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Hand Gestures Smart Classroom System Using Machine Learning and Embedded System

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ABSTRACT: This proposed research helps us to interact with machine and design more intuitive reactions. One such technique is used which makes the communication between the human and machine effective. Due to this the use of input devices like touchscreen, mouse pad and keyboards are reduced to great extent. In the proposed system the hand gesture performs the defined task. We have used classroom as in application, but more certain other applications can also be involved.

KEYWORDS: Image detection, Image processing and motion detection operations, Performing operation on Motion gesture.

I. INTRODUCTION

Machine Learning is a subfield of Artificial Intelligence (AI). The goal of machine learning generally is to understand the structure of data and fit that data into models that can be understood and utilized by people. The communication between human and computer are used frequently. Of them hand gesture is used here. Hand gesture is used in many fields games, clinics, sign language recognition & many more.

Thus recognition is mathematical interpretation by computing device. Our aim is to detect hand gestures and then recognize them which gives command to computer and at least performing defined task.

II. METHODOLOGY

Design and development a hand gesture recognition system with reduced data set, high recognition accuracy and high speed processing through machine learning approach

1.1 Challenges

The first challenge was the dataset creation. Dataset creation mean to define which hand gestures will perform defined task. The data created should not be too complex. It should be easy and accurate. This will make our system generic.

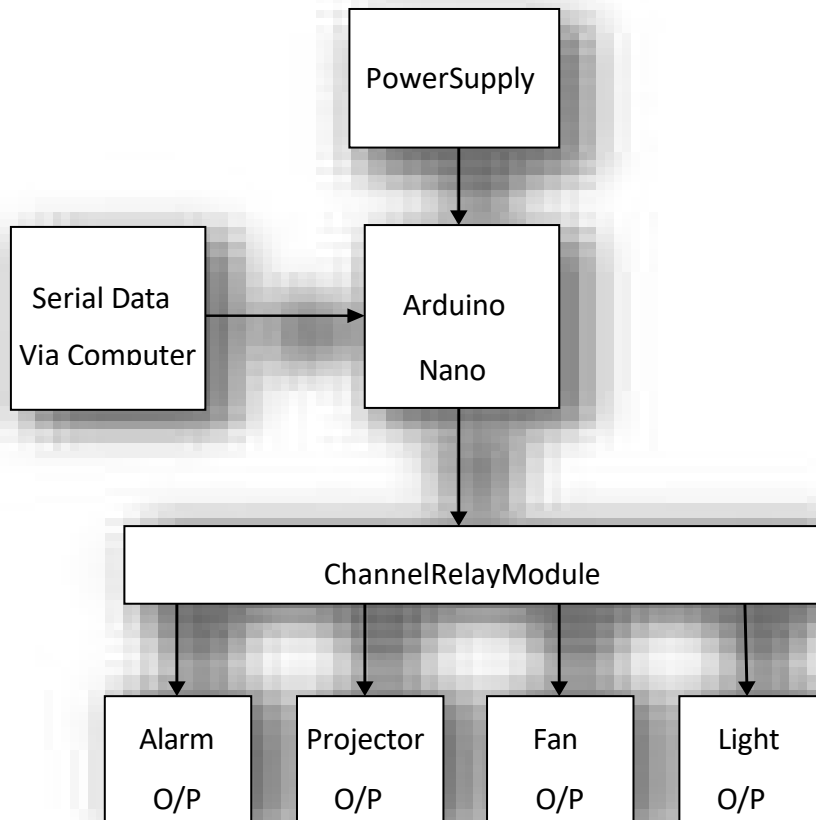
Next challenge was to use a simple technique for a complex process. If we want to detect any pattern the normal ancient method is image processing method. In this method before final output very lengthy process is performed like binary to grey conversion etc. so instead of performing such a lengthy process, we used technique CNN (Convolutional Neural Network) which reduced time of process and gave accurate output.

The third challenge was to deal with the connection from computer to Arduino. This was a bit difficult, but it was done by using UART protocol via USB.



