Hand Gesture Recognition using AI&ML

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Abstract- **In India, a significant population of approximately 855,200 individuals are paralyzed and face significant challenges in their daily routines. These individuals represent a vulnerable minority within the disabled community and often lack sufficient support services. For these people, their ability to navigate their living spaces and communicate with others is crucial for their overall well-being. Simple activities can become very difficult without assistance or communication from others.**

To address these challenges, a machine learning project has been developed that focuses on recognizing hand gestures. The project uses the convex hull algorithm to create a cost-effective gesture recognition framework that only requires the use of a bare hand. Once the gesture is recognized, it can be communicated through various channels such as audio, email, and personal message using the API integration framework. This low-cost software solution minimizes the need for additional hardware and facilitates effective communication between caretakers and those with disabilities.

Index Terms- **Artificial Intelligence, Recognition, Gesticulation, Image Processing**

I. INTRODUCTION

Advancements in science and technology have led to the practical implementation of knowledge graphs with powerful device configurations and programming languages. This has led to innovative skills and different approaches being taken into consideration for the benefit of society. Image processing has played a crucial role in enhancing the interaction between humans and machines in various sectors like industry, game design, virtual reality, and VFX. It has also contributed to various fields like medicine, object recognition, tracking, artificial intelligence, computer vision, and deep learning.

Deep learning has become prominent in recent times and is being implemented in various methodologies to achieve better results and accuracy. In a research paper, radar signatures were analyzed using smart sensing in the area of hand gesture recognition application, resulting in a 96% accuracy rate using deep learning methods. In another research paper, position recognition frameworks were implemented for robots to interact with humans more sensitively, and the rock-paper-scissors model game was used as an example.

There have been many developments in the field of artificial intelligence, especially in analytics, image processing, scientific research, and biotechnology. AI has been prioritized in building software development platforms and has been profitable. Image processing and financial statistics have also increased in their phase for future research and better technology. AI has played a crucial role in detecting objects for the blind, in the automation and textile industry, and in food processing areas.

In the past 20 years, image processing has been updated with many algorithms and in structuring data to the image park through imaging entropy standards. The filters used for image views like Gaussian, Laplacian, blur, edge, and other filters have contributed to better image techniques. Medical imaging has been crucial in detecting cancer cells and finding drug content.

Real-time basis has become a crucial factor in the industry, with many parameters considered for data validation, extraction, and reliability. Devices with OS are contributing to AI for any application. The Raspberry Pi has played a crucial role in real-time systems and gesture recognition, providing a wide variety of applications with real-time inputs and real-time message authentication. Different protocols and device drivers have been used to improve the proposed system for needy people in society with a low-cost assumption.

II SYSTEM ANALYSIS

A. Overview

Software Requirement Specification (SRS) is the starting point of the software developing activity. As system grew more complex it became evident that the goal of the entire system cannot be easily comprehended. Hence the need for the requirement phase arose. The software project is initiated by the client needs. The SRS is the means of translating the ideas of the minds of clients (the input) into a formal document (the output of the requirement phase.) System-Wide Requirements: The system will process exceptions in a consistent fashion. If the exception is a user error that can be corrected the system displays an error message with an explanation. The system allows the user to correct the mistake without starting over

B. Requirement Specifications

Software requirements

Operating System: Windows 10, Linux, Ubuntu
Programming Language: Python
Library: OpenCV, NumPy, pyttsx3, OS, smtp, Twilio.
IDE/Workbench: Anaconda

Hardware requirements

Processor: Intel Core i5
Hard Disk: 10 GB
RAM: 8 GB
Webcam: Inbuilt webcam

III. SYSTEM DESIGN

Existing Systems

The image processing area has been recently improvised in their field with many algorithms and in the attachment of the numerous problems faced by mankind. These algorithms work with the suitable hardware for the application area in micro controllers and in computer science research applications. Here we elaborate the situation for the society needs with respect to the people in their daily use case methods in typing to do some needful applications on them. by this motto we tried in the research applications only in the image for the people of the social concern. As many experiments have been conducted virtually for the impaired people who have vulnerable life routine in their daily practices. For the project, we have selected a paralyzed people who are facing difficulties in their life and need human assistance to assist them in any manner and at any time.

