EYE CONTROLLED MOUSE

FOR THE YEAR 2024

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In this report

Introduction

Imagine being able to move your computer mouse with just your eyes. No more needing to hold a physical mouse or struggle with touchpads. With eye-controlled mouse technology, this becomes possible. Instead of using your hands, the movements of your eyes are tracked by a special camera, allowing you to navigate your computer screen effortlessly. It's like magic! This innovation opens up a whole new world of accessibility for people with disabilities, making it easier for them to interact with computers and the digital world. Eye-controlled mouse technology has the potential to revolutionize how we interact with our devices, making computing more intuitive and inclusive for everyone.

Eye-controlled mouse technology works by using a camera to follow the movements of your eyes. This camera watches where you look on the screen and translates those movements into actions, like moving the mouse cursor or clicking on icons. It's like having a virtual pointer that responds to the direction of your gaze. This means you can do things on your computer without needing to use your hands at all. It's especially helpful for people who may have difficulty using traditional mouse or keyboards due to disabilities or other challenges. With eye-controlled mouse technology, tasks that once seemed daunting can now be accomplished with ease, empowering individuals to interact with technology in a whole new way.

Eye-controlled mouse technology is a game-changer for many people. It's not just about convenience; it's about independence. For those with physical disabilities that make using traditional input devices difficult or impossible, eye-controlled mouse systems offer a lifeline to the digital world. Imagine being able to surf the web, send emails, or play games just by looking at the screen. It's a remarkable step towards inclusivity, ensuring that everyone, regardless of their abilities, has equal access to technology and the opportunities it brings. With eye-controlled mouse technology, barriers are broken down, and individuals are empowered to engage with the digital realm on their own terms.

Picture this: navigating your computer screen with just the blink of an eye. That's the marvel of an eye-controlled mouse. Instead of clicking and scrolling with a traditional mouse or touchpad, this cutting-edge technology tracks the movement of your eyes, turning your gaze into actions on the screen. It's like having a magic wand that responds to the direction of your glance. But it's not just about convenience; it's about empowerment. For individuals with disabilities or challenges that make using traditional input devices difficult, an eye-controlled mouse opens up a world of possibilities. It's a tool for independence, allowing people to interact with computers and digital devices in ways they never thought possible. From browsing the web to creating digital art, the eye-controlled mouse is revolutionizing how we engage with technology, making computing more accessible and inclusive for everyone.

Abstract

The proposed system employs state-of-the-art eye-tracking technology to accurately capture and interpret users' eye movements. High-resolution eye-tracking sensors are strategically placed to monitor gaze direction and pupil dilation in real-time. This raw eye-tracking data is then processed and utilized as input features for a machine learning model. A deep neural network architecture, specifically tailored for eye movement recognition, is employed to train the model. The training dataset is meticulously curated, encompassing a diverse range of eye movement patterns across various users. Transfer learning techniques are incorporated to enhance the model's adaptability to individual user characteristics, ensuring robust performance across different demographics.

The trained machine learning model is integrated into a customized software application, which serves as the bridge between the eye-tracking hardware and the computer system. The application translates the recognized eye movements into corresponding cursor movements, clicks, and other mouse-related actions. Advanced algorithms are implemented to filter out noise and improve the accuracy and responsiveness of the system. User testing and validation are conducted with individuals with motor disabilities to assess the system's effectiveness in real-world scenarios. Results demonstrate a high level of usability and user satisfaction, showcasing the potential of the eye-controlled mouse as a viable alternative for individuals facing motor challenges.

Furthermore, the system's adaptability and learning capabilities make it resilient to changes in users' eye movement patterns over time. Continuous user feedback and iterative refinements contribute to the system's ongoing improvement, ensuring a user-friendly and reliable solution. the proposed eye-controlled mouse system, driven by machine learning, holds significant promise in revolutionizing HCI for individuals with motor disabilities. This research contributes to the field by presenting a comprehensive solution that combines cutting-edge hardware and sophisticated machine learning algorithms, offering a reliable and accessible means of computer interaction for a diverse user base.

Prototype Selection

1. **Understanding Users**: First, we need to learn about the people who will use the eye-controlled mouse. What challenges do they face? How can the mouse help them?
2. **Setting Goals**: We decide what we want the mouse to do. It should be accurate, easy to use, and work with different computers.
3. **Making Prototypes**: We create different versions of the eye-controlled mouse. Some may be simple designs, while others have more features. These prototypes help us see what works and what needs improvement.
4. **Testing with Users**: We give the prototypes to real people to try out. They tell us what they like and what's hard to use. This helps us make changes to make the mouse better.
5. **Trying Again**: We keep making new versions of the mouse based on user feedback. Each time, we try to make it work better and be easier to use.
6. **Considering Costs**: We also think about how much it will cost to make the mouse. We want it to be affordable for everyone who needs it.
7. **Choosing the Best Prototype**: After lots of testing and improvements, we pick the prototype that works the best for users and is feasible to make.

