

Virtual Calculator

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Abstract: *This project presents a Virtual Calculator employing Hand Simulation, a cutting-edge system that leverages computer vision and hand gesture recognition to execute arithmetic operations without physical contact. The system uses real-time image processing and machine learning models to recognize and understand hand gestures, so there is no need for a physical keyboard or touchscreen.*

The main technologies used in this project are OpenCV for processing images, MediaPipe for tracking hands, and deep learning for classifying gestures. A webcam records the user's hand movements, and the system processes the images to find hand landmarks. It then maps certain gestures to math functions like addition, subtraction, multiplication, and division. A custom gesture dataset is also used to make the system more accurate and stable in different lighting and hand conditions.

The main goal of this project is to make a calculation tool that is easy to use and understand, which will improve user interaction while lowering the need for physical contact. This is especially helpful in places where cleanliness is important, like hospitals, labs, and public places. Additionally, it offers an assistive technology solution for people with physical disabilities, allowing them to do math without the limitations of standard input methods.

Keywords: *Virtual Calculator*

I. INTRODUCTION

The Virtual Calculator with Hand Simulation is a new system that uses computer vision and hand gesture recognition to let you do math without touching anything. The goal of this project is to recognize hand movements and gestures and turn them into math inputs so that calculations can be done in real time. It is a contactless and easy-to-use alternative to regular calculators, which makes it useful in places where cleanliness and ease of use are important.

1.1 Objectives

The main goals of this project are:

1. Making a virtual calculator that works without buttons or screens and uses gestures.
2. Using computer vision and machine learning to correctly identify and understand hand gestures.
3. Making sure that the system works in real time with high accuracy for a smooth user experience.
4. Making it easier for people with physical disabilities to use by giving them an option to traditional input methods.
5. Looking into how people and computers interact (HCI) through a user-friendly and natural system workflow

1.2 The virtual calculator uses a structured workflow to process hand gestures and give output:

1. Hand Detection: The system uses MediaPipe Hand Tracking to find the user's hand in real time video from a webcam.
2. QR code detection: The calculator can be accessed when a QR code is found.
3. Landmark Extraction: Important parts of the hand, like the fingertips and joints, are taken out so they can be studied.
4. Gesture Recognition: Certain hand signs and poses are linked to certain math operations.
5. Performing the Calculation: After the system recognizes the math expression, it does the math and shows the answer on the screen.



6. Output Display: The result of the calculation is shown on a virtual interface, which gives the ui feedback in real time

II. LITERATURE REVIEW ¹

Sr No.	Paper Name	Year	Author	Objective	Methodology	Conclusion
1.	Virtual Calculator using Hand Gesture Recognition	Vol 5, Issue 10 October 2016	Preeti Niranjani Brijesh Pandey Masooma Nigar	To implement a virtual calculator that allows users to input mathematical operations and receive results using hand gesture	Hand Gesture Recognition Gesture-to-Action Mapping User Interface Design Processing Input: Required output	The virtual calculator using hand gestures successfully demonstrates an innovative approach to human-computer interaction, where users can perform calculations without physical input devices
2.	Hand Gesture based virtual calculator	10 May 2024	1)Dr B.Esther Sunanda Vaddi Bhargavi Varikuti Yasasri	Instead of using a physical mouse or a calculator, user can easily use different gestures and combinations of fingers to do Mathematical operation	The Graphical User Interface processes the gestures and translates into actions. The user can control various calculator functionalities like addition, subtraction, multiplication, division, equals, clear/reset and percentage calculations	This project introduces the development of hand gestures based virtual mouse and calculator which showcase the potential interaction with digital devices
3.	An Introduction To QR Code Technology	December 2016	Sumit Tiwari	The QR code system consists of a QR code encoder and decoder. The encoder is responsible for encoding data and generation of the QR Code, while the decoder decodes the data from the QR code.	Step 1: Define Objectives & Scope Step 2: Select Code Scanning Tools Step 3: Code Collection & Preprocessing Step 4: Dynamic Analysis & Simulation Step 5: Optimization & Code Refinement Step 6: Continuous Integration &	Following this structured methodology ensures effective QR code scanning, leading to high-performance, power-efficient, and reliable software/hardware designs. Regular monitoring and optimization cycles will help maintain optimal results over time.
4.	Hand Gesture Recognition:A Literature Review	Vol.3, No.4, July 2012	Rafiqul Zaman Khan Noor Adnan Ibraheem	The essential aim of building hand gesture recognition	Requirement Analysis System Design Data Collection and Pre-Processing	The Hand Gesture Recognition project methodology ensures a systematic approach to



			system is to create a natural interaction between human and computer where the recognized gestures can be used for controlling a robot etc.	Gesture Recognition Model Development Integration with Hand Tracking User Interface (UI) and Interaction Design Testing and Evaluation Deployment and Maintenance	developing a robust, real-time gesture recognition system. It involves defining clear objectives, selecting appropriate technologies, designing a strong model, and testing the system thoroughly to provide an effective solution
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III. METHODOLOGY

1. Requirement Analysis

The first step was to understand what the virtual calculator should do. The goal was to create a simple and user-friendly calculator that can perform basic arithmetic operations such as addition, subtraction, multiplication, and division. The calculator should also have a clear display and buttons that allow users to easily enter numbers and operations.

