

A Context Aware Job Information Real-Time Delivery Framework for Pervasive Environment

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Abstract: Context-aware systems are getting rapid popularity towards enabling a pervasive computing environment over hand-held mobile devices, wearable devices, and Tablets. These systems deliver services tailored to the specific needs and user's context. The context-aware system services can utilize information about the user's context to adapt services based on the user's location. The prime aim of this research paper is to investigate and analyse the critical issues and challenges while delivering the job information to the job seekers when they migrate from one place to another in search of jobs. In addition, the research also tries to investigate the challenges faced by employers/ job providers when they search and recruit the right person for the right jobs. In this paper the issues and challenges investigated and analysed were timeliness of information dissemination, opportunity missing, fake/genuine information, anywhere, anytime accessibility over small handheld devices. After rigorous analysis of the investigated issues and challenges in the existing state of art employment/job information dissemination systems, a real-time context-aware employment information delivery system framework for the pervasive environment is proposed. The research parameters considered are Preference of Job seekers, Location of Jobs, Context, Qualification, CGPA, Experience, everywhere access at any time, and Identity. The paper used both the quantitative and qualitative approaches for proposing a research-based applied solution. Survey of job seekers, Interview of recruiters, and technical observation of the researcher are used for collecting the relevant facts to check the researchability of the issues and challenges. Protégé version 4.3 is used for modelling, Edraw-Max for designing the framework, Google Form for Survey, and Justin mind tool for Prototype design and testing. The framework and its Prototype was examined using a user acceptance test. The acceptance test indicated that 84.6% of target stakeholders accepted the proposed system framework as a new knowledge solution for the aforementioned issues and challenges in the employment sectors.

Keywords: Context-aware, Framework, Job Seeker, Job Providers, Mobile Devices, Pervasive Computing

1. Introduction

In the current state of the art, information regarding vacancies, posts, or jobs in Ethiopia both by government and non-government organizations are disseminated/communicated either via the organization website or via general job posting websites and notice boards of organizations/private facilitators. Timely job information dissemination is one of the crucial challenges countrywide. There is a growing interest in the use of context-aware systems and techniques to deliver information in pervasive environments. Context-aware computing is a mobile computing paradigm in which applications can discover and take advantage of contextual information (such as user location, time and day, nearby people and devices, and user activity). The common application domain for providing ubiquitous access to users is the information dissemination domain and the best way for delivering those context-aware job information services are by using user's mobile phones since 80% of the world population uses mobile phones for their daily activities, that means there are more than 5 billion phones worldwide[1]. According to the ETHIO-telecom report, more than 54.2 million mobile subscribers are available in Ethiopia during the third quarter of 2018. In the year 2020, it will have a significant increase because of the rapid expansion of the internet from 2G Network to 3G. In this reference, the context-aware real-time job information delivery systems using mobile devices will certainly create a new paradigm of rapid information dissemination both for job seekers and job providers using context-aware techniques.

Although its ironic though that the internet has provided a historical channel to 'democratize the people's voices globally but is now struggling for its own democratic governance[2]. In case of internet, and communication channels, a location is a very important parameter for using these services over mobile services. It is usually determined using a network of satellites Global Positioning System (GPS) or a network of antennas, either a wide area Global System for Mobile Communication (GSM) or local area (e.g., Bluetooth) [3][4]. Many

other techniques are developed for location identification. Some of them are suitable for outdoor environments and some of them are better for indoor locations. The most common mobile positioning methods are based on Cell Identification (Cell ID), Time of Arrival (ToA), Received Signal Strength (RSS), Time Difference of Arrival (TDoA), or Angle of Arrival (AOA) measurements determined from the Main Station (MS) signals received at the Base Station (BS).

In this context, this research paper focuses only on mobile positioning using Cell-Id and RSS information. Here, Signal strength is an easy and low-cost method to implement in GSM, because it does not require any changes to the handset and existing network infrastructure. RSSI information is readily available to the user's applications on almost all GSM phones. Such systems have the potential of localizing 80-85% of today's cell phones [5]. In due consideration of the aforementioned technicalities, it was decided to use the RSSI positioning method for identifying the user's location and using their IMEI code to implicitly send alerts indicating that there is new context-based information. The MS continuously measures the signal strength from each base station and reports this information back to the serving base station. With this signal strength information, it is possible to calculate the position of the MS, by taking into consideration the fact where the received signal strength degrades as the distance between the transmitter and receiver increases. However, several factors limit the effectiveness of this method. Some of them are the distance between MS and BTS, the characteristic of terrain between the transmitter and receiver, and the issue of indoor attenuation[6][7][8].

2.The problem under Investigation and Goal of the Research

In the current practices, the flow of data or information for the job, searching is from "a job provider" to "job seeker" (i.e., organization website/portal/general job posting websites or on notice boards of the organizations/private facilitators to job seekers). The survey results reveal that the flow of job search information has several challenges. Some of the significant challenges are as follows-

1) In the existing system practices, job seekers search the job postings over the job provider's portals but the job providers have no mechanisms to search for job seekers. In the case of notice boards, bulletin boards, and dashboards, job seekers have to visit these portals and hence automatic job retrieval or alerts are not available. This practice is one way only.

2) In existing system practices, the job seekers often get the job information after passing the deadlines i.e. the timeliness of information dissemination is the critical challenge

3) In the existing system practices, Graduated job seekers from far rural areas have to visit the place where they can get job information and support for applying for the vacancy. The existing system does not support the anytime, anywhere information availability over any device

4) The existing systems practices over the job portals/websites, the job information is observed as an overcrowded and hence automatic search after filtration of the jobs using parameters like Preference, Qualification, Experience, and CGPA are missing

5) The existing system practices do not provide any help, support to the job seekers for getting automatic job assistance/alerts while they migrate from one place to another using context or ID of the individuals

6) The existing system practices are time-consuming, cost consuming, tiresome, boring, and in a bureaucratic structured manner. These potential issues and challenges inspired this research to design a "Reverse Search Framework" for context-aware job searching with intelligent content/ job preferences.

