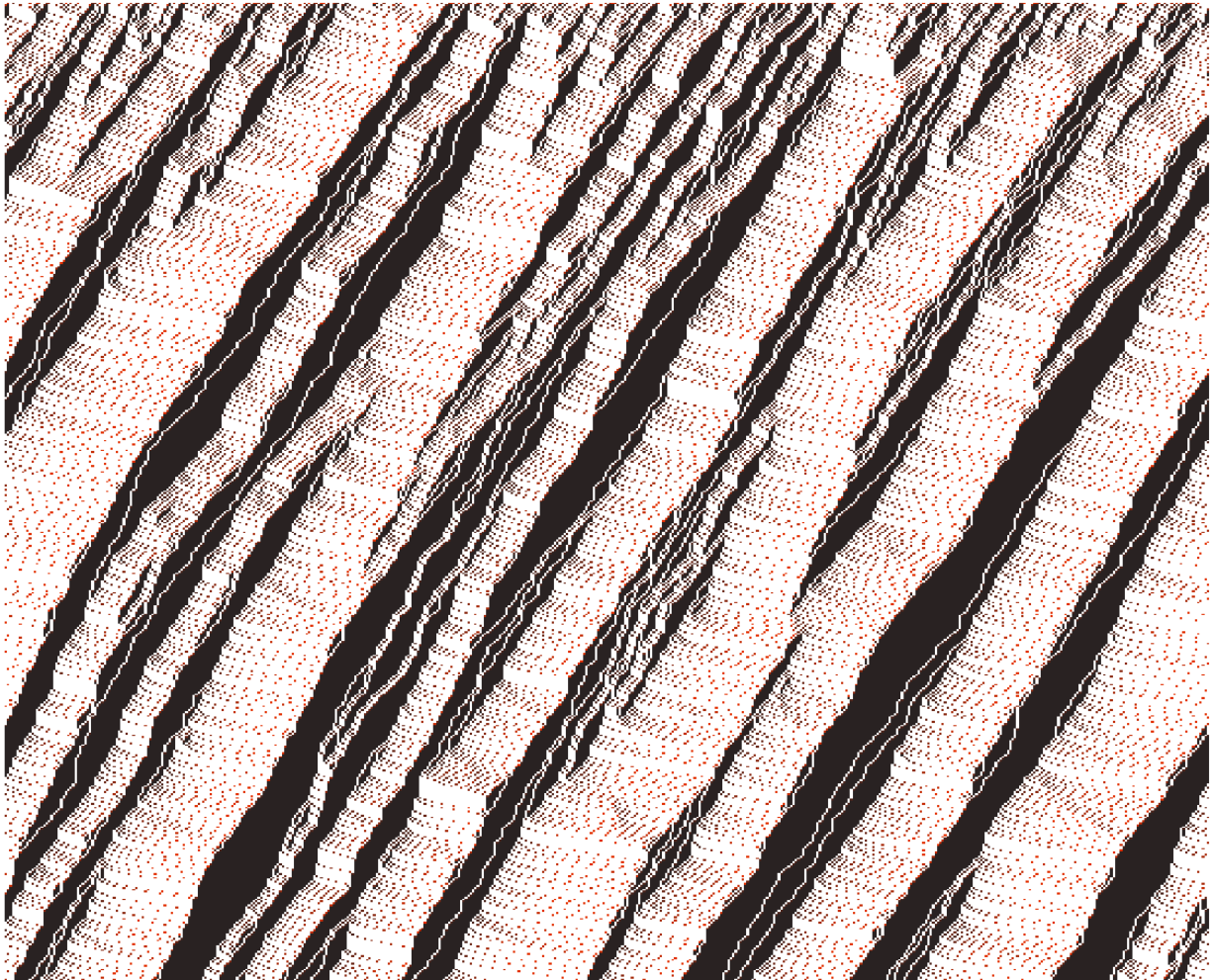


# Ergonomic Posture Detection

## Business model documentation

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## Abstract

test [1]

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# Chapter 1

## Introduction

During the COVID-19 pandemic, a lot of people started to work remotely from their homes instead of working in their offices. Their new workplaces were not ergonomically designed for long-term work. This can lead to health problems.

