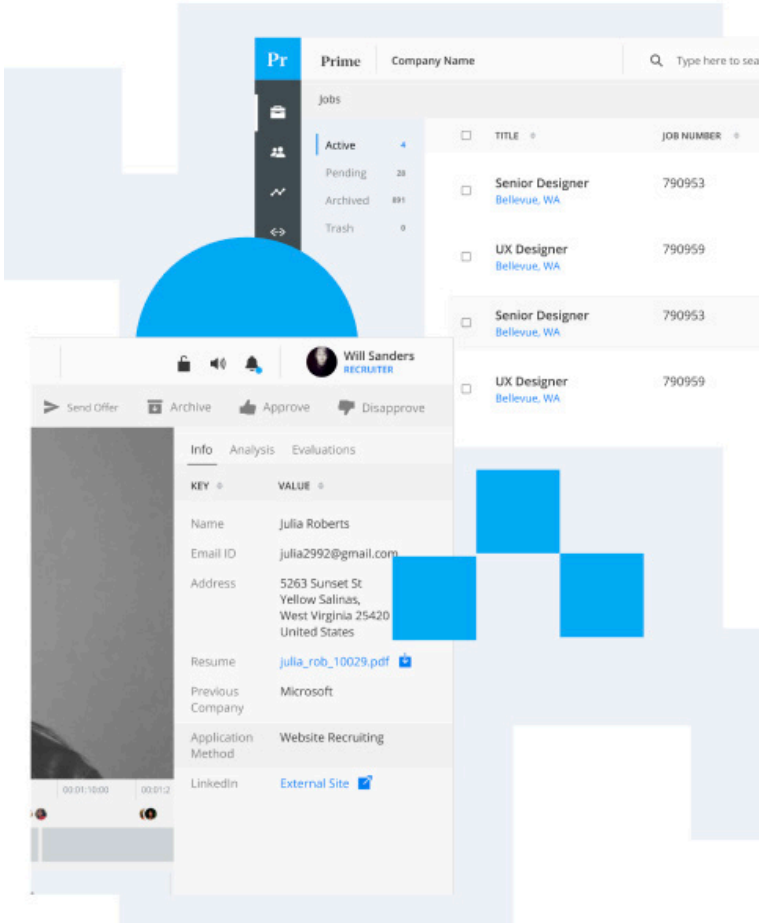

DEP406 : BDES DESIGN PROJECT - II

Artificial Intelligence Powered Enterprise Hiring Platform

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16U130021 - BDes Final Year,
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Guided by
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अभिकल्प विद्यालय

Project Approval

The project titled “Artificial Intelligence Powered Enterprise Hiring Platform” by Naveen Shaji of BDes 2016-20, is approved for partial fulfillment of the requirement for the degree of ‘Bachelor of Design’ at IDC School of Design, IIT Bombay.

Guide:

Chairperson:

Internal Examiner:

External Examiner:

Date:

Declaration

I declare that this written document represents my ideas in my own words and where others' ideas and words have been included, I have adequately cited and referenced the original sources.

I also declare that I have adhered to all principles of academic honesty and integrity and have not misinterpreted or fabricated or falsified any idea/data/fact/source in my submission.

I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Naveen Shaji
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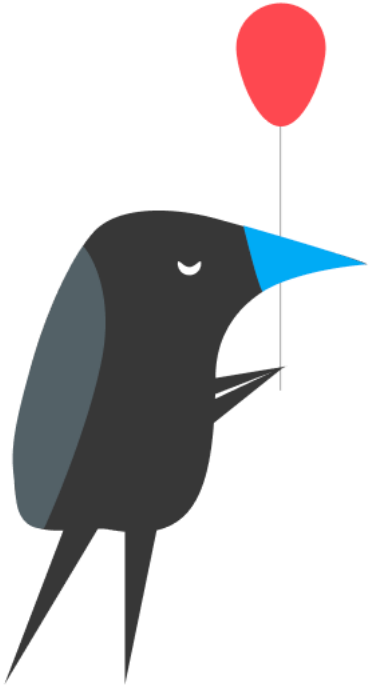

Acknowledgment

I would like to thank Prof. Venkatesh Rajamanickam for his constant support and guidance throughout the project. I am also grateful for the valuable feedback received from Prof. Aniruddha Joshi, Prof, Swati Pal, Prof. Ravi Pooviah and Prof B. K. Chakravarthy.

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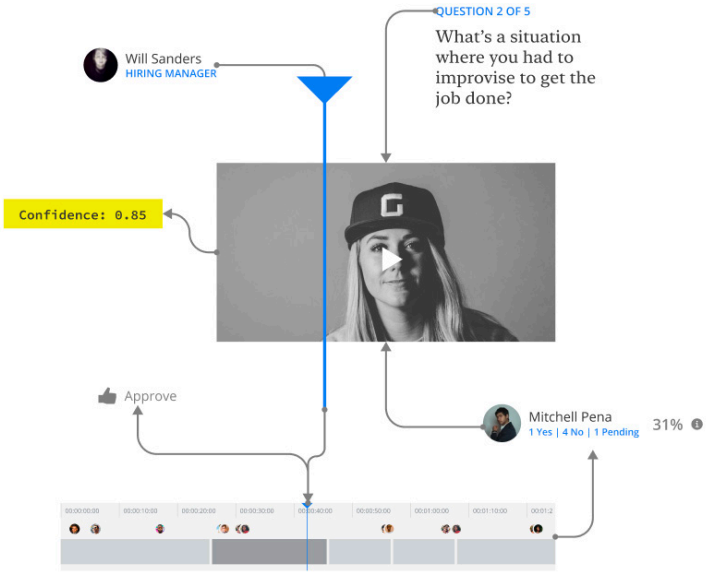


1. Abstract

Hiring is one of the most crucial functions of any organisation and hiring the right talent can be the difference between a successful company and a failed venture. As the world moves toward a virtual approach to working, it's only natural that more and more companies hire through online interviews.