Ethiopia has an acute shortage of such kinds of systems that can provide a localized guideline to develop such systems to facilitate the real-time job search flow from " job providers" to "Job seekers" i.e. organization website or general job posting websites or notice boards of the organizations/private facilitators to the Job Seekers/Aspirants in real-time fashion using job seekers Context-aware Profile (i.e. Qualification, CGPA, Experience, anywhere-anytime job information, identity, and Preference) and their Context-aware Location (i.e. Cell ID, RSSI, IMEI, and GSM), etc. If job seekers and job providers get real-time job information dissemination and retrieval, unemployment can be eradicated through job support services. This can help them determine and find suitable jobs with their requirement specifications and specialization.

2.1. Review of Related Research Literature

To understand the past research contributions of different researchers; this study reviewed numerous research papers. Finally, the summary of such research contributions with research gaps are presented as follows:

Researches[9][10] in which a context-aware machine learning framework for android was developed by integrating machine learning (ML) and context-aware (CA) computing, the researchers provided proactive

services based on the users' usage patterns of the mobile device combined with the environmental context of the user. It is very important to research and related to the proposed framework. In this research, researchers concentrate only on providing machine learning for android application service by providing a reasoning mechanism /inference engine. Another researcher [11] tried to discover context-aware tourist information and recommendation system using IQR programming code. In this research, the researcher tried to provide organized context-aware information for tourists. However, this research study is focused only on providing that context information which needs the user's interaction before accessing the tourists' information and also it missed some feature of pervasive computing. Research [12] was focused on developing a framework for pervasive context-aware in Ethiopian agricultural marketing information. In this, the researcher designed and implemented a framework for agricultural market information with special consideration to the farmer's issues. This research cost-effectively contributed to farmer location identification to make information easy to access. Even though it was focused on providing agricultural information in explicit interaction with the system using both pull and push mode, means the user needs to access the system to get the information. This research study lacks some basic features of pervasive context-aware concepts. The proposed research work focuses on implicit information delivery when some event is triggered in a real-time fashion and over any mobile phone. In 2017, a context-aware service delivery framework for an interactive mobile advertisement (AD) was designed to solve the problems encountered in mobile Ads [13]. In this research, the researcher tried to use the unique feature of context-aware service. But the study fails to consider the user's location and context as a feature of context-aware applications to create a pervasive environment. And also, another context gathering framework for context-aware mobile solutions was designed and developed for the context gathering which consists of the sensor data model, messaging and communication protocol, and software application programming interface[10]. In this research study, some of the components were missed such as enablers to support the development of context-aware mobile applications, and the research focused only on gathering that context information. After the rigorous review of related works, a clear research gap was observed in the domain-specific problems of the job market in general and Ethiopia as a specific problem. This implied and motivated the attempt for this research study. After the rigorous review of related works, a clear research gap was observed in the domain-specific problems of the job market in general and Ethiopia as a specific problem. This implied and motivated the attempt for this research study.

3 Research design and Approach

This paper followed an empirically applied research design strategy using a mixed approach (quantitative and qualitative using survey questionnaire), Interview Questionnaire with qualitative approach along with practical observation of the researcher on job posting places) for collecting relevant primary data. Quantitative methods are used to examine the relationship between parameters i.e. (1) Job seeker's preference, 2) Location, 3) Context, 4) CGPA, 5) Experience, 6) Anywhere Anytime information, 8) Qualification, and 9) users' identity through statistical analysis. The research started with an understanding of how the job information is delivered to job seekers in Ethiopia using existing state of art systems. The study is a close convergence of empirical and applied design approaches.

3.1. Sampling Design & Primary Fact-Finding

The target population was selected from government and private organizations (Ethio-Telecom, Commercial Bank of Ethiopia, NIB Bank, ELPHA, LIB (Lion International Bank), and Custom and Revenue organization). The total job seeker population was 52 of which 45 for the survey and 7 for the interview.

This study used the purposive sampling technique, which is a non-probability sampling technique in which researchers rely on their judgment when choosing elements/members of the population to participate in their study. It is also known as judgment sampling.

This research study collected data from both primary and secondary sources using the 1) questionnaire-based semi-structured open indeed interview, 2) close-ended questionnaire-based survey and 3) checklist-based technical observations of the researcher. These data collection methods are summarized in figure 1.

