

Project Phase III Report

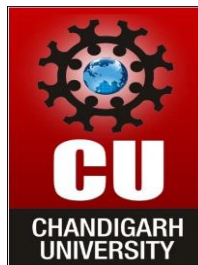
On

**Human Hand Tracking System(“H2TS=Hatuus”) Development Using
Python**

Submitted for the requirement of Project course

BACHELOR OF ENGINEERING

COMPUTER SCIENCE & ENGINEERING

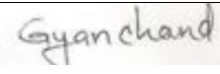
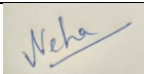


Submitted to: Mr.Gyan Chand Yadav
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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

CHANDIGARH UNIVERSITY, GHARUAN

June 2022

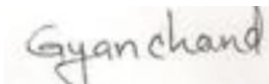
Certificate

This is to certify that Ananya Sharma(20BCS3049), Magan Jyot Kaur(20BCS3041) and Lokesh Choudhury(20BCS3033) B.E(COMPUTER SCIENCE & ENGINEERING) 2nd Year student of CHANDIGARH UNIVERSITY has done project work on

“Human Hand Tracking System- H2TS (Hatuus)”

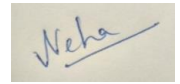
under the guidance of “Mr. Gyan Chand Yadav (Supervisor)

and Ms. Neha Sharma (Co-supervisor).



Mr. Gyan Chand Yadav

(Supervisor of project)



Ms. Neha Sharma

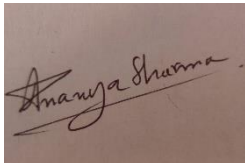
(Co-Supervisor of project)

CHANDIGARH UNIVERSITY, GHARUAN, MOHALI

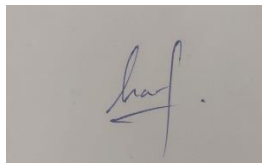
CANDIDATE’S DECLARATION

We hereby declare that the project entitled “**Human Hand Tracking System–H2TS (“Hatuus”)** submitted during a period from **February 2022** to **April 2022** by Ananya Sharma(20BCS3049), Magan Jyot Kaur(20BCS3041) and Lokesh Choudhury(20BCS3033) to the department of B.E(COMPUTER SCIENCE & ENGINEERING) at CHANDIGARH UNIVERSITY, GHARUAN, MOHALI is the record of project work carried out by us under the guidance of Mr. Gyan Chand Yadav(supervisor) and Ms. Neha Sharma (Co-supervisor).

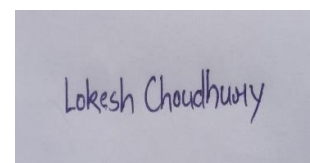
Signature of Candidates



Ananya Sharma



Magan Jyot Kaur



Lokesh Choudhry

Acknowledgement

We would like to express our special thanks of gratitude to all the people who have played a crucial role in the research for this project, without their active co-operation the preparation of this project could not have been completed within the specified time limit.

I am very thankful to our respected Co-Supervisor, **Ms. Neha Sharma** for motivating us to complete this project with complete focus and attention.

And special thanks to our project guide lecturer, **Mr. Gyan Chand Yadav** who supported us as a Supervisor throughout this project with utmost co-operation and patience and for helping us in doing this project completed successfully.

Finally, we would like to thanks “**CHANDIGARH UNIVERSITY**” for providing us an opportunity to showcase our talent through this project.

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Abstract

Hand tracking system allows user to interact without any physical input to the device by detecting the position and orientation of hands and the configuration of fingers. In this way user's hand act like an external device which inputs the data to execute a specific algorithm. In this work, we present a real-time method for performing different features using hand tracking incorporated into one program. H2TS system is based on a futuristic technological approach which will make human and software interaction much more virtual and convenient without using hardware. The advanced feature which can be incorporated are voice command, touchless operations { which can be done through web cam using hand landmarks' detection (total hand landmarks detection=21)} which will help- in cost saving (Keyboard), less maintenance cost of hardware, enough distance from hardware equipment ultimately better eye care and many more technological advantages.