During this phase, the functional requirements were identified. These include accepting user input, displaying results instantly, and handling basic mathematical calculations correctly.

2. System Design

After defining the requirements, the structure of the calculator was planned. The interface design focused on making the calculator easy to use and visually clear. Buttons for numbers (0-9), operators (+, -, ×, ÷), a clear button, and an equals button were arranged in a familiar calculator layout.

The system design also included deciding how the calculator will process inputs, store numbers temporarily, and perform calculations when the user presses the equals button.

3. Development / Implementation

In this stage, the virtual calculator was built using programming technologies such as **HTML, CSS, and JavaScript** (or any programming language depending on the project).

HTML was used to create the structure of the calculator.

CSS was used to design the layout and make the interface attractive.

JavaScript handled the logic of calculations and button interactions.

Each button was programmed to send input to the display, and the calculator logic was implemented to perform the selected operations.

4. Testing

Once the calculator was developed, several tests were performed to ensure it works correctly. Different calculations were entered to check whether the results were accurate. Special cases such as dividing by zero or clearing the display were also tested. Testing helped identify and fix small errors so that the calculator runs smoothly for users.

5. Deployment and Usage

After successful testing, the virtual calculator was made ready for use. Users can interact with it through a simple interface, input numbers, perform calculations, and receive results instantly. The calculator can be accessed through a web browser or application interface depending on how it is implemented.

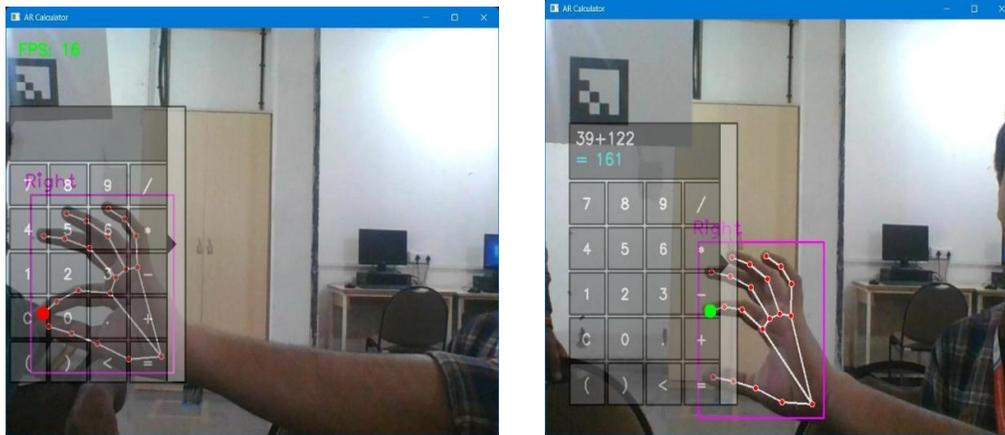
6. Maintenance and Improvements

Even after deployment, improvements can be made to enhance the calculator. Future updates may include advanced functions such as square root, percentage, memory storage, or scientific calculations.



IV. IMPLEMENTATION

Code development involves using OpenCV for capturing webcam feed and detecting ArUco markers. The calculator UI is rendered over the detected marker using 2D or 3D overlays. Input handling, either via gesture recognition or mouse emulation, is integrated to allow interaction with virtual calculator buttons, triggering appropriate computation.



V. RESULT & DISCUSSION

The experimental results show that the system is capable of detecting plant diseases from leaf images with good accuracy and providing useful treatment suggestions. The crop price prediction module successfully analyzes historical data and generates predictions that help farmers understand possible future market trends. In addition, the seasonal crop recommendation module suggests crops suitable for specific seasonal conditions. Overall, the system demonstrates that integrating artificial intelligence with agriculture can support farmers in making better decisions and improving productivity.

VI. CONCLUSIONS

The Virtual Calculator using Hand Gestures project is a new way for people to interact with computers. It uses gesture recognition technology to make it easier and more hands-free to do math. Users can interact with the calculator without having to touch it by using hand gestures. This is especially useful in situations where touching the device is not possible or not desirable, such as when cleanliness or accessibility is a concern

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