KNOWLEDGE BASED EXPERT SYSTEM FOR ON-LINE ORAL EXAMINATION

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Abstract *¾ Knowledge based on-line examination system is backbone for any E-University. This paper discusses the scope and structure of an oral examination system in era of electronic assessment. The main goal while developing this structure was to remove drawbacks of existing oral examination in which lot of factors involves in marking the performance of students. Attempt has also been made to capture operating procedure of an impartial examiner, who is treated as expert, in logical form.*

In this system, the question bank will content questions in primary, basic and expert categories. Students appearing for the oral examination will get the questions from the server program who is domain expert. Initially server will distribute questions randomly from primary knowledge category. Answers from the students are recorded and analyze by the server. Successful students from the primary category will get questions randomly from the basic and expert category successively. Students will get result immediately after the examination.

This system can identify different area of interest of students and student can be judged with respect to all dimensions of the subject. Reliability of the results improves as all the students are tested on equal predefined footings.

Introduction

Oral exmaninations have always been considers an important element of the total student evaluation system. They are being used in different situations for different purposes. The assumption on which the use of oral examination has been based is that there are many things which cannot be tested by paper-pencil examination, while they can be tested by oral examinations.

However, a group of teachers feel that oral examination provides situation for in-depth questioning, using variety, constructing question based on students response, which give oral exmination a uniqueness not possible in other form of tests. In addition, there are the other skills and abilities like shrpness in comprehending the question, organizing the response, logical presentation of one's point of view, the way of presenting giving emphesis at right points, etc., which if to be tested then oral examination is the only way. In courses where development of oral communication skills is the main objective e.g. for salesmanship, marketing products orally in one-to-one situation or one-to-large group presentation then oral examination has to be designed and developed accordingly. There are some inherent problems in oral examination – the question of bias, hallo-effect, reliability, variations in sets of questions asked to different students and examiners personal likeness and dislikeness during the interaction between examininers and examinees. It has, therefore, always been prefered to use paper-pencil test, in place oral examination if the objectives are served.

Problems in the oral examination

Past research has often confirmed the poor reliability and validity of oral examinations. But little is known about the factors influencing the evaluation of orals. Contrary to their importance, oral examinations have been the least researched of all forms of assessment. The social interaction during the examination complicates any analysis of it. Some of the research finding on oral examination are:

- Barnes and Pressey (1929) stated the variation of the same candidate's marks as obtained by different examiners.
- Trimble (1934) and two other lecturers rated 25 students of Psychology during an oral examination on eight rating scales. The inter rater reliability for the different pairs of examinars varied from – 0.231 to 0.796 for the different scales. For the general estimate of the relative position among students, correlations of 0.33, 0.40 and 0.26 were found.
- Birkel (1978) studied that the inter rater reliability of pairs of examineers who, at short intervals, ask the same candidates questions on the same objective in the same subject was around 0.40 to 0.60.
- The correlation between oral and written or practical examination with the same contents range

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from 0 to 0.70 but in most cases they are between 0.20 to 0.40.

- Betz (1974) found that sources of errors were due to the examiner being subjected to flucuations during the course of examination sessions.
- Peter Birkel (1976, 1978) studey on oral examination in German's school was aim to identify the sources of errors in the oral examination. The following observation were made:
  - The knowledge about the prevoius achievement determines the attitudes toward the candidate and therefor influences the perception of his performance. One could also call it as the hallo effect.
  - A good performance is rated better if it follows a weak performance and a weak performance following a good one receives and even worse rating.
  - For many teacher the promptness and pace of performance same to be correlated with competence and quality.
  - The speed of speking is also misleadingly associated with the rating of intelligence.
  - An examination cannot be valid if its result are so easily influenced by factors not relevant.

The finding conform that examination, which are so open to uncontrol influences, have a low inter rater reliability and therefore low reliabilty and validity.

Utility of oral examination

The oral examinations are particularly useful in situations where the eduactional objectives cannot be measured with either paper and pencil tests or with practical tests. Some of the situations where these test could be used effectively are:

- To test candidate's listining ability, as it is an important requirment in effective communication.
- To examine such candidates (a) who are not able to read and write either due to physical handicaps or illiteracy and (b) who are expected to give and take oral instructions in their jobs.
- To tests candidate's speaking ability, as it is an important element of communication specially during conversation.
- To question candidates on the processes used in making projects, models, conducting experiments, preparing drawings, sketches and paintings.
- To probe the intellectual level of the candidates in a given content area by gradually increasing the texonomy level and difficulty of the question.

