Smart Time-Based Reminder System Using Speech Recognition Supported by Arabic Language

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Summary

In the present world, people have to schedule a number of tasks to be accomplished in advance. These tasks vary from the meetings at work to the grocery shopping. Since it is hard to remember all the activities, the utilization of reminder systems on smart phones has come into place. The time-based reminders are common in the traditional methods, which help to alert users to the particular date and time. The available reminder application is based on written texts. Most of them do not support location-based reminding where the user is notified and the alarm triggers depending on arriving or leaving a specific place. To our knowledge, all available automatic reminders based on speech do not support Arabic language. This research work focuses on having a smart time-based system that allows the user to add a reminder in a modern, easy, and smooth way. The user can create a speech reminder where the proposed application can convert speech into text and makes the necessary processing to extract required information such as the title, time, place, and description. The proposed application can be set to send the notification based on a specific location either when arriving or leaving that place. The application will schedule the reminder appropriately and easily allowing users to manage their daily tasks quickly and sharing the reminder with several users

Keywords:
Markov Model, speech recognition, reminder, Mobile-App, SDLC, WFM.

1. Introduction

Now a day the use of the mobile applications developed on smart devices become very important part of our daily life, these applications including and not limited to the applications for shopping, banking, paying bills, medical tracking, sporting and health Apps…. etc. The result of these revolution in Mobile Apps are the use and the demand for mobile application development. With this, we get an opportunity to use technology in a better way so that it can be made useful to us. As the need of intelligent and efficient time management tools, a Reminder System (RS) is one of the useful applications that can be developed on smart devices and that can benefit from the free mobile platform technology. The main purpose of these Apps is to play a role as a central component of assisted living solutions that enable people to remain active and independent. To perform the reminding, a reminder system should have information

of the reminding process such as what is the issue, at where will be held and when. With that information, adaptable reminder systems can react according to the users' dynamically changing care needs and context [1].

1.2 Review of literature

Different Reminder systems have shown promise in mobile applications platform, Table 1 summarizes the work on implementing the reminders-based App using smart devices and mobile platforms techniques for scheduling and managing tasks.

Table 1: Studies of Mobil-based Reminder Apps

Reminder based Apps / Criteria	Google Keep	SIRI	Bixby	QNot	Reminder with Alarm
Create reminder based on speech	✔	✔	✔	✔	✖
Support Arabic language	✖	✔	✖	✖	✖
Location-based notifications	✔	✔	✔	✖	✖
Create reminders schedule	✖	✔	✔	✔	✔
Add images and voices to the reminder	✔	✖	✖	✖	✖
Share reminders on WhatsApp, SMS or email	✔	✖	✖	✔	✔
Using voice to create a share	✖	✖	✖	✖	✖
Notification	✔	✔	✔	✔	✔

For example, Google keep App is one of the similar projects that are related to our project, Figure 1 shows some of the

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forms of this App in which you can record what you think instantly and set a later reminder at the right place and time. You can also record a voice reminder on the app to automatically convert it to text.
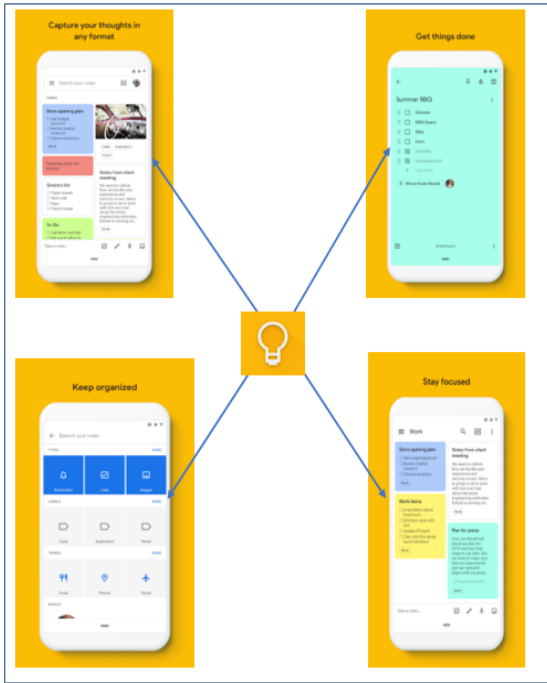

Fig. 1 Google keep app.

