Connecting daily wage workers to providers

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Abstract— This project presents a comprehensive job-matching platform designed to address the employment challenges faced by daily wage workers, particularly those with limited access to smart phones and digital services. By integrating technologies such as USSD (Unstructured Supplementary Service Data) and IVR (Interactive Voice Response) for communication , the platform ensures accessibility for non-smart phone users while offering multilingual support and geolocation-based services to enhance user experience. Machine learning algorithms, including K-Nearest Neighbors (KNN) for job matching and Content-Based Filtering for personalized recommendations, are leveraged to optimize worker-job provider connections in real-time. The platform was developed through a structured approach, involving a review of relevant literature, database creation, algorithm development, and rigorous testing. Results indicate improved accessibility, efficient job- worker matching, and high user satisfaction. This solution not only addresses the immediate needs of daily wage workers and job providers but also sets the stage for future advancements, contributing to greater inclusivity and societal impact in the labor market.

Keywords—geolocation, real-time services, USSD, IVR, K-Nearest Neighbors, Content-Based Filtering

I. INTRODUCTION

The objective of our system is to bridge the gap between daily wage workers and job providers by offering an inclusive platform that accommodates both smartphone and non-smartphone users. Our solution employs a web application that enables real-time job matching, accessible to users through various modes of communication including smartphones, USSD, and IVR. Workers can register, find jobs, and receive payments seamlessly from the job provider, ensuring that even those with basic mobile devices can participate.[1][2]

The challenge with existing job platforms is their limited scope and accessibility, especially for non-smartphone users. Many platforms require a smartphone and internet connectivity, leaving a significant portion of the daily wage workforce underserved.[5] Additionally, current systems lack real-time updates on job availability and do not cater to the specific needs of workers who rely on daily wages for their livelihood. Moreover, manual processes like identity verification and payment often involve third parties, which can lead to delays and inefficiencies.

Our project addresses these issues by developing a platform that supports multi-modal communication, enabling both smart phone and non-smart phone users to engage in the system. By integrating machine learning algorithms such as K-Nearest Neighbors (KNN) and collaborative filtering, the platform offers personalized job recommendations, ensuring that workers receive job suggestions tailored to their profiles and preferences. Additionally real-time job listings based on proximity, significantly improving the efficiency of job allocation.[4][5]

II. LITERATURE REVIEW

The COVID-19 pandemic has worsened the employment crisis for daily wage workers, as noted by Bhasker Rao K et al. (2022), who proposed a web-based platform for job matching. However, this system mainly focuses on smartphone users, excluding those with basic mobile phones. Existing platforms like bookmybai.com rely on agencies, leading to potential worker exploitation and limited access outside metropolitan areas. Studies such as Schnitzer et al. (2015) highlight inefficiencies in job selection, while Difallah et al. (2013) emphasize the importance of personalized task matching(paper3). These systems often lack inclusivity and transparency.[1]

Nahar, S., & Debnath, S. [3] "A Comprehensive Review on Job Recommendation Systems and Their Machine Learning Techniques" – This paper explores various machine learning algorithms used in job recommendation systems, including collaborative filtering and content-based filtering. It highlights the challenges of implementing scalable and adaptive recommendation systems capable of handling user-specific preferences. The study emphasizes the

importance of hybrid approaches that merge different algorithms to enhance prediction accuracy and user satisfaction. This paper's insights are relevant to the project's job-matching module, underscoring the potential for improved recommendations by integrating machine learning.

Singh, R., & Gupta, P. [3] "Enhancing Accessibility through Multimodal Interfaces" – This research discusses the design and impact of multimodal interfaces in web and mobile applications, focusing on speech, text, and touch input methods. It analyzes case studies where multimodal systems have improved accessibility for users with varied literacy and language skills. The findings are significant for the accessibility goals of the project, demonstrating that multimodal design enhances engagement and inclusivity for diverse user demographics, particularly daily wage workers who may lack digital literacy.

Patel, V., & Sharma, A. [4] "The Role of Geolocation in Job Scheduling Applications" – The study details how integrating geolocation services in job scheduling and matching systems can optimize the job search process. It explores real-time tracking and geographic filters as features that improve both user experience and the efficiency of matching workers to nearby job opportunities. This paper's analysis is directly applicable to the location-based search and scheduling functionalities in the proposed platform, illustrating the benefits of dynamic geolocation integration.