Conducting an oral exmination is a professional job, to be taken seriously. The personal contact of the examiner with the candidate during the examination often affects the judgement as many irrelevent factors such as biases and prejudices on the part of the examiners come into play and reduce the validity of the examinations

Using knowledge based expert system for oral examination improves the effectiveness of the examination, at the same time overcoming most of the problems associated with it mentioned earlier.

Knowledge based expert system

Knowledge refers to stored information or models used by person or machine to interpret, predict and appropriatly respond to the outside world. (Fischler and Firschein, 1987). The primary characteristics of knowledge representation are twofold (1) what information is actually made explicit and (2) how the information is physically encoded for subsequent use. In the real world applications of knowledge based expert system, it can be said that a good solution depends on a good representation of knowledge. Typically, however, the possible forms of representation from the inputs to internal neural parameters are highly diverse, which tends to make the of a satisfactory solution by means of a neural network a real design challenge.

A major task for a neural network is to learn a model of the world in which it is embeded and to maintain the model sufficiently consistent with the real world so as to achieve the specified goals of the application interest. Knowledge of the world consists of two kinds of information

1. The known world state, represented by the facts about what is and what has been known; this form of knowledge is referred to as prior information.
2. Observations of the wold, obtained by means of sensors designed to probe the environment in which the neural network is supposed to operate. Ordinarilly these observations are inherently noisy, being subject to errors due to sensor noise and system imperfections. In any event, the observations so obtained provide the pool of information from which the examples used to train the neural network are drawn. Each examples representing an input signal is paired with a corresponding desired response. A set of input-output pairs is referred to as a set of training data or training sample.

Voice recognition using neural network

The general steps to creating a neural-network based recognizer are:

1. Specify the phonetic categories that the network will recognize.
2. Find many samples of each of these categories in the speech data.
3. Train a network to recognize these categories.
4. Evaluate the network performance using a test set.

According to Webster's Dictionary, a phone is "a speech sound considered as a physical event without regard to its place in the sound system of a language." So, the word *phone* is used here to refer to the phonetic events that are to be classify.

In order to determine the categories that the network will classify, the following three things need to be done:

1. The designer of the recognizer needs to determine the pronunciations for each of the words that will be recognized. More accurate pronunciation models will generally yield better recognition rates.
2. Quite often, we also use context-dependent phone models, which means that one phone is classified differently depending on the phones that surround it (for example, an /aI/ following an /w/ is classified differently from an /aI/ following an /h/). The surrounding context may contain a group of phones or just a single phone. (Using groups of phones reduces the number of categories that need to be classified.) The grouping of phones into clusters of similar phones must be done by the person designing the recognizer.
3. Finally, when constructing context-dependent phone models, we divide each phone to be recognized into one, two, or three parts. Each sub-phone segment corresponds to one category to be recognized. If we keep a phone as one part, then it is used without the context of surrounding phones. If we divide it into two parts, then the left half of the phone model (the left sub-phone) is dependent on the preceding phone, and the right half of the phone model (the right sub-phone) is dependent on the following phone. If the phone is split into three parts, then the first third is dependent on the preceding phone, the middle third is independent of surrounding phones, and the last third is dependent on the following phone. One final option is to keep the phone as one part, but make it dependent on the following phone; this is called a right-dependent phone and it is used mostly for stop consonants. The designer of the recognizer needs to decide how many parts each phone will be split into.

Figure 1 shows the voice recognition process. There are four basic steps to performing recognition.

1. Divide the waveform into *frames*, where each frame is a small segment of speech that contains an equal number of waveform samples.
2. Compute features for each frame. These features usually describe the spectral envelope of the speech at that frame and at a small number of surrounding frames.
3. Classify the features in each frame into phonetic-based categories using a neural network. The outputs of the neural network are used as estimates of the probability, for each phonetic category, that the current frame contains that category.
4. Use the matrix of probabilities and a set of pronunciation models to determine the most likely word(s).

Further performance data can be evaluated by comparing the recognized word with the words stored into the database for further processing.

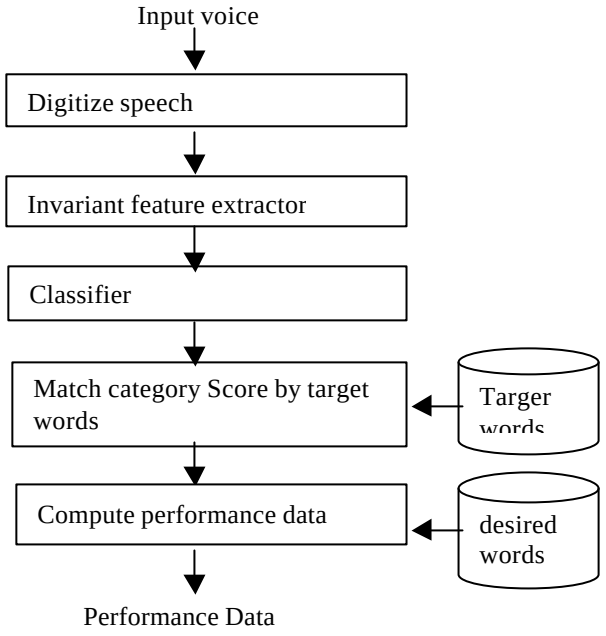

FIGURE. 1
VOICE RECOGNITION PROCESS.

Figure 5 shows voice recognision process in detail. The digitized waveform is converted into a spectral-domain representation; one of two sets of features may be used, depending on the recognizer.

To provide some information about the acoustic content, take a *context window* of features, as shown by the vertical lines in the upper-right diagram in Figure 5. This means simply taking the frame of interest as well as frames that are -60, -30, 30, and 60 msec away from the frame of interest. This is done to take into consideration the dynamic nature of speech: the identity of a phoneme will often depend not only on the spectral features at one point in time, but it will also depend on how the features change over time. Send the features in a context window to a neural network for classification.

The output of the neural network is a classification of each input frame, measured in terms of the probabilities of phoneme-based categories. By sending context windows for all frames of speech to the neural network, build a matrix of the probabilities of phoneme-based categories over time. In this example of neural-network output, the word to be recognized is *two*, and the darker regions in the t, t<u, and u

categories indicate the greater probabilities of those classes at the indicated times.

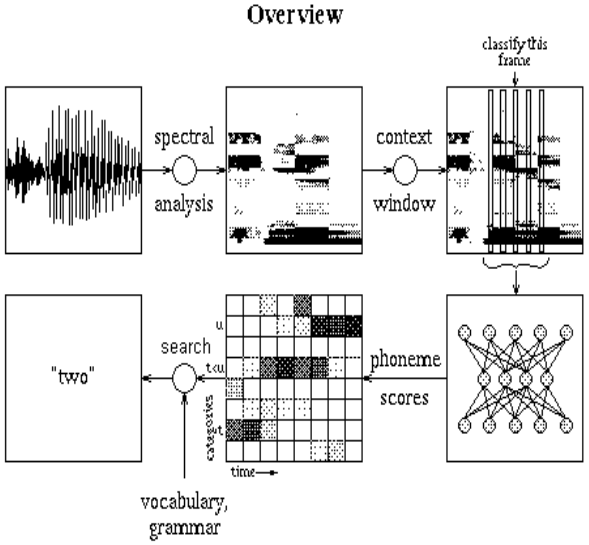

FIGURE. 2
VOICE RECOGNITION PROCESS IN DETAIL

The target-word pronunciations are then expanded into strings of phonetic-based categories, and search procedure is used to find the best path through the matrix of probabilities for each legal string. The output of recognition is the word string that corresponds to this best path.

Proposed expert system for on-line oral examination system

Architecture of the system

Figure 3 shows architecture of expert system for on-line oral examination. It is divided into following parts.

1. Question bank
2. Development unit
3. Administration unit
4. Examination Server
5. Examination unit
6. Trainig unit

1. Question bank

Following main points that must be consider during the design and implementation of the question bank database :

- System must be capable of handling large amount of data.
- System must be fast enough to respond to database access request.
- It should avoid redundancy problem.
- Efficient, effective information storage and retrieval should be achieved.