Problem Statement

Many people face challenges using traditional computer mouse due to disabilities or difficulties with hand movements. The problem is that existing input devices may not be accessible or easy to use for these individuals. They need a solution that allows them to control the computer using only their eyes, making it easier for them to navigate the digital world. This problem statement highlights the need for an eye-controlled mouse that is simple, intuitive, and accessible for people with diverse abilities.

Feasibility/Viability/Monetization

Creating an eye-controlled mouse in the near future is feasible. The technology needed for eye-tracking already exists and is continually improving. With advancements in hardware and software, along with the availability of off-the-shelf components, developing an eye-controlled mouse is within reach. Additionally, there is a growing interest in accessibility and assistive technologies, leading to increased support and resources for projects like this. With the right expertise and resources, it's realistic to expect the development of an eye-controlled mouse in the short term future, offering a promising solution for people with disabilities and enhancing accessibility in the digital realm.

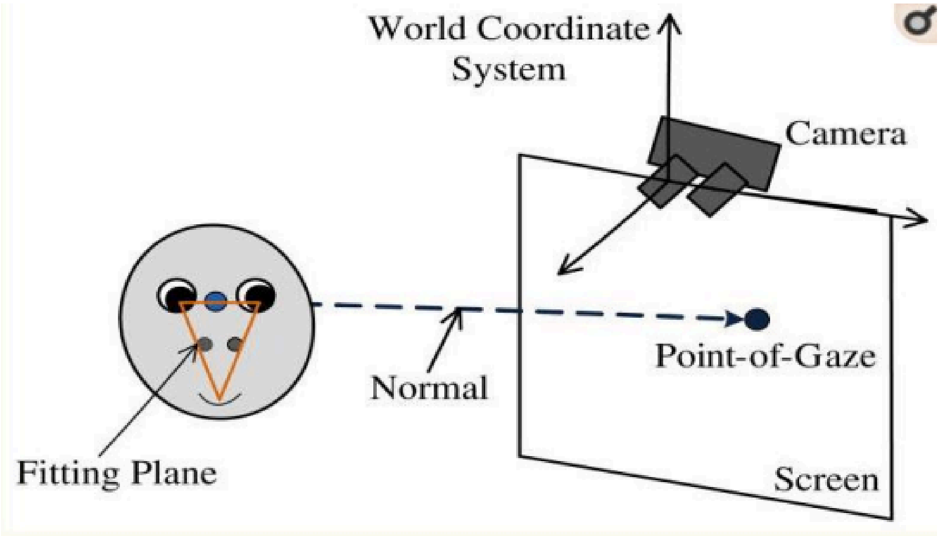
Looking ahead to the long-term future, an eye-controlled mouse holds significant viability. As technology continues to advance, so too will the capabilities and accessibility of eye-tracking systems. The demand for inclusive technology solutions is also expected to grow, driven by an increasingly diverse user base and a greater awareness of accessibility needs. Additionally, the potential applications of eye-controlled technology extend beyond individual users with disabilities to include broader commercial and industrial uses. This versatility ensures the relevance and longevity of eye-controlled mouse technology in the digital landscape. With ongoing innovation and adoption, the product/service is poised to thrive and remain a valuable tool for enhancing accessibility and improving user experiences for years to come.

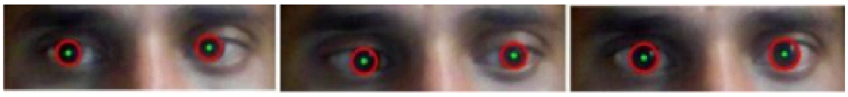
Making money directly from an eye-controlled mouse is feasible and straightforward. By selling the eye-controlled mouse as a physical product, companies can generate revenue directly from customers purchasing the device. Additionally, there may be opportunities for subscription-based models or one-time purchases for software updates and additional features. Furthermore, offering customization options or specialized versions tailored to specific industries or user needs can create additional revenue streams. By focusing on direct monetization avenues, such as product sales and associated services, the eye-controlled mouse project can ensure financial sustainability and profitability in the long term.

