**Application for patent filing**

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| Area of invention | : | **Gesture RecognitionTop of Form** |
| **Title of the invention** | : | **Screen Control using Gesture Recognition** |
| Possible domain for field application | : | **Assistive Technology for Visually Impaired Individuals** |
| Possible sector for commercialization | : | **Mining Sector** |

**Invention Disclosure Form**

**To be filled by the inventors**

Please provide highly relevant information for details asked below and use consistent language while describing the specific feature or element in the invention disclosure.

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| 1. | **Title of invention** (Please indicate a title for the invention and technology of the invention)  **Screen Control using Gesture Recognition** |
| 2. | **Describe the invention**. (Please describe specifically about the general purpose of invention. Is the invention a new process, device of product, system, software or a combination of these elements?)  **The invention is an innovative gesture control program that offers a comprehensive solution for simultaneously controlling both the mouse and keyboard using hand gestures. It employs sophisticated gesture recognition algorithms and state-of-the-art technologies to precisely interpret user gestures and convert them into corresponding mouse and keyboard actions. This program is distinguished by its unique integration of mouse and keyboard control within a single system, an attribute not observed in existing systems. Developed using Python, the program provides a user-friendly interface and customizable gesture settings, accommodating diverse user preferences. The invention seeks to transform computer interaction, offering a more intuitive and efficient method for users to navigate and control their digital environment. It represents a novel combination of software and system elements designed to enhance user experience and interaction with computing devices.** |
| 3. | **Does the invention provide a new use of or improvement to an existing product or process? (Highlight the use or improvements from the existing with recent and relevant references)**  **Yes, the invention introduces both a novel application and substantial enhancements in the realm of computer interaction, particularly in the unified integration of mouse and keyboard control via hand gestures. Conventional systems typically segregate mouse and keyboard control[1][2], necessitating users to alternate between disparate input methods or devices. Our invention presents an integrated system that seamlessly merges both controls, allowing users to execute mouse functions and type solely through hand gestures. This innovation enables complete system communication using only the user's fingers, eliminating the need for physical contact with the device. This feature is particularly advantageous for individuals in the mining sector, where the removal of heavy equipment for system interaction can be cumbersome.**  **Key improvements and features include:**   1. **Advanced Gesture Recognition: Employing cutting-edge algorithms and technologies such as OpenCV, MediaPipe, and machine learning, the program delivers precise and responsive gesture recognition, surpassing the capabilities of existing systems.** 2. **Integrated Control System: The program amalgamates mouse and keyboard functionalities, providing a more intuitive and efficient computer interaction experience, reducing the reliance on physical input devices, and streamlining user workflows.** 3. **Customization and Flexibility: The system allows users to personalize gestures and assign specific actions, enhancing the system's adaptability to individual preferences and requirements.** 4. **User-Friendly Interface: Designed with a focus on user experience, the program offers a straightforward and accessible interface for configuring and utilizing the gesture control features.** 5. **Novelty in Integration: While existing systems offer gesture-based control for either mouse or keyboard, the unique attribute of this invention is its integrated approach, merging both functionalities into a cohesive system, marking a significant advancement in the field.**   **These enhancements underscore the invention's potential to transform computer interaction, providing a more natural and seamless way for users to navigate and control their digital environment, particularly benefiting those seeking alternatives to conventional input devices.** |
| 4. | State the **Novelty** of the invention and specify the claims in the invention.  **The invention presents a novel integration of virtual mouse control and keyboard simulation within a single program, enabling complete system interaction through gestures without any physical contact. Utilizing the latest version of Python and cutting-edge libraries, our program offers a unique method for users to communicate with their systems and the world solely through gestures. This innovative approach combines mouse control, keyboard simulation, and sign language interpretation into one cohesive system.**  **Key Claims of the Invention:**   1. **Integrated Control System: A unified program that combines mouse control, keyboard simulation, and sign language interpretation, allowing complete system control through gestures without the need for physical contact.** 2. **Gesture-Only Input: The first system to be entirely independent of physical mouse and keyboard inputs, relying solely on gesture recognition for user interaction.** 3. **Real-Time Translation: The ability to interpret and translate user gestures into actionable commands and typed text with high accuracy and speed.** 4. **State-of-the-Art Technology: Utilization of the latest Python version (3.10) and advanced libraries to ensure optimal performance and compatibility with contemporary computing environments.** 5. **Advanced Gesture Recognition: Integration of sophisticated neural network algorithms for precise gesture recognition, enabling seamless and intuitive user communication with the system.** |
| 5. | Describe the **advantages of the present invention over the existing technologies** (please identity the advantages e.g. efficiency, cost benefits, simplicity etc.  **The present invention offers several advantages over existing technologies in the field of gesture-based computer interaction:**   1. **Advanced Integration: Unlike existing technologies that use outdated libraries and separate mouse and keyboard control, our system employs the latest libraries and combines both controls into a single, streamlined system.** 2. **Comprehensive Functionality: Our program is designed with a specific use case in mind, offering a wider range of functionalities compared to existing technologies, which often lack such integration.** 3. **Touch-Free Interaction: Existing technologies require repeated physical interaction with the mouse and keyboard. In contrast, our system allows for complete control through gestures alone, eliminating the need for physical contact with the device[3][4].** 4. **Improved Performance: Our system achieves an average frame rate of approximately 11 fps, which can be further enhanced with the addition of GPU acceleration. By leveraging CUDA technology, we anticipate a significant boost in performance compared to existing projects.** 5. **User-Friendly Design: Our project is designed to be user-friendly and easily understandable, even for beginners. This contrasts with existing projects, which may not offer such a seamless and intuitive user experience.** 6. **Innovative Combination: Our project uniquely combines mouse control, keyboard simulation, and sign language interpretation in one system, a feature not found in existing technologies.** |
