Intelligent Assistant to Help Blind people for Selecting Wearable Items

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Abstract: We introduce intelligent assistant for the blind people that support them in selecting wearable items. Many intelligent systems have been developed for the people with impaired vision. These systems help them to deal with daily life problems like avoiding obstacles, face recognition, reading, and writing. However, blind persons still have to face a lot of problems in choosing their daily commodities .Therefore a system is needed for such people that can assist them in selecting their accessories. Our proposed system that is using text to speech technology for direct communication is intelligent enough to facilitate blind people in choosing their wearable items like dresses, shoes, hair styles, jewelry, and glasses according to the causal or formal events. The main purpose of this assistant is to make blind persons more independent and more confident so that they can enjoy life like healthy persons. The system's objectives are achieved with the unification of artificial intelligence particularly knowledge based system and image processing. We validate our system on various blind persons and get satisfactory results. [**Farzana Jabeen, Aslam Muhammad, Maliha Saleem Bakhshi, Martinez-Enriquez A. M**. Intelligent Assistant to Help Blind people for Selecting Wearable Items. Journal of American Science 2011;7(8):833-840] (ISSN: 1545-1003). http://www.americanscience.org.

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1. Introduction

According to the world health organization surveys, the number of vision impaired people is estimated to be between 40 and 45 million [4]. In every era vision impaired people have to face a lot of problems in daily life that sighted people take for granted. In particular, these people face huge difficulties in reading, writing, moving freely in ever changing environments, and selecting their daily wearable items. As a result, blind people are in danger while moving on their own, and their sovereignty is limited. They have to depend upon on some of the friends or relatives to perform their daily life activities.

Above all huge estimated figure of vision impaired persons and their issues regarding daily life cannot be neglected. Many intelligent systems have been introduced to meet the needs of vision impaired people that help them in face recognition, reading, writing, avoiding obstacles. White cane [6] (purely mechanical device) is the most commonly used travel aid by the vision impaired people to avoid obstacles, uneven surfaces, holes, steeps and other hazards. Due to limited proximity detection (3-6 feet) and detection of obstacles with contact urged the scientists to introduce new mobile robots assistants (Navbelt, Guide cane) for better travel assistance of blinds. Robotic walker [8] is a more reliable device that is especially designed for indoor assistance of vision impaired persons. Grava architecture [7] is introduced with minimum modeling language for facial recognition.

Although all the existing intelligent systems are doing well at their own still blind persons have to face a lot of problems in choosing their accessories. A common belief exists that vision impaired people are not interested in their physical appearance. A sighted person can say this easily because he is independent and unaware about the difficulties that a vision impaired person has to face in the selection of daily commodities. Vision impaired person can make difference among the fabrics of their dresses but can never in case of colors, fashion, new trends. Some blind people organize their room wardrobe in a way that help them to select their dresses, shoes, ties, and pants etc. easily. For example they hang causal outfits on one side of the closet, and the formal on the other. When purchasing the new clothes, the blind people can distinguish only on the basis of fabrics and material of their accessories that may result in collection of similar colures. That's why blind people always needed the help of a sighted person so that he can assist them in shopping.

Unfortunately in our society it has become a norm that people are treated according to their way of dressing. So, blind people are hesitant to attend the formal functions because of the deficiency of selecting wearable items. This deficiency makes them realize their dependence on others. Vision impaired people want to become independent in their lives.

In this paper we have tried to tackle above issue.

Therefore, we propose an intelligent assistant agent system that assists blind people in selecting their wearable items like dresses, shoes, hair styles, jewelry, and glasses according to the causal or formal events. The main purpose of this assistant is to make blind persons more independent and more confident so that they can actively participate in every event.

The system objectives are achieved with the unification of artificial intelligence techniques (knowledge based system), digital image and signal processing (feature extraction, speech to text and text to speech conversion).The system gets input from sensors (gait detector, camera) and verbal description like (height, waist, and category) in order to facilitate the selection of wearable items. The system makes decision about the wearable items by using knowledge based system and then provides verbal description to the user regarding his getup. This system plays the role of human assistant, who helps the users in selecting wearable items.

Related work is presented in Section 2. Section 3 describes proposed system. Section 4 describes case study, in Section 5 conclusions and some future perspectives are given.