A. RFID Distance metric evaluator

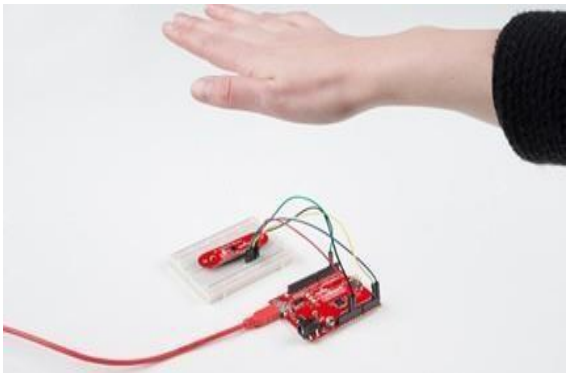

Figure 1: RFID Integrator

Radio-frequency identification (RFID) is a technology that uses electromagnetic fields to identify and track objects through tags attached to them. These tags contain important information and are detected by modules that generate radio waves of varying frequencies, including low, high, and ultra-high frequencies. While this technology has improved over time, the cost and compatibility issues of the hardware have limited its widespread adoption. In order to ensure compatibility, the tags with the smallest wave spread are selected to integrate with external modules, although the security of the output is not a top priority. The current resources used in this system are cost-effective but have resulted in failures in real-time systems due to power loss and fatal errors caused by small pin size configurations in some chips.

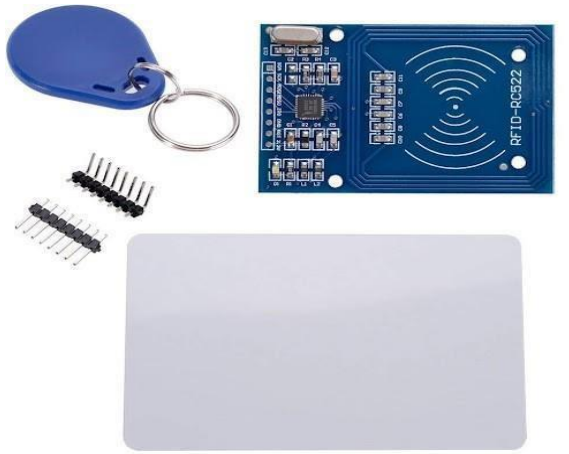

Figure (2): RFID Sensor

B. GPS Navigation gesture

Figure (3): GPS Navigation Sensors

The GPS navigation system helps people access remote areas safely but can be unreliable due to accuracy and integration issues. Reliable hardware is crucial for emergency situations, and response time needs to be in real-time. The robustness of the hardware is focused on integrating modules and their concurrent execution. The real-time functioning capabilities need to be user-friendly and accessible for all. Communication setup should be deployable on any application.

Drawbacks of Existing Systems

A. Sensitivity

The sensitivity of the existing systems differs from the hardware fetching data and may or may not be reliable to the integrated hardware or sensors as it is a time-lapse in the coding part or in communication. thereby due to low adaptation related to time response, there is low sensitivity in nature for this hardware.

B. High interfaces

As this integrated hardware with the chip design, it would be hectic for the product to interact with each module of the hardware and thereby resulting in the vulnerability and sophisticated deployment of hardware. these result in large power dissipation and sometimes leads to short circuit with wiring.

C. Reliability

The products shown to be in a motion of working irrespective of the movement and in inertia to the position of the object. things were not reliable as large integration leads to fluctuations in the product and won't be good for the production.

D. Robust

The existing products or hardware hardly depends on the software and chip design for the working mechanism. hence the working mechanism has the great motto of the project and these integrated sensors should be reliable to become robust in the hardware production and aim to work in any relative environment.

E. Response time

The response time can be replication or reflex actions taken by the integration and well-developed software and coding. these existing systems doesn't have the response time within the perspective of human friendly behaviours and adjusted error to maintain the same time response. hence the response time of the products need to priority and given the best communication and multi threading of the code to integrate with hardware and system development in good sustained response and get better response with small minute fraction of time.

IV. PROPOSED SYSTEM

The proposed system has new features for ease of use by people with numbness. It's an offline system with real-time data input and output. The algorithm is mathematically based and includes gesture and speech recognition. Key features include live camera mode, text output generated by gesturing, SMS and email capabilities, and no pre-trained models used.