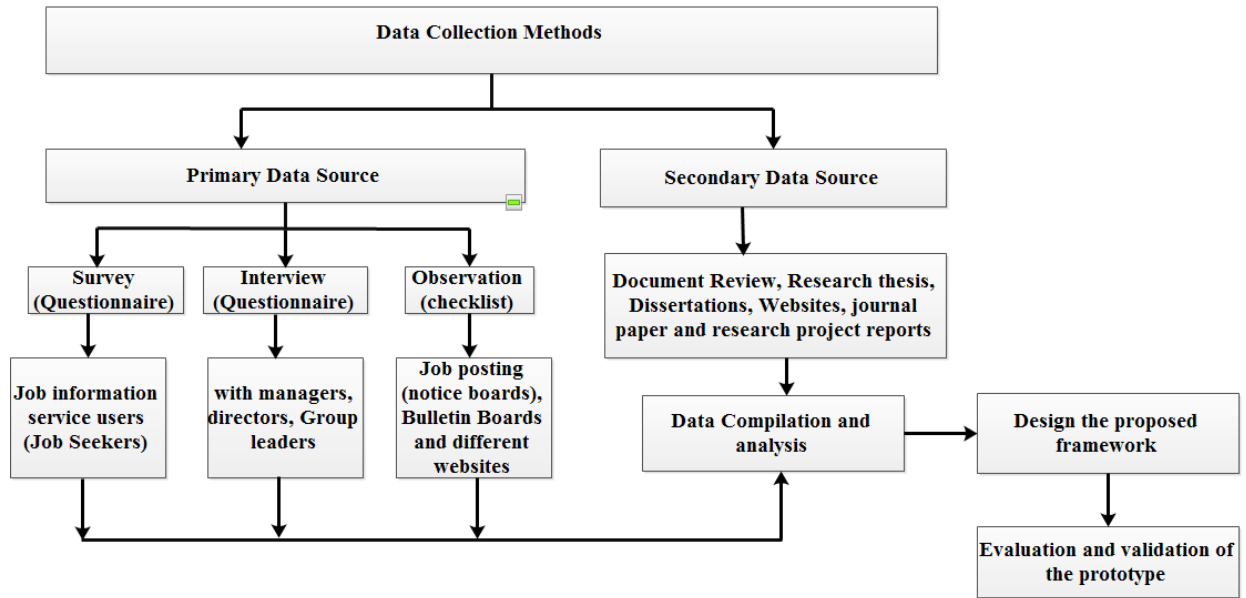


Figure 1: Data Collection Procedure

3.2 Data Analysis and Discussion

Different data collection techniques like survey, personal interviews of the different stakeholders (i.e. domain professionals), and the researcher’s self-technical observations were used for collecting the primary facts about the existing system practices using selected parameters i.e. (1) Job seekers preference, 2) Location, 3) Context, 4) CGPA, 5) Experience, 6) Anywhere Anytime information, 8) Qualification, and 9) users' identity. To get a complete view of the existing situation and the current state of art practices, an online survey was conducted using questionnaires. Online survey questions (questionnaires) were created over cloud-based Google form and disseminated to the target respondents. A total of 45 respondents’ responded using an online survey.

1. What was the academic institution type you were graduated from?

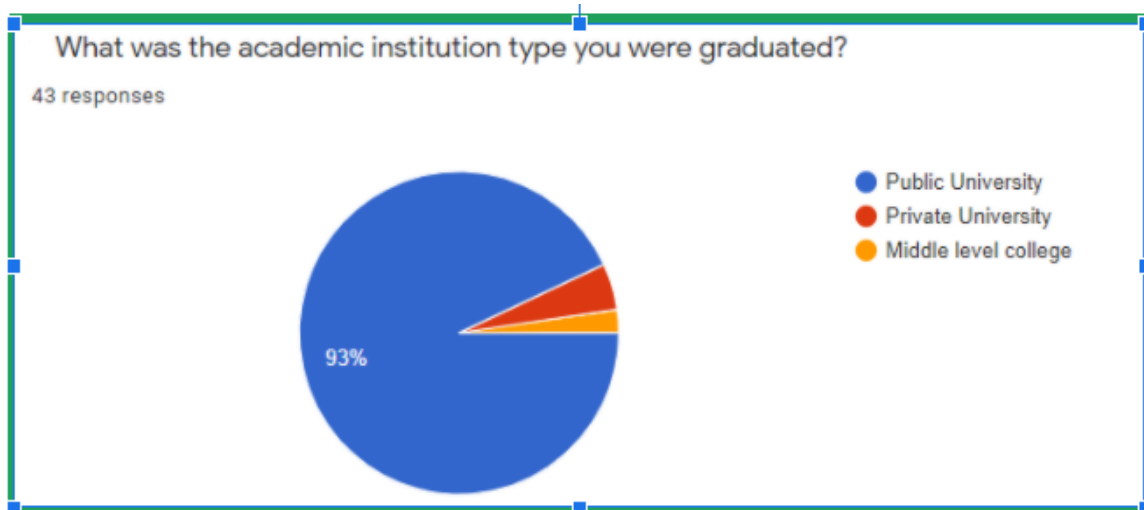


Figure 2: Academic institution

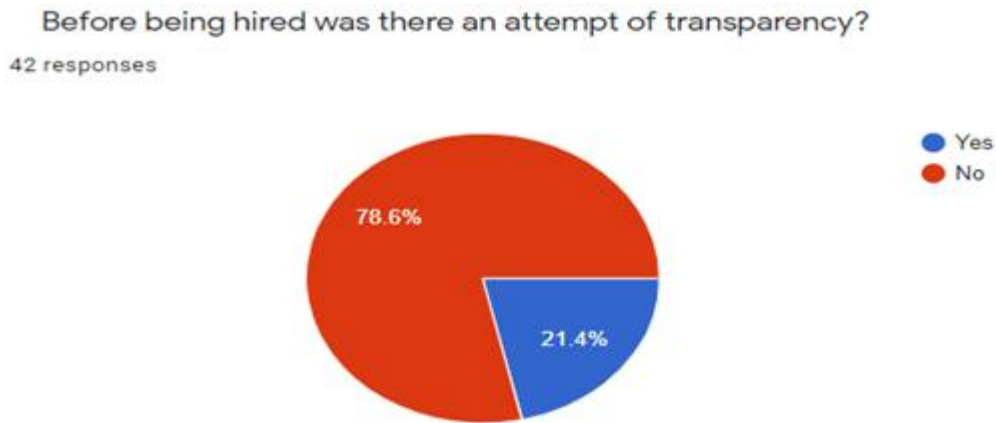


Figure 3: Transparency checking

The majority of the respondents (i.e. 93 %) as presented in figure (2) were those who graduated from public universities and the remaining were graduated from private colleges. This result clearly shows that job searching is a tedious issue in both public and private academic institutions/organizations.

When a question about the transparency of the job posting was questioned, 78.6% of respondents revealed that there is a lack of transparency in the hiring process while 21.4% responded that there is transparency. Here the majority of the respondents are not satisfied with the existing practices of the hiring process in terms of transparency. This is just because of the manual job posting mechanisms and presented in figure (3). It indicates a strong need for an alternative technology-enabled system.