Services like LinkedIn offer one click application to job roles using your online LinkedIn profile. This, while making it easier for candidates to apply for roles, also puts stress on the human resources team that's screening applicants. There has been a rise in automated software that analyses candidate resumes and shortlists a smaller, more manageable number of candidates. Only these shortlisted candidates are then allowed to proceed to the next step in the hiring process. More often than not, this process overlooks a lot of applicants who may be a great fit for the team, but were eliminated in favour of applicants who look better on paper due to resource costs associated with interviewing a large number of people.

The product outlined in this paper aims to automate part of the

interviewing process so as to enable a more comprehensive screening method whereby a larger number of applicants are interviewed and evaluated on a multitude of factors using artificial intelligence so as to reduce interviewing costs while still retaining the ability to evaluate more than just resume points. It fits into the existing pipeline of hiring tools, working as a recommender system by analysing communication and cognitive skills and competency in a wide range of scenarios matching the job requirements to find the best fit for the role.

2. Background

The application of Artificial Intelligence and Machine Learning in Hiring started with software that screened online applications from thousands of applicants on a website based on keywords, work experience, or experience in a particular industry.

In recent times, companies have started interviewing candidates remotely for on-site job openings, while some companies have taken this one step further and introduced artificial intelligence agents to evaluate interview responses.

> *"People are rejected all the time based on how they look, their shoes, how they tucked in their shirts and how 'hot' they are, Algorithms eliminate most of that in a way that hasn't been possible before."*
> *- The Washington Post*[1]

Many of the Fortune 500 companies, including Vodafone and Singapore Airlines, have been using Artificial Intelligence based systems to evaluate candidates. At the consumer goods conglomerate Unilever, HireVue, a prominent Artificial Intelligence based Interviewing tool, is credited with helping save 100,000 hours of interviewing time and roughly $1 million in recruiting costs a year

1 https://www.washingtonpost.com/technology/2019/10/22/ai-hiring-face-scanning-algorithm-increasingly-decides-whether-you-deserve-job/

3. Introduction

Anyone who has gone through the arduous process of job searching can tell you that more often than not, applying to a company through their job portal by submitting your resume will not yield any response. While this makes sense from the company's perspective considering they'll be getting thousands of applicants each day, it's disheartening to learn that most of these candidates do not even get a chance to show their worth.

The landscape of hiring today is riddled with a few systemic inadequacies that suggest the need for a more efficient system. Recently more and more companies have started exploring artificial intelligence based screening for more and more of their hires. Some companies use it for shortlisting resumes for interviewing, others use it in the interview process itself. This approach had a few distinct benefits. All candidates were evaluated across multiple attributes, and it reduces hiring time drastically. Candidates hired this way reportedly have a 30% lower dropout rate at Vodafone[2]

2 https://www.hirevue.com/customers/vodafone-hirevue

3.1 Hiring Costs

An ideal system should be fair to both the company as well as the thousands of potential applicants. There is a finite amount of human time cost associated with hiring and every minute interviewing a candidate is time away from the company's main operation for each manager, which can prove very expensive. This cost increases manifold if the interviews need to be in person when factoring in the transport and logistics costs which are borne by the company itself.
The current solution to this problem is to aggressively eliminate potential candidates by ranking their resumes, which may not paint the whole picture, or worse, ignoring large amounts of applications that come in through mass application systems like online job portals. This is far from ideal.

3.2 Interviewer Bias

Humans have time and again proven themselves to be largely biased when it comes to making hiring decisions. Studies show that interviewers still allow illegal and often irrelevant factors, such as the combined effects of ethnicity and accent,

to affect judgments and decisions about job applicants, instead of focusing only on job-related qualifications.[3] More than 180 human biases have been defined and classified by researchers at IBM, and any one of which can affect how humans make decisions.[4]

> *"We don't realise how biased we are until we see an AI reproduce the same bias, and we see that it's biased." - John Shawe-Taylor, UNESCO AI Chair & Professor at University College London*

Advent of advanced techniques in artificial intelligence allows careful training and correction of the machine learning models to eliminate all forms of bias in artificial intelligence models and applications. This has been done by developing a methodology to reduce the bias present in any dataset so that any algorithm that learns from it will be free of bias.[5]

3.3 Motivation

Designing interactions for the inevitable future where AI could be more and more involved in hiring, right at the bleeding edge of technology and establishing user experience models and frameworks in such a novel space could have far reaching implications that I'm excited about.

I've been designing artificial intelligence based tools that generate and visualise highly complex in-video metadata over the last three years, which are currently in use by companies like Sony, 9X, Zee, and Viacom18. This puts me in a position where I understand the underlying technology as well as its applications.

3 Segrest, 2006 : Segrest Purkiss, S. L., PerrewÃ©, P. L., Gillespie, T. L., Mayes, B. T., & Ferris, G. R. (2006). Implicit sources of bias in employment interview judgments and decisions. Organizational Behavior and Human Decision Processes, 101(2), 152-167. https://doi/10.1016/j.obhdp.2006.06.005