| 6. | Describe how the **present invention overcomes the drawbacks** of currently available technology related to your invention. (please include the relevant references)  **The present invention overcomes several drawbacks of currently available technology related to gesture-based computer interaction:**   1. **Limited Integration: Existing technologies often treat mouse and keyboard control as separate entities, requiring users to switch between different input methods. Our invention integrates both controls into a cohesive system, enabling seamless interaction with the computer using hand gestures alone. This eliminates the need for physical input devices and streamlines the user experience.** 2. **Outdated Libraries: Many current systems rely on outdated libraries, which can limit their compatibility and performance. Our invention utilizes the latest version of Python and incorporates cutting-edge libraries, ensuring optimal performance and compatibility with modern computing environments[5][7].** 3. **Touch Dependency: Conventional systems necessitate physical interaction with the mouse and keyboard, which can be inconvenient or impractical in certain scenarios, such as in sterile environments or for users with mobility limitations. Our system allows for complete gesture-based control, removing the need for physical contact and enhancing accessibility[6].** 4. **Limited Functionality: Existing technologies often focus on either mouse control or keyboard simulation, but not both. Our invention provides a comprehensive solution that includes mouse control, keyboard simulation, and sign language interpretation, offering a wider range of functionalities in a single program.** 5. **Performance Issues: Many existing systems suffer from low frame rates, which can result in laggy or unresponsive interactions. Our system achieves an average frame rate of approximately 11 fps, with the potential for further improvement through GPU acceleration using CUDA technology. This ensures a smoother and more responsive user experience.** 6. **Complexity: Current technologies can be complex and difficult for beginners to understand. Our invention is designed with user-friendliness in mind, offering an intuitive interface and easy-to-understand functionalities, making it accessible to users of all skill levels.**   **By addressing these drawbacks, the present invention provides a more integrated, efficient, and accessible solution for gesture-based computer interaction, representing a significant advancement in the field.** |
| 7. | Describe **uses, applications and benefits** of the invention.  **The invention, a novel gesture control program, offers a wide range of uses and applications across various sectors, providing significant benefits over traditional interaction methods:**   1. **Office and Home Computing: The program enables users to control their computers with gestures, making it an ideal solution for presentations, navigating multimedia content, and general computer usage, enhancing convenience and efficiency.** 2. **Accessibility: Individuals with mobility impairments or disabilities can greatly benefit from this technology, as it allows them to interact with computers without the need for physical keyboards or mice.** 3. **Education and Training: In educational settings, the program can be used to create interactive learning experiences, allowing students to control educational software through gestures.**   **Benefits:**   1. **Touch-Free Interaction: Eliminates the need for physical contact with devices, reducing the spread of germs and increasing hygiene, especially important in public or shared computing environments.** 2. **Increased Productivity: Streamlines workflows by combining mouse and keyboard functions into a single gesture-controlled system.** 3. **Enhanced Accessibility: Provides an alternative interaction method for individuals with physical limitations.** 4. **Cost-Effective: Reduces the need for additional hardware, such as separate mice and keyboards.**   **Importance for “Miners and Individuals Wearing Heavy Equipment”:**  **The invention holds particular importance for miners or individuals wearing heavy equipment. In such environments, removing gloves or equipment to interact with computer systems can be cumbersome and time-consuming. With the gesture control program, these individuals can communicate and convey information seamlessly without the need to remove their protective gear. This not only enhances efficiency and safety but also ensures that communication is not hindered by the physical barriers imposed by their equipment.** |
| 8. | Does the focus of the invention results in **societal impact technology**? (Please describe how in detail, also specify the commercial applications, market need of product/ service of invention and why?)  **Societal Impact of the Invention:**  **The invention, a gesture control program for computer interaction, has the potential to create a significant societal impact through its innovative approach to human-computer interaction. By enabling touch-free control of computers using hand gestures, this technology can improve accessibility, hygiene, and efficiency in various sectors.**   1. **Accessibility: One of the most profound societal impacts is the enhancement of accessibility for individuals with physical disabilities or limitations. By allowing users to control their computers without the need for a physical mouse or keyboard, the technology provides a more inclusive environment, enabling people with mobility impairments to interact with digital content more easily and independently.** 2. **Hygiene: In the wake of global health concerns, touch-free technologies have gained importance in preventing the spread of pathogens. The gesture control program reduces the need for physical contact with shared devices, making it a valuable tool in public computers, healthcare settings, and educational institutions.** 3. **Efficiency and Safety: The technology streamlines workflows by integrating mouse and keyboard functions, reducing the time and effort required for computer interaction. This is particularly beneficial in environments where efficiency is critical, such as in industrial and research settings.**   **Commercial Applications and Market Need:**  **The invention has a wide range of commercial applications, including:**   1. **Healthcare: In medical facilities, touch-free interaction can reduce the risk of cross-contamination and improve hygiene, while also allowing healthcare professionals to access information without removing gloves or sterilized equipment.** 2. **Industrial and Mining: For workers in industrial and mining sectors, the ability to control computers without removing heavy gloves or equipment enhances safety and productivity. This is especially important in hazardous environments where quick and efficient communication is crucial.** 3. **Education: The technology can be used in educational settings to create interactive and engaging learning experiences, accommodating students with varying abilities.**   **Market Need:**  **There is a growing need for touch-free interaction technologies in various sectors, driven by concerns about hygiene, the demand for improved accessibility, and the desire for more efficient and intuitive interaction methods. The gesture control program addresses these needs by providing a versatile and user-friendly solution that can be adapted to different environments and user requirements.**  **Importance for Miners:**  **For miners and individuals wearing heavy equipment, the ability to control computers without physical contact is particularly valuable. In mining operations, where safety and efficiency are paramount, the gesture control program allows workers to communicate and access information without the need to remove protective gear. This not only enhances productivity but also reduces the risk of accidents and injuries associated with manual interaction with devices.** |
| 9. | Characterize the **disadvantages and limitations** of the invention.   1. **Limited Frame Rate: The system is currently limited to a maximum frame rate of 30 fps. This limitation can affect the smoothness and responsiveness of gesture recognition, potentially leading to delays in executing commands.** 2. **Similar Gestures: The program may struggle to distinguish between gestures that are similar in appearance, which can lead to unintended results or inaccuracies in command execution.** 3. **Environmental Factors: The effectiveness of gesture recognition can be influenced by environmental factors such as lighting conditions and background noise. Inconsistent lighting or cluttered backgrounds may reduce the accuracy of gesture detection.** 4. **Learning Curve: Users may need to invest time in learning and adapting to the gesture control system, especially if they are accustomed to traditional input methods. This could pose a challenge for those who are not tech-savvy.** 5. **Hardware Requirements: The program relies on specific hardware components, such as cameras and sensors, for gesture recognition. This could limit its applicability on devices that do not meet these hardware requirements or lead to additional costs for users.** 6. **Fatigue and Ergonomics: Prolonged use of gesture-based control may lead to user fatigue, especially if the gestures require significant arm or hand movements. Ergonomic considerations will be important to ensure user comfort and prevent strain.** 7. **Complexity of Gestures: The system's ability to recognize and interpret complex gestures may be limited, which could restrict the range of commands that can be executed through gestures.** 8. **Interference: The system may be susceptible to interference from other electronic devices or signals, which could affect its performance and reliability.Top of Form** |
| 10. | Enclose the **sketches, drawings, photographs** and other materials that help in better understating/ illustration of the novelty in the invention.    Figure 1 Flowchart of our project  Figure 2 workflow of our project    Figure 3 Usage of Virtual Mouse detecting hand gesture    Figure 4 Gesture for in virtual mouses  Figure 5 Sign Language detection |
| 11  . | **Current development status of the invention**   1. Has your invention been tested experimentally   Partially   1. Describe the experimental approach of the invention also state the methods adopted in the experiment.   The experimental approach of our invention involves a comprehensive integration of sign language alphabet detection and virtual mouse control using advanced deep learning techniques. The system is based on two core components: the YOLOv8 model for sign language recognition and a separate model for virtual mouse control.  For the sign language recognition component, the YOLOv8 model has been fine-tuned on a custom dataset comprising images and videos of various sign language gestures. The dataset ensures diversity in gestures and environmental conditions, enhancing the model's robustness. Training parameters included an input image resolution of 640x640 pixels, a batch size of 16, and an initial learning rate of 0.01, with the model trained for 50 epochs. The performance of the YOLOv8 model was evaluated based on precision, recall, and mean average precision (mAP), demonstrating its effectiveness in accurately recognizing sign language alphabets.  The virtual mouse control component utilizes a separate deep learning model, which is specifically designed to interpret hand gestures for cursor movement and click actions. This model is trained on a dataset of hand gestures representing different mouse actions, such as moving the cursor, left-click, right-click, and scrolling. The integration of this model with the sign language recognition component allows for seamless translation of hand gestures into corresponding mouse actions, providing a natural and intuitive way for users to control their computer.  By combining the capabilities of the YOLOv8 model for sign language recognition and the dedicated model for virtual mouse control, our invention offers a holistic solution for gesture-based computer interaction. Users can communicate using sign language and control their computer using hand gestures, enhancing accessibility and efficiency. The system has been optimized for real-time performance, ensuring smooth and responsive interaction.  The experimental results showcase the accuracy and efficiency of both components. The YOLOv8 model achieves high precision and recall rates in sign language alphabet detection, while the virtual mouse control model accurately interprets and executes hand gestures for cursor control and mouse actions.     |  |  | | --- | --- | |  |  |   **Intersection over union (IOU) overlapping rate**  The above graph depicts the experimental outcomes of virtual mouse. The accuracy rate is 90% and even above with the mouse. First graph shows the accuracy of a recent gesture and the second graph shows which gesture were performed.   1. Are the experimental data is documented in a formal log or any instrumental confirmation available for the invention (kindly provide the details)   No   1. Is further development of your invention is necessary or development of the invention is in progress (provide the relevant information)   Yes, the model enhancement is progressing for better and more accurate model. |

[1]. Oudah, M.; Al-Naji, A.; Chahl, J. Hand Gesture Recognition Based on Computer Vision: A Review of Techniques. J. Imaging 2020, 6, 73. <https://doi.org/10.3390/jimaging6080073>

[2]. Tsai, Tsung-Han, Chih-Chi Huang, and Kung-Long Zhang. "Embedded virtual mouse system by using hand gesture recognition." 2015 IEEE International Conference on Consumer Electronics-Taiwan. IEEE, 2015.

[3]. Puri, Rachit. "Gesture recognition based mouse events." arXiv preprint arXiv:1401.2058 (2014).

[4]. Xu, Pei. "A real-time hand gesture recognition and human-computer interaction system." arXiv preprint arXiv:1704.07296(2017).

[5]. Balaji, R., et al. "Handwritten gesture recognition for gesture keyboard." Tenth International Workshop on Frontiers in Handwriting Recognition. Suvisoft, 2006.

[6]. Nikhil, Chinnam Datta Sai, et al. "Finger recognition and gesture based virtual keyboard." 2020 5th International Conference on Communication and Electronics Systems (ICCES). IEEE, 2020.

[7]. Bi, Xiaojun, et al. "Bimanual gesture keyboard." Proceedings of the 25th annual ACM symposium on User interface software and technology. 2012.

13. **INVENTOR(S) AND/OR CONTRIBUTOR(S):**

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**14. ASSIGNMENT DETAILS: Assignee is the entity or individual who holds the patent.**

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