A. Block Diagram

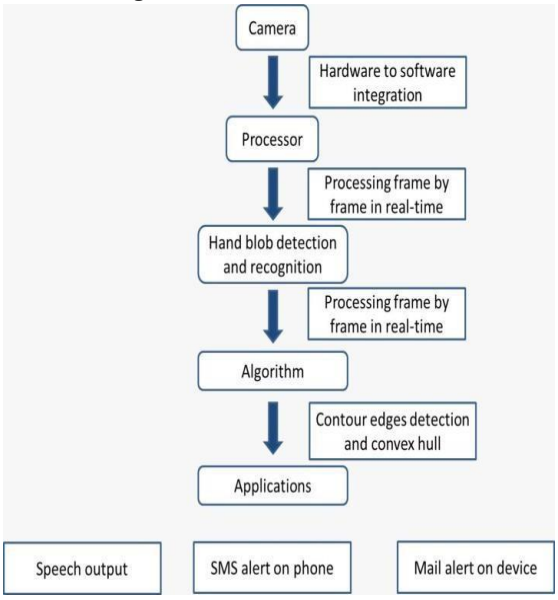

Figure 4: Block Diagram of the Proposed System

The proposed model combines hardware and software to provide computer vision services to society. The

camera captures real-time input frames, which are processed by a Raspberry Pi. The computer vision embedded in the hardware sustains the frames and provides emergency outputs in various formats such as SMS, email, voice, and display. The system is designed to be real-time and innovative. Unlike other hardware, we were given live feeds to collect samples and reflect the image with vision output as an emergency. The output can be SMS, Email, Voice, or Display. The System Design helps to create a clear overview of the proposed hardware.

B. System Design

The system architecture was prepared in an evolution stage levels for the projectsÂ the artificial intelligence software. dropped on the hardware environment and made a reliable and robust algorithmÂ to maintain the system stability and the hardware resources. the deploymentÂ of the software part in hardware and use of the camera drivers in it to claim the video capture of the systems to be well streamed to the real-time.

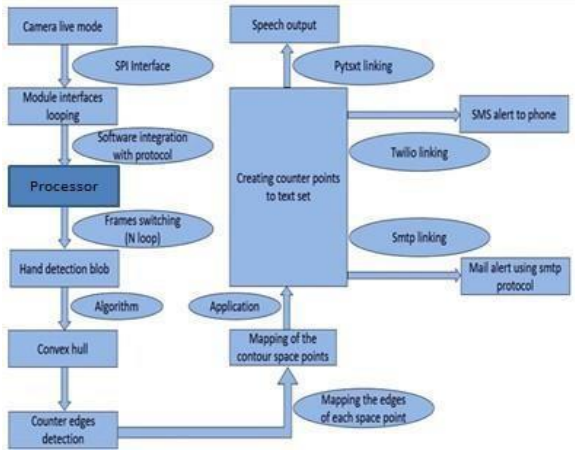

Fig 5: System Architecture of the Proposed system

C. Methodology

The proposed model uses python bindings and hardware integration with the best camera driver installation. Mathematical Euclidean distance and contour setup on real-time frames are key methods used. The image is analyzed with 26 video frames, and data extraction and gesture visualization are done accurately at the back end of the gestures. The model does not require a dataset and instead uses mathematical observations. The Gaussian blur filter is imposed on the image pixels for structured integration in real-time, and the threshold is implemented on the cropped image area. The convex hull algorithm combines contours and edge points to form a line correlation to the end of the strip edges.