Feature/characteristics identification

The distinctive characteristics of a project are as follows (**according to the problem statement specify details in these points**):

- **Objectives:** First objective of this project is to allow the communication between human and computer by the use of gestures and hand movements to be more intuitive.
Second objective of this project is to create a complete system to detect, recognize and interpret the hand gestures through computer vision.
Third objective of this project is to do more and more work on the computer with the help of hand gestures such as to control volume of the system, mouse control, game control and many more.
- **Single entity:** This project is created by the efforts and cooperation of three students I.e., Ananya Sharma, Magan Jyot Kaur and Lokesh Choudhury. Each member of team coded a different function or feature which is in the end incorporated in the main code to give finished product.
- **Life span:**

Stage or Module	Time Taken
1) Planning	6 Days
2) Defining Requirement	4 Days
3) Building or developing the product	Total Days = 24
i. Hand Tracking Module Creation	4 Days
ii. Virtual Volume Controller (VVC)	3 Days
iii. Virtual Mouse Controller (VMC)	3 Days

iv. Virtual Car Racing Game Controller (VGC)	4 Days
v. Virtual Calculator (VC)	2 Days
vi. Virtual Painter (VP)	2 Days
vii. Software And Human Virtual Interaction (SAHVI)	6 Days
4) Testing	5 Days
5) Deployment	1 Day

- **Require funds:** Project funding is the means by which the money required to undertake a project, program or portfolio is secured and then made available as required. Funding for standalone projects may be via a single source or through multiple investors. As this is a college project and no external hardware is used in this project, therefore no reserve is required.
- **Life cycle:** A detailed plan was created before the starting of project for seamless process while being considerate of customer’s expectations to create an errorless product within the completion time.
 - Stage 1: Planning and Requirement Analysis

In this stage user expectations and needs are determined for a new or modified product. As this is a college project, assumptions and suggestions were made and discussed by us.
 - Stage 2: Defining Requirements

In this stage documentation process is maneuvered which is further presented in front of stakeholders for approval. As this is a college project, all the product requirements to be designed and developed during the project life cycle were noted down and analyzed within the team.
 - Stage 3: Building or Developing the product

In this stage the actual development starts and the product is built. The programming code is generated as per the decisions that were made before in an organized and detailed manner.

➤ Stage 4: Testing the product

In this stage the product is tested by running diverse tests for identification of any bugs and errors in the software before implementation phase begins. The project is going through distinct tests to find its shortcomings and then necessary actions are taken by the team.

➤ Stage 5: Deployment in the Market and Maintenance

After the product is tested thoroughly, the finished product is deployed in appropriate market. As this is a college project, after completion of testing stage, finalized project will be submitted to the appropriate authority for further examination.

- **Team spirit:** Team spirit is when a group of people really feel invested in reaching a goal together and are there to support each other. Teamwork in project management leads to increased efficiency and productivity. The support provided by our supervisor, co-supervisor and teammates motivated us to fully commit ourselves.
- **Risk and uncertainty:** The risk involved in this project is that while working on various programs and features repeatedly sometimes it might get hanged and the program needs to be restarted in order for proper working of the project. It was also found during the testing that if the system was once fully trained for all the gesture types then it gives us accurate results otherwise if it was just trained for a single or two gestures and then tested then it performs erroneous processing or mistaken assumptions. It is also found that sometimes if the user wants to switch from one program to another then the current program in which the user has switched does not work properly and thus leading to program failure.
- **Direction:** Project is always performed according to the direction given by customer with regard to time, quality and quantity. As this is a college project, time is decided by management or the subject teacher whereas decisions on other factors are concluded by us.

Project direction is dynamic and continuing function. Based on the progress changes in plan can be initiated by team. Directing deals with the relationship between people working on a project in an organization. It creates co-operation and harmony among the members of groups.