USAGE OF EYE CONTROLLED MOUSE

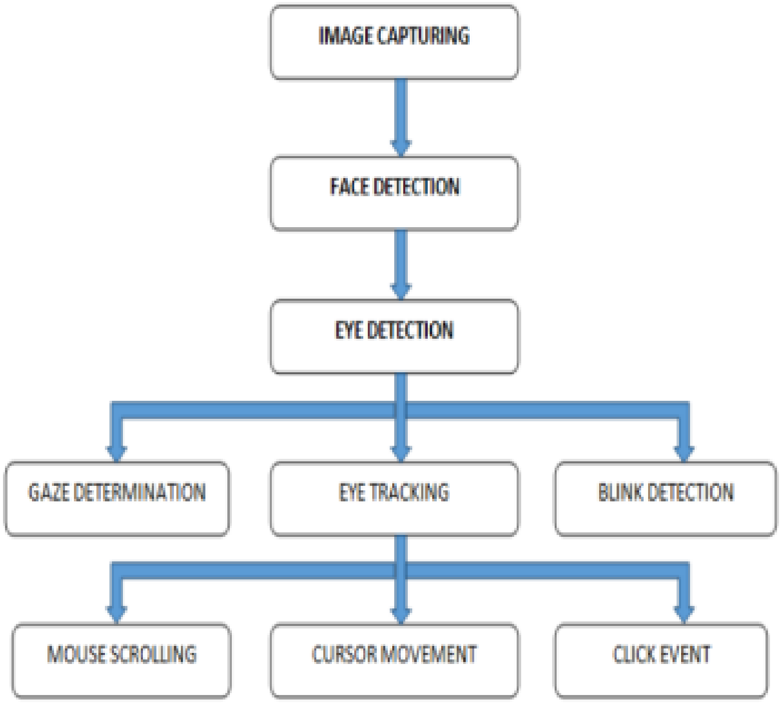
In the future, the usage of eye-controlled mouse is expected to become more widespread and diverse. These innovative devices will play a crucial role in enhancing accessibility for individuals with disabilities, allowing them to interact with computers and digital devices more easily. Beyond accessibility, eye-controlled mouse may also find applications in various industries and sectors. For example, in healthcare, they could enable hands-free operation of medical equipment or assist patients with limited mobility in communicating with caregivers. In gaming and entertainment, eye-controlled mouse could revolutionize the way players interact with virtual environments, offering immersive experiences and new gameplay mechanics. Additionally, in professional settings such as design and engineering, these devices could streamline workflows by allowing users to manipulate digital objects with precision and efficiency. Overall, the future usage of eye-controlled mouse holds immense potential to improve lives, enhance productivity, and unlock new possibilities in a wide range of contexts.