## Chapter 2

# Solution: How to adress this need?

(by Ari Wahl)

The first goal of this project is to develop a software that helps people to work ergonomically correct. We will develop an application that will be able to detect the user's posture in real-time and give feedback to the user. The feedback should be given in a way that users can correct their posture if necessary. The software should be easy to use and should be able to run on different platforms and devices. It should be available and easily accessible to businesses and private users. Ideally, the user can just use the webcam of their device to use the software. The application will be able to run in the background and give the feedback in a subtle way. We propose a traffic light colored-scheme that will be displayed as a frame around the users screen. This means that the frame will be green if the user's posture is correct, yellow if the posture is not optimal and should be changed soon and red if the posture is bad and should be changed immediately. We will also provide an option to display the feedback as sound. There will be no sound if the posture is correct, a beep from time to time if the posture is not optimal and a continuous sound if the posture is bad. The user can choose if we will also provide a visual feedback in the form of a small window that will be displayed in the corner of the user's screen. This window will show the user's posture in real-time and in case of a bad posture highlights the regions that contribute most to the detection of a bad posture. So the user can know which parts of their posture they should correct. Eventually we will also display arrows in the image on how/which direction to correct the posture next to the highlighted parts.

As data privacy is an important issue with real-time video analysis, we will develop the software in a way that the raw video data will not leave the user's device. It will be processed locally in a first step on the user's device and only the processed data will be sent to the server.

To further develop our application we will (optionally) also analyse the data over time and give the user feedback about their posture in the form of a dashboard. This dashboard will show the user for example how much time they spent in a good, bad or neutral posture and which is their most used bad posture, etc. It will also show the user how much time they spent sitting in total.

As a further step, the application will be extended to optionally also give the user advice on how to compensate for long sitting periods. This will be done by suggesting the user different exercises once in a while after they have been sitting for a long time.

For further development we see the potential to grow into an ergonomic workout application branch. This means that we will have an additional model to detect the user's posture and movements during workout and give them feedback on how to do the exercises correctly.

Another possible area of growth will be physiotherapy applications. This means that we will have an additional model to detect the user's posture and movements during physiotherapy exercises and give them feedback on how to do the exercises correctly.

Since these further developments need additional resources and domain knowledge we will focus on the implementation of the first step of this project.

## Chapter 3

# Technology: Why is it unique?

by Ari Wahl

For our Ergonomic Pose App "PoseFix" we will use YOLO v8 pose as a base model. It can run on mobile devices (Android and Os) with 6-7 frames per second [1], which is more than enough for our application as well as on laptops or desktop computers. For data protection and privacy we will send only the keypoints from the pose detection the be evaluated online on our classification layer or alternatively run the model as a lightweight application completely on the users devices. Either way, this ensures that there is no threat for businesses or private persons as customers to be victims of spy attacks. Just having keypoints would only allow for an extremely abstract representation and is therefore a perfect measure to protect the data and privacy of our customers. For the adaption of the YOLOv8 pose model for our application, we train a classification layer on basis of the keypoint representation. To evaluate, if a pose is ergonomic or not, we collected a dataset, which uses classification levels from the well established RULA (Rapid Upper Limb Assessment) employee assessment worksheed [2]. Additional implementations that exceed the base model will be a dashboard for monitoring the posture over time and show long term improvements to the customer. Also we plan to optionally leverage Explainable AI methods to indicate which joint positions are problematic and show in which direction an improvement can be achieved most quickly. To establish more trust among our (potential) customers we will also aim to get some certification(s) that prove the health impact of our application, e.g. TÜV. For our applications we use the following modules and packages so far: ultralytics YOLO, openCV, Numpy, Pillow, Cocoa, Quartz, objc, PyObjCTools.