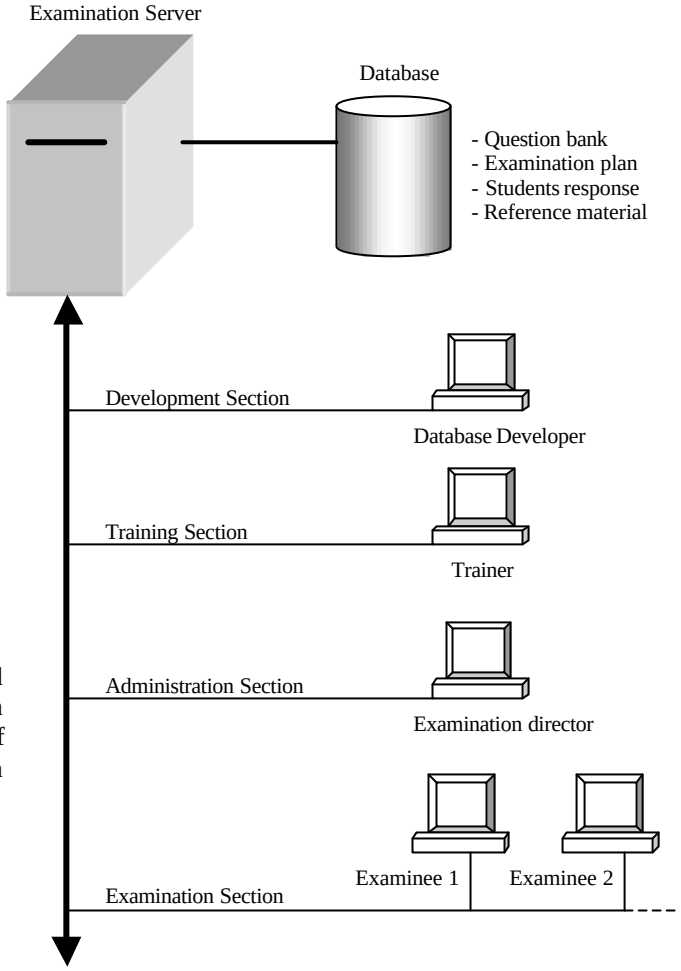

FIGURE.3
ARCHITECTURE OF THE SYSTEM

All questions in the question bank can be uniquely coded and strored into the question bank as per the categiries defined by expert. Categories such as primary, basic and expert categories may be formed. These categories form heirarchical structure. All questions belong to same category shuld be at the same level.

2. Development unit

The main objective of this unit is to develop question bank. This unit provide powerful integration development environment to add, delete and revise questions from question bank, testing and debugging question bank, and advance procedures to integrate audio, video, animation and pictures along with text into questions. Strong graphical user interface makes the task of defining the struture of the questions more easier.

3. Administration Unit

This unit is responsible to define overall structure of the examination. It specify the way by which the examination is carried out and criteria to control the examination. Criteria such as the randomize question generation and number of times repeatation of the same set of questions.

Following figure 4 shows sample structure of the examination plan.

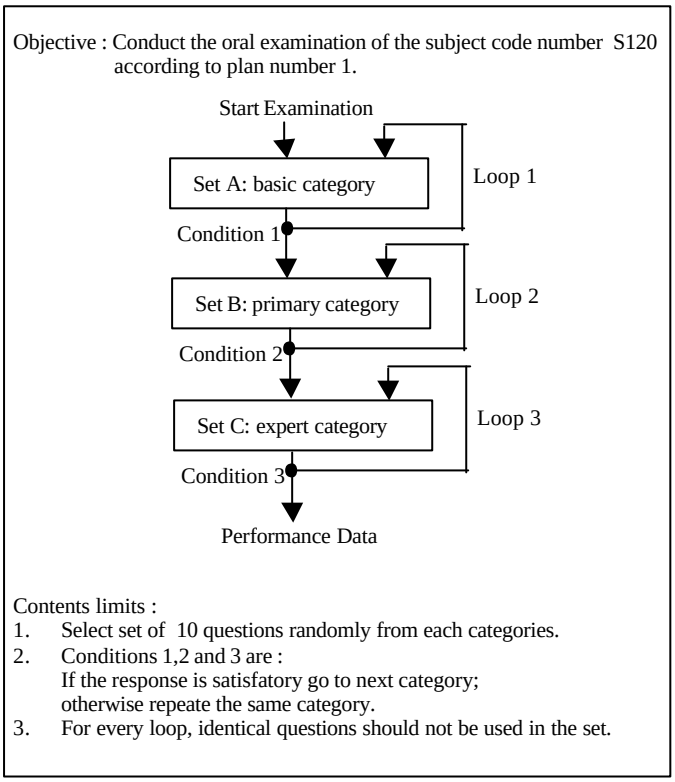

FIGURE. 4
EXAMINATION PLAN

Above plan desctibe the caegories of questions and way in which question will be asked during the examination.

4. Examination unit

The main objective of this unit to view the questions, record students responce and students performane attributes such as responce time, if necessary and provide it to the examination server.

