Framework of an Intelligent Job Recommendation System

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ABSTRACT

Employment opportunities provided to men and women empower them in social and economic aspects. In developing countries like India and other Asian countries, people are not aware of these resources and thus fail to grab them. The study on various employment opportunities both from governmental and non-governmental sectors insist on eradication of unemployment problem in the society to greater extent. The framework provides mechanism to amplify job opportunities to the middle and lower class people using a mobile application. The district chosen for the study is Vellore, Tamil Nadu, India. Analysis on the unemployment problem has been done and a solution for the same is provided through a mobile application (Mobile app). Collecting various job openings and taking them to the appropriate person in the nearby location through mobile app is the task. The prototype of the model is framed using intelligent pattern matching technique with locality based classification. A job recommendation system can be built based on the proposed framework; so that it can help the people in the locality to get job alerts based on their qualification and skillset.

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1. Introduction

Unemployment is defined as an economic and social issue where an individual, especially youth, eligible and willing to work is not offered a job (Axelrad, Malul & Luski, 2018). The rate of unemployment is the ratio between number of unemployed to the total number of people in the labor force (Altuzarra, Galvez & Gonzalez, 2018). Labor force is the subset of individuals in the population who are available, willing and able to work. Unemployment is an important measure to define the economic status of the society. Some of the reasons for unemployment are increase in population, slow economic growth, caste system, some seasonal occupation, slow growth of industrialization, lack of job opportunities, lack of education, lack of skilled and technically trained workers etc. Changes in technology, recessions, inflation and disability to look for employment are some of the other causes. The causes of unemployment varies from individual to individual, location to location, urban to rural, national to international, public to private and so on. The effect of unemployment has its footprints in both economic and social sectors (Quintano, Mazzocchi & Rocca, 2018). The unemployed people will not have enough money to spend thereby decreasing the sales in shops which in-turn may lead to unemployment again. This causes problems not only in the society but also at homes. Especially in the families where there is an unemployed, he/she has to depend on somebody for their necessities. This will create a poor and unhealthy relationship between family members. The unemployment will result in situations like stress, arrogance, homicides, inferior and sometimes physically and mentally ill (Alves, Reibeiro & Rodrigues, 2018).

Mobile application development life cycle involves a series of steps like analysing the requirements, designing the interface, developing the code and testing that requires multi-platform development, cross device testing, deploying, adding support features and finally releasing it to the world. A successful mobile application should reach the intended user and perform the required task without any discrepancies (Anureet Kaur, Kulwant Kaur, 2018).

A software application that runs on hand-held devices can be considered as mobile application, which needs smartphone. This requires global positioning system, notifications and an internet connection. The application can be made available in IOS or an android smartphone.

2. Literature Survey

Nowadays people search job opportunities or candidates mainly online, where several websites for this purpose already do exist. This task is especially difficult because of the large number of items to look for and manual compatibility verification. The authors propose in this paper a Hybrid Job Recommendation System that considers the user model (content-based filtering) and social interactions (collaborative filtering) to improve the quality of

its recommendations. The solution is able to generate adequate teams for a given job opportunity, based not only on the needed competences but also on the social compatibility between their members (Coelho, Costa & Goncalves, 2015).

In this the researchers have constructed an automatic ontology based job recommendation system that can help both the employees and the employers for best selection of organization and workers respectively. The collected data for the web-portals are analysed, mapped, indexed and ranked based on the similarity measure. The data has been collected from various web portals and converted to .owl file format which is a web ontology language file. Ontology is generated using the given set of attributes and relationships, which in turn is queried based on the requirements (Kethavarapu & Saraswathi , 2016).

Job recommendation system called "ResuMatcher" has been proposed that matches appropriately the resume form the employee or the job seeker to the job from the organization or the employer. The machine learning intelligent techniques have been used for extracting the link between the jobseeker and job postings. The object based design of the resumatcher helps in generating domain based ontology for finding the relationships between the skills of the jobseekers and the requirements of the job postings (Guo, Alamudun & Hammondet, 2016).