A PEST-analysis was done to evaluate the external factors that might influence our business. Since this includes political, economic, social and technological factors, and we focus on the technological factors in this chapter, we decided to include the PEST-analysis in this chapter. And since we are a startup, we also included a SWOT-analysis, that was informed by the PEST-analysis.

### 3.1 PEST-analysis

#### 3.1.1 Political Factors

Our business model is influenced by several key political factors, including labor laws, data privacy laws, AI-related regulations, and copyright laws.

**Labor Laws:** The Workplace Ordinance ArbStättV is crucial for our business, outlining employers' responsibilities towards the ergonomic design and maintenance of workplaces. Our model could benefit from stricter ergonomic requirements [3].

**Data Privacy:** Compliance with the General Data Protection Regulation GDPR is essential, especially for products dealing with employee data [4].

**AI-Related Laws:** The forthcoming EU AI Act may impact our use of third-party AI software, affecting costs and accessibility [5].

**Copyright Laws:** Ensuring that all third-party software or pretrained models used are either copyright-free or appropriately licensed is crucial [6].

**Opportunities and Risks:** Current labor laws create a favorable environment for our B2B model, but changes in ergonomic regulations could present risks. The GDPR, while imposing higher initial compliance costs, offers an opportunity to appeal to privacy-conscious customers. The evolving landscape of AI and copyright laws presents both challenges and opportunities.

### 3.1.2 Economic factors

Right now, one of the economic factors that would influence our business model most is businesses that pressure their employees into returning to the offices again. Less remote work would influence our business model, since the B2C part highly relies on the people working remotely but still wanting to have ergonomic working conditions. It might also diminish the amount of possible buyers in total, because a person working remotely often still has another workplace in the office, doubling the numbers of workplaces per person. People returning to their offices for all days in the week would in total mean less demand for our product and our profitability would suffer. Another factor in the economy would be the distribution of jobs in general. If the (national) economy would develop into less office / desk jobs overall and more manual labor, this would be a problem for our business model in the beginning. In the long run, the business can also focus on manual labor, where ergonomic posture is also a very strong long term health factor that is often not met. So this could rise the demand for our service from the manual labor side. But it needs a lot more training and training data to include all possible manual labour applications, so this could have a negative impact on our overall profitability. With AI introduced into economy, it is unclear how the job distribution will develop in the next years. Right now AI technologies mostly threaten higher skilled workers in desk jobs, but this not necessarily means more manual labor employment on the other hand. It is vital for our business model to watch these developments closely to take strategic measures at the appropriate time. Also the currently high inflation rates might have a negative impact on the demand for our product since businesses may need to keep investments low to survive.

### 3.1.3 Social factors

Social aspects that may impact our business might be changing sensibilities towards AI monitoring. The trend in recent years was people being more and more desensitized for data privacy issues. The wide spread use of social media presence where everyone is giving up at least parts of their privacy voluntarily or just accepting that this is the price for having online attention and connection with friends and acquaintances. This trend is in favour of our product because otherwise people might find it scary (some maybe still do) to be constantly visually monitored at the workplace, even if the data is anonymized at the location before it gets sent to be evaluated by our AI model. A change in lifestyle, social media use and consumer attitudes towards a higher sensibility for this kind of monitoring might therefore threaten our business model. We would need to invest in good marketing, TÜV certifications, etc to assure our customers that their privacy is protected. This could negatively impact our overall profitability. But right now, it seems the trend towards desensibilisation is still unbroken. Another social and cultural aspect impacting our business might be the concept and importance of health in our society. Recent trends lead to a focus on the continuous improvement of healthy behaviour, aiming for longer and better quality of life. Our product greatly profits from this trend, especially in the B2C sector but this also influences the regulations that control the demand in the B2B sector. If this trend changes, the demand of our product might decrease making our business less profitable. For now, the demographics are on our side. A lot of older workers, already suffering from back pain due to unhealthy ergonomics at their workplaces for decades or neglected ergonomics at their remote workplaces that impact older people faster and harder, should stabilize the demand for our product for the next five years. A threat for the demand of our product in the long run though might be the mass retirement of the boomer-generation, that is already happening. The step-by-step retirement of this numerically strong generation might influence the demand of our product. Also younger people that do not want to work five days a week could influence the need and as a result the demand of our product. If people work less and move more in their free time they might suffer less chronic pains or it might take longer to get those even if they do not work under ergonomically good conditions.

### 3.1.4 Technological factors

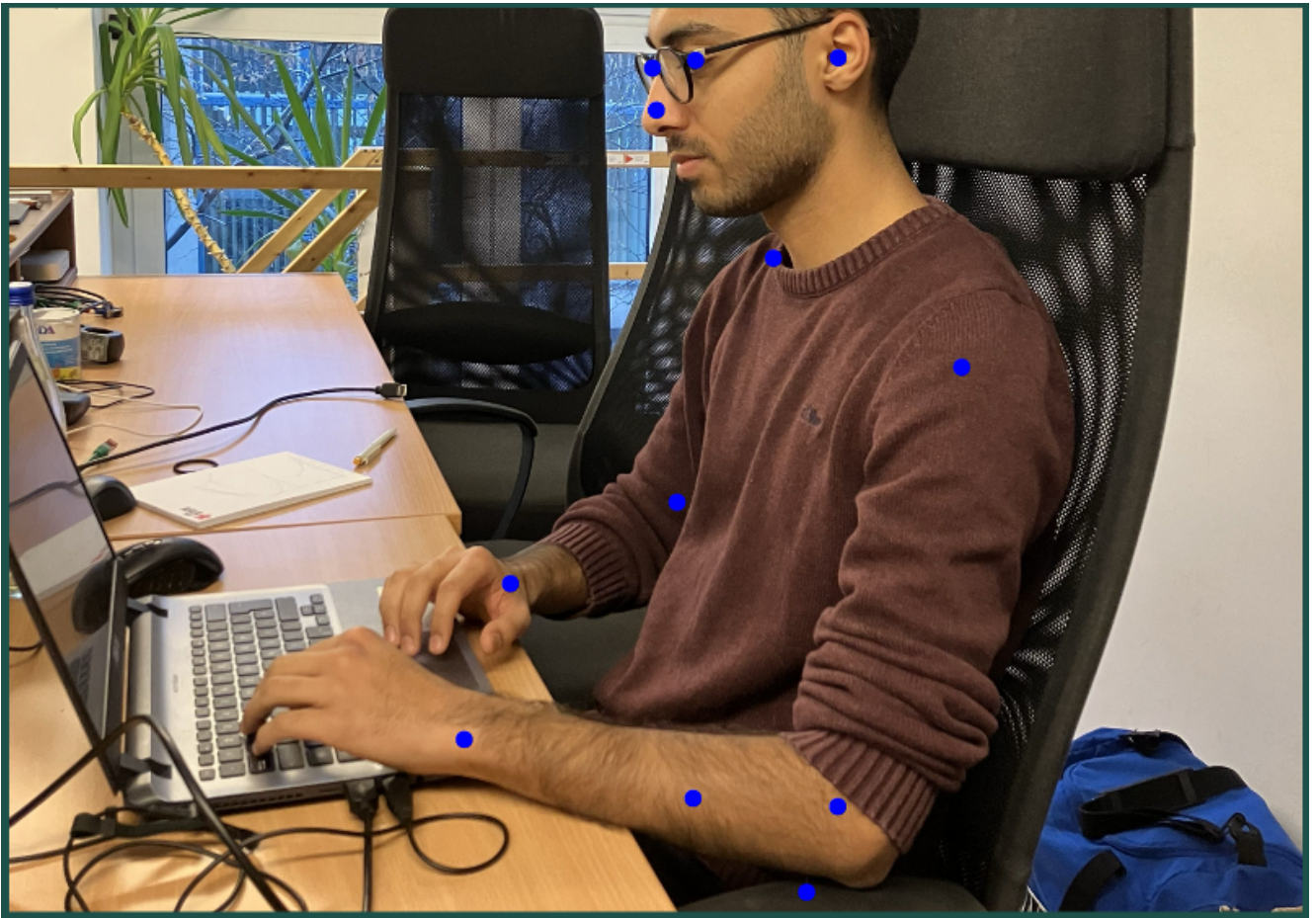
Since our product is state of the art in technology and automation the influence of technological factors may, for now, not be this big. It is still necessary to have Research and Development positions to watch out for technological improvements and new technologies, that might lead to better predictions of ergonomic poses or better data privacy prediction, smaller and more ecological AI models and technology, etc. The idea is to stay in a state of the art position regarding our product, so that new developments are not a threat for our business. The main technological threat to our business model is a big tech company picking up the business idea and incorporate it in their business model. It would then be within an operating system or microsoft 365 applications which would then be ubiquitous and not be a business model for a small or middle sized company anymore. It would drop the demand of our product significantly and abruptly.