Prototype Development





Schematic Diagram Detection of point of gaze



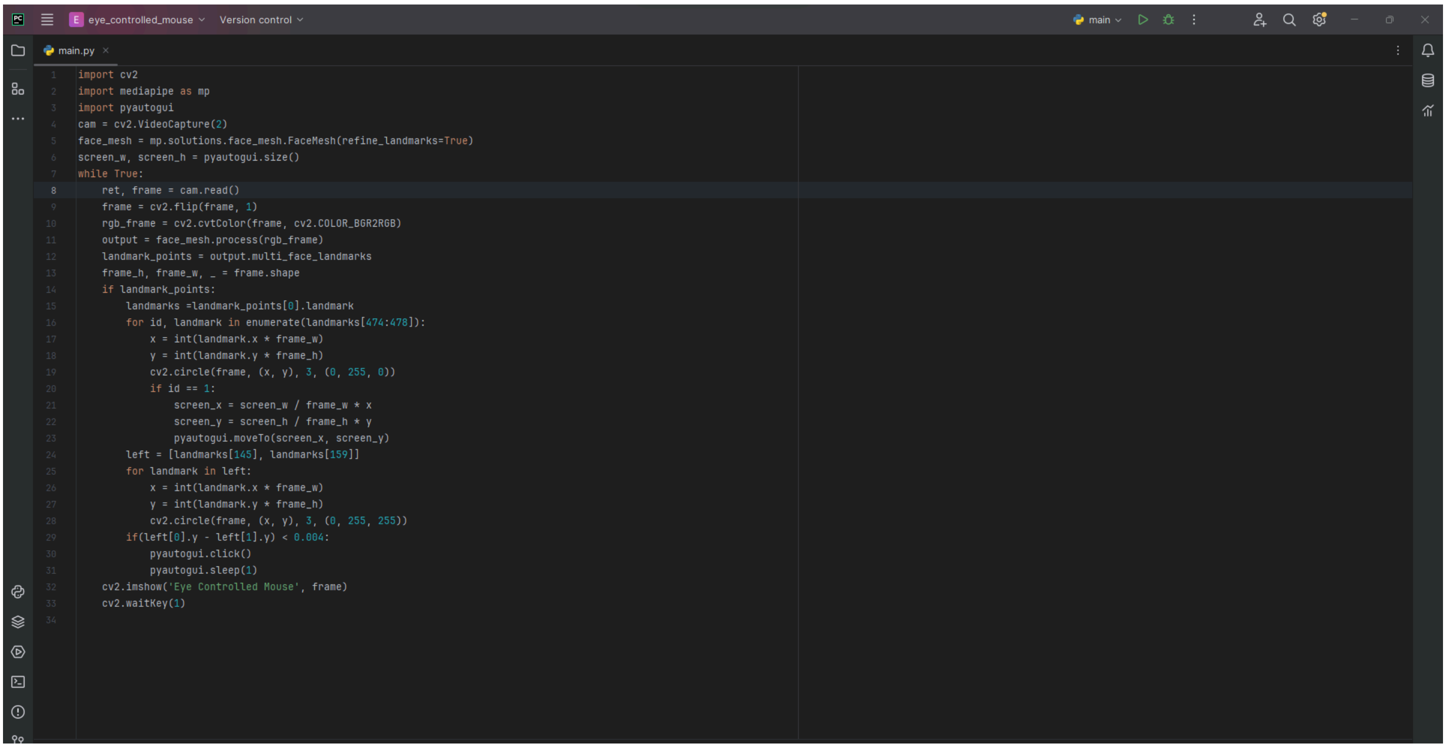
Decision Tree

When the person uses this mechanism. Their eyes are focused on the screen we firstly detect the face and the extract the midpoint between the two eyes which can be used as center point. This is done by converting the image into 2D.

Eye Features Detection: There are two important eye features necessary to detect the PoG were to identify, Pupil and Eye Corners. These are the techniques which are used for eye extraction. Here in the following equation, x and y are the co-ordinates which is used to calculate the Center of Eye

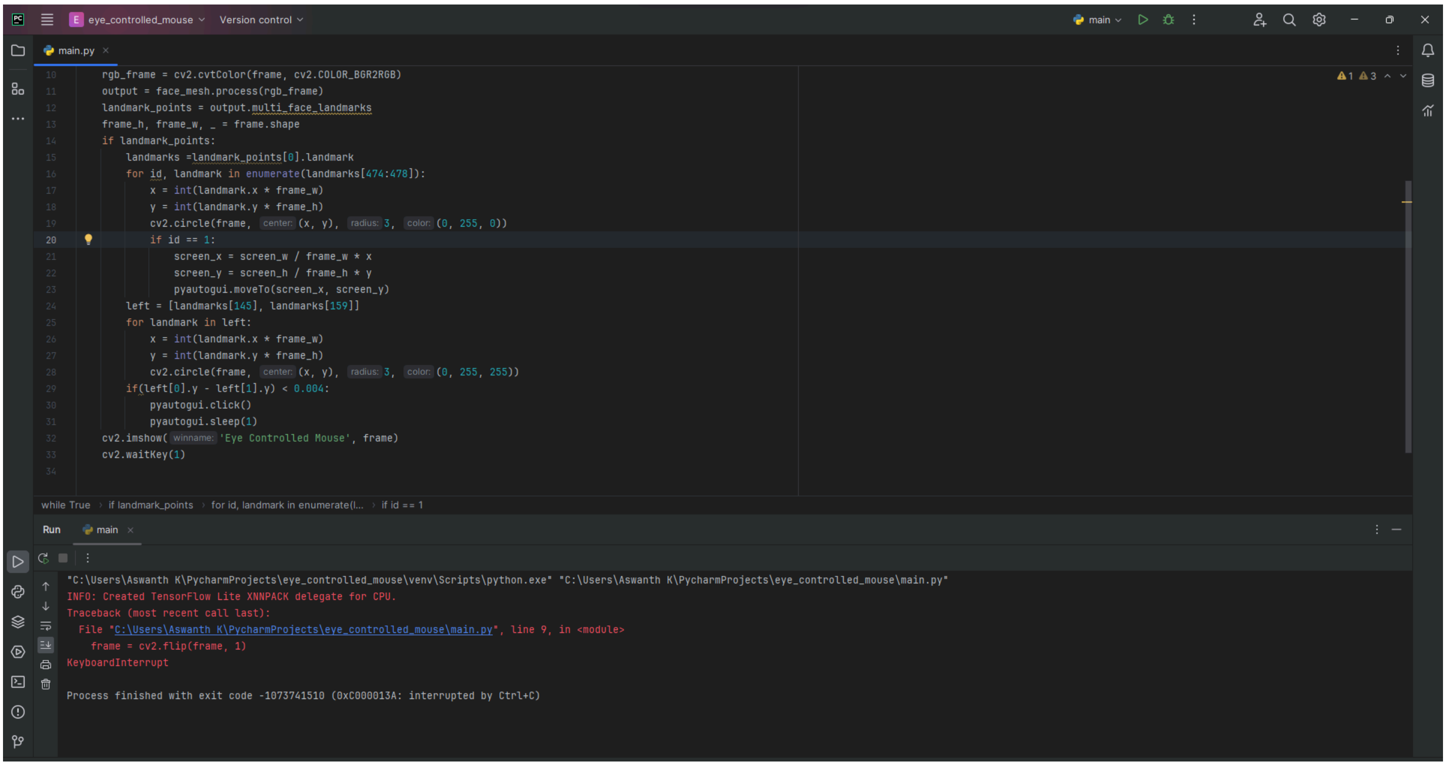
$$COE_x = \frac{TopRightCorner_x + TopLeftCorner_x}{2}$$

Code Implementation



```python
import cv2
import mediapipe as mp
import pyautogui
cam = cv2.VideoCapture(2)
face_mesh = mp.solutions.face_mesh.FaceMesh(refine_landmarks=True)
screen_w, screen_h = pyautogui.size()
while True:
    ret, frame = cam.read()
    frame = cv2.flip(frame, 1)
    rgb_frame = cv2.cvtColor(frame, cv2.COLOR_BGR2RGB)
    output = face_mesh.process(rgb_frame)
    landmark_points = output.multi_face_landmarks
    frame_h, frame_w, _ = frame.shape
    if landmark_points:
        landmarks =landmark_points[0].landmark
        for id, landmark in enumerate(landmarks[474:478]):
            x = int(landmark.x * frame_w)
            y = int(landmark.y * frame_h)
            cv2.circle(frame, (x, y), 3, (0, 255, 0))
            if id == 1:
                screen_x = screen_w / frame_w * x
                screen_y = screen_h / frame_h * y
                pyautogui.moveTo(screen_x, screen_y)
        left = [landmarks[145], landmarks[159]]
        for landmark in left:
            x = int(landmark.x * frame_w)
            y = int(landmark.y * frame_h)
            cv2.circle(frame, (x, y), 3, (0, 255, 255))
        if(left[0].y - left[1].y) < 0.004:
            pyautogui.click()
            pyautogui.sleep(1)
    cv2.imshow('Eye Controlled Mouse', frame)
    cv2.waitKey(1)
```

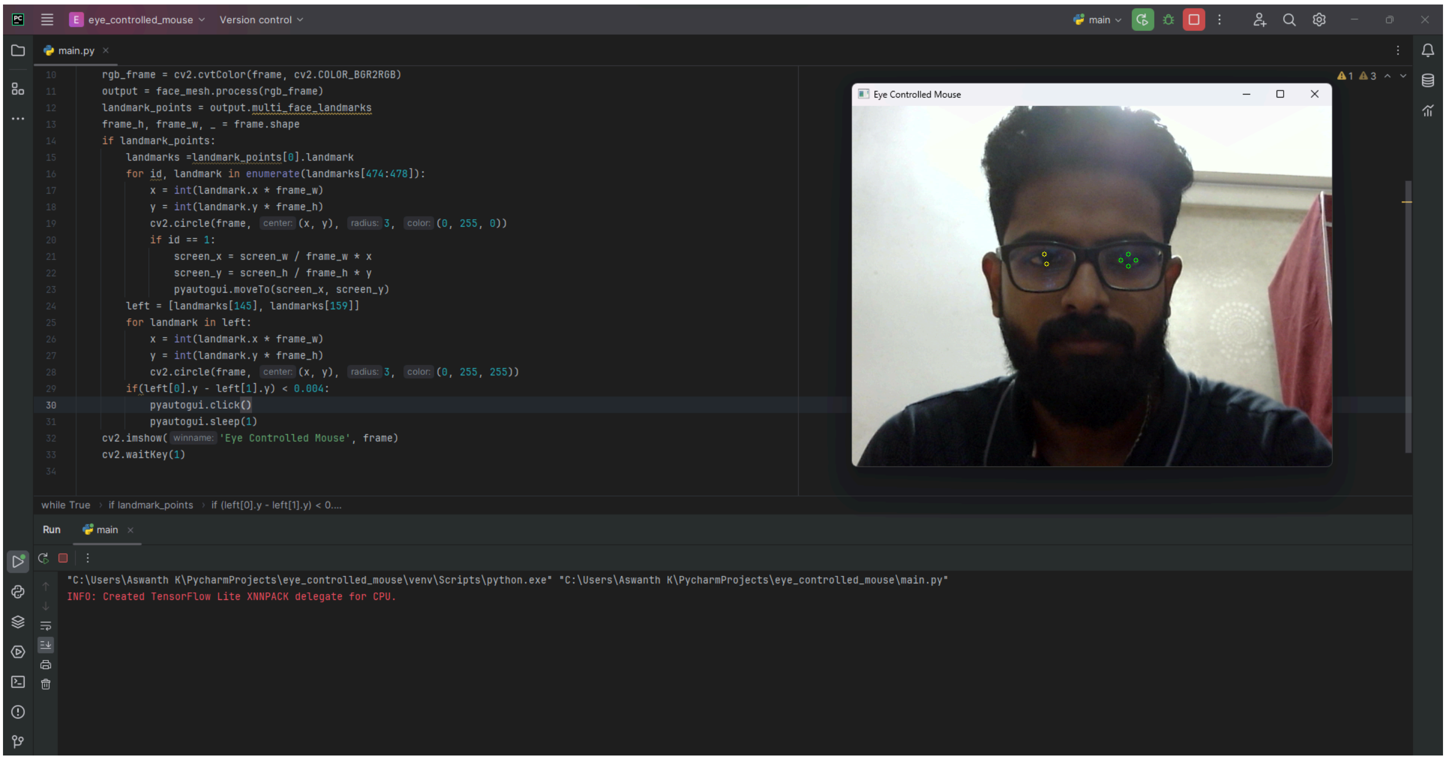
Output Snapshot



```
"C:\Users\Aswanth K\PycharmProjects\eye_controlled_mouse\venv\Scripts\python.exe" "C:\Users\Aswanth K\PycharmProjects\eye_controlled_mouse\main.py"
INFO: Created TensorFlow Lite XNNPACK delegate for CPU.
Traceback (most recent call last):
  File "C:\Users\Aswanth K\PycharmProjects\eye_controlled_mouse\main.py", line 9, in <module>
    frame = cv2.flip(frame, 1)
KeyboardInterrupt

Process finished with exit code -1073741510 (0xC000013A: interrupted by Ctrl+C)
```

Output Eye Tracking



So in the above output snapshot we can see by using the webcam/external cam it will read our eye movements. Green is for the movement of the pointer and yellow is for clicking. It happens when we close our eyes those yellow dots will come closer so that's a click.

Business Modelling

Developing a business model for an eye-controlled mouse involves several key components to ensure its success and sustainability. Firstly, the product itself would be sold to customers who need the device for accessibility purposes or other applications. Revenue would come from direct sales of the eye-controlled mouse, as well as potential accessories or customization options. Additionally, offering maintenance and support services, such as repairs or technical assistance, can create ongoing revenue streams and build customer loyalty. Partnering with healthcare providers, assistive technology organizations, or educational institutions could lead to bulk purchases or distribution agreements, expanding the reach of the product. Furthermore, exploring opportunities for licensing the technology to other companies for integration into their products could generate additional revenue. Overall, a comprehensive business model for an eye-controlled mouse would involve a combination of product sales, services, partnerships, and licensing to ensure financial stability and success in the market.