- **Uniqueness:** Every project has its own charm and it differs a little from already existing ones. Human computer interaction is a flourishing field which has already been exposed a lot. In this project we have incorporated different features into one project and used a virtual assistant named SAHI (Software and Human Interaction) to make the product more user friendly and accessible. SAHI will help user for feature's usages to do each task one by one through voice command.
- **Flexibility:** Project management flexibility focuses on allowing flexibility in the processes and taking a pragmatic view to reveal tasks that could be scaled back which frees time for other resources on unexpectedly large challenges. It is not constrained by number of tasks; any number of tasks can be added in future.
- **Sub-contraction:** Sub-contracting refers to the process of entering a contractual agreement with an outside person or a company to perform a certain amount of work. In undertaking a contract from a contract, subcontractors carry out work that the contractor can't perform, but remains responsible for. As this is a college project, all work is done by the team and no outsourcer is involved in project building process.
- **Cost:** A review of budget estimates for the cost of work and time scheduled is compared to the actual time and costs. The original estimates of contingency time are reviewed to determine if the time duration, costs and float are accurate. Most of the additional work is added to the end of the project so as this the cost estimation may differ. The end of this

process will determine the size and features dependencies of the project. As this is college project the development costs required for the project is null.

Constraints Identification

There are six major constraints in project management to consider.

- 1. Time:** The project completion is well defined and it will be completed before the due date. All the necessary features and requirements will be completed in order for proper working of the project. The project is currently in the testing stage and we are making some necessary changes for making the project more user friendly to the user. The project is tested by project members which will then be discussed and will rely on to work on some solutions in order to deliver the project before the due date. The project documentation is also getting reviewed up to date. Once the project outcomes are documented and the necessary services and objectives are set out to accomplish then we are finally getting closer to the successful project completion.
- 2. Cost:** The original schedule of activities and events that caused changes to the schedule are reviewed to see how the use of contingency reserves and disruption is caused by those events. A review of budget estimates for the cost of work and time scheduled is compared to the actual time and costs. The original estimates of contingency time are reviewed to determine if the time duration, costs and float are accurate. Most of the additional work is added to the end of the project so as this the cost estimation may differ. The end of this process will determine the size and features dependencies of the project. As this is college project the development costs required for the project is null.
- 3. Scope:** H2TS system is based on a futuristic technological approach which will make human and software interaction much more virtual and convenient without using hardware.

The advanced feature which can be incorporated are voice command, touchless operations {which can be done through web cam using hand landmarks’ detection (total hand landmarks detection=21)} which will help- in cost saving(Keyboard), less maintenance cost of hardware, enough distance from hardware equipment ultimately better eye care and many more technological advantages.

4. Quality: This system is come up with many qualities of advanced technology for users’ interface. It recognizes serval gestures with the very less interval of time, means it’s decision making power for different gestures is smooth and strong enough so that user will interact by gesturing in the view of the camera. It’s camera resolution is 640x480 and video frame rate is 30fs with pixel depth minimum 1.3 mega pixels. It is an ideal system so it does not need any kind of gloves, sensors, USB cables, markers but a human hand only with any kind of skin color. Gesture recognition can also provide better ergonomics for consumer devices.

5. Benefits: As we know the time when the touchscreen technology was introduced, many people were excited to stop interacting with physical buttons to navigate their phone, TVs and to instruct cars system, monitors and other devices by switching to smart screen’s technology. This saved our time and was very suitable and entertaining to use. But with time customer preferences have changed, especially in times of the pandemic. People think it's unhygienic to use a touchscreen mainly in public places or devices like touch screen monitor, car navigation system, etc.

So, we come with the solution of Human Hand Tracking System with many benefits in it. Firstly, you can access it through the voice commands that control many features and perform different tasks on real time. Secondly, you can do all these tasks by just using different hand gestures, it means there is no need of mouse, keyword and this is the big benefit for the user. There are also some other comforts with this system of hand tracking

such as, this system is quit hygienic as there are several contact-less operations with the software and it is easy to install in our system with immensely affordable prices.

- 6. Risk:** The risk involved in this project is that while working on various programs and features repeatedly sometimes it might get hanged and the program needs to be restarted in order for proper working of the project. It was also found during the testing that if the system was once fully trained for all the gesture types then it gives us accurate results otherwise if it was just trained for a single or two gestures and then tested then it performs erroneous processing or mistaken assumptions. It is also found that sometimes if the user wants to switch from one program to another then the current program in which the user has switched does not work properly and thus leading to program failure.