III. OVERVIEW OF THE SYSTEM

1.1 Block Diagram of System



1.2 Fig 1. Block Diagram of Project

The above figure is a block diagram of our proposed system consist of power supply and serial data given via computer to the board. The board used is Arduino Nano board. A channel relay module is used to drive the four outputs. The work of project is carried out in two domains-

- a. Hardware
- b. Software

The main moto of the project is detecting large set of hand gesture and generating the result and after that applying that result to the application.

For recognizing or for processing we are giving large number of gesture but only application are given to four gestures. Here we are using a classroom automation as an application for our system.

The result will be generated in computer and sent serially through USB port [RS-232] this result is given in Arduino board. In Arduino board some programming will be performed and after that it is given to all applications. These applications are controlled by relay and controlled according to the given data.

1.3 Elements of System

Power Supply:

The Arduino Nano can be powered via Mini-B USB connection Pin 30 - 6-20V OR Pin 27- 5V

Arduino Nano:

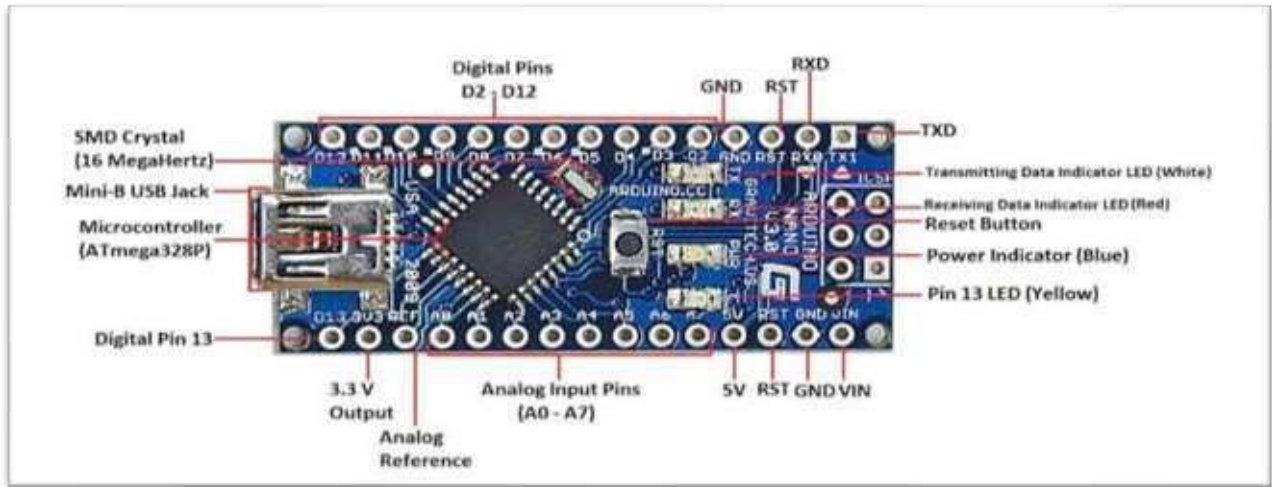


Fig. 3.2(b) Arduiono Nano

Arduino Nano is based on the AT mega 328P. It is small and friendly based. It has number of facilities which are used for communication with computers, other Arduinos and microcontrollers. Arduino Nano is preferred over Arduino Uno because it has 50 % more memory and bigger 200 % RAM. Some of the main technical specification are- Operating voltage - 5 Volts I/P Voltage – 6 to 20 V Digital I/O Pins – 14 Analog I/P Pins – 14 SRAM – 2 KB EEPROM – 1KB

Channel Relay:

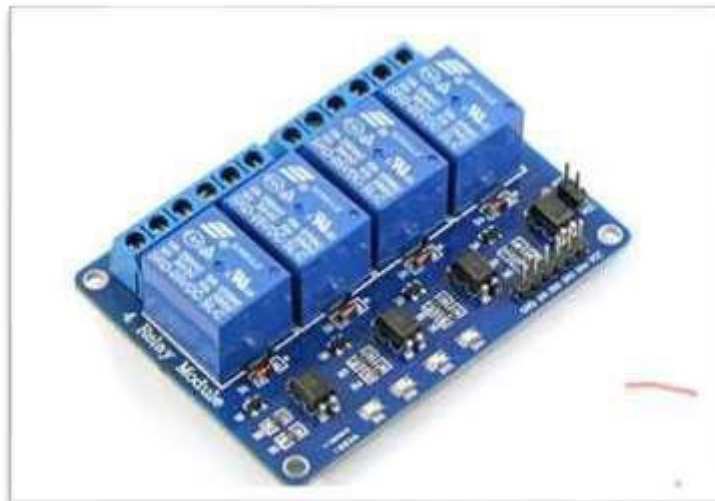


Fig. 3.2(b) Channel Relay

To switch high voltage and high current loads 4 channel relay is easy way to use with Arduinos. This 4 channel relay is used to drive the four applications in proposed system.