It provide strong graphical user interface to view questions, advanced procedures to represent varied question containig such as audio, video, animation and pictures along with text. Advanced instruments like camera is also added to capture any visual procedure or to make face-to-face contact with other examinees or examiners, if such feature is granted.

5. Examination server (Expert system)

Examination server provide services to the clients. It provide the inteface between question bank and examinees. Its main responsibility is to conduct examination. One of the major feature of the examination server is the ability to search and retrive questions form the question bank that meet specific search criteria decided in the test plan by the examination director.

Examination server must allow more than one clients at a time. This feature allow more than one students can face examination at the same time. For this, server must use connection oriented, concurrent communication protocol such as TCP.

Figure 5 shows the interaction between examination unit and examination server. Initially examination server validate students by asking his name, password, identification number (1). If registered students will be allowed for the examination and supply necessary instruction (2). When student get ready for the examination, he/she send ready signal to the examination server (3). Then examination server will distribute questions randomly from first category of the examination plan (4). Examination unit send recorded asnwers (5). Expert system will analyze these recorded answers by following way :

- First perform voice recognition process. Determine actual answer by converting recorded answer into words or sentence.
- It compare the actual answer with the desired answer strored into the database. It compute performance data including at a minumum, proportion correct, discrimination indices.
- If values of these attributes above the threshold, accept the answer otherwise reject it.

Successful students from the first category will get questions randomly from the next category successively (step 4 and 5). At the end of the examination result is calculated and send to the candidate (6). Result include overall performance in the subject, topicwise and/or subtopicwise performance, status of the candidate among the candidates appeared for the same examination.

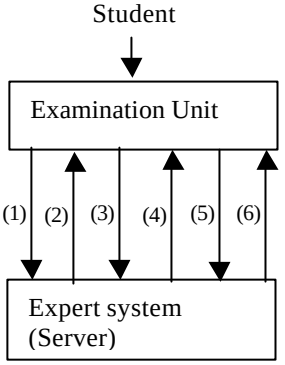

FIGURE. 5
INTERACTION BETWEEN EXAMINATION UNIT AND EXAMINATION SERVER

6. Trainig unit

Main function of this unit to train expert system to recognize voice. Figure 6 shows trainig process of neural network of the expert system.

In supervised learing it is assume that at each instance of time when the input is applied, the desired responce of the system is provided by the teacher. The distance between the actual and desired responce serves as an error measure and is used to correct netwok parameter externally to make the output closer to given desired output. After several repetitions of this (each repetition is an iteration), the network can produce the correct output given a loose approximation of the input. We call this process training.

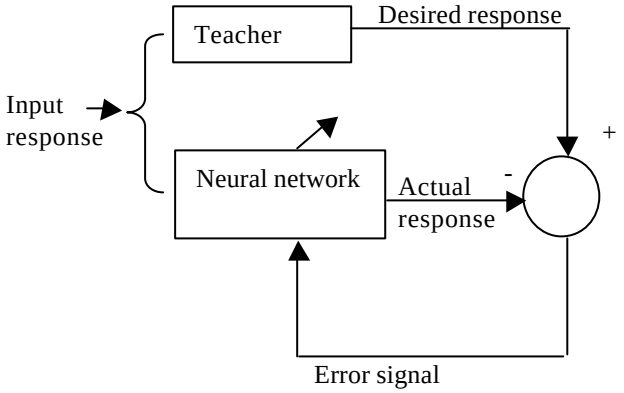

FIGURE. 6
TRAINING PROCESS

Advanteges in on-line oral examination

The psychological make up the students and their personality characteristics introduce errors in the measurment of performance of the students. For example help, motivation, imotional strains, fatigue, etc. Affect candidate adversely. For nervous and shy students, facing the examiners is an ordeal which they would not like to undergo. Such students perform poor in oral examination, although they would do well on a written examination on the same objective.

On the other hand exterovt students with better vocabulary and expression dedge the examiner by their verbalism and mannerism. They create a hallo effect and are rewarded not for their intellectul achievement but for something different.

Such problems are automatically overcome when on-line oral examination administered. Here a student faces a machine and not a person, he/she can take the examination when feels confortable, thus overcomming anxiety. Since the test is administrated through computer, the question of bias or hallo effect infuencing assessment do not arise.

Lookin into the future

On-line oral examination will be one of the most interesting new directions. I expect that in the comming years the technology and pedagogy will drive us to a historic change in the way people will face the oral examination. The attempt to merge wirless techonology and hand held computers with on-line instuction will make on-line oral examination even more accessible.

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