This app allows you to easily record your thoughts and to retrieve them and share them with others. Additionally, you could Add notes, lists, and photos to Google Keep [6]. If you don't have time, you can record a voice memo and the app will convert it to text for later retrieval. You can share your thoughts with your friends and family. In addition, you can mark notes with color codes to quickly organize them and keep track of your tasks. If you want to search for something you've already saved, it's easy. If you want to get a reminder of what you want from the grocery store, you can set a location-based reminder to remind you of the desired shopping list when you arrive at the store. The Set reminders using SIRI, Siri is a virtual assistant that is part of Apple Inc.'s for iOS operating systems, Figure 2 shows some of the forms of this App. The assistant uses voice queries and a natural-language user interface to answer questions, make recommendations, and perform actions by delegating requests to a set of Internet services [7]. Siri is designed to help the user accomplish everyday tasks easily, which is the job description of the service that need to create and update your daily reminders. One of the easiest things you can do with Siri is to set up a quick reminder. Using Siri, you could add reminders and share it using you own voice in an easy and simple step. Bixby helps

you focus on what matters most, Figure 3 shows some of the forms of this App. It learns everything you love to do and works with all your favorite apps and services to help you get things done. It's a Galaxy app allowing you simplify your tasks and your daily routine. You can set reminders, manage your schedule, or even request recommendations for dinner [8].
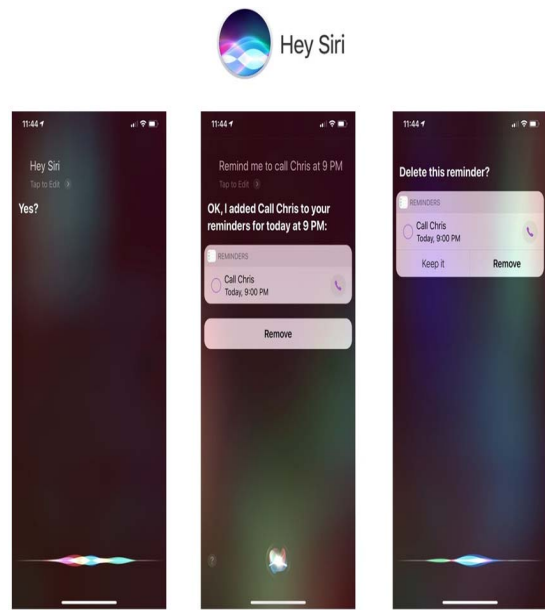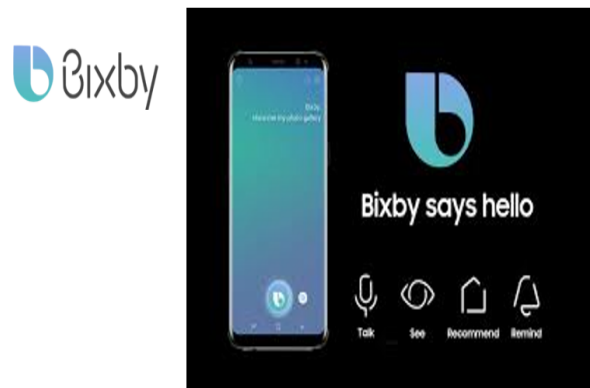

Fig. 2 SIRI app.

Fig. 3 Bixby app.

You can use Bixby to create complex reminders just by speaking. So, if you say "Bixby, remind me to pick up water and milk when I leave home". This app is easy to use even with voice dictation and vocal commands. It also allows you to create post-it with customized widgets that will allow you to view a Note or List, or a list of all your recent activities. It also has a hands-free and surprisingly

swift app, as you can simply dictate the words you want to insert directly on your note [9]. One of this app's features is that you can use voice commands that will allow to quickly set your alarms and reminders instead of manually entering the dates on your device. Reminder with Alarm Reminder with Alarm app is a reminder app which you could simply create a reminder for each deadline and let the app do the work for you Figure 5 shows some of the forms of this App. The system has the ability to allow the user to create a weekly reminder for each meeting with never missing one [10].