Analysis of features and finalization subject to constraints

Hand tracking system allows user to interact without any physical input to the device by detecting the position and orientation of hands and the configuration of fingers. In this way user's hand act like an external device which inputs the data to execute a specific algorithm. In this work, we present a real-time method for performing different features using hand tracking incorporated into one program. H2TS system is based on a futuristic technological approach which will make human and software interaction much more virtual and convenient without using hardware. The advanced feature which can be incorporated are voice command, touchless operations { which can be done through web cam using hand landmarks' detection (total hand landmarks detection=21)} which will help- in cost saving (Keyboard), less maintenance cost of hardware, enough distance from hardware equipment ultimately better eye care and many more technological advantages

So, here **SAHVI (Software and Human Virtual Interaction)** a virtual assistant will help user for features' usages to do each task one by one through voice command.

Currently it will assist five different tasks like –

- Virtual Volume Controller
- Virtual Mouse Controller
- Virtual Game Controller
- Virtual Calculator
- Virtual Painter

It is not constrained by the number of tasks we can add more tasks to it. As hand tracking system is a good option to eliminate interaction with hardware and with the use of virtual assistant the interaction with the software will be very smooth.

1)Virtual volume Controller [VVC]: Under this feature we develop an interface which will capture human hand gesture dynamically and will control the volume level. The camera in our device is used for this. It detects our hand with points in it (21 landmarks) so as it can see the distance between our thumb fingertip and index fingertip. The distance between the tips of these two fingers is directly proportional to the volume of device, in other words, via increasing and decreasing distance between thumb fingertip and index fingertip we can increase and decrease device's volume respectively.

2)Virtual mouse Controller [VMC]: Under this feature we develop a mouse simulation system which performs all the functions performed by mouse corresponding to hand movements and gestures. It retrieves necessary data and implements it to the mouse interface of the computer according to predefined notions. The finger tip of finger which is suspected to work as replacement of cursor is detected. Desired item can be selected by clicking index fingertip and middle fingertip.

3)Virtual game controller(car) [VGC]: Video gaming is a form of entertainment which is advancing at a rapid rate leading industry to pick up its pace. For higher involvement in the game, we use human computer interaction as to increase the audience immersion. Landmarks of index fingertip, index finger joint point and wrist are detected. The angle between these landmarks is calculated and based on the angle the game can be played by the user.

4)Virtual Calculator [VC]: Under this feature we develop an interface for virtual calculator that uses finger movements to operate. The camera detects the landmarks of index fingertip and middle fingertip. Calculator is visible on the right side of screen where the user can move around their fingers and click their index fingertip and middle fingertip to select an operand or operator to perform the desired operation.

5)Virtual Painter [VP]: Virtual Painter is an application that enables one to virtually paint in the air using their fingers. It can be used to draw on your system screen based on your index finger movement. As soon as the presence of hand is detected, application draws a bounding box around the hand. If user shows only index finger than the user is in drawing mode. To select different color or eraser the user must select it by clicking his index and middle finger together at the top of

icon. If the user wants to erase the drawn painting, then user needs to select the eraser and just slide the eraser on top of the drawn image.

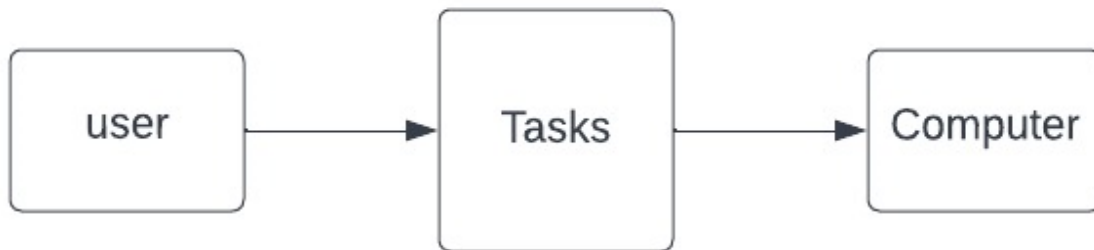
Constraints Identification for this project:

- Can't be used for long distance
- Brightly lit place is must
- Requires decent webcam
- Detection of more than one or two palm can result into ambiguous outcomes
- System maybe hang with maximum usage