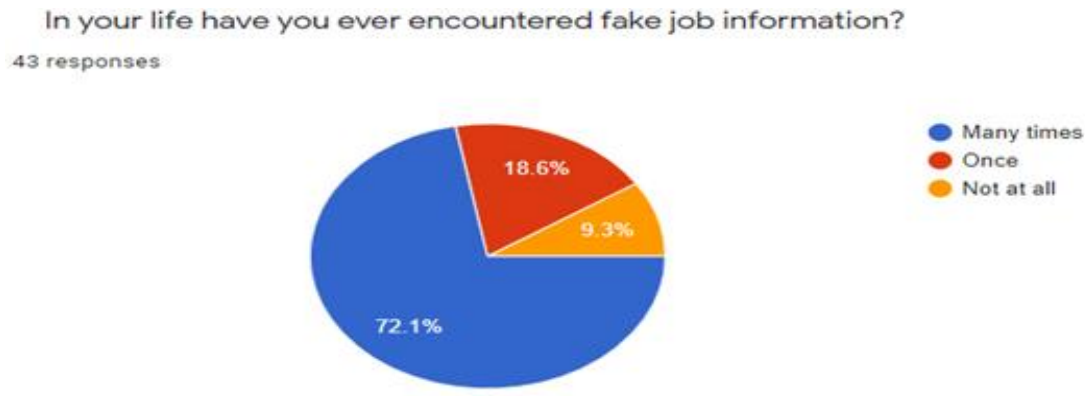


Figure 4: Fake Job Information Dissemination

When a question was raised about the fake job postings 72.1% of respondents responded that this issue is serious in the countryside, 18.6% responded that it happened once a while and 9.3% revealed not at all faced such problems and presented in figure (4). A similar experience was responded to by the professionals when they were interviewed and also verified during the personal observation of the researcher. In addition to this, the researcher got another fold alarming state that job seekers are cheated repeatedly but they don't want to share this as they do not feel comfortable to share.

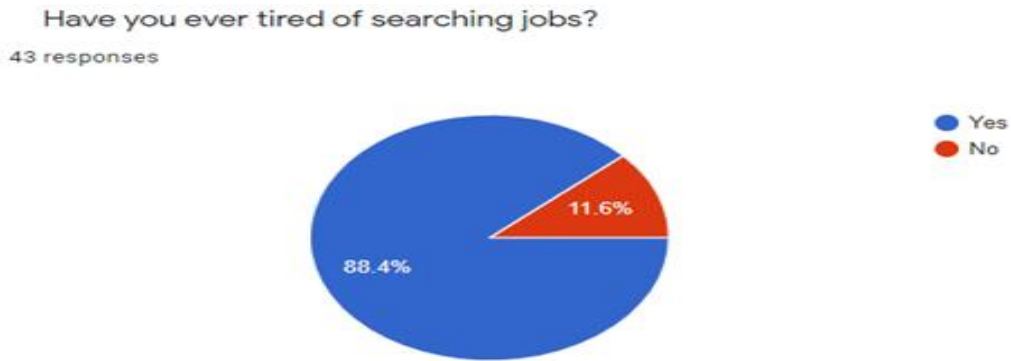


Figure 5: Frustration While Searching Jobs

Furthermore, typically frustrated tiredness in the job searching process in the open market was also revealed, i.e. 88.4% of respondents accepted that they are frustrated with the current system of job searching and looking for a new/alternative system for countrywide adoption with trust, transparency, and speed. In this only 11% of respondents were found satisfied with the current system of job searching. This scenario is presented in figure (5).