Four outputs:

The four outputs are driven using relay driver.

The one output is light, the next one is fan, third is a projector and fourth one is an alarm, or a buzzer are taken in account but for ease of operation LED's are connected in our hardware.

We can also implement many applications but for the ease of operations we have used four here.

1. System Methodology

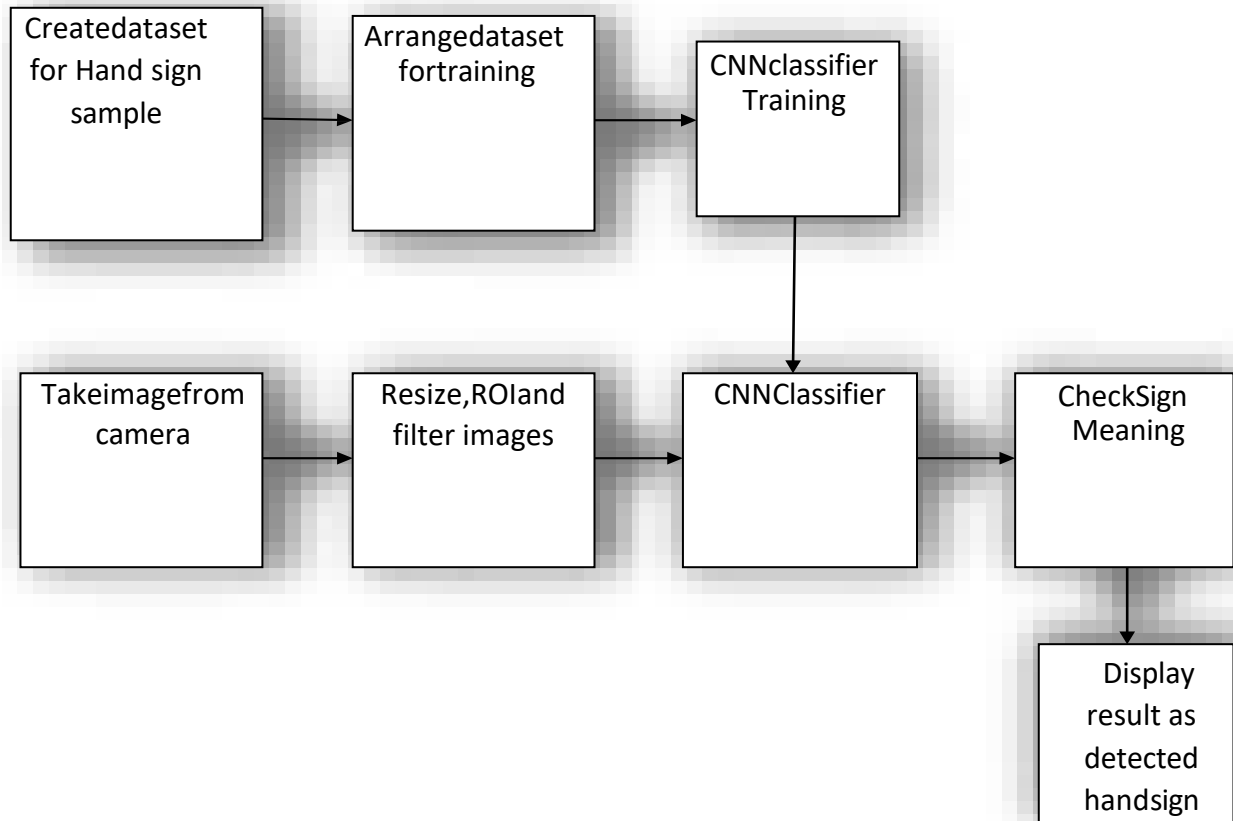


Fig 5.1(a) Methodology Block Diagram

This system is supposed to detect hand gesture and give command to computer then the system will perform the defined task.