Kumar, H., & Iyer, M. [5][7] "Multilingual Support in Digital Platforms: A Case Study" – The paper studies the impact of multilingual capabilities in platforms aimed at a linguistically diverse user base. It showcases the successful implementation of language support in popular social platforms and its effect on user adoption rates. The study's findings support the project's plan to include multilingual features to enhance accessibility for daily wage workers from different linguistic backgrounds, ensuring a wider reach and greater inclusivity.

Smith and Lopez [6][7]"Machine Learning-Driven Job Recommendations: Challenges and Solutions" – The study provides an overview of machine learning-based recommendation systems used in job platforms, addressing key issues such as data sparsity, cold start problems, and recommendation biases. The paper reviews hybrid models that merge content-based and collaborative filtering approaches to deliver more personalized and efficient job suggestions.

III. PLATFORM SELLECTION

There are several platforms and programming languages available for building web applications that integrate both smartphone and non-smartphone users. The selection of the right platform is critical to ensure inclusivity, scalability, and efficiency in connecting daily wage workers with job providers. Some of the prominent platforms and technologies considered for our system include: [1][7][8]

- Node.js(JavaScript)
- Express.js
- React.js (JavaScript)
- USSD and IVR APIs for feature phone integration

Each of these platforms has its own advantages and limitations. However, our project has unique requirements that influenced the platform choice:

Multimodal Communication: The system must support smartphone users via web apps and non-smartphone users via USSD and IVR services to ensure widespread accessibility.

Machine Learning Integration: The platform should seamlessly integrate machine learning algorithms such as K-Nearest Neighbors (KNN) and collaborative filtering to enable personalized job recommendations.[7]

Considering these requirements, Express.js (JavaScript/Node.js) was chosen as the primary backend framework due to its flexibility, high performance, and compatibility with a wide array of libraries that support machine learning and secure integration of APIs. Express.js is well-suited for implementing machine learning algorithms when combined with Node.js packages such as TensorFlow.js. Additionally, Express.js is highly scalable and ideal for handling asynchronous operations. The RESTful APIs created with Express.js also make it straightforward to provide interfaces for USSD and IVR systems, ensuring accessibility for non-smartphone users.

On the frontend, React.js was selected for its ability to create responsive, dynamic user interfaces that are easy to maintain and scalable. The initial version of the platform will focus on a web-first approach.

These technologies together offer the necessary flexibility to meet the project's goals of inclusivity, real-time services,and efficient job matching, making Express.js ,Node.js and React.js the ideal choice for the backend and frontend, respectively.

IV. EXISTING TECHNOLOGIES

In most of the scenarios, an idea like this is implemented through agencies where the agencies quotes a higher price to the person hiring and pay the worker a lesser amount. This makes it an advantage to the agency alone and makes it a disadvantage to both the person hiring and the person getting hired. All these below websites use the concept of agencies where the admin of the enterprise get to interview the workers and quote the price:

1) https://www.bookmybai.com/ - In this website, the complete control of the worker is in the hands of the agency. They have the policy that says that the employer can pay the money only if they are satisfied with the performance of the worker. This gives the employer to take a chance of this opportunity and make the worker do all the work and tell the agency that they have not performed well. This will result in a scenario where the worker would have done all the work but not get paid. [8]

2) https://www.jobnukkad.com/ - In this website, although they are not providing the option of maid replacement or full payment only if they are satisfied with the worker, the user has to pay a minimum amount of Rs. 499/- to make use of the website. This website usage is restricted to the cities Mumbai, Delhi, Gurgaon, Noida, Pune and Bangalore.[8]

3) https://www.indianmaidagency.in/ - In this website, the portal is limited to hiring only a maid and does not provide an option to hire the workers for other roles such as cooks, plumbers, baby sitters, etc.[8]

V. ARCHITECTURAL DESIGN AND IMPLEMENTATION

The architecture diagram represents a comprehensive system for connecting daily wage workers with job providers, integrating both smartphone and non-smartphone users. Here's an explanation of the key components and their functionality:

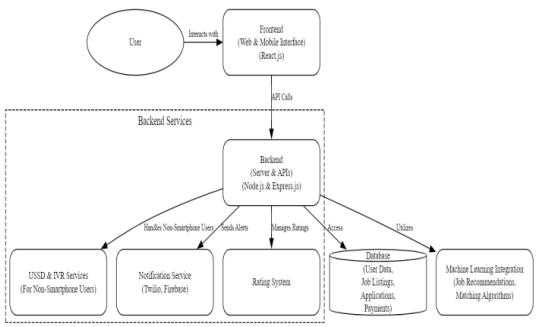

Fig 1

1. User (Front-end Interaction): Users access the platform through a web or mobile interface built with React.js, interacting via API calls to perform tasks like searching for jobs and submitting applications.

2. Back-end Services: The backend, built using Node.js and Express.js, handles requests, managing core functions such as job applications, ratings, and notifications.

3. USSD & IVR Services: These allow non-smart phone users to access the platform through USSD and IVR technologies, ensuring inclusivity for all users.

4. Rating System: Enables users to rate each other, fostering trust within the platform.

5. Database: Stores user data, job listings, applications, and ratings, ensuring smooth data management.

6. Machine Learning Integration: Uses algorithms to provide personalized job recommendations and matching, enhancing user experience.

The implementation of our web platform, designed to connect daily wage workers with job providers, is detailed below, encompassing system architecture, development tools, and core functionalities.

1. System Architecture: The platform is structured using a multi-tiered architecture comprising a user interface (UI) layer, application logic, and a database layer. The UI allows interaction for both job providers and job seekers, while the backend logic handles data processing, machine learning-based recommendations, and system responses. A robust database is utilized for storing user profiles, job listings, application data, and ratings.

2. Technologies Used: Our project leverages modern web development technologies for efficient implementation:

- Frontend: Built using React, to create a responsive and user-friendly interface.
- Backend: Developed using a JavaScript-based backend framework (e.g., Node.js with Express), enabling smooth handling of user requests, data validation, and processing.
- Database: Implemented using a combination of MongoDB for data storage and Firebase for user authentication.

- Machine Learning: Applied JavaScript libraries such as Tensor Flow.js for tailored to user profiles and job preferences.

Content-Based Filtering: This method recommends jobs by matching user profiles with job descriptions. It uses features such as job type, skills required, and location to find similarities between job postings and user preferences. Content-based filtering ensures that job seekers receive recommendations tailored to their specific skills and job history.

3. Development Process: The development follows a modular approach for building the different components of the platform.

Frontend:

- Designed for optimal accessibility, the UI allows job seekers to browse job listings and submit applications, while job providers can post jobs and review applications.
- Integrated multilanguage support for improved accessibility and user experience.

Backend System:

- The Node.js framework handles user requests, interacts with the database, and delivers appropriate responses efficiently.
- Implemented a RESTful API using Express.js to enable seamless communication between the frontend and backend components.
- User authentication and session management were handled through Firebase, enhancing security and real-time capabilities.

Machine Learning-Based Recommendations[7]:

- Collecting and preprocessing job and user profile data to train the recommendation system.[7]

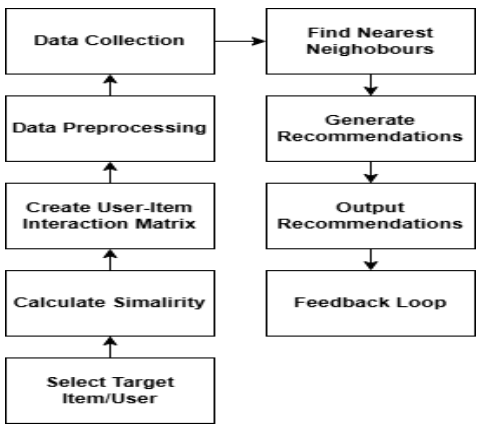

Fig 2

- The K-Nearest Neighbors (KNN) algorithm is a popular method for content-based filtering in machine learning, particularly in recommendation systems. It works by identifying the 'k' most similar items or users based on a defined similarity metric, such as cosine similarity or Euclidean distance.
- Implementing content-based filtering algorithms to match job seekers with relevant job postings.
- The model was fine-tuned using hyperparameter tuning to improve prediction accuracy.

Database Integration:

- Structured job data, user information, and ratings are stored in MongoDB databases for efficient querying.

Network Initiated USSD with response (USSR):

Step 1: A new job is listed on the platform.

Step 2: The system sends an SMS notification about the new job to relevant job seekers.

Fig 3

Step 3: After receiving the SMS, the job seeker calls the system using a toll-free number or USSD to request further job details and confirm interest.

Step 4: The system responds with detailed job information via USSD or SMS, including job requirements, location, and payment details.

Step 5: Once the job seeker has all the necessary details, direct communication is established between the job seeker and the job provider to finalize arrangements and confirm the job.

This process ensures that job seekers receive immediate notifications, can retrieve additional information as needed, and can directly connect with job providers for final confirmation

VI. CHALLENGES AND LIMITATIONS

Access and Inclusivity Constraints Although the platform is designed to support both smartphone and non-smartphone users via USSD and IVR

technologies, there are still potential limitations in ensuring complete accessibility. For example, some users may lack familiarity with these systems, leading to usage barriers. Additionally, providing consistent access to IVR services in regions with limited telecommunications infrastructure remains challenging, especially in rural or remote areas where daily wage work is often concentrated.

Literacy Barriers The platform's accessibility may be limited for job seekers who are illiterate or have low literacy levels. Although the platform supports USSD and IVR systems to accommodate non-smartphone users, individuals who cannot read or navigate text-based instructions may face significant challenges in using the platform effectively. This limitation can hinder the platform's inclusivity, particularly among daily wage workers in rural and underserved areas, where literacy rates may be lower.

Data Quality and Availability High-quality, reliable data is essential for accurate job-worker matching. However, collecting comprehensive data on worker profiles, skills, job preferences, and availability may be challenging, especially in areas where digital literacy is low. Inadequate data, incomplete profiles, or inaccurate job postings can lead to mismatches, reducing user satisfaction and potentially eroding trust in the platform.

Risk of Algorithmic Bias Machine learning models trained on historical job matching data may inadvertently learn biases present in those datasets, such as preferences for certain demographics or skill levels. This bias can result in unfair job recommendations or exclusionary matching patterns that disadvantage certain user groups. Ensuring fairness requires regular model audits, continuous training with diverse data, and an evaluation process focused on reducing potential biases.

Real-Time Matching and Scalability The platform's effectiveness depends on real-time job matching, which requires low-latency data processing. As the number of users and job listings grows, scalability becomes a challenge. Handling large volumes of requests in real-time while ensuring accurate matches may necessitate advanced load-balancing and optimization techniques, particularly for USSD and IVR interactions, which are inherently slower than smartphone-based interactions.

Sensitivity to Geolocation Data For location-based matching, accurate geolocation data is critical. However, variations in GPS accuracy, especially for users in densely populated urban areas or areas with limited network coverage, can impact match precision. Additionally, some non-smartphone users may not have geolocation capabilities, which could reduce matching effectiveness or lead to irrelevant job recommendations.

Limitations in Recommendation Algorithms While Collaborative filtering are effective for initial recommendations, these algorithms may struggle to adapt quickly to changing user needs or preferences without regular retraining and updates. They may also be limited in generating highly personalized recommendations for users with sparse data profiles, leading to less accurate matches for new users or users with non-standard skill sets.

Dependency on External Infrastructure The platform's reliance on telecommunications infrastructure (for USSD and IVR) and network connectivity can impact performance. In areas with intermittent or weak connectivity, real-time job matching and notifications may be delayed or inaccessible, limiting the platform's effectiveness in regions where it is most needed.

VII. CONCLUSION AND FUTURE DIRECTIONS

In this research, we designed and developed a job management platform focused on connecting daily wage workers with job providers, addressing the specific challenges faced by this workforce. The system incorporates essential features such as job posting, applications, and rating mechanisms, which facilitate seamless interactions between job seekers and providers. Built on a scalable architecture, the platform leverages Node.js with Express.js for efficient API handling, React.js for an intuitive front end, and machine learning models for personalized job recommendations. Notification services, powered by Twilio and Firebase, keep users informed of job opportunities, while USSD and IVR services ensure accessibility for non-smartphone users, broadening inclusivity.

Future enhancements aim to further improve the platform's functionality, security, and accessibility. Advanced machine learning models could be implemented to offer more precise job recommendations, utilizing user behavior and past job

success rates to improve matching accuracy. Multilingual support is a key area for future development, enabling the platform to reach a more diverse user base. Enhanced security measures, such as two-factor authentication and data encryption, should also be explored to strengthen user privacy and data protection.

In conclusion, this platform represents a significant step toward improving accessibility and employment opportunities for daily wage workers. Through continued innovation and expansion, it has the potential to bring lasting positive impact to both workers and job providers, fostering a more inclusive and resilient job market.

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