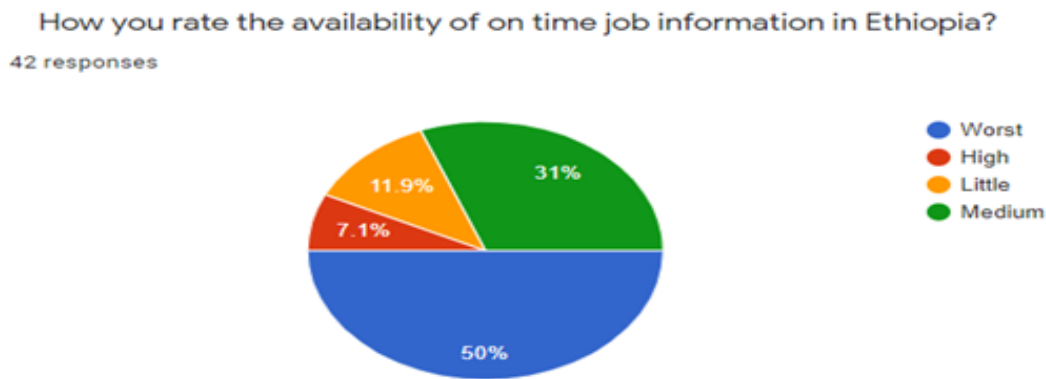


Figure 6: The availability of real-time job information

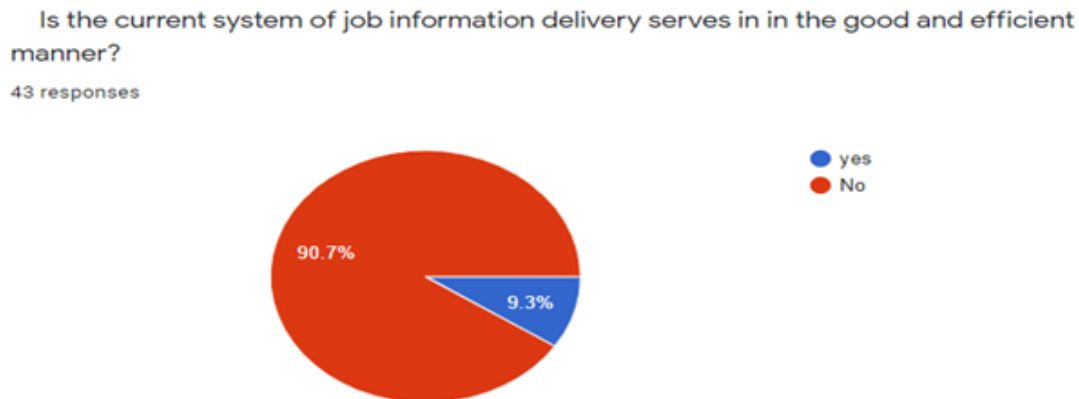


Figure 7: Current System Evaluation

Another question was related to the availability of on-time job information presented in figure (6). Here the survey data revealed that almost 50% of respondents agreed that the existing systems in practice are the poorest, 31% agreed on Medium, and 11.9% said low and only 7.1% accepted as very good means high. The respondents indicated that the current systems of job searching are not serving in any time anywhere manners. Further, when the question was asked about the efficiency and effectiveness of the job searching process, 90.7% of respondents responded that it's neither efficient nor effective as presented in figure (7).

If No, do you believe that there is a need for such a system to improve the current state of art systems of job information delivery which are lacking in anytime, anywhere over any device real time job information delivery?

42 responses

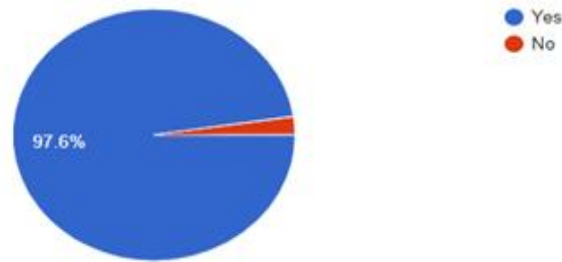


Figure 8: Current system improvement

Further when the question was asked about the “need of a newly proposed system to resolve the aforementioned issues in the current system i.e. any time anywhere over any device information delivery” as presented in figure (8) only 2.4 % of respondents responded negative and the remaining 97.6% of respondent’s response was positive. This result showed that there is a strong need for an alternative system that can help in providing anytime, anywhere job information services in an efficient manner over any device. When this question is verified with the experts/professionals' perspectives, it is verified and the same has been observed by the researcher during personal observation.

Have you ever heard about an organization which use/ provide pervasive environment to access context based real time job information?

43 responses

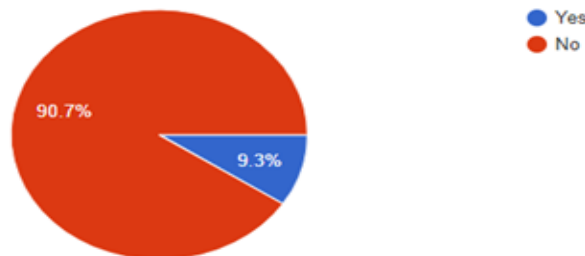


Figure 9: Organizations which use pervasive technology

Further when the question was raised to know which organization in the local territory of Ethiopia uses a pervasive environment, as presented in figure (9). The 9.3 % responded YES means organizations use pervasive technologies and the remaining 90.7% of respondents responded NO means don't use. From these survey results, the researcher clearly identified that there is a strong need for an alternative system and awareness about the newly proposed framework for creating the context-aware pervasive environment. Since it is a new and emerging technology and therefore only a few respondents i.e. 9.3% were familiar.

Which statement best describes the importance of context based real-time information delivery in pervasive environment in compare to the current state of art system.

43 responses

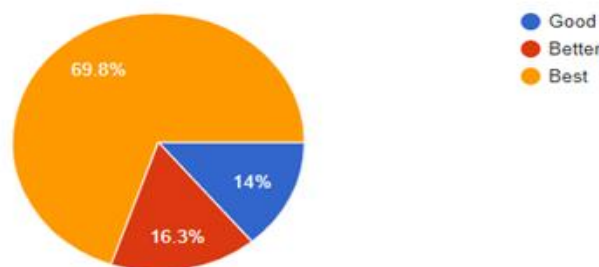


Figure 10: Importance of context based real-time information delivery

Do you recommend the adoption of context based real-time job information delivery technology for your organization?
43 responses

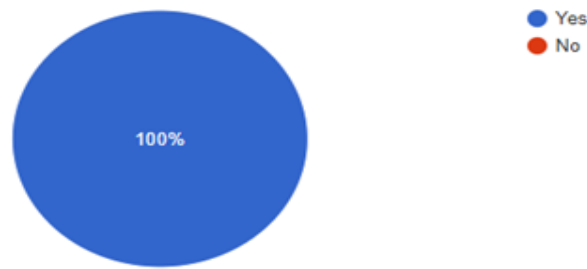


Figure 11: Adoption of context-based real-time information delivery for organizations

When another question was asked to investigate the importance of context-based real-time information delivery on a pervasive environment by comparing with the current job posting system as presented in figure (10). 16.3% of respondents responded BETTER, 14% of respondents responded GOOD and the majority of respondents 69.8% responded THE BEST option. The result from the survey clearly showed that the newly proposed real-time information delivery system framework on the pervasive environment is considered as a better environment than the current manual job posting platform for the betterment of the service delivery.

Further, when a question was raised to understand the perception towards the adoption of context-based real-time job information delivery for their organization using a pervasive environment, as presented in figure (11). The response was amazing, all the respondents i.e. 100% responded YES. This result revealed that there is a significant interest among organizations for the adoption of a pervasive environment in their day-to-day activities.