D. Convex-Hull

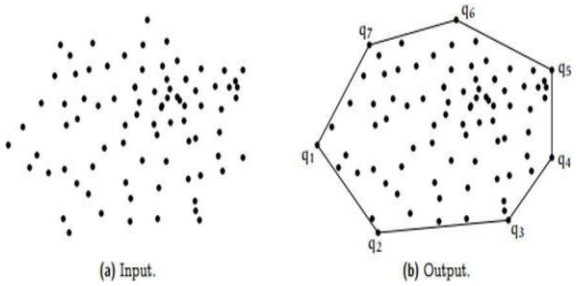

Figure 6: Convex Hull

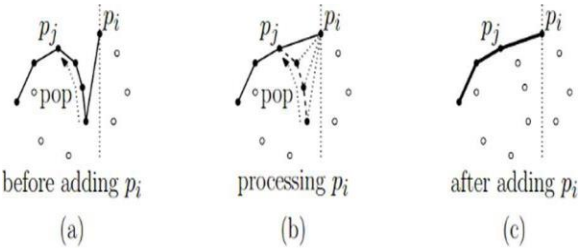

Figure 7: Sorting points of regional hulls

To find the convex hull of a set of points, the leftmost and rightmost points are first identified, and the points are partitioned into equal-sized groups. Graham's scan is then used to segment the point set and find the upper and lower hulls. Line segment vertices are determined for each mean point on the set. The orientation of gesture recognition is captured on video frames and the system uses mathematical formulas based on euclidean distance for accuracy and quick response in real-time. The proposed model is efficient and compatible with various operating systems and hardware, with library binding playing a crucial role in implementation and integration with camera drivers.

E. IMPLEMENTATION.

To install Anaconda 3, download the installer and double-click it to launch. Follow the prompts to select the installation options, including the destination folder and whether to add Anaconda to your PATH environment variable. After installation, launch Spyder to create a new file or use the default "temp.py" file. Save the file with an informative name in the Documents folder. To run the file, open Anaconda Prompt, navigate to the file's directory, and enter the "python" command followed by the file's name. The Anaconda prompt will display the host IP address,

which you can copy into a browser to view the project webpage.

V. RESULTS

Computer vision technology emerges with the huge demand on the industry and in research for the society in which we can learn many innovative ideas and many needful things for the society.

A. Testing for installed software working modules

The best part of the project is to install independent software into the best platform OS (operating systems). lets test the basic openCv working with python code on the Windows OS. the Linux depends choose the best version as direct and indirect update of the software and applications been recovered in an easy manner.

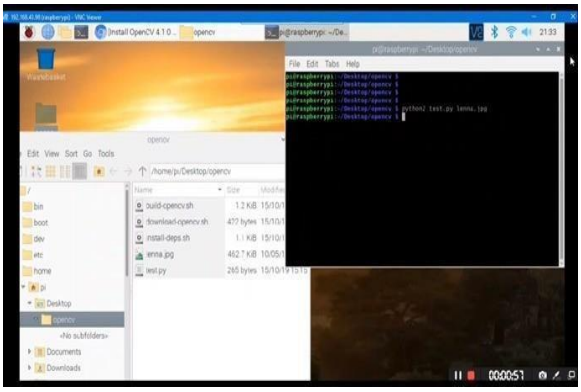

Figure 7.1: OpenCV path and findings

B. Image Processing

Artificial intelligence improvised its area in image processing with the mathematical illustration on image processing area for the benefit of mankind. Here the propaganda

for the process of the proposed system been implemented with the computer vision tool on a hardware platform with the coding part onto image camera drivers to set up the best approach on the existing system. The model which we are obtained using the mathematical approach for convenience without using any of the databases available. There was no database involved in the system design for the proposed system, only the mathematical approach with the image-driven model on the hardware platform been implemented in real-time.

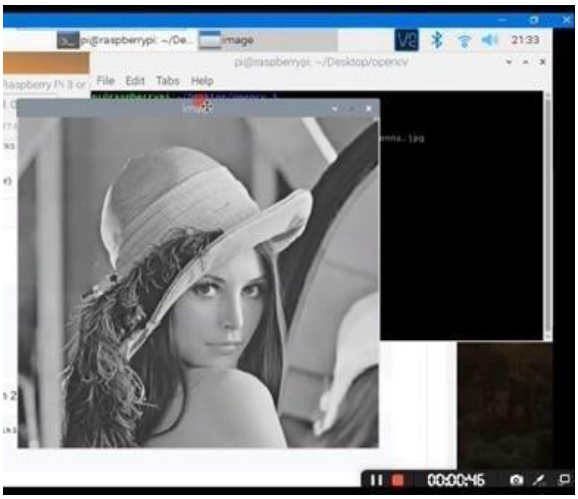

Figure 7.2: Image test using OpenCV

The proposed model employs technology to use algorithms and drivers in hardware, including communication protocols for camera and SPI interfaces, to establish a stable connection with Raspberry Pi. Python bindings are used with the in-built Raspberry Pi on Linux Raspbian OS for handling the camera setup and real-time scenario. Real-time image processing techniques and filters are used for gesture recognition without the need for a database. The frame reading capacity is increased to 30 frames per second, and Gaussian blur is applied to the camera using a relevant convex hull algorithm for contour setup. Circles and lines are considered in constructive stages to embed fingers onto the image.