2. Materials and Methodology

Speech recognition is a subfield of Artificial Intelligent (AI) regarding the possibility of making the machine understands spoken language. It concerns about developing methods that can identify spoken words and phrases in spoken languages and convert them into a machine-readable format [2]. The main idea of this work is to develop an Intelligent Mobile Reminder system using Speech Recognition which will be available to all iPhone platforms. The proposed solution will allow the user to add a reminder in a modern, easy, and smooth way. The user can create a speech reminder in which the application will be able to convert speech into text and makes the necessary processing to extract required information such as the title, time, place, and description. The system can be set to send the notification based on a specific location either when arriving or leaving that place. The application will schedule the reminder appropriately and easily allowing user to manage their daily tasks quickly and sharing the reminder with several users.

2.1 Speech Recognition Systems (Hidden Markov Model)

At the beginning, let us define what is speech recognition means, the technology of speech recognition (it is called Automatic Speech Recognition (ASR) as stated in [14]) refers to the ability to listen to input words and gives the correct meanings of these words, or it concerns with the transformations of input audio steaming data into text data [14]. This technology allows the computer to distinguish words which can be input through a device such as a microphone or telephone device. Another definition of ASR is the process of converting a spoken word into its corresponding text. An ASR is said to be speaker independent if it can reliably recognize what is being spoken irrespective of who is speaking. For the ASR system two aspects are there, one is the training aspect, and the other is the decoding or the recognition aspect. The characteristics of the speaker with recognition system is considered when three categories are exits, namely, specific

speech recognition, speaker-independent speech, and Recognition system for several folks [5]. If the style of speech is considered, recognition system can also be divided into three categories, namely, isolated word speech recognition system, connected word speech recognition system, that wants clear pronunciation of each word, the articulation development appears, continuous speech recognition system, that is in continuous speech input, giant legato and diacritic seem.

Some recent available technology of APIs for speech recognition is Microsoft speech for Windows which supports the languages such as English, Spanish, French, German, simplified Chinese, and traditional Chinese [15]. Microsoft.NET is another way to achieve windows speech recognition through a system, in which this technology supports 26 different languages.

Hidden Markov Model (HMM) is One of the more effective methods for speech recognitions. As stated in [4] the full description of HMM is as the following: before the HMM method is applied to detect the speech, "the speech samples are extracted to features or coefficients by the use of Mel Frequency Cepstral Coefficient (MFCC)". This process separates the audio clip into small segments that the HMM can use as an input. The HMM uses a dictionary of word pronunciations to determine the word W by choosing the maximum probability $(W|Y)$ where Y is the audio clip recorded. This maximum probability is computed using the probability (W) which is calculated using a language model. By using this technique, the HMM can produce the text from the given speech [4]. Figure 4 below shows the architecture of MHM.
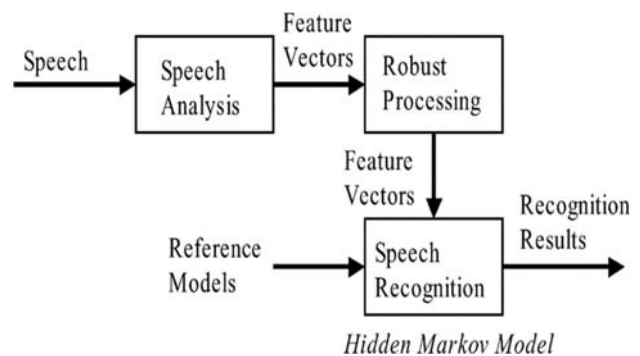

Fig. 4 Hidden Markov Model (Speech recognition) [4]

Sphinx 4 is a new open sources speech recognition that is based on HMM and that is developed by JAVA. HMM Toolkit (HTK) is a toolkit used for building & manipulating HMMs. HTK is also used in speech synthesis, character recognition, and DNA sequencing. HTK can form complete continuous-speech, speaker-independent and large-vocabulary recognition systems for any demanded language. It also supplies tools to create and train acoustic models [16]. Recently java speech API included Javadoc style API which

has 70 classes and interfaces to API. The Google Cloud Speech API has been developed by Google Inc., and it is available in Google Now, Google Assistant, and Google Search. The advantage of Google speech recognition system is ability to support real-time audio conversion. Furthermore, Cloud Speech API can recognize human speech in over 80 languages and support the conversion of Thai language. The API implemented Deep Neural network technology with 8% of error rate in 2015. It has been reduced from 23% in 2013. Google acquired the technology from DeepMind, DNN research, and Jetpac. Nuance Dragon SDK support several languages as French German, Italian, and Dutch. This applied to Desktop, PC and MAC and as well in mobile app for Android & iOS. Nuance also gives software development kit for development of window application SDK as backend and mobile SDK develop apps for iOS, Android, and windows phone. As shown in Figure 5, the sound that passes through the voice recorder is reworked to a degree of electrical signal when the voice recognition system is operated which it is the initial stage. In the process of sound processing, the system creates an audio model that is consistent with the characteristics of human voice, then analyzes the input audio signal and extracts the options selected accordingly.
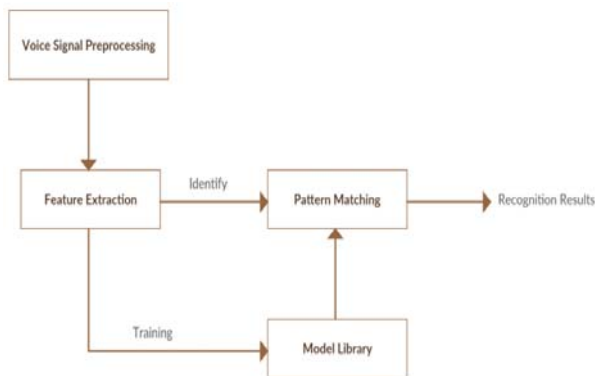

Fig. 5 Basic block diagram of a speech recognition system [3].

2.2 Overall Architecture of the System

The proposed model for the Intelligent Mobile Reminder System uses Speech Recognition that helps users to add reminders through speech and it can help to manage their tasks and appointments as shown in Figure 6 (system architecture). The proposed approach for the application will be able to send the notification based on a specific location either when arriving or leaving that place. Depending on the voice recognition technology, the application can analyze the voice and extracts some information then it manages the information and sets a reminder. In the user's voice file, there are some keys the application must consider like the date, time, and the title. Users can replay the recorded audio at any time. Users can

edit the reminder, so they may add images, links, and more. It is not just a reminder application; it can be used for another purpose as a guideline for other linked users. For example, on a specific day and time, the manager wants
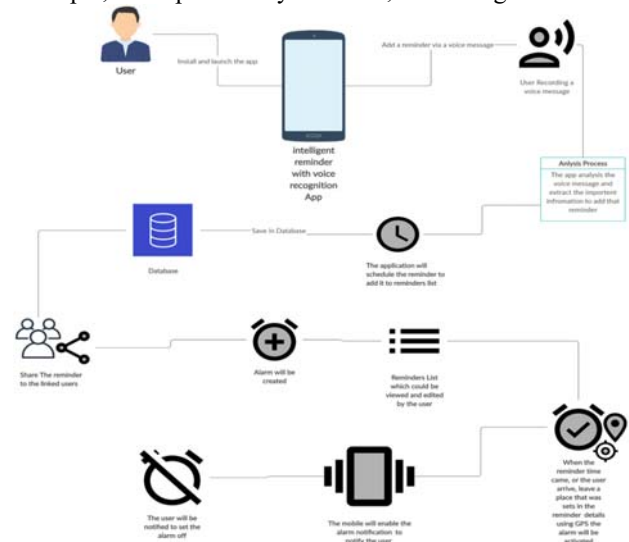

Fig. 6 Application architecture and scenario app.

each employee to do some tasks, the reminder then will display the tasks for each user at the same time. The main objectives of the proposed smart-reminder system are to develop mobile model system that converts the voice message to a text to create a reminder, the mobile application shares the reminder with all the linked users in the group if there is the word "Share it" in the voice message context and Users can see how many in the group accept the reminder, the application can be set to send the notification of the reminder based on a specific location either when arriving or leaving that place, the system will have a database to store the user's reminders and personal information, the reminder application views upcoming or past added reminders, the users can select a custom alarm or image for reminders, the application allows the users to add an image or google map location related to the reminder, and finally, the proposed system will allow the users to add comments related to the subject of reminder and it will serve whose Arabic is their native language.

The benefits of the proposed system is to help users to add a reminder in easy as possible way by just click a button and record that reminder details, Set reminders for daily tasks such as set a reminder for taking a medicine or take some time off to exercise or drink water at regular intervals, Set reminders based on a location on google map which when the user goes to that location, the application will remind him about something is relevant to that location

he set it when he add that reminder, Create a reminder using your voice via speech recognition feature, Set an Alarm for your friends or team work to meet up by sharing the reminder with them, The application help users to never forget anything again by putting up an event reminder for such as scientific conferences, Set reminders for important meetings at work, Never miss a deadline with the help of reminders which enable users to renew to services they had booked before and need to renew it in each period, and Track time and make sure being productive by organizing your time and not forgetting the important things to do in your daily life. The development methodology of the proposed system follows the waterfall model (WFM), as WFM have been appearing in supporting project management. In the waterfall model, all the processes in software development are divided into stages and each stage must be completed before the next stage begins [11].

WFM is one of the easiest models to manage because each phase has a specific deliverable and a review process. It works perfectly for smaller-sized projects where its requirements are easy to understand. Faster delivery of the project, Review process and its results are well documented. Easily adaptable method for shifting team. One of the advantages of WFM is that it allows management and control, so you can set a schedule with deadlines for each stage of development in the system and the application can proceed through the development process model one by one. The tools and software that have been used for the development processes are an integrated development environment for macOS Xcode 11.1 containing a suite of software development tools developed by Apple for developing software for macOS, iOS, iPad, watchOS and TVOS. Coding by swift 5 as programming language developed by Apple Inc. Django 2.0 is python-based free and open-source web framework, which follows the model-template-view architectural pattern; we use Django to build web service that communication with the IOS App. To implement speech recognition using Apple's new speech framework for Swift, or connect the app by web services, Python packages basic speech recognition using The Cloud Speech API. The prototyping presents a simple pilot model of the proposed system.

The prototype phase provides a simulation of the system work, the form of interface and the interaction with the system. The Balsamiq program is used to design the system interfaces. Figure 7 and Figure 8 present the registration as well as the login screen to the system. The prototyping screens presents a simple pilot model of the functionality of the system represented by adding the reminder parameters like the date, type of reminder (meeting, shopping, or going for picnic… etc.), and the place of the events. It also shows the models of adding reminder using manual approach as well as the model of adding the reminder using sound recognition approach. The prototyping also presents the geographical location of the

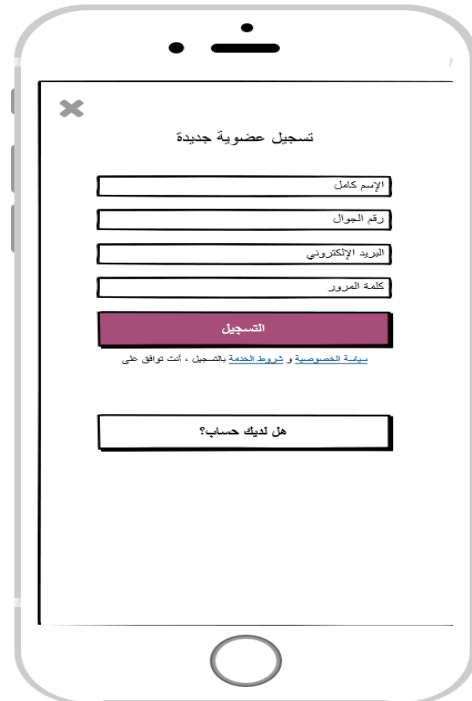event begin scheduled. The user can edit, add, or delete the selected location of the reminder.

Fig. 7 Registration and login Model for RS.

Fig. 8 Adding Reminder Model using manual and speech approaches.