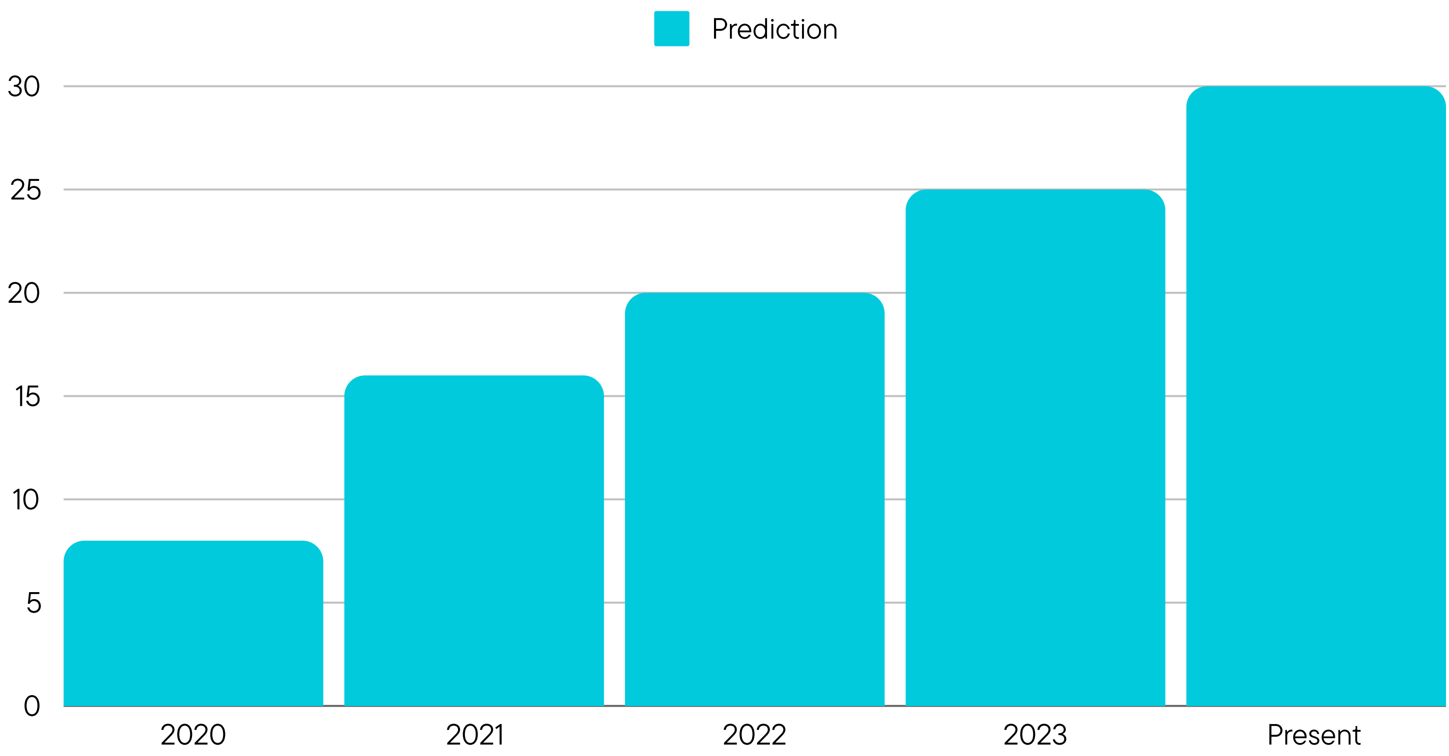
In addition to direct sales and services, a successful business model for an eye-controlled mouse could also explore avenues for collaboration and innovation. This could involve partnering with software developers to create specialized applications that maximize the utility of the device in specific industries or use cases. By fostering an ecosystem of compatible software and tools, the value proposition of the eye-controlled mouse is enhanced, attracting more customers and creating additional revenue opportunities. Moreover, investing in research and development to continuously improve the technology and expand its capabilities is essential for staying competitive in the market. This commitment to innovation not only drives product evolution but also opens up possibilities for new revenue streams through the introduction of upgraded models or advanced features. By embracing collaboration and innovation, a business model for an eye-controlled mouse can thrive in the dynamic landscape of accessibility technology.

Financial Modelling

The market for the eye-controlled mouse spans across various sectors, with the primary focus on accessibility technology and assistive devices. Individuals with disabilities who have difficulty using traditional input devices such as mouse or keyboards represent a significant portion of the target market. This includes people with motor impairments, spinal cord injuries, or conditions like cerebral palsy or multiple sclerosis. Additionally, the healthcare industry is a key market, where eye-controlled mouse can be used for patient rehabilitation, communication assistance, and hands-free operation of medical equipment. Furthermore, there is potential for the gaming and entertainment market, where eye-controlled mouse can offer innovative and immersive gaming experiences. Professional sectors such as design, engineering, and research also present opportunities, as eye-controlled mouse can streamline workflows and enhance productivity. By targeting these diverse markets, the eye-controlled mouse can reach a broad audience and make a meaningful impact on accessibility and user experiences across various industries.

