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Gesture Based Robotic Control and Indoor Dangerous Gas Environment Detection

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ABSTRACT: Gestured based Robotic Control is the attractive solution for human computer interaction and machine vision application like robotic application. The common systems assumption under such a systems are a constant environment, like persons wearing non-skin-colored clothes with long sleeves and a fixed camera position under constant lighting conditions. In this paper we are evaluating the performance of a simple hand and finger gesture recognition system that can be mapped to various tasks for robotic application. One of the main constrain for implementing the vision based gesture recognition system on robotic platform is the computational complexity associated with the system because of the low computation power available on the tiny embedded system on robots. So here we are evaluating a simple hand gestures for that purpose based on connected component analysis technique, morphology, region property and skin detect function.

I. INTRODUCTION

Finding a natural and effective way of communication with robots is important in order to enhance their contribution in our daily lives. For this purpose, there have been various developments in the area of Human-Robot Interaction. It is known that using a computer, a gamepad or a keyboard can be teleoperative but it is still unnatural and difficult to control. Hence, it is still one of the major research directions to design ease of use and intuitive modes of communication with robots.

Another form of communication is gestures. Vision-based hand gesture recognition is an active area of research in human-computer interaction (HCI), as direct use of hands is a natural means for humans to communicate with each other and more recently, with devices in intelligent environments. The trend in HCI is moving towards real-time hand gesture recognition and tracking for use in interacting with video games, remote-less control of television sets, robot interaction and interacting with other similar environments. This system generally involves measurement of hand location and shape. Achieving high accuracy and speed in measuring hand postures are two important aspects of these systems. Numerous approaches have been explored to extract human hand regions either by background subtraction or skin-color segmentation. Methods based on background subtraction are not feasible when applied to images with complex backgrounds or real- world scenarios.

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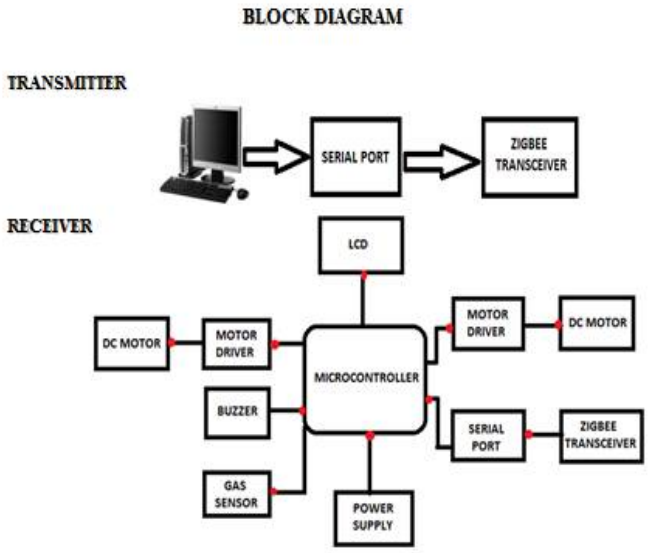
II. SYSTEM MODEL

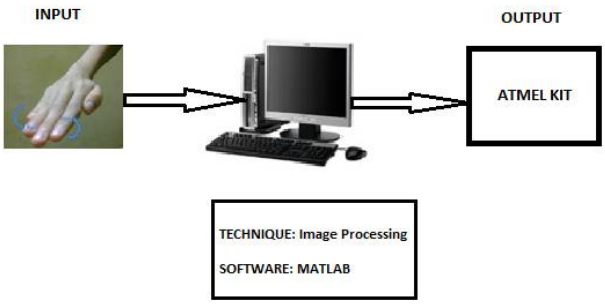


Our system uses very simple algorithm for gesture recognition. Here hand portion of the image is segmented by the simple algorithm connected component analysis technique, morphology, region property and skin detect function.

III. PATTERN RECOGNITION

Webcam is connected to the computer. This webcam collects the data in the form of images and compute these data to get information. The hand and finger gestures are captured by the webcam and the computer processes these images using the Image Processing algorithms.

The image captured through the web camera is in YUY format and this image is converted to RGB format. Frames are nothing but steps and image is the product of the pixel range and the number of frames. The image captured consists of noise and along with the hand signal, unwanted exterior images are captured. The control signals are differentiated from the unwanted noise image by “Skin Detect Function”.



A. SKIN DETECT FUNCTION

i. The YUV colour space was chosen due to the fast transformation of the RGB model. The Y channel represents the luminance of the colour, while the U and V channels represent the chrominance.

ii. Separating the luma from the chromatic reduces the effect of light changing and shadow noises.

iii. The skin detection threshold, which is based on the YUV colour model, was built based on 200 faces with different colors.