## 3.2 SWOT-analysis

<p><b>STRENGTHS:</b></p> <ul style="list-style-type: none"> <li>o <b>User Experience:</b> intuitive and user-friendly user feedback as frame in traffic light scheme</li> <li>o <b>Technology Stack:</b> Advanced and secure technology</li> <li>o <b>Strategic Partnerships:</b> with tech companies, platforms, or health organizations</li> <li>o <b>Compliance with Privacy Laws:</b> Adherence to GDPR, CCPA, etc.</li> <li>o <b>Trust and Transparency:</b> Open communication about data privacy</li> <li>o <b>Sophisticated Monitoring:</b> tracking performance, user behavior, etc.</li> </ul>	<p><b>WEAKNESSES:</b></p> <ul style="list-style-type: none"> <li>o <b>Lack of business experience</b></li> <li>o <b>Limited resources:</b> Budget constraints, small team, etc.</li> <li>o <b>Scalability issues unknown:</b> challenge to handle increased users or data</li> <li>o <b>Technical issues unknown:</b> bugs, slow performance...do more testing</li> <li>o <b>Marketing strategy:</b> Limited reach due to limited resources</li> <li>o <b>Dependency on Third-Party Platforms:</b> reliance on app stores</li> <li>o <b>User Concerns about Privacy:</b> skepticism towards video monitoring</li> </ul>
<p><b>OPPORTUNITIES:</b></p> <ul style="list-style-type: none"> <li>o <b>Technological advancements:</b> Leveraging new lightweight models, etc.</li> <li>o <b>Regulatory changes:</b> Stricter workplace regulation laws or policies</li> <li>o <b>Partnerships or alliances with health insurances</b></li> <li>o <b>Integration Possibilities:</b> Opportunities to integrate with other services</li> <li>o <b>Innovative Privacy Solutions:</b> Constantly improving data privacy</li> <li>o <b>Adding new features and growing into other markets:</b> Manual labor, physiotherapy, and workout</li> </ul>	<p><b>THREATS:</b></p> <ul style="list-style-type: none"> <li>o <b>Competitive Market:</b> similar products or big tech companies integrating something like our product on operating system level or into office suites</li> <li>o <b>Regulatory Challenges:</b> EU AI Act could impose restrictions or require costly compliance measures</li> <li>o <b>Changes in consumer preferences:</b> Increasing skepticism towards AI, less remote work or also a cultural development towards less long-term health orientation</li> <li>o <b>Economic Downturns:</b> Which could impact funding or consumer spending</li> <li>o <b>Public Perception and Trust Issues:</b> Perceived (or real) privacy concerns</li> </ul>

## 3.3 Mock-up







## **Chapter 4**

# **Business Model: How to capture value?**

## **Chapter 5**

# **Marketing and sales: How to sell it?**

## **Chapter 6**

### **Competition: Who else is in the game?**

## **Chapter 7**

**Implementation team: Who will implement the plan?**

## **Chapter 8**

**Status or timeline: Where are we now, what next?**

## **Chapter 9**

**Executive summary: Concise overview of the opportunity**



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