CrowdAssistant: A Virtual Buddy for Crowd worker

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ABSTRACT

Crowdsourcing is an emerging practice which provides workers, across the globe, to work on their choice of tasks. It offers many benefits to people over traditional long term employment model, such as, schedule and geographic flexibility, easy access to work, an opportunity to gain experience on wide variety of tasks, or supplemental revenue streams. However, it also brings a new set of challenges to the workers. Workers on crowdsourcing platform do not have similar level of support as they get in traditional employment model, such as career guidance, compensation counseling, HR support, etc. To overcome the challenges crowd workers face, we propose "CrowdAssistant" which acts as a virtual buddy for the worker and helps them throughout their career journey on the platform. It even renders a level of support impossible for human managers and career counselors to provide. The proposed system acts as a personalized assistant and pro-actively supports worker's needs. It is the first of its kind to the best of our knowledge.

CCS CONCEPTS

• **Information systems → Crowdsourcing**; • **Computing methodologies → Intelligent agents**;

KEYWORDS

Intelligent Agents, Virtual Agent, Crowdsourcing, Crowd Worker

ACM Reference Format:
Kumar Abhinav, Alpana Dubey, Sakshi Jain, Gurpriya Kaur Bhatia, Blake McCartin, and Nitish Bhardwaj. 2018. CrowdAssistant: A Virtual Buddy for Crowd worker. In *CSI-SE'18: CSI-SE'18:IEEE/ACM 5th International Workshop on Crowd Sourcing in Software Engineering (CSI-SE 2018), May 27, 2018, Gothenburg, Sweden,* Jennifer B. Sartor, Theo D'Hondt, and Wolfgang De Meuter (Eds.). ACM, New York, NY, USA, Article 4, 4 pages. https://doi.org/10.1145/3195863.3195865

1 INTRODUCTION

Emergence of gig economy and millennial joining the workforce is changing the modern workforce in big ways. Millennial prefer jobs that meet their passion and provide them flexibility in terms of work timing and employers. In addition, employers are looking for flexible and temporary talent pool. Crowdsourcing platforms meet both the above needs. Crowdsourcing platforms connect skilled individuals with work opportunities. The accessibility of high speed internet and the availability of globalized workforce talent at competitive rates have made crowdsourcing platforms more successful and accessible than ever. Crowdsourcing platforms not only assist workers in connecting with employers and showcasing their skills, but also provide a fluid talent pool to global employers, enabling them to scale up and down their workforce depending on demand. Growing number of workers and enterprises are now realizing the mutual benefit of freelance work and connecting with each other through crowdsourcing platforms. From 2009-2014, the number of workers has exponentially increased from 1 million to 10 million on crowdsourcing platforms. It is estimated that by 2020, more than 40% of US workforce would be freelancers. A steady flow of new workers, retaining existing workers, and maintaining a healthy demand and supply are some of the fundamental requirements for a sustainable crowdsourcing platform. Therefore, platforms must be optimized for better user experience. For crowd workers, a better user experience includes assistance on jobs selection based on his/her profile, guidance on leading a successful career as a freelancer, and seamless onboarding on the platform.

Facilitated by digital platforms, the rise of the gig economy brings many new benefits to crowd workers, such as schedule and geographic flexibility, easy access to work, an opportunity to gain a range of job experience, and supplemental revenue streams, but it lacks some of the support structure available in traditional workforce models. In traditional workforce model, workers get assistance at several levels. They have superiors to guide them, understand their career preference, and provide support for career growth. There is a defined compensation structure and any issues related to it can be sorted out as per prescribed norms. Organizations support their employees' career path by providing adequate training and even prepare a road-map for their learning and development. Organization train employees to meet their current/future business goals. However, this support is not provided to crowd workers as these platforms are not driven by a single organization. Crowdsourcing platform act as a mediator between employer and freelancer whose engagement is short term and contractual. Based on our survey conducted on crowdsourcing platforms, we observed that worker faces following challenges: 1) **Task selection**: Due to large number of tasks, it is difficult for workers to choose from the wide variety of tasks that might fit their profile. As a result, they work on tasks that are not relevant to their goals. 2) **Career guidance**: As there

CSI-SE'18, May 27, 2018, Gothenburg, Sweden

ACM ISBN 978-1-4503-5733-3/18/05…$15.00
https://doi.org/10.1145/3195863.3195865

is no availability of any mentor/counsellor to advise them on the career trajectories, it is difficult for workers to decide on how they can grow their career as a freelancers. This lack of infrastructure and direct support can cause stagnation in both their performance improvement and career progression. 3) **Comparison with peers**: There is no mechanism to assess their progress with other crowd workers. Compensation is one of the major challenges that crowd workers face in this regard as they are not able to determine the best billing rate to make the most profit from their skill. 4) **Creating a marketable profile**: There is no guidance on the information they should provide in their profile and frequency with which they should update their profile. This problem can even be exacerbated by the wide array of possible task, marketplaces and career trajectories available to a crowd worker, making it difficult to navigate the platforms.