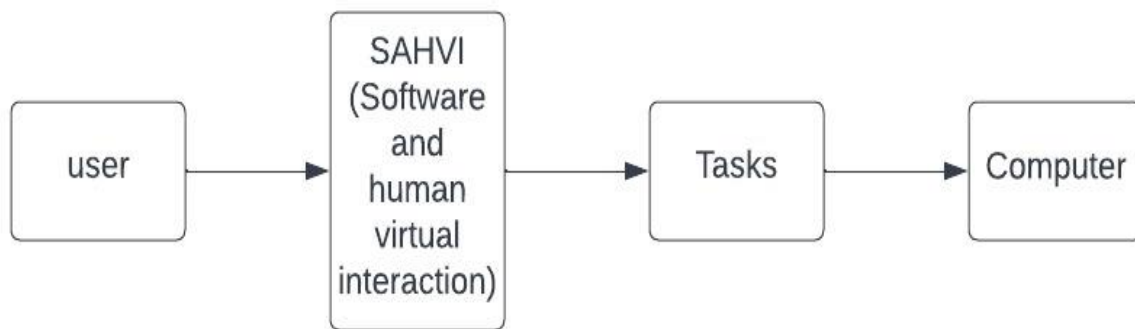
Design Selection

1. Data Flow Diagram (DFD):

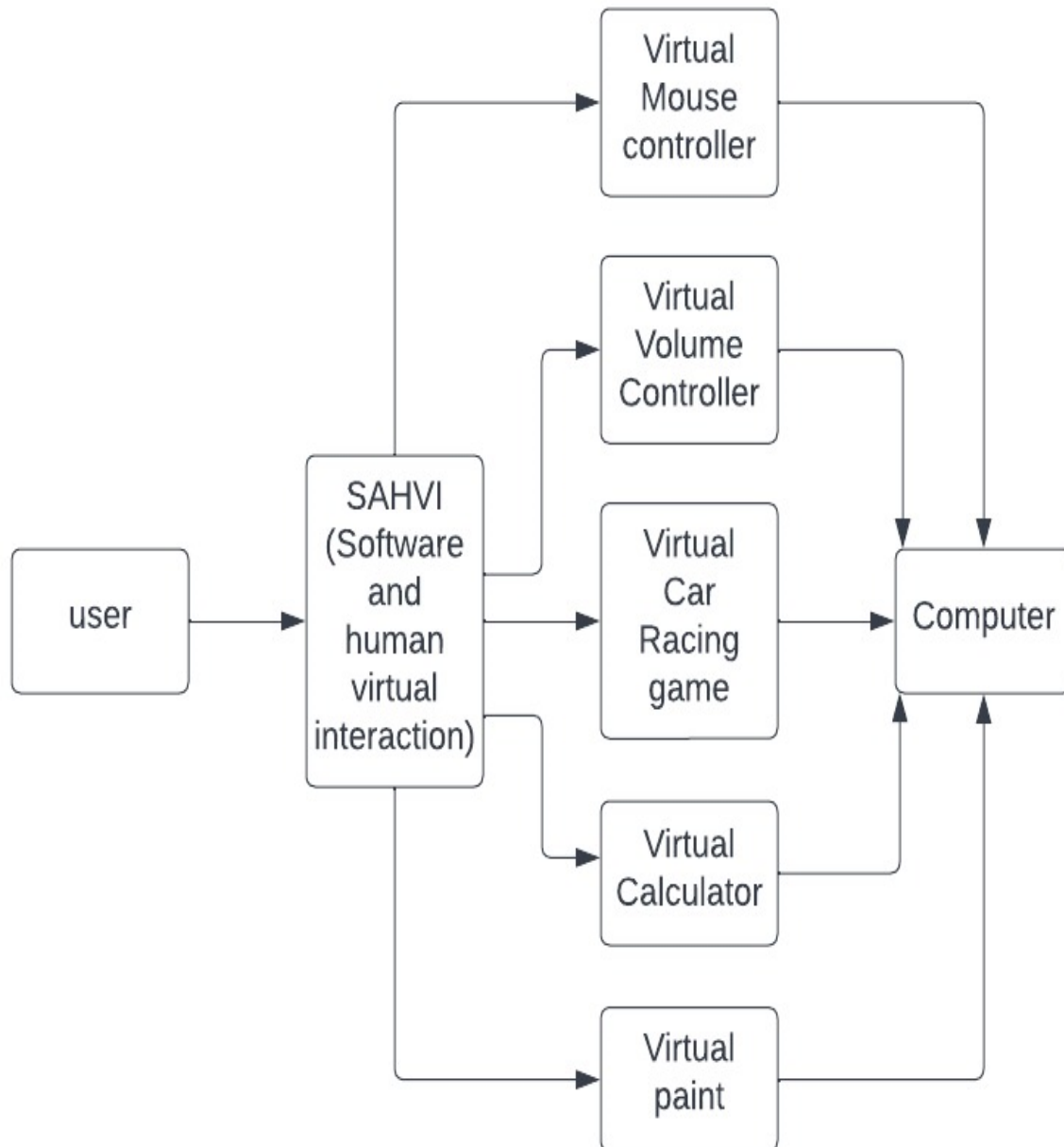