Career-oriented social networking sites are very much useful for job seekers to find a suitable job and useful for recruiters as well to find the right candidate for a job. Job recommendation system helps job seekers to find appropriate jobs matching with their profile. So, it can be considered as recruiters approaching a suitable candidate whenever they have an appropriate job for them. In this paper, the authors present a research technique of developing a job recommendation system for the online job hunting websites to predict suitable job postings that are likely to be relevant to the user i.e., the job postings with which the users can possibly interact. An algorithm for job recommender system has been developed, which can calculate similarity for user-user, item-item and hybrid of user-user and item-item perspective between training and test data set based on weighted scores (Ahmed, Hasan, Hoq & Adnan, 2016).

At present, there are many job posting websites providing a huge amount of information and students need to spend hours to find jobs that match their interests. At the same time, existing job recommendation systems only consider the user's field of interest, but do not take into consideration the user's profile and skills, which can generate more relevant career recommendations for users. In this work, the authors propose CaPaR, a Career Path Recommendation framework, which addresses often occurred shortcomings. Using text mining and collaborative filtering techniques the system first scans the user's profile and resume, identifies the key skills of the candidate and generates personalized job recommendations (Patel, Kakuste & Eirinaki, 2017).

To deal with the information overloaded for students during their transition into work, a job recommendation system can be very valuable. In this research, after fully investigating the pros and cons of current job recommendation systems for university students, the authors propose a student profiling based re-ranking framework. In this system, the students are recommended a list of potential jobs based on those who have graduated and obtained job offers over the past few years. Furthermore, recommended employers are also used as input for job recommendation result re-ranking (Liu, Rong, Ouyang & Xiong, 2017).

Online professional social networks such as LinkedIn play a key role in helping job seekers find right career opportunities and job providers reach out to potential candidates. LinkedIn's job ecosystem has been designed to serve as a marketplace for efficient matching between potential candidates and job postings, and to provide tools to connect job seekers and job providers. LinkedIn's job recommendations product is a crucial mechanism to help achieve these goals, wherein personalized sets of recommended job postings are presented for members based on the structured, context data present in their profiles (Kenthapadi, Le & Venkataraman, 2017).

In this work a standard taxonomy for job vacancies is created automatically. Machine learning is used for a better classification of web job vacancies (Roberto Boselli, et al., 2018). The data has been collected from the web sources and real-time labor market analysis is done. This process is called data scrapping. Job vacancy classification is done on the selected occupations and skills. The system works on multi-lingual lexicons used in the job vacancy texts. Finally the query is answered based on the resultant knowledge base over the identified dimensions. Tuples for identifying the web job vacancy, job occupation and skill are finely tuned and defined for better classification. Machine learning techniques like Support Vector Machine (SVM), Random forest and neural networks were used for training, testing and validating the dataset (Boselli, Cesarini, Mercorio & Mezzanzanica, 2018).

3. Illustrations

Vellore district is part of Tondaimandalam (Tondai Nadu), and one of the 32 districts in the Tamil Nadu state of India. It is one of the six districts that from North region of Tamil Nadu. It is one of the biggest districts in Tamil Nadu. Vellore City is the headquarters of this district. As of 2011 census, the district had a population of 3,936,331 with a sex ratio of 1,007 females for every 1,000 males. The Government of India recently included Vellore city into prestigious smart City project along with 26 more cities.

The district had 929,281 households. There were 1,689,330 workers, comprising 153,211 cultivators, 254,999 main agricultural labourers, 106,906 in household industries, 845,069 other workers, 329,145 marginal workers, 21,897 marginal cultivators, 136,956 marginal agricultural labourers, 29,509 marginal workers in household industries and 140,783 other marginal workers.

According to the official report on employment and labour, table 1, projects the number of male and female registered and unemployed.

Table 1 - No. of persons registered during the year and total no. of persons waiting up to the end of the year as per live register. (Year 2015-2016)

Sl. No	Gender	No.of persons registered during the year	No. of persons waiting up to the end of the year
1.	Male	35313	207183
2.	Female	34679	202920
	Total	69992	410103

A total of 4,10,103 citizens in Vellore are unemployed. Even though there are ample opportunities in Vellore district people are unable to find the right job. This app therefore will help the citizens of Vellore to find suitable jobs in their respective locations.

Table 2 provides an overview of some of the well-known fields that have employment opportunities. The jobs suitable for educated and uneducated are indicated along with the jobs that require skills.

Table 2 - Job categories

Sl. No	Job title	Job description	Educated	Uneducated	Skilled
1	Graduates UG/PG	Clerical types of job	√		
2	Agricultural jobs	Jobs related to farming		√	√
3	Animal & Diary products	Jobs related to cattle and poultry farming		√	√
4	Banking sectors	Jobs related banking operations and transactions	√		
5	Fisheries	Jobs related to fishery farming		√	
6	Handloom & Handicrafts	Jobs related to weaving and handmade productions		√	√
7	Housing	Jobs related to house / any building construction		√	
8	Industries /Factories	Jobs related to industrial works in both small scale and large scale	√	√	
9	Mining and quarrying	Jobs related to digging pits for water/ minerals.		√	√
10	Medical services	Jobs related to nursing, lab workers, scanning operators.	√		
11	Printing and publication	Jobs related to printing, operating, publishing		√	√
12	Textiles	Jobs related to sales and tailoring		√	
13	Transport	Jobs related to driving, cleaning, servicing the vehicles		√	
14	Tourism	Jobs related to travels and driving		√	√

Agriculture loans, employment and electricity for agriculture are the three top priorities for rural voters in Tamil Nadu. This was inferred from a survey conducted by non-political organization, Association for Democratic Reforms, comprising 16,000 respondents in all the constituencies of the southern state. Of the people interviewed in rural areas, 24.75 percent said that availability of agriculture loan was the top priority for them. The next major priorities were better employment opportunities with 22.88 percent respondents vouching for it, followed by electricity for agriculture at 20.72 percent. Creating jobs is one of most important priorities of the state. The Labour Department is committed to regulate the employment conditions at work places to ensure safe and conducive working conditions for every employed person. The Government recognizes that the safety, health and economic well-being of workers have a positive impact on industrial productivity including economic and social development of the State. The department firmly believes in industry friendly and labour sensitive approach in enforcement of labour laws and settlement of disputes moving towards complaint based inspections, minimizing the burden of maintenance of records by simplification of forms for filing of returns, promoting 'ease of doing business' through online portal and enhancing working relationship between the employer and employee. Ensuring safety and welfare of temporary workers engaged in difficult occupations including interstate migrant construction workers is an important mandate for the department.

In order to enforce the various labour laws towards the protection of rights and implementation of welfare schemes, the Labour Department headed by the Commissioner of Labour is functioning with 568 officers and 2180 staff. This department has one Additional Commissioner of Labour, 12 Joint Commissioners of Labour, 16 Deputy Commissioners of Labour, 24 Assistant Commissioners of Labour, 100 in the cadre of Labour Officer, 70 Deputy Inspectors of Labour, 220 Assistant Inspectors of Labour, 20 Statistical Inspectors, 101 Stamping Inspectors, two Assistant Surgeons (Plantations), one Accounts Officer and one Public Relations Officer.

The special adjudicating bodies, like Labour Courts and Industrial Tribunals issue awards on labour related matters and industrial disputes as specified in the second schedule of the Industrial Disputes Act, 1947. There are 13 Labour Courts and one Industrial Tribunal in Tamil Nadu to adjudicate upon the industrial dispute cases which have not been amicably settled through the conciliation process. Chennai has four Labour Courts, Vellore and Coimbatore

have two each and Salem, Cuddalore, Tiruchirappalli, Madurai, and Tirunelveli have one each. These adjudicating forums pave way for quick disposal of the disputes for the benefit of all sector workers in various industries. During the year 2016, the Labour Courts have disposed 1,733 cases. An Industrial Tribunal at Chennai adjudicates upon matters specified in the third schedule appended to the Industrial Disputes Act, 1947. In the year 2016, the Tribunal has disposed 46 cases.

Financial resources committed at State level

The state budget estimate from table 3 shows that the government has allocated a total of 60,43,437 especially for the commissionerate of labour, employment and training. The objective is to provide employment opportunities to all the unemployed citizens throughout Vellore district.

Table 3 - Labour and Employment Department –Budget Estimate 2017-2018 (Rupees in Thousands)

Sl. No	Head of Department	Revenue	Capital	Loan	Total
1	Secretariat	7,66,10	---	1	7,66,11
2	Commissionerate of Labour	144,55,46	13,25,00	---	157,80,46
3	Directorate of Employment and Training	442,54,61	3,99,30	---	446,53,91
4	Directorate of Industrial Safety and Health	34,68,52	80,16	---	35,48.68
5	Directorate of Medical and Rural Health Services (ESIS)	362,78,51	---	---	362,78,51
Total		992,23,20	18,04,46	1	1,010,27,67

Table 4 provides the estimate of the amounts required for expenditure for the year 2017-2018 in all the government sectors. For labour and employment the budget estimation is 547,38,80 which is the highest when compared with all the other mentioned areas.

Table 4 - Estimate of the amounts required for expenditure in 2017-2018 (Rupees in Thousands)

		2015-2016 Accounts	2016-2017 Budget Estimate	2016-2017 Revised Estimate	2017-2018 Budget Estimate
2059	Public works	37,70	36,53	70,02	38,02
2202	General Education	-1	---	---	---
2210	Medical and Public Health	287,44,55	305,94,33	354,49,44	362,78,53
2225	Welfare of scheduled castes, scheduled tribes other backward classes and minorities	5,51,80	7,01,30	6,51,24	6,94,64
2230	Labour and Employment	361,89,23	589,99,80	551,48,64	547,38,80
2235	Social security and Welfare	18,72,19	18,26,54	17,84,25	34,95,90
2250	Other social services	10,77,39	21,30,00	16,89,80	21,30,00
2251	Secretariat Social services	6,41,70	8,15,83	7,24,10	7,66,11
3475	Other General Economic services	9,20,14	12,60,62	10,32,74	10,81,27
4250	Capital outlay on other Social Services	31,46,02	16,46,85	24,77,13	18,04,46
7610	Loans to Government Servants etc.	9,00	25,00	45,00	1

4. Challenge & Constraints

The government of Tamil Nadu has taken major steps to eradicate unemployment problem from the state. Due to over population and also the ignorance (i.e.) lack of knowledge among the citizens, the situation has not changed and the results of the state priorities are not fruitful. To overcome the problem of unemployment this paper gives a detailed view about how to provide effective schemes that can bring awareness among the people to search for jobs and earn for their living.

The paper's focus is not only on the educated unemployed but also on the uneducated and illiterate people of the society. Now-a-days there are many number of mobile users all over India. Any individual is able to handle mobile and can make maximum use of it with GPS (Geographical Positioning System), Facebook, online payments, whatsapp and many more apps.

The challenge here is to provide an app that should be user friendly and comprehensible. The app should provide the information in the regional language (Tamil). Data storage is also a challenging one, as the data to be collected will be huge in volume. Speed and security are to be provided without any affecting the objective.

5. Description of framework

A mobile based app is developed to enhance the employment offers to be made visible to the common man. The mobile app will eradicate the unemployment problem from the society. The app will easily convey the message to anyone who has registered with the app. Based on the unemployed, registered person's skillset and qualification, job alerts will be sent. The employers can register and update the vacancies available in their organisations. The app can easily notify any person belonging to any field of work viz., electrician, carpenter, plumber, fisherman, farmer, etc. The app can be easily followed by educated and uneducated people of the society. The authenticity of the person is checked before registering with the app. Therefore fraudulent can be easily detected by a well secured system.

The android application that includes the following:

1. User interface
2. Registration and login using OTP for secured and authenticated mobile numbers.
3. Users form the organizations / employers login using OTP for secured and authenticated mobile numbers.
4. Unemployed registrants' details are stored in the database with their name, gender, age, qualification, location, experience.
5. Employers' details are also stored in the database with the job code, job title, job description, location, date of advertisement, expiry date.
6. A message notification for the suitable unemployed person, as and when a demand for a particular job arises.
7. Message notification contains the employer details.
8. Suitable security based algorithm that makes a safe and secured messaging.
9. Locality based notifications. Users of the particular locality will be notified first.
10. Huge volume of data to be stored in a private cloud.

Registration phase:

During the registration phase the user send the details like his name, phone number, aadhar number. Receiving the details from the job seeker an OTP is generated with 6 digits and sent to the mobile. The OTP is again sent by the seeker. This ensures that user is an authenticated person (Mohsin Karovaliya, Saifali Karedia, Sharad Oza, Dr.D.R.Kalbande, 2015) and confirms the registration. Once it is identified that the user is a human and not a machine, the details of the user in short terms like name, gender, age, qualification, location, experience are obtained. For the employer, the details like job code, job title, job description, location, date of advertisement, expiry date are obtained. These are the important parameters required to perform job matching between the employer and the appropriate job-seeker (May Fern Koh, Yew Choong Chew, 2015)

Tables 5 and 6 are to be created for storing employer and job seeker details in the database.

Table 5 -Employer details

Job Code
Job Title
Job Description
Location
Date of advertisement
Expiry date

Table 6 -Job-seeker details

Name
Gender
Age
Qualification
Location
Experience

The objective of the work is to provide the employment details to the people who can make use this opportunity for their day to day living as well as people who are educated. To cope up with the different group of users, the interface designed can be matching all the levels of users. Once the user does the registration, the data will be stored in the database. On the other hand the employer also registers with appropriate data. This data again is saved in the repository. When there is a need of manpower for a particular job like carpentry, plumbing, farming, office assistant etc, the details of the required job is sent to the model for further processing. The model will first create clusters of the job seekers based on the skill set, experience and locality. The focus will be on the individual cluster which matches with the most appropriate group thereby limiting the search to that group of users.

The figure 1 gives the framework of the proposed work. The registration done by the employer and the jobseeker is stored in the central database. The deep learning model is used perform the clustering based job matching. Clustering is a data mining technique that enables to group the data available in large volume into individual and independent groups containing similar features and characteristics. After grouping into clusters, the relevant cluster is selected and again clustering based on another parameter is done. This goes on until the successful match is found. The Divide and conquer mechanism is followed in this approach which is a major practice when the data is huge in volume (R. Li, X. Dong, X. Gu, Z. Xue, K. Li, 2016).

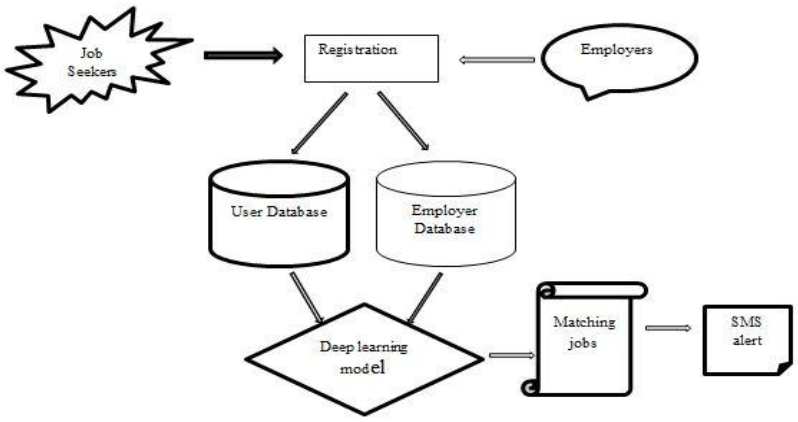

Fig 1 - Frame work of the proposed work

6. Conclusion

The proposed work will definitely create a very good impact on the society. As there are more number of unemployed citizens in the state especially in Vellore district, the implementation will create a good impact on the growth of every individual in the society. The implementation of the proposed app will help to eradicate the unemployment problem thereby provide a helping hand in uplifting the life style of the individuals in the society. This eradicates the unemployment problem in the society at least to some extent. Analytical report obtained from the feedback section given by the stakeholders (Employer and Employee) of this app. Unlike other job recommendation systems, this recommender makes use of the clustering and classification using deep learning model so as to improve the performance of the system. The framework will be a help hand to the society so as to provide job opportunities.

The work can be extended to support employment facilities for other districts in Tamil Nadu and also to some other states. Due to the availability of large volume of data, a cloud based data repository can be owned to manage the data.

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