4. A Context Aware Real-Time Job Information Delivery Framework

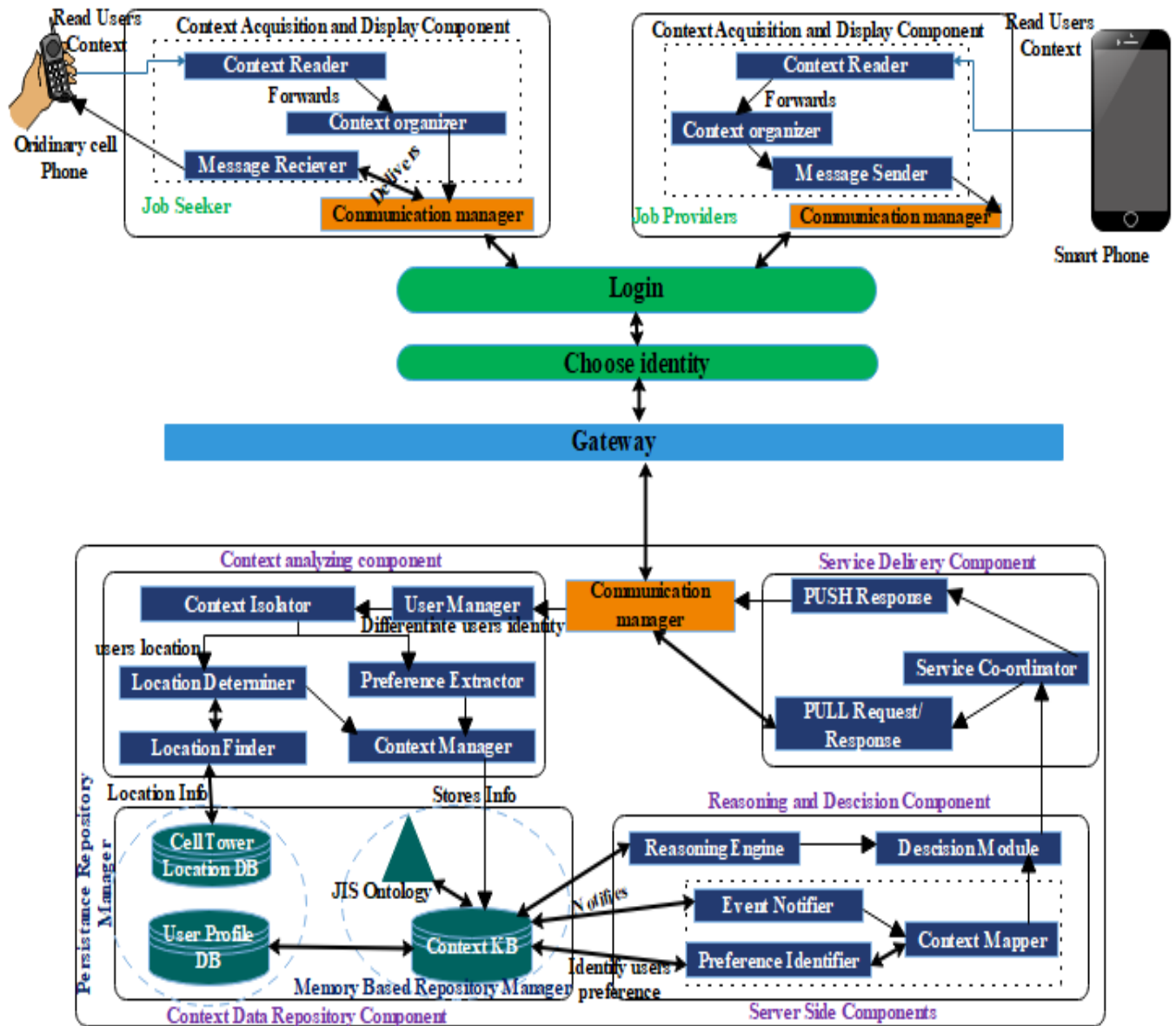


Figure 12: Proposed Framework

The proposed framework consists of six major layers that reside on either the server-side and/or the client-side. These layers communicate via the Internet (TCP/IP). These layers are Context Data Acquisition and Display, Communication Manager, Context Analysing, Reasoning and Decision, Context Data Repository, and Service Delivery. The salient components of the proposed framework are viewed and presented in figure (12). These components co-operate and communicate for effective assistance to the users in getting the right (relevant) information at the right time and place on his/her mobile device. Each of the major components is composed of several modules that are needed to carry out different tasks in the course of giving the context-aware job information service.

4.1 Context Acquisition and Display Component

This component as presented in figure (12) resides on the two-sided devices (job seeker and job provider mobile devices). Its main responsibility is similar for both the job seekers and job providers, which need to capture and submit raw context data to the server as requested and display the server’s response on the client’s mobile devices. This component is composed of three subcomponents/modules along with a communication support manager. This is described in the following subsections.

4.2. Context Reader

It is responsible for reading implicitly raw context data (such as location and time) from the user mobile the device through APIs. This module as presented in figure (12) forwards this context data to the Context Organizer module on the client's mobile phone to be sent to the server to provide localized computation.

4.2.1 Context Organizer

This module as presented in figure (12) is responsible for organizing the context data that is received from the Context Reader module and submits it to the Communication Manager to be sent to the server.

4.2.2 Message Receiver

This module as presented in figure (12) is responsible for accepting all the incoming messages, which holds the context information that is sent by the server and submits to the Job Seeker's (User's) interface to be displayed on the mobile device of the job seeker.

4.3 Communication Manager

This module as presented in figure (12) resides outside the skirt of the context acquisition and display component **on** both sides i.e. client-side mobile device and server-side device and manages the communication between the client and the main server over the Internet gateway as a communication backbone.

4.3.1 Context Analysing Component

In this module several modules are interrelated (work together) to analyse the context data. Finally, they hand over the analysed context information to the Reasoning and Decision-Making Component. This component as presented in figure (12) consists of six modules that are presented in the following subsections.

4.3.2 User Manager

This module as presented in figure (12) accepts the data from the communication manager and identifies the user's category i.e. (end-user (service requester/job seekers) and context data the provider (job providers/ job service provider) and their request to forward to the responsible module for further process.

4.3.3 Context Isolator

This module as presented in figure (12) accepts the context raw data from the User Manager and separates location data from other context data. Afterward, it passes location data to the Location Determiner Module for the identification of the user's location. And other context data to Preference Extractor to identify and manage user's preferences and to handle the user request based on the interests of the users.

