

## Preface

This project was developed as part of the requirements for the M.Sc. Data Science and Spatial Analytics Six Months Final Project course at the Symbiosis Institute of Geoinformatics, Pune, during the academic year 2023. Hand gesture recognition has gained prominence as a more intuitive and natural way of interacting with computers. This technology allows users to manipulate virtual objects, navigate interfaces, and perform actions using simple and expressive hand movements. By leveraging computer vision and machine learning, hand gesture recognition enhances user experiences by providing a seamless and engaging interface. The aim of this project is to develop a system that allows users to control a computer mouse using hand gestures. By leveraging computer vision techniques, machine learning algorithms, and automation libraries, we can create a virtual mouse that responds to the user's hand movements in real-time. The focus of this project is the utilization of PyAutoGUI, a powerful Python library that provides cross-platform control of the mouse and keyboard. By integrating hand gesture recognition models with PyAutoGUI, we can translate specific hand gestures into mouse movements and actions. Throughout this exploration, we will delve into various aspects, including the underlying computer vision techniques for hand detection and tracking, the training and deployment of hand gesture recognition models, and the integration of PyAutoGUI to control the mouse based on recognized gestures. Additionally, we will discuss the challenges, potential applications, and future directions for this technology. This project serves as a comprehensive guide for researchers, developers, and enthusiasts interested in building virtual mouse systems using hand gesture recognition and PyAutoGUI. It combines theoretical concepts, practical implementations, and references to relevant research papers and resources, providing a solid foundation for understanding and developing gesture-based interaction systems. During this project, extensive time was invested in studying numerous research papers and understanding various algorithms used for hand recognition and virtual mouse functionality. Substantial effort was also dedicated to optimizing the model's performance, gradually improving its accuracy. The project highlights the methods employed to enhance the system and serves as a starting point for future developments. The intent is to further refine this work and potentially transform it into a publishable piece.

## Abstract

This research project focuses on the development of a virtual mouse system using a hand gesture recognition model implemented with the PyAutoGUI library. The aim of the project is to create a natural and intuitive interface for human-computer interaction by allowing users to control the mouse cursor and perform clicks through hand gestures, eliminating the need for physical input devices. The project begins with an introduction to hand gesture recognition and its potential applications in various domains. Computer vision techniques are employed to detect and track hand gestures, which are then translated into mouse movements and clicks using the PyAutoGUI library. The development process encompasses building the hand gesture recognition model, collecting, and pre-processing the hand gesture dataset, training the machine learning model, and integrating it with PyAutoGUI for mouse control functionality. Throughout the project, several challenges and limitations are addressed, including variations in lighting conditions and hand positions, as well as optimizing the machine learning model for accuracy and reducing latency in the virtual mouse's performance. The performance of the developed virtual mouse is evaluated using metrics such as accuracy, precision, and recall. The results of the project demonstrate the feasibility and effectiveness of the virtual mouse system. The system achieves accurate and responsive hand gesture recognition, offering a potential alternative to traditional mouse-based interfaces. The research also discusses the future scope of the project, including integration with other applications and opportunities for further advancements in the field of hand gesture recognition. In conclusion, this research project presents a comprehensive exploration of developing a virtual mouse system using hand gesture recognition and PyAutoGUI. It highlights the potential of hand gesture recognition as an intuitive interface for human-computer interaction and provides valuable insights into the development process, challenges faced, and the performance of the system. The project's findings contribute to the growing body of research on gesture-based interaction systems and pave the way for future advancements in this field.