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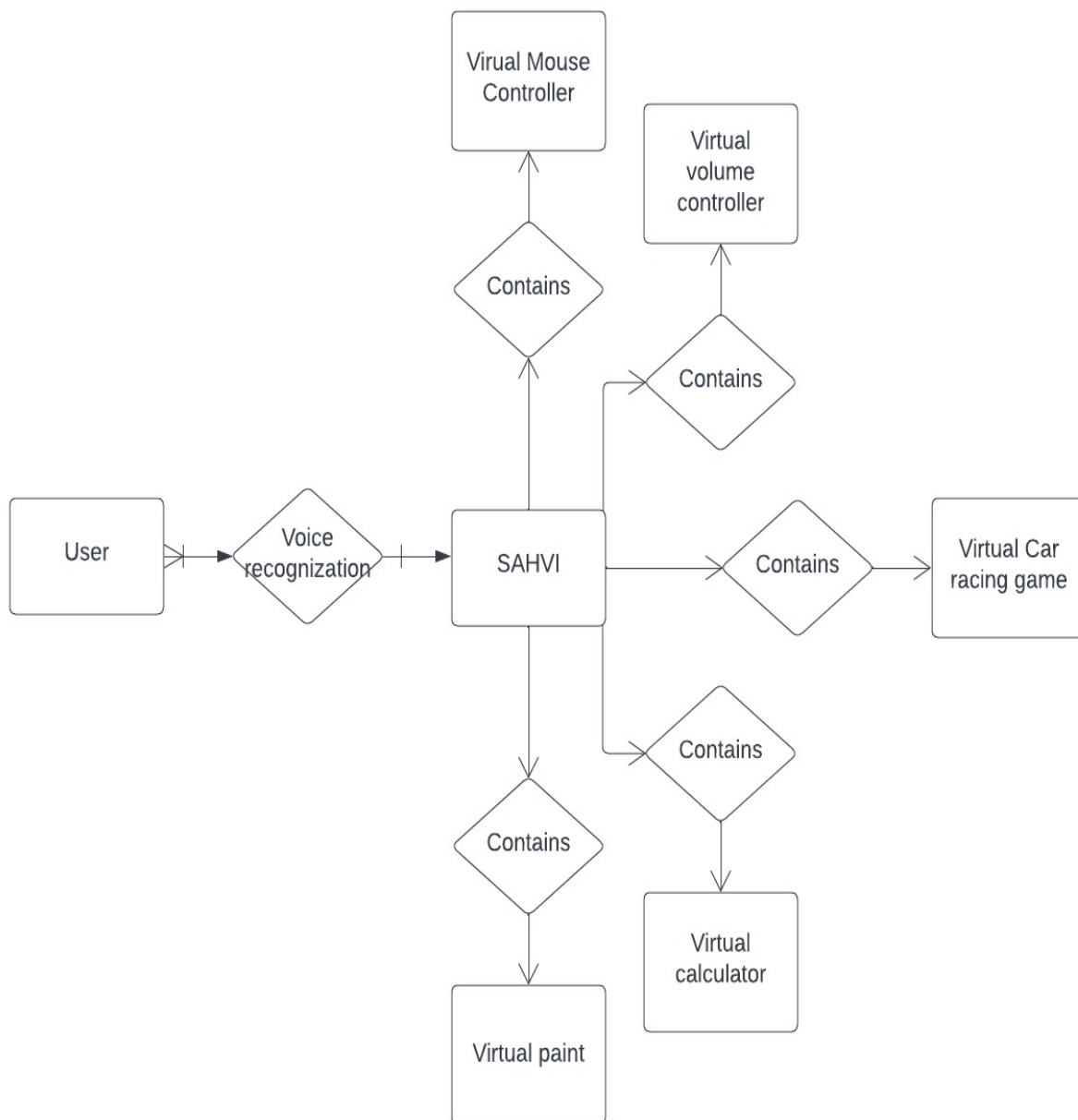