4 https://www.research.ibm.com/5-in-5/ai-and-bias/

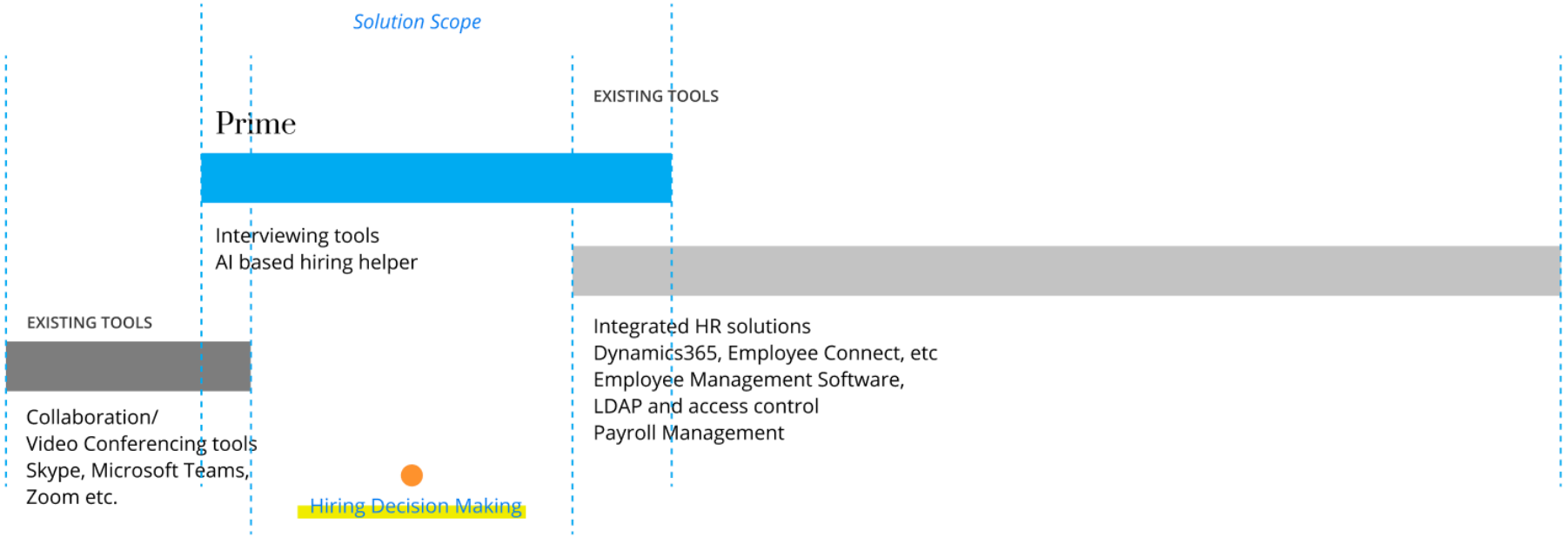
5 Calmon, 2017)(Optimized Pre-Processing for Discrimination Prevention - Flavio Calmon, Dennis Wei, Bhanukiran Vinzamuri, Karthikeyan Natesan Ramamurthy, Kush R. Varshney: http://papers.nips.cc/paper/6988-optimized-pre-processing-for-discrimination-prevention

4. Project Scope

This project aims to develop a pragmatic model for a web application (called Prime) that uses Artificial Intelligence to facilitate and aid the process of hiring from a large pool of candidates at medium to large organisations across roles.

4.1 Target Users

The program is multi-faceted in the sense that while being primarily geared towards hiring managers and HR staff, there will be an applicant facing part that the interviewee interacts with. In terms of the value that it delivers, it affects companies by allowing them to hire from a larger pool of candidates without facing the overhead, as well as applicants by



empowering them to showcase their personality and soft skills and not just their resumes.

4.2 Goals

Empowering hiring staff at a company to effectively evaluate a large number of candidates while requiring minimum human intervention. The solution needs to be scalable to fit in different industries, roles, and scenarios.

Make users comfortable with interviews that are one-sided, where the response is recorded and evaluated separately.

4.3 Non-Goals

Create an explainable machine learning algorithm that scores candidates on different parameters while eliminating bias and bubble formation.

5. Literature Review

Previous works in the area of analysis of structured video interviews show that using a facial expression analysis toolkit on corpus recorded using actors that mimic performance traits, performance scores can be calculated[67]. These studies show that it is in fact feasible to find correlation between a simple facial expression analysis and job performance. A true multi-modal system which asynchronously evaluates, speech tone, facial expressions, and speech intent towards a psychologically formulated questionnaire designed to elicit performance metrics could provide accurate insights into candidate performance in

6 Lei Chen, Su-Youn Yoon, Chee Wee Leong, Michelle Martin, and Min Ma. 2014. An Initial Analysis of Structured Video Interviews by Using Multimodal Emotion Detection. In Proceedings of the 2014 workshop on Emotion Representation and Modelling in Human-Computer-Interaction-Systems (ERM4HCI '14). Association for Computing Machinery, New York, NY, USA, 1–6. DOI:https://doi.org/10.1145/2668056.2668057

7 Shruthi Kukal Nambiar, Rahul Das, Sowmya Rasipuram, and Dinesh Babu Jayagopi. 2017. Automatic generation of actionable feedback towards improving social competency in job interviews. In Proceedings of the 1st ACM SIGCHI International Workshop on Multimodal Interaction for Education (MIE 2017). Association for Computing Machinery, New York, NY, USA, 53–59. DOI:https://doi.org/10.1145/3139513.3139515

different spheres.[8]

The use of a three dimensional modelled virtual interviewer has been showcased to be effective in making one sided interviews more natural with an interactive multimodal dialogue system.[9] This solution helps naturalise the otherwise un-natural process of talking to a screen with no response, or worse, talking to a screen of your own image reflected back at you. Recent advancements also allow the use of Intelligent Interviewers that can ask follow up questions to confirm if a particular answer matches a goal answer.[10]

8 Sowmya Rasipuram, Pooja Rao S. B., and Dinesh Babu Jayagopi. 2016. Asynchronous video interviews vs. face-to-face interviews for communication skill measurement: a systematic study. In Proceedings of the 18th ACM International Conference on Multimodal Interaction (ICMI '16). Association for Computing Machinery, New York, NY, USA, 370–377. DOI:https://doi.org/10.1145/2993148.2993183

9 Kirby Cofino, Vikram Ramanarayanan, Patrick Lange, David Pautler, David Suendermann-Oeft, and Keelan Evanini. 2017. A modular, multimodal open-source virtual interviewer dialog agent. In Proceedings of the 19th ACM International Conference on Multimodal Interaction (ICMI '17). Association for Computing Machinery, New York, NY, USA, 520–521. DOI:https://doi.org/10.1145/3136755.3143034

10 Kathleen Weaver, Anita Komlodi, and Brian Duffy. 2013. Using an intelligent interviewer to perform cognitive assessments. In CHI '13 Extended Abstracts on Human Factors in Computing Systems (CHI EA '13). Association for Computing Machinery, New York, NY, USA, 259–264. DOI:https://doi.org/10.1145/2468356.2468403

These extremely sophisticated technologies acting together can create a very compelling cohesive experience.