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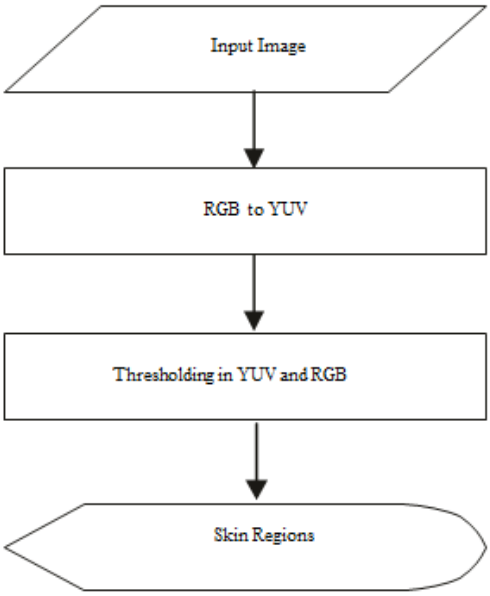
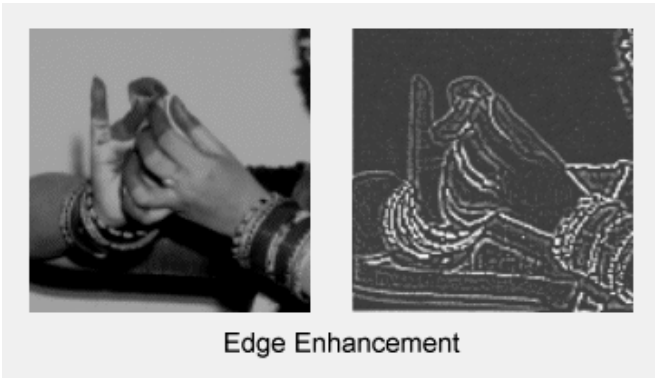
iv. The threshold values used to detect human skin using U and V channels were determined by testing the boundary of skin colours with the help of the colour histogram. The threshold values, which are used to segment skin regions based on the
RGB colour space.



Skin Segmentation Process

v. Once the output is found by comparing the threshold values the segmentation process is done. Here the hand region or the edges of the control signal (hand) is highlighted. The YUV colour space is converted to binary format.

vi. Then the filtering process is done. The output is set for a threshold of 100, such that all elements detected below 100 are considered to be Noise and they are rejected.



Edge Enhancement

B. MORPHOLOGY

i. Morphology is Tool or Operation that is used for describing or characterizing image regions and image filtering

ii. In this project we are using the opening and dilate property of Morphology technique.

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C. CONNECTED COMPONENT ANALYSIS

i. Once region boundaries have been detected, it is often useful to extract regions which are not separated by a boundary.

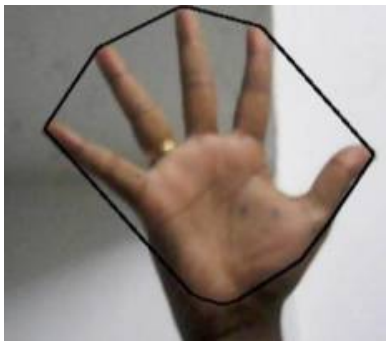
ii. Any set of pixels which is not separated by a boundary is call connected.

iii. Each maximal region of connected pixels is called a connected component.

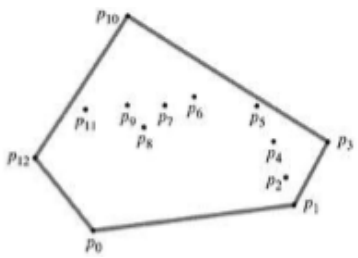
iv. The set of connected components, partition the image into segments.

v. Image segmentation is a useful operation in many image processing applications.

vi. Once the connected components are identified region property function is used to combine the pixels of the hand region (finger - segments).



vii. Here the maximal region is connected and the detected boundary is taken to be the control signal.



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IV. FINGER GESTURE RECOGNITION

We propose a fast algorithm for automatically recognizing a limited set of gestures from hand images for a robot control application. Hand gesture recognizing is a challenging problem in its general form. We consider a fixed set of manual commands and a regionally structured environment, and develop a simple, effective, procedure for gesture recognition .Our approach contains steps for segmenting the hand region and classifying the gesture

Our proposed method of figure gesture recognition consist of following stages:

• Localizing Hand-like regions based on learned skin colour statistics.