4.3.4 Location Determiner

The main task of this module is to determine the location of the user that has a mobile phone (without built-in GPS). This module as presented in figure (12) executes the mobile location determination algorithm.

4.3.5 Location Finder

This module as presented in figure (12) is used to acquire the actual geographical location of a given cell tower through look up the Cell-Tower-Location database.

4.3.6 Preference Extractor

The main responsibility of this module is to extract the user's interest and preferences from the raw context data that is received from the context filter module. It passes the identified user's preference and interests to the context manager module for further process.

4.3.7 Context Manager

The Context Manager (CM) is the module in charge of delivering analysed context data to the Reasoning and Decision-Making component for further processing and response.

4.4 Reasoning and Decision Component

The main responsibility of this component is to make decisions by examining contextual information or user requests against the existing context instance of data in the context repository as presented in figure (12). The component comprises five modules as presented in Figure (12). 1) Reasoning Engine, 2) Event Notifier, 3) Decision module, 4) Preference Identifier, and 5) Context Mapper. These all the modules combined can carry on the context reasoning process.

4.4.1 Reasoning Engine (RE)

This is the core module of the Reasoning and Decision-Making component. The main responsibility of this module is to infer the suitable information to be dispatched to the job seeker based on his/her current context either in PULL or in PUSH mode.

4.4.2 Event Notifier

This module of the system framework is responsible to notify the occurrence of a new event based on the monitored context and any new change in the parameters.

4.4.3 Preference Identifier

This module of the system framework is responsible to analyse and dispatch the user's preferences and interests either based on the occurred event that accepts from the Context Mapper module, or through periodically navigate the user's (job seeker's) profile histories from the User Profile database.

4.4.4 Context Mapper

This module of the system framework performs its tasks based on two cases- 1) one is during Event Notifier modules notifies the occurrence of a special event, 2) Preference Discovery module submits context information to be dispatched to a user (job seeker) based on his/her profile history.

4.4.5 Context Data Repository

The Context Data Repository component of the system framework is responsible to store ontology-based context data instances into a responsible backend database for future references.

4.4.5.1 Memory-Base Repository Manager

This module of the system framework is responsible for managing the interaction of other components with the backend databases and JIS ontology. It is also responsible for analysing and dispatching the context data to Persistence Layer to be stored into a responsible backend database based on the received context from other components.

4.4.5.2 Persistence Repository Manager

This module of the system framework is responsible for managing the data store and access to the underlying relational database system and provides an abstraction for data access and retrieving operations.

4.5 Service Delivery

This is one of the main modules of the system framework. The main responsibility of this module is to submit the received context information from the Reasoning and Decision-Making Component to the Communication Manager Component in the form of a message either in a PULL or PUSH situation. Since this component handles the two situations, it comprises three modules, which are- 1) Service Coordinator, 2) Information Dispatcher, and 3) Notification Manager. The context information here is to mean that the responses to the user's interests and preferences.

4.5.1 Service Coordinator

This module of the system framework is responsible for deciding the type of action to be taken or response to be given, and submit this to the responsible module for the action/response to be given.

4.5.2 PULL Request/Response

This module of the system framework is responsible for submitting the required context information that is received from the service coordinator module to the communication manager component to be sent to the client during the PULL Situation.

4.5.3 PUSH Response

This module of the system framework is the last in the service coordination. Its main responsibility is to submit the context information that is accepted from the Service Coordinator module and passes the way of dispatching mechanism (either SMS or e-mail) to the Communication Manager component. Before submitting the context information, this module creates a message that holds the context information and the dispatching mechanism.

4.6 Prototype

This section of the research study describes the design and development of the prototype for functional evaluation and validation of the proposed concept and its theoretical system framework. The main goal of the

prototype and its demonstration is to prove the conceptual system framework design. A proof of this concept demonstration has been constructed using an online tool i.e. Justinmind, Mockplus, and Protégé version 4.3

The majority of the components in the framework are demonstrated as per the theoretical specifications formulated for each component. The demonstration has been incorporated into two situations (PUSH and PULL). The communication between the client mobile phone and the Server PC is carried out using Java socket programming interface over Internet Gateway

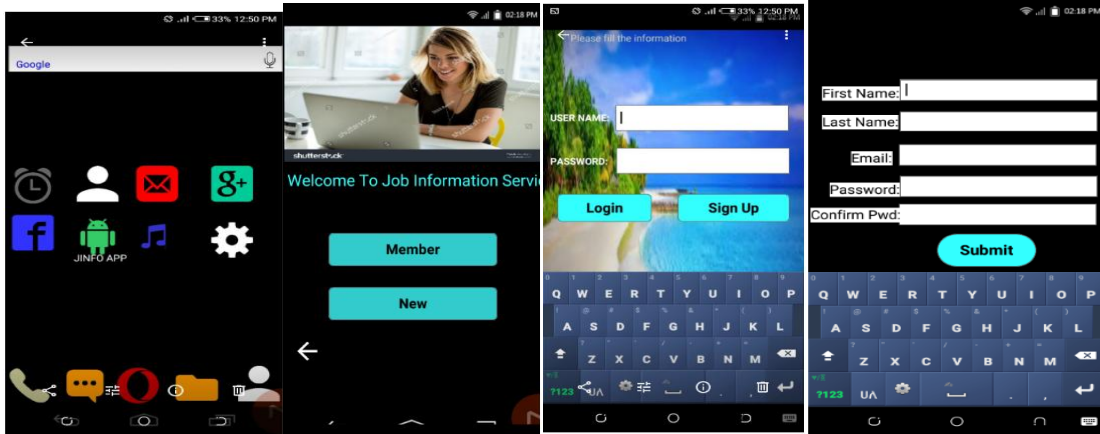


Figure 13: Job Info App Figure 14: Home Page Figure 15: Login Page Figure 16: User Info