6. Existing Solutions

There are a few solutions that try to use artificial intelligence in different phases throughout the hiring process. The most common use case is as a resume screening tool that learns from past hires. More recently tools that analyse a multitude of attributes from recordings of video interviews have emerged as well with HireVue being the market leader with clients like Unilever, Vodafone, and Singapore Airlines.

6.1 Resume Screening Software

These software churn through thousands of resumes that come in through the application portal and apply stringent pre-set rules to try and reduce the number of resumes that are presented for human evaluation. Newer versions of these

software use machine learning to learn the qualities that make a good hire and can apply that to filter the stack of resumes further.

6.2 Virtual Interviewing Software

There has been a recent increase in virtual interviewing software. Services like panna.ai, Interviewer.ai, and Harver have emerged. However, HireVue remains the market leader with the largest client base. Most of these applications often work as a single-modal evaluation of generic traits. This approach often fails to translate into transparent actionable insights for the review team. Transparency in scoring is also something which is not seen. Some of these offerings include resume screening alongside virtual interviews, real time chat with applicants, and hiring analytics based on a multitude of data points.

However, none of the offerings provide an end-to-end solution for hiring and remain mostly constrained to the interviewing space.

6.3 Employee Management Software

Employee management software like Dynamics365 are powerful, full featured suits of applications that include everything from payroll management to employee tracking. This is standard at most large companies, however these employee management programs are not specifically built for hiring and often come into the picture only after a hiring decision has been made.

7. Primary Research

Conducted unstructured and semi-structured interviews with 4 hiring managers from multiple startups and multi-national companies in the country who have been responsible for anywhere between 20 and 100 hires each and 4 applicants who had interviewed at different companies in the past few months. The interviews were conducted either via phone or in person.

7.1 Hiring Workflow and Structure

At larger companies managers usually reach out to the hiring staff through a team admin with the requirements for the role. University recruiting is done irrespective of specific job scenarios to fill openings in different teams. This process is handled entirely by the hiring staff and an evaluation panel from across different teams.

Larger companies usually use a large and powerful enterprise suite of tools to manage employee pipelines and track statuses. These are highly complex software that handle things like onboarding as well as tax filing and employee leave management. The solution that is implemented needs to be able to integrate well with existing services. This is the key to adoptability in larger organisations.

Medium size companies and startups typically rely on a plethora of consumer tooling to manage and hire employees and can vary wildly based on the company and region. They are also more eager to try new solutions. However the a lot of the value in this project is lost as they are applied to smaller companies who face a manageable amount of applicants. Most startups interview almost every candidate who applies and fits the job description.

7.2 Interview Scheduling and Decision Making

Interviews are usually scheduled manually by recruiting staff through emails sent to candidates. If candidates are unavailable during a chosen time, they usually get back to the recruiter via email to inform them and get another time slot.

For most applicants at a large company like Microsoft for Full-Time Employee (FTE) roles, there are 5 rounds of interviews. Each interview culminates in a ‘Hire’ or ‘No-Hire’ recommendation. If the applicant does not get a ‘Hire’ recommendation at least twice in the first four rounds, then they won’t proceed to the final round. The final round is usually scheduled with a very senior manager in the organisation structure called the As Appropriate (AA). The AA may not be the actual hiring manager, however, the hiring manager almost never overrules the AA.

After each interview, interviewer notes are shared with the HR staff who maintain a record for future employment opportunities as well. Most companies decline to interview a candidate who has been interviewed in the past year so as to not waste resources.

7.3 Applicant Perspective

Applicants who are evaluated through one sided pre-recorded interviews often find themselves staring at their own reflection on the screen through the webcam. Some have gone so far as to actually paste a post-it note over the screen so that they didn't have to see themselves while talking as that is reportedly distracting.

Applicants expect their recorded interviews to be evaluated by humans, and not algorithms. They are apprehensive about the use of algorithms deciding something that can have such a large impact on their lives.

7.4 Hiring Manager Perspective

Interviewers like the concept of having to interview only the best candidates, but are skeptical about the accuracy of AI in hiring decisions. They find value in being able to go through an interview at any time.

All interviewers prefer to see an aggregate score for each candidate's performance, and then have the freedom to review the data and see the video feed if needed. They were not particularly interested in the details of how such a score is obtained, while they wanted control over the kind of qualities they were looking for based on the type of hire. They look for different qualities in different hiring scenarios based on the open role, while looking out for candidates that are a better fit for the company's overall culture.

They agreed that having a transcript of the interview is helpful and would make it more likely that they don't actually listen to the full interview.

7.5 Enterprise Requirements

Enterprises usually have a large number of employees working on just hiring new talent. Managing access and permissions to effectively manage the use of a platform by a large number of people is crucial.

Hiring new talent includes a lot of enterprise headway in terms of acquiring the required approval and getting the paperwork and documentation done before an offer is sent out. Required processes like employment history checks, background and criminal verification, and visa sponsorship are all handled by different teams.

Having an efficient workflow that automates this handoff between the different teams that have their own role to play will definitely help larger teams.

8. Design Interventions

The product was designed based on multiple design interventions coming together after evaluating multiple solutions for each aspect of the collective problems outlined during primary research.

8.1 Types of Interviews

Since it was found to be imperative that the solution be scalable across a range of scenarios, different types of interviews and rounds need to be addressed. The platform should facilitate everything from custom crafted screening for specific traits to just scheduling a face to face real life interview. Due to this scalability being paramount to market acceptance, the product needs to handle at least four different interview scenarios. These different types of interviews can be stacked together as different rounds to create templates for jobs.

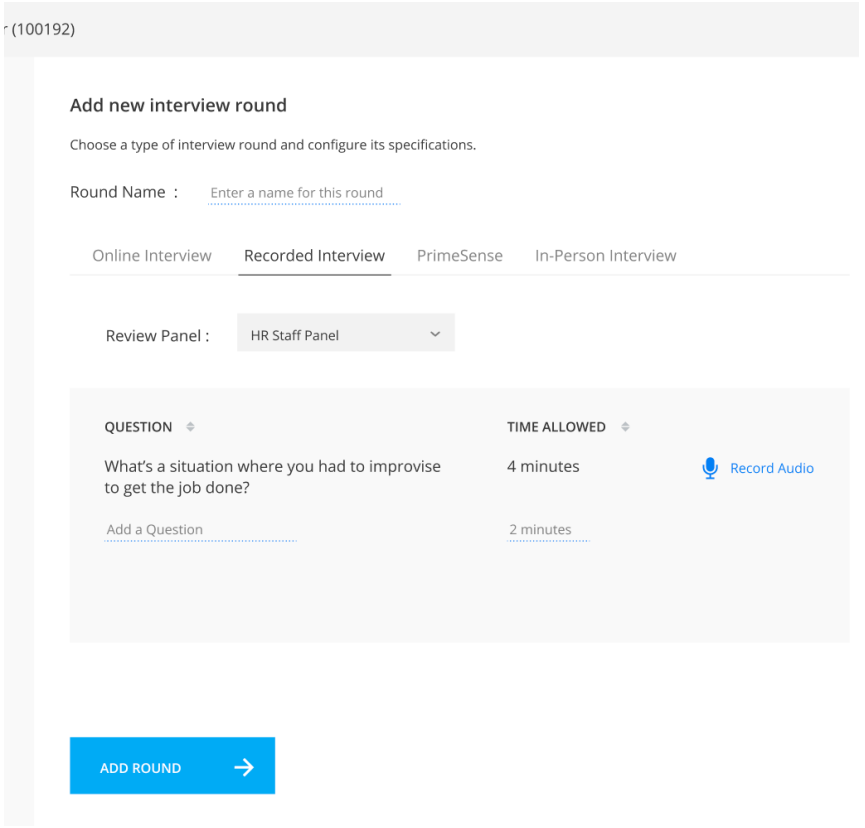
8.1.1 Multi-modal evaluation of traits that contribute to job performance (PrimeSense)

In this scenario, the hiring manager can choose the ideal employee profile from a cluster of different psychological and personality traits. The traits needed for a manager will be widely different from that of an Individual Contributor (IC). These traits will be measured by assessing multi-modal features extracted from a recorded structured video interview where the questions are chosen to evaluate specifically the mix of traits that have been chosen as ideal by the hiring manager. Candidates will then be ranked by default in the order of their fit with the defined profile for review.

8.1.2 Recorded Interview with a subset of generalised traits

This type of interview allows for custom questions to be set by the hiring manager which could include technical questions. The applicant's answers can then be viewed as video responses or through a transcript while reviewing.

Traits like confidence will be measured based on speech and affect analysis on the video feed. This could be used for evaluating technical finesse without being as resource intensive as a live interview.



8.1.3 Online Live Interview

Online live interviews can be scheduled and conducted through the platform, on completion of which a recording can be used to further train the machine learning model.

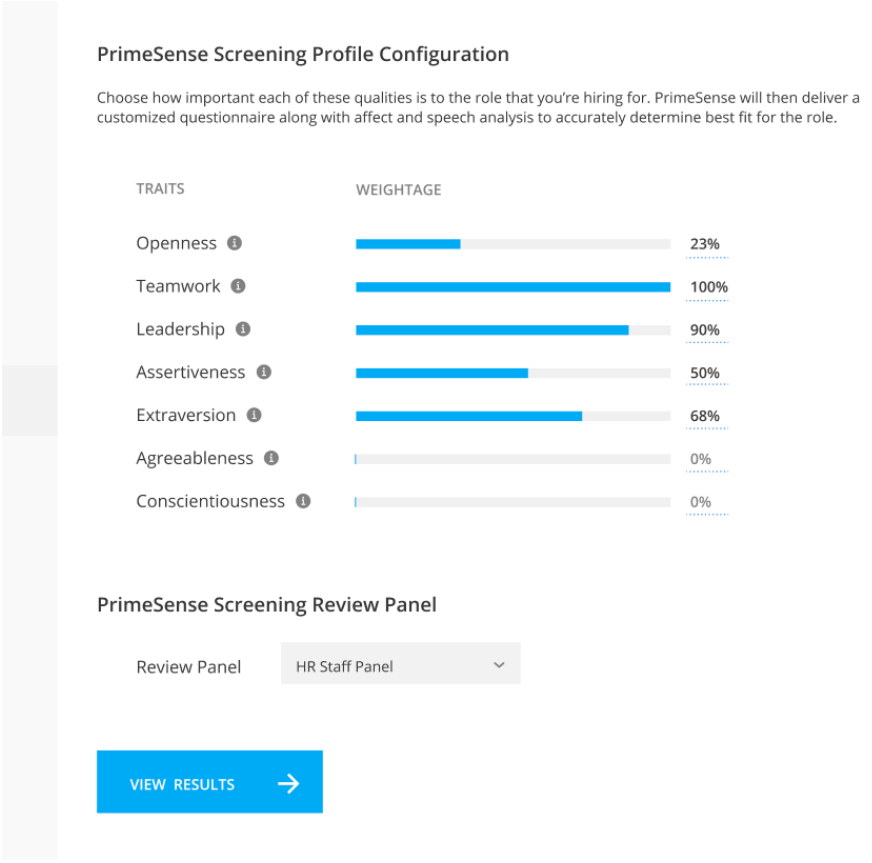
8.1.4 In-Person Interview

In-Person Interview rounds can also be configured and scheduled while also providing a platform to retain interview notes and update recommendation status for candidates.

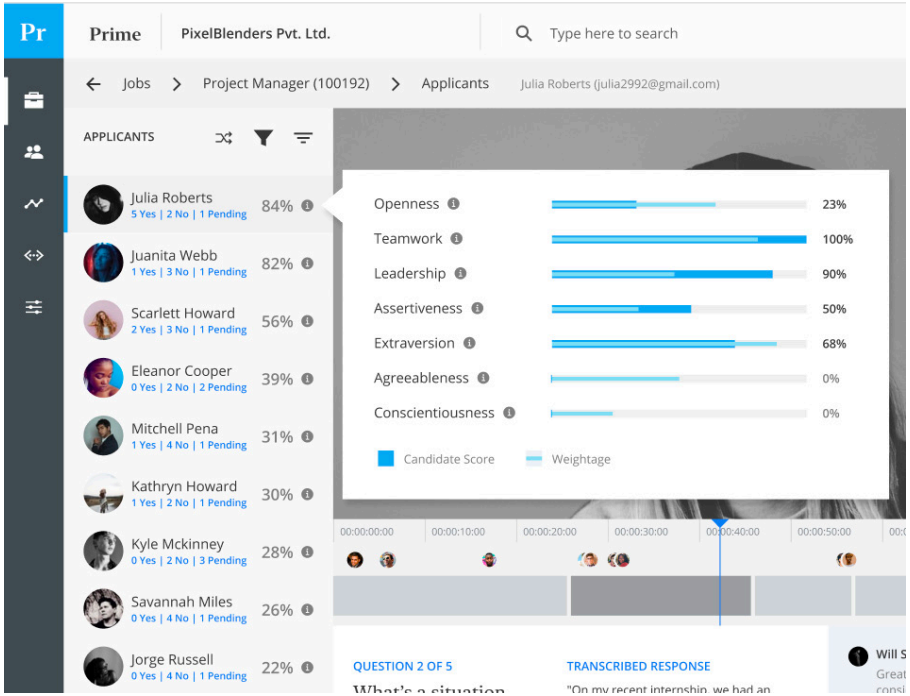
8.2 Custom Weightage of Attributes

PrimeSense enables hiring managers to create their own model of ideal profile for a specific job role by assigning weightage for multiple roles. Openness, Teamwork, Leadership, Assertiveness, Extraversion, Agreeableness, and Conscientiousness are some of the qualities that can be measured and scored based on. Each trait is also explained separately in order to better communicate what the trait translates to when it comes to job performance.

For example, conscientiousness stands for meticulousness in performing duties. It's got a very high correlation to job performance and productivity. It's a quality sought after in individual contributor as well as manager roles.



Once the hiring manager chooses the right blend of traits that he would want to see from prospective hires, all candidates evaluated by the system would be scored relative to this ideal model. When the results are reviewed, the candidates are sorted according to the percentage fit for the role. Reviewers can make a hire or no hire recommendation then based on this score as well as a review of the interview footage.



The percentage score is also explained to reviewers with a visualisation over the ideal score weightage across the different traits and how the candidate measured up against it.

8.3 User Management, Workflows and Pipelines

8.3.1 User Management

User Management is mostly done by team admins and managers. Users are part of different work groups, and within a work group, they can have roles which are responsible for the permissions and level of access they get. Within a group, admins and group managers will usually have higher privileges than reviewers. However, none of this is set in stone. The platform is completely scalable and allow custom user roles and groups with varying permission structures as required for the organisation.

This is a completely scalable framework designed to adapt to any form of enterprise hierarchy and organisation structure

while remaining powerful enough to work in every scenario.

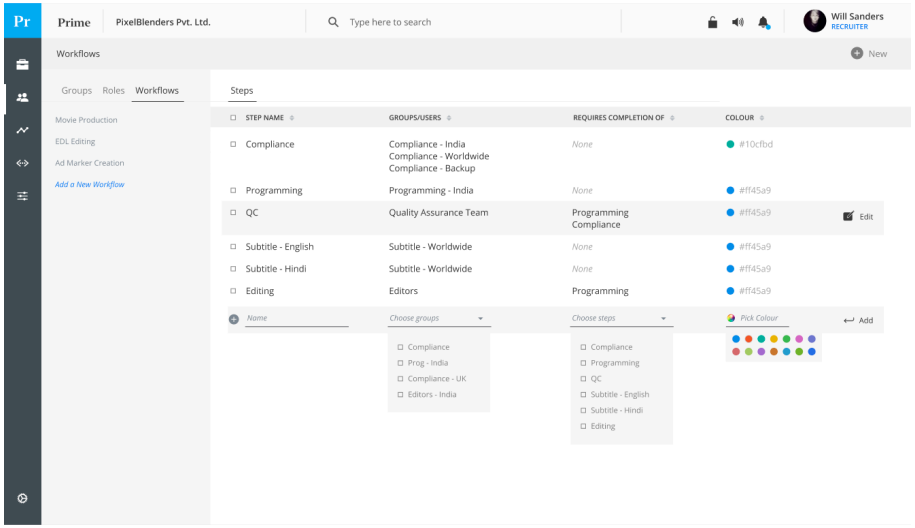
8.3.2 Workflows and Pipelines

Since work moves around different teams in large organisations where one step in the process is dependant on the completion and outcome of another step that is executed by another team, workflow tracking and automation speeds up the hiring process.

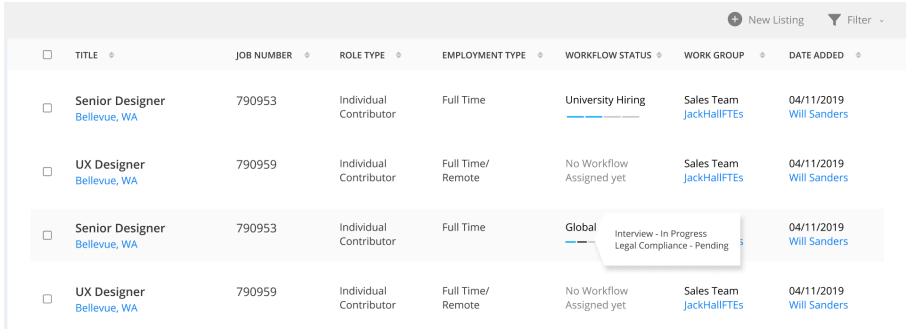
Building around the ideals of scalability and modularity, the workflow framework designed here enables seamless handoff of candidates through multiple teams while providing ample tracking and status updates.

Workflows can be created by defining custom steps. Each step is attached to a user or team and can have dependancies on other steps. This allows for serial and parallel workflows for non-conflicting steps. The team or the user concerned can update the individual status of a step to pending, or in-progress, or completed.

The status of each job which has a workflow attached to



it can be seen in the main job listing on the dashboard. On hover, details about the progress of steps are shown as well. This provides a convenient way to track candidate onboarding across the hiring process.

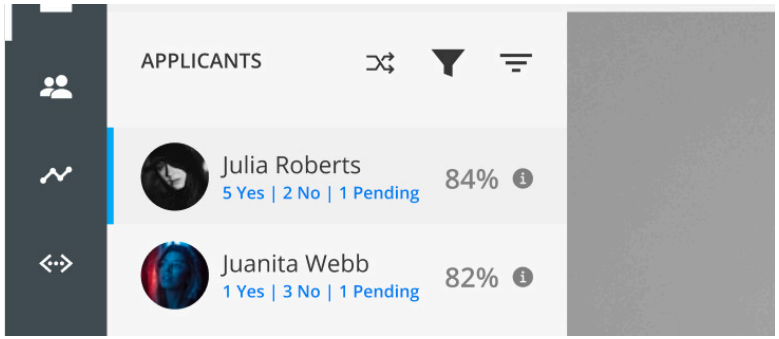


8.4 Review Mechanics

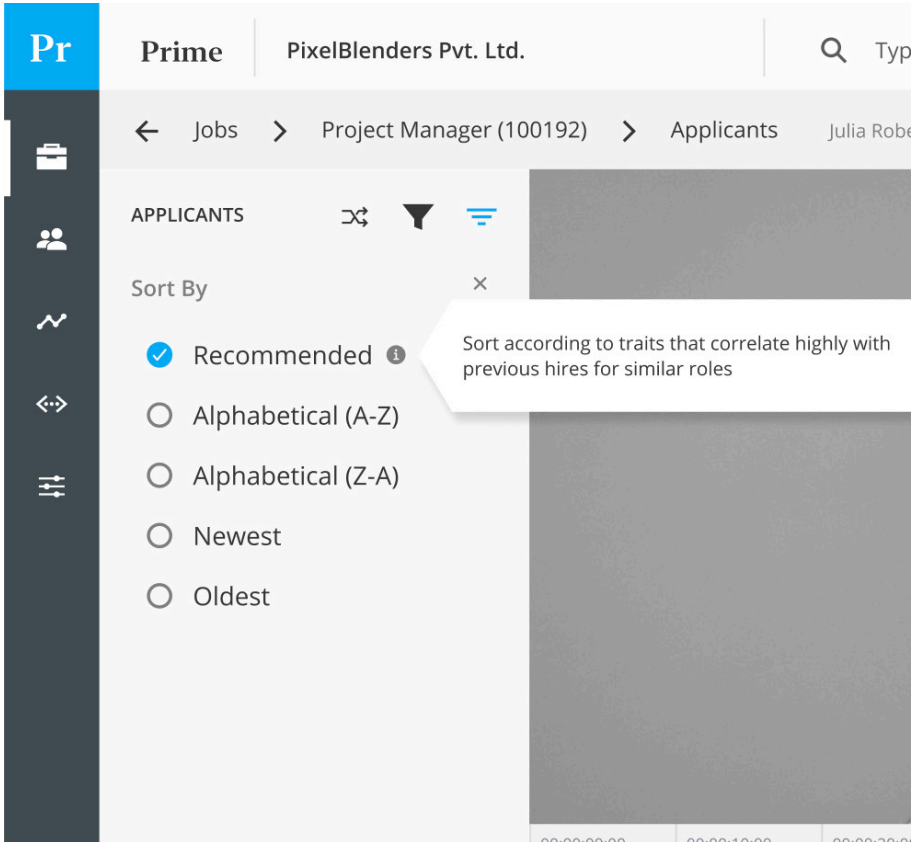
Reviewers evaluate candidate responses and decide on a Hire/ No-hire response based on the data available. The experience is designed in such a way that reviewers can see the candidates who fit best in the role according to the profile set by the hiring manager.

8.4.1 Candidate order and sorting

By default candidates are sorted according to best fit for the role, along with a percentage score showing how traits measured from the candidates responses and behaviour compare to the ideal composition. The score is a relative percentage fit value.



If all candidates need to be reviewed without taking the score into account, the candidates can be sorted based on time or alphabetical order.



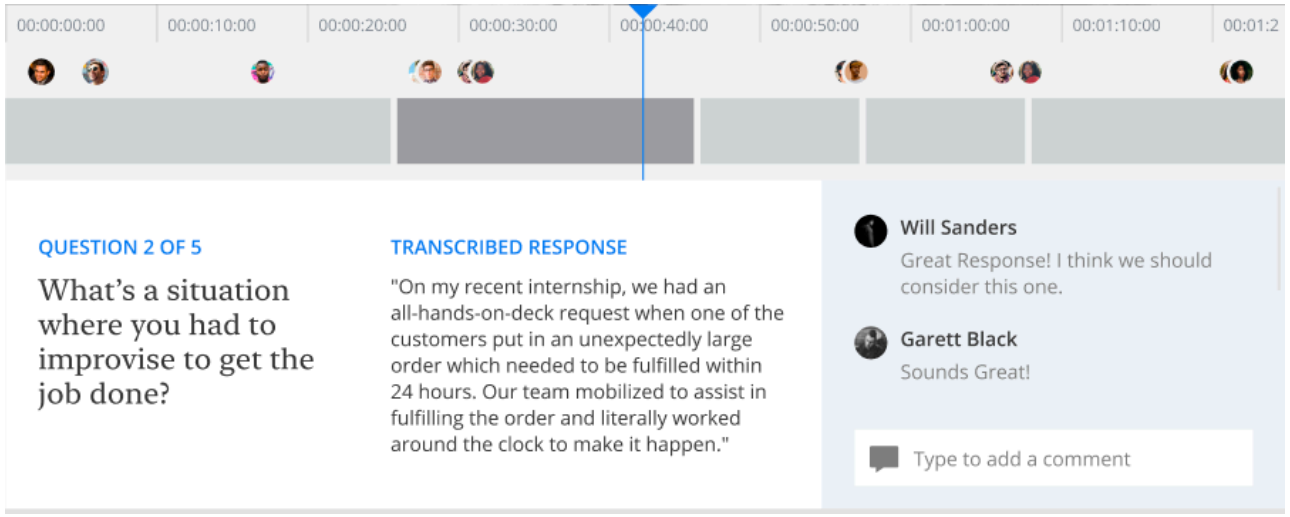
8.4.2 Questions and transcribed responses

While reviewing answers given by the candidate for custom questions, an automated transcript is made available for the reviewer to quickly skim through. This saves quite a bit of time in the workflow.