To address the challenges faced by crowd workers, we propose CrowdAssistant, a conversational Artificial Intelligence (AI) agent, for crowd workers to support them in their career journey. CrowdAssistant provides data driven advice to worker. The AI assistant helps the user to navigate crowdsourcing platform, guides the user towards the most appropriate tasks, recommends the best career path progressions and skills to train in, and even helps determine the best billing rate to make the most of the worker's skill-set. CrowdAssistant provides an end-to-end, continuous support to crowd workers. The proposed system leverages recent advances in recommendation engines and Natural Language Processing. The present system brings four main advantages. Firstly, it can be easily scaled-up for very large workforce pool. Secondly, it provides a personalized journey to crowd worker which is extremely important for sustainable growth of marketplace. Thirdly, the analytic techniques make use of much richer data available about workers on these platforms which is difficult to perform manually. Finally, it improves the overall efficiency and career growth of workers, thus prepares the future workforce to consider freelancing as an equally promising long term career option.

The remainder of this paper is structured as follows: Section 2 discusses the related work. In subsequent Section 3, we describe the CrowdAssistant system. We present the system architecture in Section 4. In Section 5, we presented the evaluation. Finally, Section 6 concludes the paper with future work.

2 RELATED WORK

The challenges faced by newcomers and existing developers have been extensively studied in case of Open Source Software (OSS) projects [1]. A lot of approaches have been proposed to keep them engaged as well as motivated to work on the projects. Our work is closely related to the work proposed by [4]. The authors present six challenges faced by newcomers in crowdsourced software projects. These barriers were identified from a survey conducted on 20 newcomers. Our work can be differentiated along two dimensions. Firstly, the challenges discussed by [4] is mostly in context of software development, such as poor documentation, understanding code architecture, etc. However, the challenges discussed in this paper is independent of type of work and mainly focuses on the challenges workers face during their journey on the platform. Secondly, we propose a personalized virtual assistant for the crowd worker to solve some of these challenges.

3 CROWDASSISTANT

Crowd workers can query CrowdAssistant via conversational interface for multiple categories of assistance.

3.1 Profile Assistant

An accurate and comprehensive profile is very important for getting selected for a job. However, often workers are not sure of how to best represent their profile. Task posters use profile information to assess applicants. Hence, it becomes particularly important for crowd workers to update profile summary, skills, billing rate, etc. The Profile Assistant generates recommendations for profile update based on the worker skills, educational background, academic projects, and work experience. This information can be explicitly provided by the worker while creating their profile on the platform or can be pulled via worker's social profile, such as Github or LinkedIn.

(1) The Profile Assistant generates a profile summary for the worker to include in his/her profile and suggests missing key points based on the worker's basic profile information (skills, education, experience, etc.). The profile summary is generated to emulate profile summaries from similar workers. The Profile Assistant analyzes the worker's profile (such as completed tasks, profile summary, skills, etc.) periodically to check for any missing profile information and provides update recommendations.
(2) In a distributed working scenario, it also becomes difficult to decide the billing rate workers should put in their profile. The billing rate is the rate that the worker charges per hour. The Profile Assistant recommends the optimized billing rate based on a similarity metric between the worker's profile information and the other similar workers. A weighted average is taken over the billing rate of the top N similar workers and their corresponding similarity score. The system computes similarity between the workers based on their profile information, such as profile overview, education, experience, skills, etc. and past tasks information, such as title, description, budget, etc.

3.2 Task Assistant

The main motive behind crowd workers to come to crowdsourcing platform is to easily find the most relevant task which could provide them the maximum benefit in terms of money and help them in meeting their career goals. The Task Assistant helps in attaining this major goal of the crowd worker.

(1) **Task selection**: It is one of the major challenges that crowd workers face on the platform [2][3]. The Task Assistant recommends tasks to workers based on worker's preference, captured through:
   (a) profile information such as skills, billing rate, profile summary, academic projects, country, etc.
   (b) career preference such as worker's aspiration

(c) tasks registered or completed by the workers, such as Similar Task experience
(d) task poster preference, i.e., task posters with worker's prefer to work such as collaboration with Task poster, similar task poster experience, etc.
(e) other factors like availability, location, etc.

(2) Apart from the recommended tasks, the worker might also look for tasks of his/her choice. The worker can provide the information on the type of task he/she is looking for. The Task Assistant receives the search query and recommends one or more available tasks, considering factors discussed earlier.
(3) **Budget recommendation**: On crowdsourcing platforms, workers are often not sure of the price that should be quoted while applying for the task. Sometimes, this may result in underestimating the price of the task. The Task Assistant considers the workers' task history and the profile information to recommend the right price that should be quoted by a worker to submit his/her bid. We assume that the workers that have successfully completed tasks have made the right price (bidding) decisions and thus can be used to build a regression model. The model considers task related features, such as title, description, skills, etc. and worker related features, such as country, skills, past tasks completed, profile summary, rating, etc. and task poster related features, such as country, number of hires, past hires, etc. The model predicts the price of the task based on these features.
(4) Task Assistant also helps in predicting fitment of a worker with the selected task, i.e., how fit a worker is for the selected task.

3.3 Career Assistant

Crowdsourcing platforms don't provide any support to the workers for their career improvement. Therefore, workers are often not sure of the skills or certifications they should opt to achieve their career goals. The Career Assistant presents a career survey to be filled by workers. The survey includes the questions related to career goals and interests of the worker. Based on the survey responses from the worker, the career assistant determines an understanding of the worker's career goals, and generates a career path with recommended options for the worker to achieve their career goals. The Career Assistant recommends new skills to the worker (i.e. new skills that workers should acquire) that takes into account the current skills of a worker and skillsets of other similar workers. We model the problem of career recommendation as a sequential problem. Markov Decision Process (MDP) provides a more appropriate model for building such recommendation systems. MDP is defined as a four tuple $<S, A, R, T_r>$ where S is set of states that represents different skills available on the platform, A is set of actions that corresponds to recommendation of skills, R is reward that represents the increase in earning after acquiring new skills, and T_r is the state-transition function. There is a reward associated with each transition when a worker acquires a new skill. Skills already acquired by workers over a period of time is used as training data. The system will learn from the experience of each worker.

3.4 Marketplace Assistant

A marketplace is a group within the crowdsourcing platform. Marketplaces group tasks related to a specific skillset, region, or related job types. The Marketplace Assistant serves the following purposes:

(1) The availability of many marketplaces can often overwhelm the crowd worker when selecting the best marketplace that fits to his/her needs. The Marketplace Assistant recommends the right marketplace to the crowd workers based on profile information, such as skills, education, experience, profile description, etc.
(2) The Marketplace Assistant also provides an analysis of the marketplace to help worker in decision making. Marketplace analysis captures: i) Number of active tasks related to worker's skills. ii) Monthly or Yearly Pay Trend for the marketplace. iii) Total Number of tasks completed vs posted relative to worker's skills (month-wise/yearly) iv) Hiring rate relative to worker's skills v) Demand-Supply for that skills over a period of time.

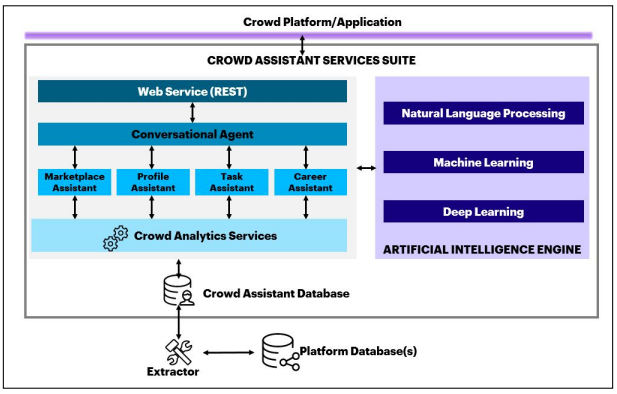

Figure 1: System Architecture

4 SYSTEM ARCHITECTURE

CrowdAssistant utilizes a suite of services to assist the crowd worker on a crowdsourcing platform. These services are exposed as JSON REST based APIs that can be consumed by any crowdsourcing platform. The worker interacts with the CrowdAssistant via conversational interface. The architecture is shown in Figure 1. The system comprises of four main components:

(1) CrowdAssistant Database (CAD): CrowdAssistant Database contains the data from crowdsourcing platforms to perform analytic operations. Data from the platforms is pulled into the CAD using Extractor. The Extractor has a predefined format in which data needs to be extracted from the sourcing platform.
(2) Artificial Intelligence Engine (AIEngine): Artificial Intelligence Engine component includes Natural Language Processing (NLP), Machine Learning and Deep Learning modules. It makes use of rich data available on the platforms to devise various analytics techniques, such as building an ML based regression model for price prediction, analyzing marketplace

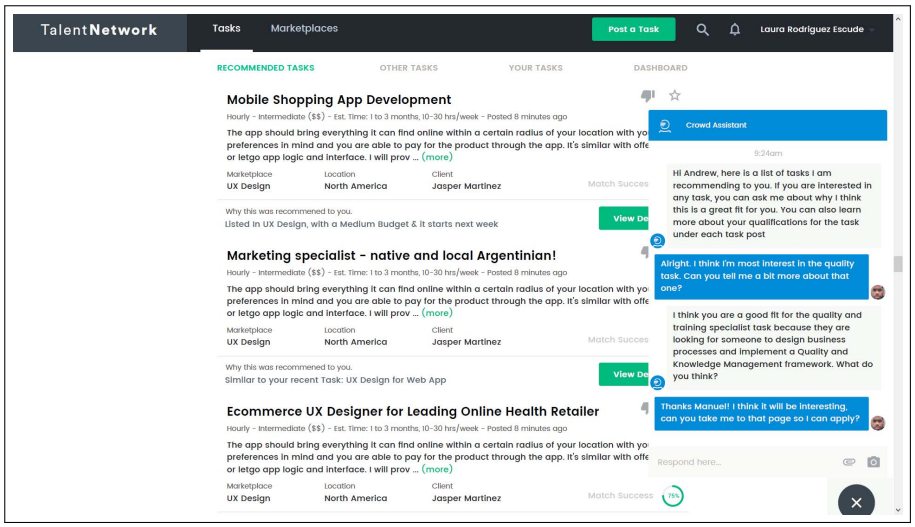

Figure 2: CrowdAssistant integrated with Platform

data, etc. The NLP component helps in understanding the worker's conversation and the goal behind it.

(3) Crowd Analytics Services: Crowd Analytic Services (CAS) component applies algorithms to provide recommendation for a marketplace, profile, task and career by making use of the data available in CAD. It uses the AIEngine component to build various predictive (regression as well as classification) models. The various assistants such as Marketplace, Profile, Task and Career Assistants leverage the CAS component to expose functionalities to assist the crowd.

(4) Conversational Agent (CA): Conversational Agent acts as a communication channel, interpreting the messages from the crowd worker. It uses the NLP component of AIEngine to identify the goal of the worker and activate the relevant Assistant. For instance, if the worker is looking for certain type of tasks on the platform, then the goal is to "search for tasks" and the Task Assistant will be invoked with the worker's query as input. The Task Assistant retrieves the relevant tasks based on the worker's query and passes them to the Conversational Agent. The Conversational Agent presents the response to the worker in a conversational interface. The goal can also be system generated based on the current state of the worker. If the new worker is on the Marketplace tab of the platform, then the system will generate the goal as "Recommend Marketplace", and the Marketplace Assistant is invoked. The Marketplace Assistant retrieves the relevant marketplace based on the worker's profile information and passes it to Conversational Agent to show it on the interface. The Conversational Agent also keeps track of the worker's status and activities on the platform.

The initial version of application is shown in Figure 2.

5 EVALUATION

We conducted an interview with 5 freelancers from a popular online marketplace to give a feedback of their experience on the overall system and to understand which features they found to be most useful. The freelancers had a background in UX/UI Design, Creative Design, and Software Development. They had completed an average of 100 jobs on the marketplace and have been active for 2 years on the platform. Based on their responses, we observed that all the participants liked the concept of personalized assistant and agreed that this will help them in their career growth on the platform. They particularly found this tool to be very useful for a newcomer on the platform as they face lot of challenges initially to find the task on the platform. Price prediction for task, career support and task recommendation along career path are the features they found to be the most useful within the proposed system.

6 CONCLUSIONS

In this paper, we discussed the challenges faced by workers on the crowdsourcing platform. We proposed "CrowdAssistant" that assist the workers in their journey on the platform . We have demonstrated the system to internal stakeholders and their response was very positive. As part of future work, we will be developing analytics techniques to overcome the challenges faced by workers. We will also propose similar kind of AI Assistants to solve some of the challenges faced by task posters on the platform.

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