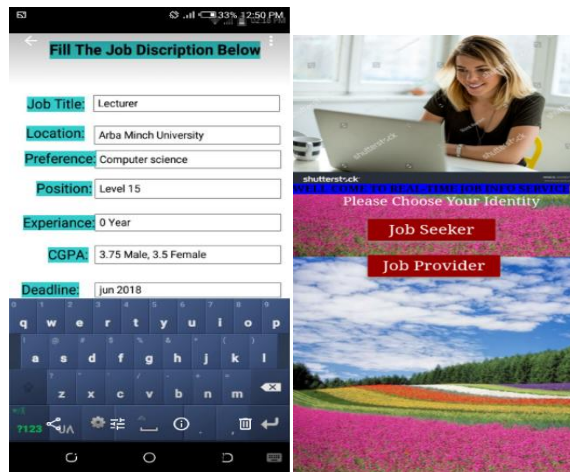


Figure 17: Populated Job Info Figure 18: Identity choosing

4.6.1 PULL Situation

When a user first initiates a JIS application installed on his/her mobile phone. This scenario is presented in figure (13), in which the system displays the welcome window as presented in figure (14). If the user is already registered, the User (Job Seeker/ Job Provider) selects a “member” from the options, and then the login page is displayed as presented in figure (15). If a User is new then a signup page is displayed for the User to register as presented in figure (16). Afterward, an interface is displayed to select explicitly the identity of the User (Job Seeker/ Job Provider) as presented in figure (18).

When the User (Job Seeker/ Job Provider) clicks the “Ok” button, an interface is displayed based on his/her identity. Since the user identity is “a job provider”, the system displays an interface that helps the user to insert explicitly job information as presented in figure (17). Similarly, for any user that is different from a job provider, an interface is displayed. It helps the user to insert explicitly his/her preference and interest after this interface is displayed to the user on their mobiles. The system implicitly captures the user’s (Job Seeker/ Job Provider) location information. Then the User (Job Seeker/ Job Provider) submits his/her request to the server. The server analyses his/her interest, and preferences, then, it sends the relevant information to the User (Job Seeker) according to his/her current location by consulting the context repository

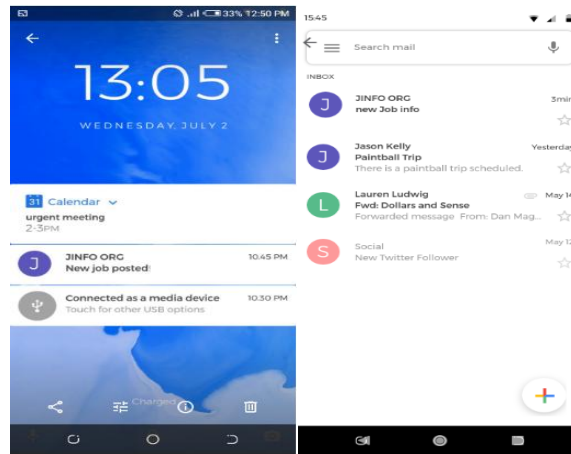


Figure 19: Notification Received on Mobile

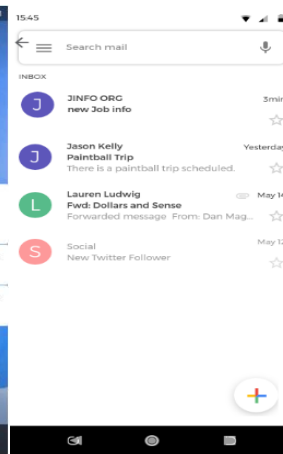


Figure 20: Notification Details

4.6.2 PUSH Situation

As presented in figure (19), when the User (Job Seeker) receives a notification message on his/her mobile then he or she can check the details in his/her email address using the same or other device. The server sends a notification message to the User (Job Seeker) through his/her email address, after discovering his/her preference and interest from his/her profile history, then the user clicks on the notification button to see the detailed job information message as presented in figure (20).

5. Conclusion

This research proposes a framework for context-aware real-time job information delivery in a pervasive environment. This is done by collecting local job information data from job service providers while inserting job details via their mobile devices. Unlike other related researches, this research study uses an approach in which the following three component activities are incorporated: 1) firstly, the researcher collects primary input data from job seekers, job providers, experts, and researcher self for the real-time information delivery on any communication device in anywhere and anytime manners to the target job seekers in rural and urban areas, 2) Secondly, the researcher describes how the intended services are delivered to the end-users (job seekers & job providers) using the two basic delivery modes the PULL and PUSH. This situation is described during the prototype demonstration of the proposed framework and 3) finally; an algorithm that is used to identify the user's (job seekers) location from the fetched cell-ID and RSSI information from the user mobile phone is used. The prototype of the proposed system framework was built using 'Justin's mind and mock plus tool' for user acceptance and validation. Since most of the users, especially from the rural areas are unable to afford smartphones, this system framework supports them to access the services using an ordinary phone. The usability of the system can be greatly enhanced by utilizing contextual factors to display only the needed information and to provide optimized job information following the user preference and interest at anytime, anywhere over any device manners.

6. Recommendations

Pervasive computing is still in its early stages of implementation or usage in developing countries like Ethiopia and therefore numerous researches need to be done in the area. As stated in the limitation part; the proof of concept the demonstration was done on one of the popular tools with limited performance and resources to address cell phone features. So, the researcher recommends using a better deployment platform or high performing machine to test the framework to the fullest potential and for better performance.

Besides this, the usability of the service increases, if the multilingual capability is incorporated in the service because in Ethiopia there is a diversity of languages. Incorporating the multilingual capability helps the users, especially rural job seekers to access the service in their languages.

Future research studies can include different features like job seekers' GPS location, ordinary cell phone's advanced features, or Tablets. The researcher suggests the full implementation and evaluation of the framework

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