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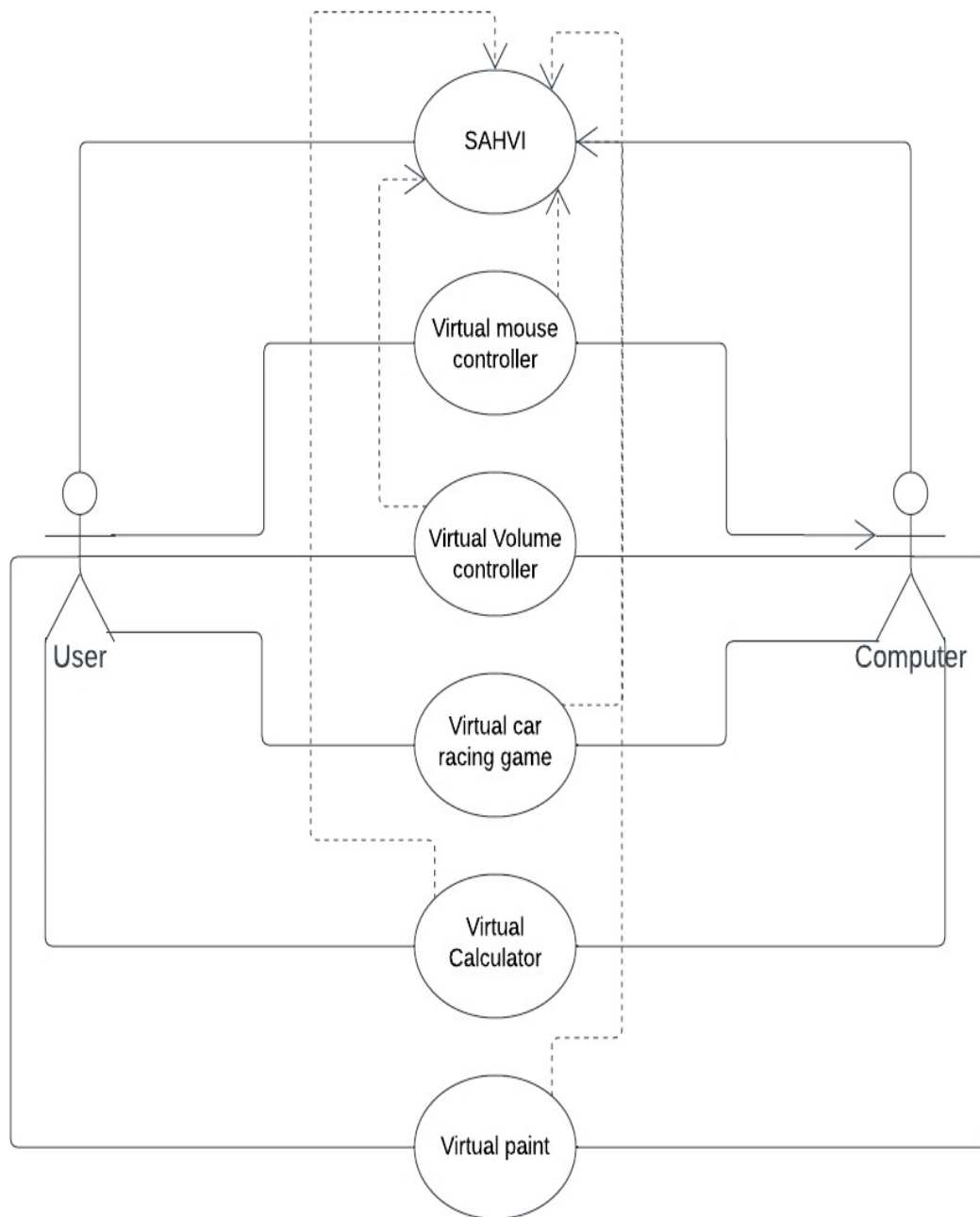
- **Level Two**