While specific data on the market for eye-controlled mouse may vary, there are general trends and statistics that highlight the demand for accessibility technology and assistive devices. According to the World Health Organization (WHO), over 1 billion people worldwide live with some form of disability, many of whom could benefit from assistive technologies like eye-controlled mouse. Additionally, the assistive technology market is expected to grow significantly in the coming years. For example, a report by Grand View Research estimates that the global assistive technology market size was valued at over $25 billion in 2020 and is projected to reach nearly $35 billion by 2027. Furthermore, there is increasing recognition of the importance of accessibility and inclusion in various sectors, including healthcare, education, and technology. This growing awareness and demand for accessibility solutions suggest a promising market opportunity for eye-controlled mouse and other assistive technologies. As the technology continues to advance and become more affordable, the market for eye-controlled mouse is likely to expand further, providing valuable solutions for individuals with disabilities and improving their quality of life.

Prediction of market



We can make educated guesses about how the market will grow or change over time. For example, if there's a trend towards greater awareness and adoption of accessibility technology, we might predict an increase in demand for eye-controlled mouse. Similarly, if there are advancements in eye-tracking technology that make these devices more affordable or easier to use, we might expect to see a corresponding increase in market demand. However, predicting the market is not an exact science, and there are always uncertainties and variables that can affect outcomes. Nonetheless, by carefully analyzing past data and trends, we can make informed predictions about the future of the market for eye-controlled mouse, helping businesses plan and adapt to meet evolving customer needs.

Use the power of data storytelling through interactive charts! Use a treemap to visualize your large data sets while maintaining their hierarchy and relationship. This chart is interactive, which means you can tap and zoom in on a specific section or subsection.

Accompany your chart with a short description to complement the data and guide your readers as they toggle through the information.

Design Financial Equation

For a market that grows linearly, we can create a financial model using the equation $y=mx(t)+cy=mx(t)+c$, where yy represents the total profit. In this equation, mm stands for the pricing of the product (how much it sells for), $x(t)x(t)$ represents total sales over time, and cc represents production, maintenance, and other fixed costs associated with making and selling the product. This model assumes that for every unit sold, the profit increases by a fixed amount, determined by the product's price, and that there are certain fixed costs that need to be subtracted from the total profit.

On the other hand, for a market that grows exponentially, an exponential market trend can be represented by the equation $y=a\times ebxy=a\times ebx$. Here, yy still represents the total profit. aa is the initial profit or starting value, ee is Euler's number (approximately 2.71828), and bb is the growth rate of the market. xx represents time. In this model, as time progresses, the total profit increases at an ever-accelerating rate, reflecting the exponential growth of the market. This means that the market is expanding rapidly, with the rate of growth proportional to its current size.

Linear and exponential financial models for the market of eye-controlled mouse:

1. Linear Financial Model:
2. For a linearly growing market, we can use the equation:
3. $y=mx(t)+cy=mx(t)+c$
4. Where:

- yy = Total profit
- mm = Pricing of the product (price per unit)
- $x(t)x(t)$ = Total sales (market size as a function of time)
- cc = Production, maintenance, and other fixed costs

This model assumes that the market grows at a constant rate over time, resulting in a linear increase in total sales. Profit is calculated by multiplying the price of the product by the total sales and subtracting the fixed costs.

1. Exponential Market Trend:
2. For an exponentially growing market, we can use the equation:
3. $y=a\times ebxy=a\times ebx$
4. Where:

- yy = Total profit
- aa = Initial profit or starting value
- ee = Euler's number (approximately 2.71828)
- bb = Growth rate of the market
- xx = Time

This model assumes that the market experiences exponential growth over time, resulting in an increasing rate of total profit. The parameter bb represents the rate at which the market is growing exponentially.

These financial models can help businesses analyze and predict profit trends based on the growth pattern of the market for eye-controlled mouse.

Production Cost

The production cost for eye-controlled mouse includes various expenses related to developing, testing, and maintaining the software that enables the device to function effectively. These costs typically involve hiring software developers, engineers, and designers to create the user interface, algorithms, and underlying code that power the eye-tracking and mouse control functionalities. Additionally, there may be expenses for acquiring or licensing specialized software development tools and platforms. Quality assurance and testing processes are also essential, requiring resources for testing the software across different devices, operating systems, and user scenarios to ensure reliability and performance. Furthermore, ongoing maintenance and updates to address bugs, improve functionality, and adapt to changes in technology or user needs incur additional costs. By carefully managing these production costs, businesses can ensure the software for the eye-controlled mouse is robust, user-friendly, and continually evolving to meet the demands of customers. The only materials you require is a desktop/laptop and a web cam with that u can make it work at anytime any place.

Reference

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