The methodology block diagram is shown in the figure above. The following process is carried out- Hand sign sample dataset is created which is very simple.

1. This dataset is arranged in proper order and sent to CNN classifier block for training purpose.
2. Images are taken from the camera as shown in the figure.
3. Proper resizing and filtering of the images are done after images are taken from the camera.
4. These images are given to CNN classifier. After that it checks gesture meaning and displace result as a detected hand gesture.
5. The algorithm in which software works is described below.

III. EXPERIMENTAL RESULTS

Our prototype was tested for different hand gestures. Different operations are performed for different hand gestures. Gained results are shown below and explained also.



Hand gesture



A) Results

Here first hand gesture is detected and result we got that LED1 is ON.



Hand gesture

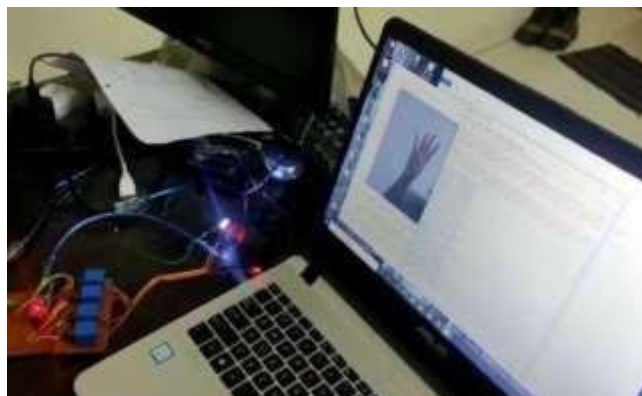


B) Results

Here second hand gesture is detected and result we got that LED 2 is ON.



Hand gesture

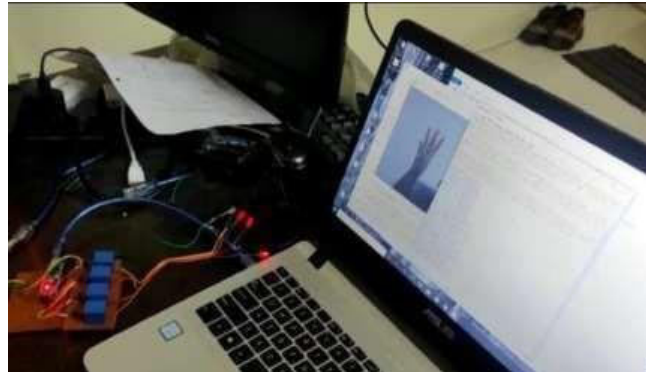


C) Results

Here third hand gesture is detected and result we got that LED3 is ON.



Hand gesture

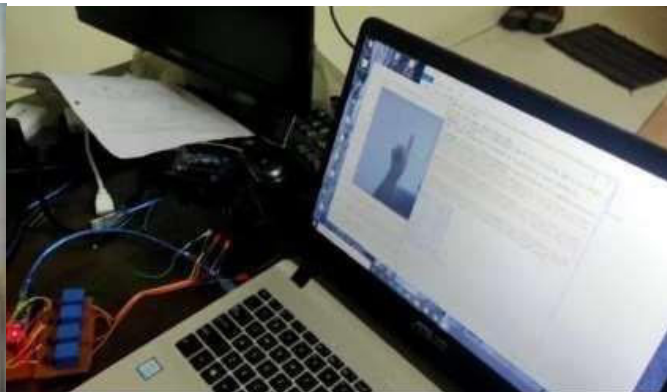


D) Results

Here fourth hand gesture is detected and result we got that LED 4 is ON. Likewise many more hand gestures are detected in above scenario. The again same gesture were performed for turning this LED OFF



Hand gesture



E) Results

Here same hand gesture was shown in 1 and we observed that LED got off.

IV. CONCLUSION

Finally, hand gesture recognition system using machine learning approach has been developed which is healthier than the previous ones. It is giving excellent accuracy and high speed processing and made possible to detect large number of hand gestures.

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