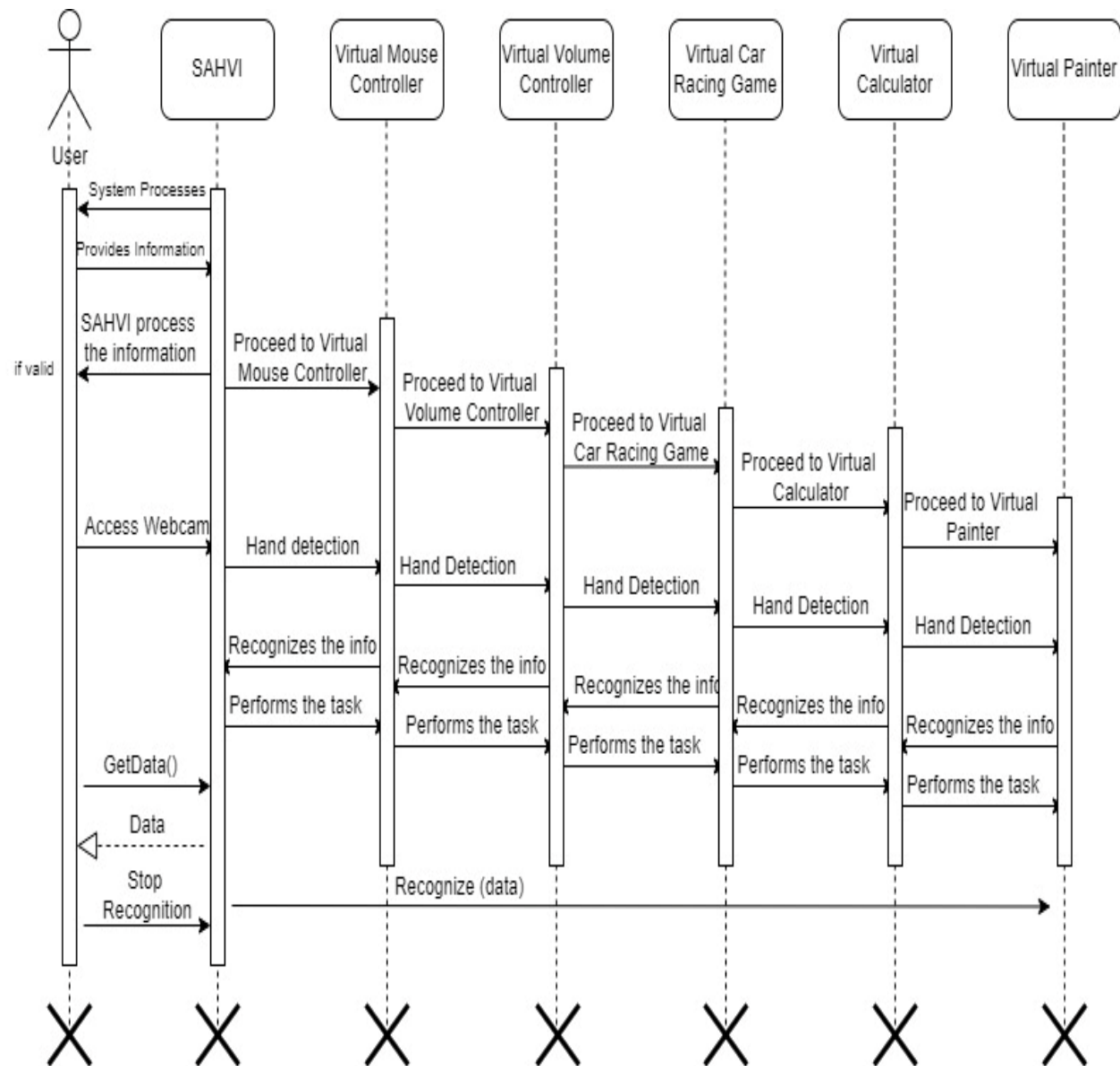
2. Entity Relationship Diagram (ERD):



3. Use Case Diagram (UCD):



4. Sequence Diagram:



5. Activity Diagram:

