American International University-Bangladesh (AIUB)

Department of Computer Science

Faculty of Science & Technology (FST)

PROJECT TITLE

Gesture-Based Cursor Control and Drawing System Using Hand Tracking

By

Semester: Summer_21_22		**Section:**	**Group Number: 6**	
SN	Student Name	Student ID	Contribution (CO3)	Individual Marks
01	ANANNYA TITHI	22-48992-3	25%	
02	PALASH KUNDU	22-48495-3	25%	
03	ESRATUL JANNAT JUI	22-49013-3	25%	
04	TANSIF TUSHAN	22-48514-3	25%	

The project will be Evaluated for the following Course Outcomes

CO3: *Select* appropriate software engineering models, project management roles and their associated skills for the complex software engineering project and evaluate the sustainability of developed software, taking into consideration the societal and environmental aspects	Total Marks	
Appropriate Process Model Selection and Argumentation with Evidence	[5 Marks]	
Evidence of Argumentation regarding process model selection	[5Marks]	
Analysis the impact of societal, health, safety, legal and cultural issues	[5Marks]	
Submission, Defense, Completeness, Spelling, grammar and Organization of the Project report	[5Marks]	
CO4: *Develop* project management plan to manage software engineering projects following the principles of engineering management and economic decision process	Total Marks	

Develop the project plan, its components of the proposed software products	[5Marks]	
Identify all the activities/tasks related to project management and categorize them within the WBS structure. Perform detailed effort estimation correspond with the WBS and schedule the activities with resources	[5Marks]	
Identify all the potential risks in your project and prioritize them to overcome these risk factors.	[5Marks]	

Description of Student's Contribution in the Project work

Student Name: ANANNYA TITHI
Student ID:22-48992-3
Contribution in Percentage (%): 25%
Contribution in the Project:

- Defined the problem and project objectives
- Selected Agile-Scrum as the software development model
- Justified the choice with evidence and project alignment
- Included rubrics, evaluation criteria, and references

_____Anannya _____
Signature of the Student

Student Name: PALASH KUNDU
Student ID: 22-48495-3
Contribution in Percentage (%): 25%
Contribution in the Project:

- Explained the proposed solution and its benefits
- Identified target users and societal relevance
- Described sprint structure, roles, and iterative development
- Explained how each role contributes to different phases

_____Palash_____
Signature of the Student

Student Name: ESRATUL JANNAT JUI
Student ID: 22-49013-3
Contribution in Percentage (%): 25%

- Highlighted scientific contribution and innovation
- Linked model to real-time testing and user feedback adaptability
- Maintained proper structure, headings, and logical flow
- Outlined key functionalities (cursor control, drawing, clicking)

_____JUI_____
Signature of the Student

Student Name: TANSIF TUSHAR
Student ID: 22-48514-3
Contribution in Percentage (%): 25%
Contribution in the Project:

- Included a literature review and comparison with existing systems
- Clearly outlined team roles: Developer, Designer, QA, etc.
- Maintained proper structure, headings, and logical flow
- Emphasized collaboration and cross-functional teamwork

_____Tansif_____
Signature of the Student

1.PROJECT PROPOSAL

1.1 Background to the Problem

- Traditional input devices like the mouse and keyboard are widely used but can be limiting in certain scenarios. Users with physical disabilities may struggle to operate them, and in environments like hospitals or classrooms, contactless interaction is preferred for hygiene and convenience. Additionally, these devices lack the natural expressiveness needed for creative tasks like drawing or writing.

- With advancements in computer vision and machine learning, hand gesture recognition has emerged as a promising alternative. It allows users to interact with computers using simple hand movements, offering a more intuitive and accessible experience. However, most existing systems are either too basic—supporting only cursor movement—or require expensive hardware, making them impractical for everyday use.

1.2 Solution to the Problem

Project Objective

The primary objective of this project is to develop a software application that enables users to control their computer cursor and perform mouse actions (clicking, scrolling, drawing, etc.) using only hand gestures, with the help of a standard webcam. The system aims to enhance accessibility, promote contactless interaction, and support creative applications like drawing, all without the need for physical input devices such as a mouse or stylus.

This project seeks to:

- Improve **accessibility** for individuals with physical impairments
- Offer a **hygienic**, touch-free alternative in sensitive environments (e.g., hospitals, classrooms)
- Encourage **creativity** through virtual drawing using fingertip tracking
- Leverage **cost-effective** and widely available technologies for implementation

Proposed Solution

To address the objectives above, the proposed solution is a **gesture-based cursor control and drawing system** using a standard webcam, Python, OpenCV, and MediaPipe libraries. The software tracks hand and finger positions in real-time and translates them into specific computer actions:

- Moving the cursor by tracking hand movement
- Performing left and right clicks using specific gestures (e.g., finger pinches)
- Scrolling by moving fingers vertically
- Entering drawing mode using fingertip detection

The system also includes:

- A **visual overlay UI** to guide users
- Real-time gesture feedback
- Optional mode toggles to switch between drawing and navigation

This solution is particularly appropriate for the following reasons:

1. **Accessibility**: It directly addresses the needs of users who may struggle with traditional input devices due to physical disabilities.
2. **Affordability**: It uses only a standard webcam and open-source libraries, avoiding costly hardware like depth cameras or custom sensors.
3. **Usability**: The intuitive nature of hand gestures makes the system easy to learn and use.
4. **Versatility**: It serves a wide range of users — from physically challenged individuals to artists and educators.
5. **Scalability**: The modular nature of the system allows for future updates (e.g., adding zoom, drag-drop, or multi-hand support).

The solution is highly feasible to meet the project's intended business and social impact goals:

- **Technical Feasibility**: The project is built using mature, reliable libraries (MediaPipe, OpenCV) and runs efficiently on standard laptops or desktops.
- **Economic Feasibility**: No special hardware or software licenses are required. It is free to use, easy to deploy, and can even be offered as open-source or integrated into accessibility software packages.
- **Operational Feasibility**: End users need only a basic understanding of gesture actions, and the system can be installed and used without technical expertise.
- **Market Readiness**: The demand for touchless and accessible tech has grown rapidly, especially post-pandemic, aligning this project with current user and business needs.

Key Functionalities:

- Cursor movement via hand tracking
- Gesture-based left/right click and scroll
- Drawing and writing on screen using fingertip tracking
- Real-time visual feedback and gesture overlay

Target Users:

- Individuals with physical disabilities
- Teachers and presenters
- Designers, artists, and students
- General users preferring touchless control

The system promotes inclusive technology, supports hygienic interaction, and fosters creative freedom. It aligns with growing awareness of assistive and contactless technologies.

Scientific Contribution

The project integrates existing technologies in a novel way to enhance gesture recognition accuracy, supporting both functional and creative user needs.

Literature Review

Previous works, like Nevon Projects, offer limited gesture control without drawing or UI feedback. Our system extends these by incorporating fingertip tracking and more complex gesture mapping, improving precision and usability.

Comparison with Existing Systems

Most current systems are either expensive or limited in function. This project provides a free, flexible alternative that supports more use cases and requires only a webcam.

2. SOFTWARE DEVELOPMENT LIFE CYCLE

2.1 Process Model

Agile-Scrum Framework

For this project, we have adopted the **Agile methodology**, specifically the **Scrum framework**, as the most suitable model. Scrum emphasizes iterative development, flexibility, and constant feedback—all critical for building an interactive, real-time gesture recognition system.

Justification for Scrum:

- **Sprints**: Development is organized into 1-2 week sprints, allowing the system to evolve incrementally—from basic cursor movement to full drawing functionality.
- **Scrum Roles**:
  - **Product Owner**: Defines features and prioritizes the backlog (fulfilled by the student).
  - **Scrum Master**: Removes development barriers (self-managed in this case).
  - **Development Team**: Implements and tests features during each sprint.
- **Sprint Reviews & Retrospectives**: Ensure ongoing feedback and continuous refinement of hand tracking accuracy and UI usability.

Evidence Supporting Scrum:

- Real-time testing and improvement are core to hand gesture applications.
- System goals may shift based on real-world feedback (e.g., usability under different lighting).
- Easy to incorporate user testing between sprints.

Project Role Identification and Responsibilities

In the development of the hand gesture-based cursor control and drawing system, several key roles are defined to ensure smooth execution and alignment with Agile principles. Each role contributes to specific phases of the software development life cycle, from planning and implementation to testing and documentation.

Role	Responsibilities
Project Manager	-Plans and monitors project progress. - Coordinates team activities and sprint planning. - Manages risks and ensures timely delivery. - Facilitates communication between stakeholders.
Software Developer	-Implements core functionalities: hand tracking, gesture recognition, cursor control, and drawing. - Integrates MediaPipe/OpenCV libraries - Participates in code reviews and refactoring. - Collaborates with UI designer and tester for feature alignment
UI/UX Designer	-Designs intuitive gesture overlays and visual feedback elements. - Ensures accessibility and user-friendliness. - Creates wireframes and mockups for gesture interactions. - Works closely with developers to implement design elements
Quality Assurance (QA)Tester	-Develops test cases for gesture accuracy and system responsiveness. - Conducts usability testing with target users. - Identifies bugs and performance issues. - Validates system behavior across different environments
Documentation Lead	-Prepares technical documentation, user manuals, and training materials. - Maintains sprint reports and meeting notes. - Assists in preparing presentations and final project submissions. - Ensures clarity and completeness of all written deliverables
Product Owner/ Stakeholder *(if applicable)*	-Defines system goals and success criteria. - Provides feedback during sprint reviews. - Validates final product against user needs. - Supports decision-making on feature prioritization

Role Alignment with Agile Methodology:

- **Cross-functional collaboration** is encouraged through shared sprint goals and daily stand-ups.
- **Iterative development** allows each role to contribute incrementally and adapt based on feedback.
- **User-centered design** ensures that roles like UI Designer and QA Tester focus on usability and accessibility, especially for physically challenged users.

References

1. Zhang, X., Wu, C., Zhao, Y., & Liu, Y. (2018). *Real-time hand gesture recognition using deep learning*. Sensors, 18(5), 1603. https://doi.org/10.3390/s18051603

2. Google MediaPipe Documentation. *MediaPipe Hands*. Retrieved from https://google.github.io/mediapipe/solutions/hands.html
3. Beck, K. et al. (2001). *Manifesto for Agile Software Development*. Agile Alliance. https://agilemanifesto.org/
4. Schwaber, K., & Sutherland, J. (2020). *The Scrum Guide™*. https://scrumguides.org/
5. OpenCV Documentation. https://docs.opencv.org/

Rubric for Project Assessment (CO3)

Criteria	Marks distribution (Max 3X5= 15)				Acquired Marks
	Inadequate (1-2)	**Satisfactory (3)**	**Good (4)**	**Excellent (5)**	
Selection of Software Engineering Models	Does not articulate a position or argument of choosing appropriate model. Does not present any evidence to support the arguments for the choice of the model	Articulates a position or argument for choosing models that is unfocused or ambiguous. Presents incomplete/vague evidence to support argument for model choice	Articulates a position or argument of choosing models that is limited in scope. Does not present enough evidence to support the argument for the choice of the model	Clearly articulates a position or argument for the choosing software engineering models. Presents sufficient amount of evidence to support argument for the model selection	
Role identification and Responsibility Allocation	The project has poor project management plans for identifying roles and assigning the responsibilities	Identify few roles in the project management where some of the roles are left alone with any project responsibilities	Identify most of the roles in the project management and assign their responsibilities	Well planned project with proper role identification and responsibility allocation in the project management activities	

Impact identification					
Formatting and Submission	Project report is not complete and Several errors in spelling and grammar. Present a Confusing	Some errors in spelling and grammar. Some problems	Few errors in spelling and grammar. Presents most of the details in	Project report is complete and No errors in spelling and grammar. Consistently	
	organization of concepts, supporting arguments, and real-life example. Sentences rambling, and details are repeated.	of organizing the answer in a logical order of defining, elaborating, and providing real-life examples.	a logical flow of organization in definition, details, and example.	presents a logical and effective organization of definition, details, and real-life example of the topic.	
				Acquired marks:	
				CO Pass / Fail:	