The reviewers can also leave comments on all responses by the candidate. These comments are visible to HR staff as well as other reviewers and could help them make more informed decisions.

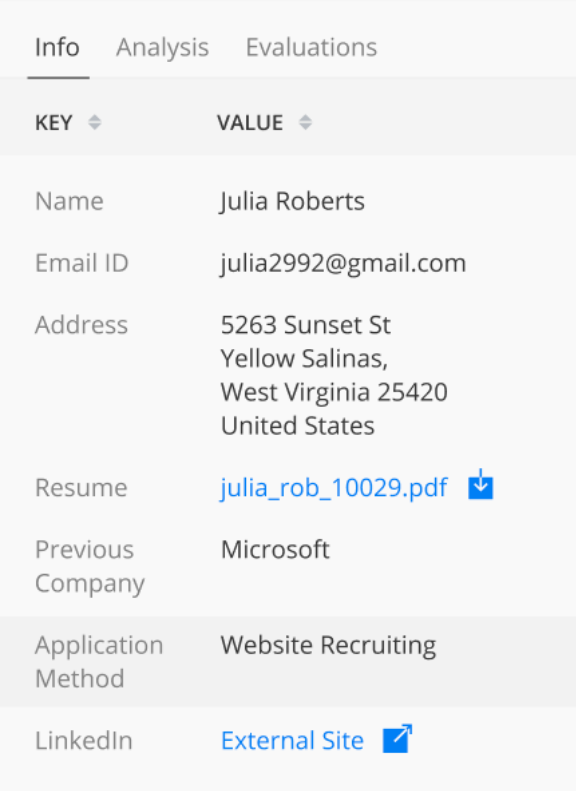
8.4.3 Interactive Timeline

Reviewers are also presented with an interactive timeline of the virtual interview recording where they can navigate to different sections in the interview. Reviewer comments are shown on the timeline itself, and the timeline is broken down segregating the different questions and the corresponding responses. The system intelligently detects long pauses and lets the reviewer skip through them.

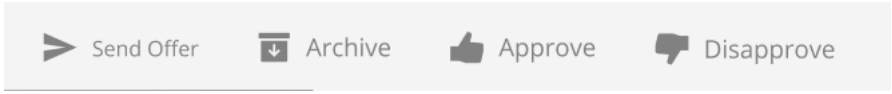


8.4.4 Metadata and Reviewing

Applicant metadata including resume and job history are visible throughout the review process for all reviewers, this helps them save time and take better informed hiring decisions, all without leaving the reviewing dashboard.



Once the reviewers are ready to make their decision, they can submit either a hire or a no-hire response along with any notes they may have taken, to be recorded on file.



8.5 Candidate Experience

Rather than re-invent the wheel when it comes to interviews through video calls, the virtual interview can take place through any video conferencing solutions available in the market. The platform can schedule a Skype/Zoom/Teams call with the candidate and use the appropriate APIs to transmit a 3D render of a virtual interviewer who will ask the questions using the virtual interviewer agent detailed in literature review. The virtual interviewer agent is able to use Natural language processing to further help make the interaction natural and help clarify questions for the applicant. The entire interaction will be recorded and analysed asynchronously and then put up for review.

9. Information Architecture

10. Visual Design Framework

Consistent design guidelines were implemented and followed stringently throughout the design process. This greatly helped in maintaining a pixel perfect design throughout the various phases in the iterative design process.

10.1 Colours

Colour styles were created to keep things consistent across the application. Design Lint was used to ensure compliance with styles at every layer. This greatly eases things during development as well as improve maintainability of designs.

- Text/Primary
- Text/Secondary
- Text/Black
- Text/Blue
- Background/Primary
- Background/Secondary
- Background/Blue
- Background/LightBlue
- Background/Yellow

10.2 Typography

Open Sans was used in three different weights throughout the application. This helps keep the application lightweight. Font sizes were set on fibonacci scales to ensure visual harmony in the typography. Font Icons were sourced from Ionicons (ionicons.com)

10.3 Accessibility

The Web Content Accessibility Guidelines (WCAG) 2.0 covers a wide range of recommendations for making Web content more accessible. Compliance with the Guidelines makes content available to a broader range of people with disabilities, including blindness and low vision, deafness and hearing loss, learning disabilities, cognitive limitations, limited movement, speech disabilities, photosensitivity and combinations of these.

Accessibility was a significant factor during the entire visual design phase, and most design decisions have been taken keeping accessibility in mind.

The Visual Design of this app, including all aspects of the UI and colour palette, conform to at least AA on the WCAG 2.0 Specifications.

11. Prototyping and Testing

This phase has been impacted the most by the recent disruption in services and timelines due to the ongoing pandemic.

11.1 Prototypes

With many of the design interventions spanning across different aspects of the scalable framework that has been designed, it wasn't easy to implement a featured working prototype. Limited Wizard of Oz prototypes were designed to gauge qualitative feedback from Subject Matter Experts (SMEs) and users.

11.2 Testing

The prototypes are to be tested with the users virtually, however due to the current global situation, it has been difficult to get in touch with people on time. This section will be updated with testing details and methodology shortly.

12. Evaluation and Feedback

This section will be updated with the qualitative evaluation results shortly.

13. Conclusion

The ideas presented here that build upon previous works are aimed to serve as a model for future enterprise hiring software that use cutting edge artificial intelligence to make hiring smarter, less biased, and more efficient. Especially in the current situation with the Covid-19 pandemic in the world, as more and more people start working remotely, and more and more hiring happens remotely, it's important that we push the boundaries of hiring tooling to make it more efficient and empowering for candidates as well as for organisations.