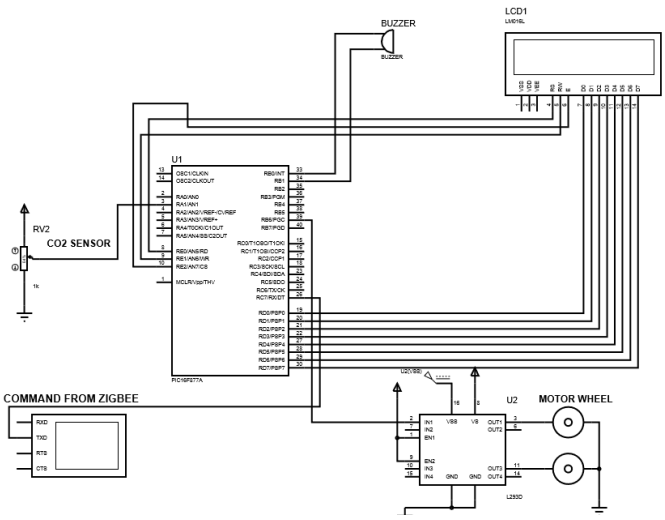
• Finding the total count based on threshold (50) value for each hand pose.

• Based on each figure gesture recognition the given instruction is executed.

1) For single finger pose “move forward” instruction is executed.
2) For two finger pose “move backward” instruction is executed.
3) For three finger pose “move right” instruction is executed.
4) For four finger pose “move left” instruction is executed.
5) For zero finger pose “stop” instruction is executed.

V. GESTURE BASED ROBOT

The transmitter circuit packages the data to be sent
with an address. This data is transmitted in serial data format. The message received by receiver is provided to the microcontroller this controls the motor driver to run the motor.



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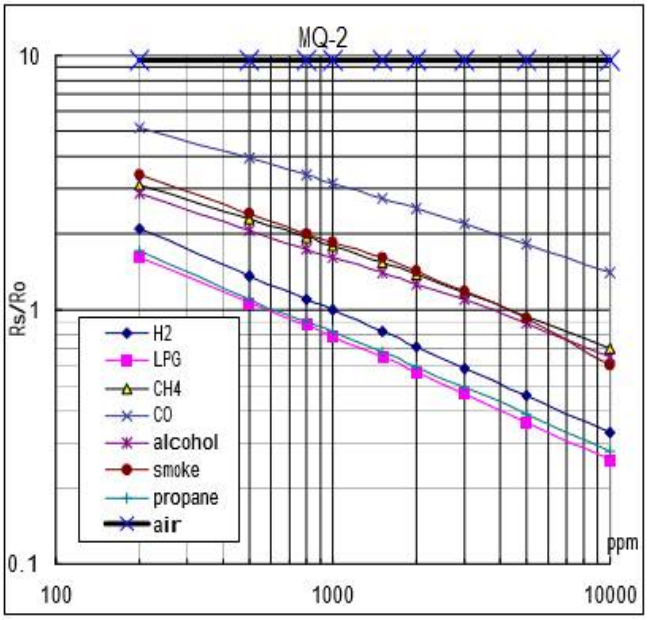
The microcontroller passes the command signal in order to drive the Robot and is also used in an application to detect harmful gases in the environment.

The MQ-2 sensor is used as gas leakage detecting equipment. They are suitable for detecting of LPG, i-butane, propane, methane, alcohol, Hydrogen and smoke. This equipment is hereby used by the Robot to detect any harmful gas in the Indoor environment. Sensitive material of MQ-2 gas sensor is SnO2, which has lower conductivity in clean air. The sensor's conductivity is higher when the concentration of the gas increases.



This figure shows the typical sensitivity characteristics of the MQ-2 for several gases at: Temp: 20℃, Humidity: 65%, O2 level: 21% RL=5kΩ
Ro: Sensor resistance at 1000ppm of H 2 in the clean air.
Rs: Sensor resistance at various concentrations of gases.

The Buzzer is used to indicate whether the gas concentration exceeds the threshold which is harmful in the indoor environment.

VI. OBSERVATION

Observation	No. of trials	No. of successful outcomes	Accuracy (%)
Go Straight(0)	30	29	96.67
Go straight(1)	30	29	96.67
Turn left	30	26	86.67
Turn right	30	27	90.00
Go Backward	30	28	93.33
Stop	30	28	93.33
		Overall accuracy	92.78

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VII. CONCLUSION

In this project we have used very simple algorithms that will be suitable for real time implementation of robotic applications. This algorithm is used to identify simple hand gestures which is thereby converted into control signal. The overall computation time of the algorithm shows it is feasible to implement in a low end embedded system based robotics in real time. Our future work is focused on implementation of this algorithm for various other applications as currently we have only implemented the microcontroller to drive the motors and detect the harmful gases in connection with sensors which in extension can be used in chemical industry due to its low computational complexity.

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