C. Output Gesture Recognition

The output of the proposed model is generated with 5 output stages as the gesture with fingers states the 5 fingers with 5 outputs are shown below.

Figure 7.3: Gesture recognition for finger 1

The gesture recognition of the system with finger one describes the emergency stating 'MEDICINE PLEASE' on the display of the camera on the live mode in offline mode hardware platform.

Similarly, the other gesture recognition will be taken into consideration of the fingers which are to be detected and visualised same as the computer vision how it detects in hardware platform. the camera is attached to the system hardware using USB communication transfer with good results. The gesture recognition of the system with finger one describes the emergency stating 'I WANT WATER' on the display of the camera on live mode in offline mode hardware platform.

Figure 7.4: Gesture recognition for finger 2

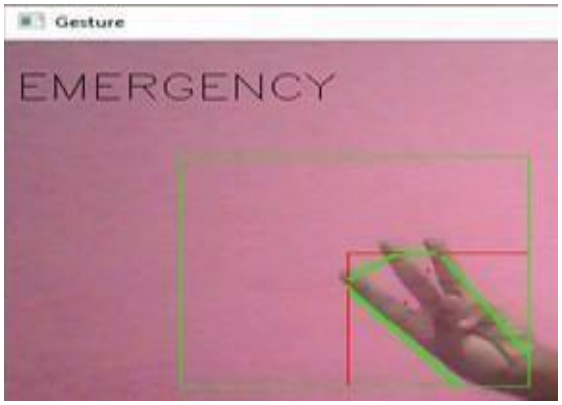

Figure 7.5: Gesture recognition for finger 3

The gesture recognition of the system with finger one describes the emergency stating 'EMERGENCY' on the display of the camera on live mode in offline mode hardware platform. The contours which act in the background were focused on the convex hull and euclidean distance between the edge points and provide lines of travel from on edge to other point edge, hence these back propagation needs to execute on all time on basis of the real-time input and output system.

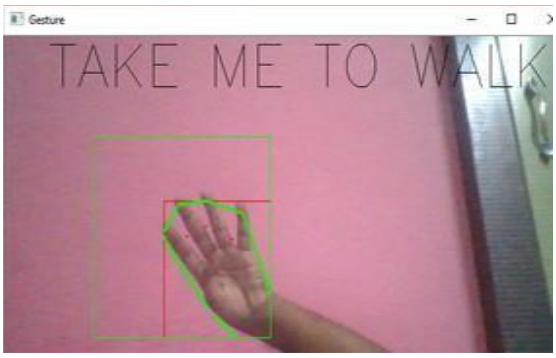

Figure 7.6: Gesture recognition for finger 4

The gesture recognition of the system with finger one describes the emergency stating 'TAKE ME TO WALK' on the display of the camera on live mode in offline mode hardware platform. The gesture recognition of the system with finger one describes the emergency stating 'IM HUNGRY' on the display of the camera on live mode in offline mode hardware platform.

Figure 7.7: Gesture recognition for finger 5

VII. CONCLUSION

The existing systems denied for real-time with time lapse in milliseconds and accuracy and reliability for the entire hardware. Thus the hardware has the relevant best accuracy and real-time response and with reliable to any environment. This proposed model helps in gathering the info in the form of contours and has a stable helping platform in the gesture format on image processing in a real-time approach.

VIII FUTURE ENCHANCEMENT

The project's future work aims to enhance gesture detection accuracy by implementing a hand recognition framework before detection. This involves accurately detecting and tracking the hand in real-time using deep learning algorithms or computer vision

techniques. Improving hand recognition can lead to more effective and efficient human-computer interaction.

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