3. Results and analysis

Consequently, the selection of an appropriate and suitable intelligent mobile-based reminder system is a paramount issue for both all sectors of the community starting with students, teachers, managers, doctors, and other educational institutes. Therefore, in this section, we investigated the need and the importance of having an intelligent mobile-based reminder system that is supported by speech recognition, location, and Arabic speech recognition. The collected dataset was using questionaries and it has been divided into four groups, the general data of the participants as shown in Figure 9, the investigation of the need of a reminder application and if the users use one before and what is their problems as shown in Figure 10, the development of an application that can add reminder via speech recognition with the location-based function as shown in Figure 11, and the integration of Arabic language with the application functions and take users notes and suggestions as shown in Figure 12. We also visualized the current dataset to further understand the input variables and performed several experiments to answer the research questions. We performed data visualization to further understand the experimental dataset. These visualization results show the importance of having intelligent mobile-based reminder system with the proposed features. This result further indicates that speech recognition as well as the Arabic support features are currently in the greatest demand. We will start with the first group, the general data, 3.1% of the participants was in the age lees than 18, 40.9% was in age between 18-25, 21.8% was in the age between 26-35, 20.2% was in the age between 36-45, 21.8% was in the age between 36-45, and 14% was in the age greater than 46 as shown in Figure 9 (1). If you would like to itemize some parts of your manuscript, please make use of the specified style "itemize" from the drop-down menu of style categories. For the gender 85.4% form the participants was female while 14.6% was male as shown in Figure 9 (2). For the occupations 44.5% form the participants were students, 21.5% was teachers, 4.1% was mangers, 2.6% was doctors, and 27.6 was holding other occupations as shown in Figure 9 (3).

For the investigation of the need of a reminder application, for the question (Do you have difficulties in remembering the tasks?) 23.80% form the participants answered Yes, while 31.6% answered No, and 44.6% answered Maybe as shown in Figure 10(1). For the question (Do you record and remember your tasks by writing them down on a piece of paper?) 30.20% form the participants answered Yes, while 26.8% answered No, and 43%answered Maybe as shown in Figure 10(2). For the question (Do you use traditional reminder programs by entering tasks manually?) 51.70% form the participants answered Yes, while 48.30% answered No shown in Figure

10(3). For the question (If you use traditional reminder programs, does it take time to enter your tasks into it?) 23.10% form the participants answered Yes, while 49.50% answered No, and 27.4% answered Maybe as shown in Figure 10(4). For the question (Have you ever used software that allows you to locate a specific task?) 28.90% form the participants answered Yes, while 54.30% answered No, but I want, and 16.80% answered No, I don't want as shown in Figure 10(5).
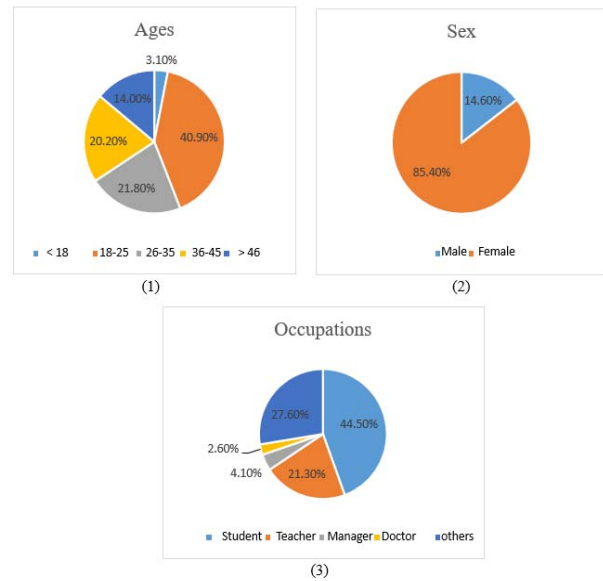

Fig. 9 The general data of the participants (1) Ages of the participants (2) the gender of the participants (3) the occupations of the participants.

For the investigation in the need to develop an application that can add reminder via speech recognition with the location-based function, for the question (Have you ever used a program that allows you to share the tasks you need to remember with others?) 14.20% form the participants answered Yes, while 58 % answered No but I want, and 27.8% answered No but I don't want as shown in Figure 11(1).

For the question (Have you ever been using software that arranges your tasks using sound recognition instead of using handwriting software?) 12.40% form the participants answered Yes, while 64.7 % answered No but I want, and 22.9% answered No but I don't want as shown in Figure 11(1).
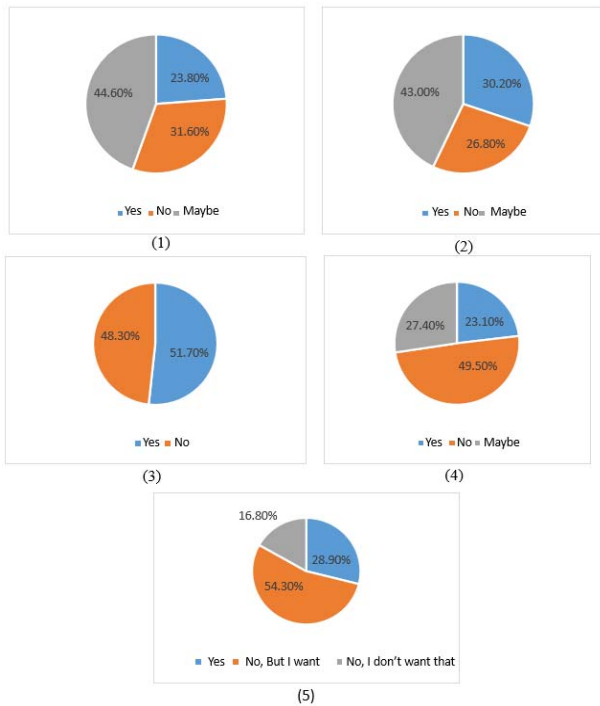
Fig. 12 The responses of the participants: Do you support that this application supports the Arabic language?

4. Conclusion

The proposed intelligent mobile-based reminder system that support speech recognition, location-based, and Arabic language is in highly demand as show in the analysis study, as this project is an efficient and user-friendly mobile-based application for all types of users. The integrated features will make it easy for the users to enable them adding their reminder in an easy way via record a voice message. The recorded message will be processed via Markov Model to extract the important information and add that reminder information to the database. This integrated system is capable for meeting the user's requirements related to different parts such as edit and delete the reminders easily, Also, share the reminder to all group's members.

Fig. 10 The responses of the participants (1) Do you have difficulties in remembering the tasks? (2) Do you record and remember your tasks by writing them down on a piece of paper? (3) Do you use traditional reminder programs by entering tasks manually? (4) If you use traditional reminder programs, does it take time to enter your tasks into it? (5) Have you ever used software that allows you to locate a specific task?
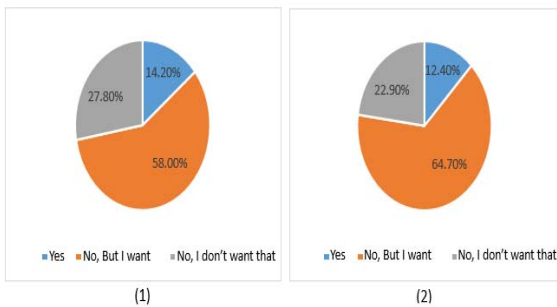

Fig. 11 The responses of the participants (1) Have you ever used a program that allows you to share the tasks you need to remember with others? (2) Have you ever been using a software arranges your tasks using sound recognition instead of using handwriting software?

For the investigation in the need to integrate the Arabic language with the application functions and take users notes and suggestions, for the question (Do you support that this application supports the Arabic language?) 97.00% form the participants answered Yes, while 3 % answered No as shown in Figure 12.
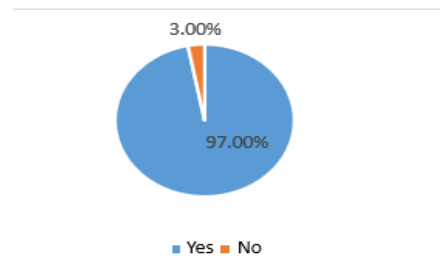
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