay's coil voltage rating and resistance must suit the circuit powering the relay coil. Many relays have a coil rated for a 12V supply but 5V and 24V relays are also readily available. Some relays operate perfectly well with a supply voltage which is a little lower than their rated value.
3.Coil resistance: The circuit must be able to supply the current required by the relay coil. You can use Ohm's law to calculate the current:
Relay coil current = supply voltage / coil resistance
For example: A 12V supply relay with a coil resistance of 400 passes a current of 30mA. Most ICs will require a transistor to amplify the current.
4.Switch ratings (voltage and current): The relay's switch contacts must be suitable for the circuit they are to control. You will need to check the voltage and current ratings. Note that the voltage rating is usually higher for AC, for example: "5A at 24V DC or 125V AC".
5.Switch contact arrangement (SPDT, DPDT etc.): Most relays are SPDT or DPDT which are often described as "single pole changeover" (SPCO) or "double pole changeover" (DPCO).

DC MOTOR:

The steel can forms the body of the motor in addition to an axle, a nylon end cap and two battery leads. If the battery leads of the motor are hooked up to a flashlight battery, the axle will spin. If leads are reversed, it will spin in the opposite direction. Here are two other views of the same motor. The nylon end cap is held in place by two tabs that are part of the steel can. By bendin¬g the tabs back, the end cap can be made free and remove it. Inside the end cap are the motor's brushes. These brushes transfer power from the battery to the commutator as the motor spins. The figure 16 shows all the parts of the DC motor.

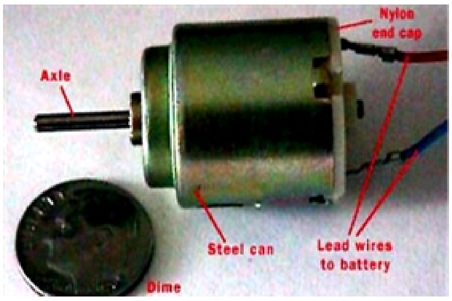

Figure parts of a DC motor

Results:

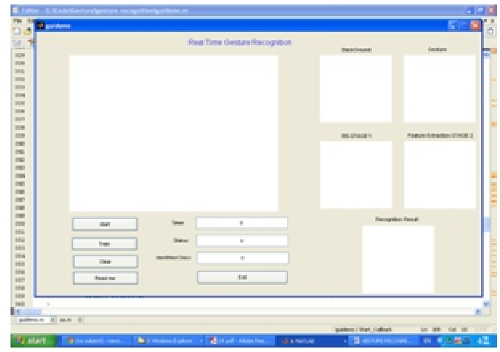

Fig: Gesture Recognition in GUI window

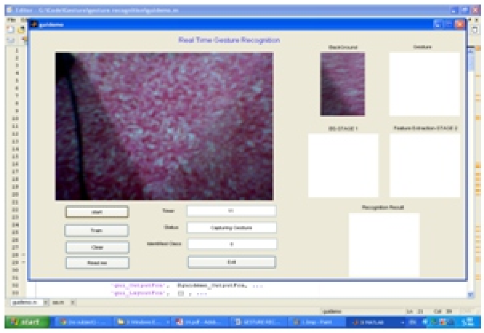

Fig: Capturing Background

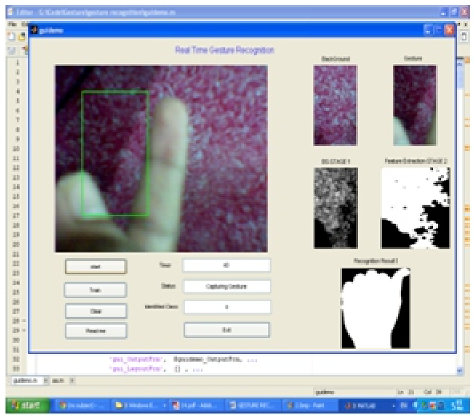

Fig: Recognition of Gesture

Conclusion:

We planned a quick and straightforward algorithmic program for a hand gesture recognition downside. Given ascertained pictures of the hand, the algorithmic program segments the hand region, and so makes Associate in Nursing logical thinking on the activity of the fingers concerned within the gesture.

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we've incontestable the effectiveness of this computationally economical algorithmic program on real pictures we've noninheritable . supported our motivating mechanism management application, we've solely thought-about a restricted range of gestures. Our algorithmic program will be extended in an exceedingly range of how to acknowledge a broader set of gestures. The segmentation portion of our algorithmic program is just too straightforward, and would wish to be improved if this method would wish to be utilized in difficult operative conditions. but we should always note that the segmentation downside {in a|during a|in Associate in Nursing exceedingly|in a very} general setting is an open analysis downside itself. Reliable performance of hand gesture recognition techniques in an exceedingly general setting need coping with occlusions, temporal trailing for recognizing dynamic gestures, still as 3D modeling of the hand, that area unit still principally on the far side the present state of the art.

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