2. Related Work

Many intelligent agent systems have been developed for the assistance of blind persons that help them in increasing their limited sovereignty. This global system combines intelligent systems, virtual reality systems and multimodal interfaces in a house with domotics devices. The main purpose of this application is to support a blind person [3]. To complete system's objective multimodal interfaces, autonomous intelligent agents, virtual reality, and UML methodology are used. The system focuses on the facial expression to communicate with the blind users. This intelligent systems consists of two parts (a) a virtual character (the butler) who accomplishes all the tasks of butler. The butler interacts with the house and users, receiving perceptions and taking actions. (b) The system is a multi agent system. Each agent manages a specific module of the application and receives a set of perceptions that helps evaluate the environment and provides a set of actions.

Intelligent tutoring system (ITS) is designed to run on a handheld device with the aim to increase the independence of people with cognitive disabilities in industry and daily life activities [2]. ITS collects the idea of an active distributed support system where the knowledge of how to perform an activity is shared between people and artifact. This system consists of a Task Management System that includes a Content Management System and modules for ergonomic characteristics and personal information of users.

This work presents a review of existing locomotion assistance devices for the blinds. These devices measure the distance to the nearest obstacles and convey this information to the vision impaired people [1]. The proposed system introduces different methods for the distance measurement like infrared sensors, ultrasonic sensors, laser telemeters. This work also describes about the shortcomings of existing system and the methods to improve those systems.

This implicit interface is developed to assist the sighted persons so that they can easily choose entities like dress, shoes and hair style [5]. The proposed system is based on implicit Human Computer Interaction concept and knowledge based systems. System gathers customer information to facilitate the selection of daily life commodities.

A color recognition system is built on the smart phones for the blind people [10]. The user needs smart phone with a camera and to install this application on their phones. The proposed system has user interface with text to speech technology that helps in identifying object's colors.

All above intelligent systems assist the blind people in walking freely, face recognition, talk independently, color recognition and express their emotions properly in their discomforts. Still an intelligent system is missed that can help vision impaired persons in selection of their daily commodities.

3 Intelligent Talk-able Assistant for Blind (ITAB)

Our proposed system assists visual impaired people in shopping and selecting their daily life accessories according to their own taste. Text to speech technology with English language [9, 10, and 11] is used that not only makes system's interface friendly but also provides an efficient way of direct communication between user and system. Our system consists of two parts. Hardware support and software support. The hardware support shows the details of all physical devices (Figure 1) that help user to interact with the system and provides its personal and functional information according to the need of the software system. System inner working is explained with the help of Figure 2 that provides a broad vision about the role of agents.

The Figure 1 shows the physical components that describe about the hardware detail of ITAB. We are suggesting a trail room that is specifically dedicated for blind. The specialty of trial room is that all physical components of ITAB are set up there so that blind can easily interact with the system in isolation. Isolation helps user to describe about his/her desiring accessories openly in absence of any disturbance and human assistant.

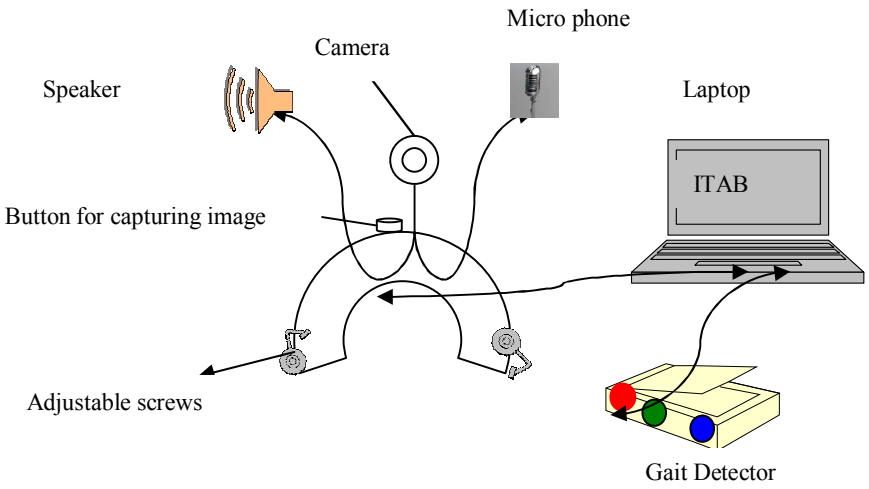

Figure 1: Model of Intelligent Talk-able Assistant for Blind (ITAB)

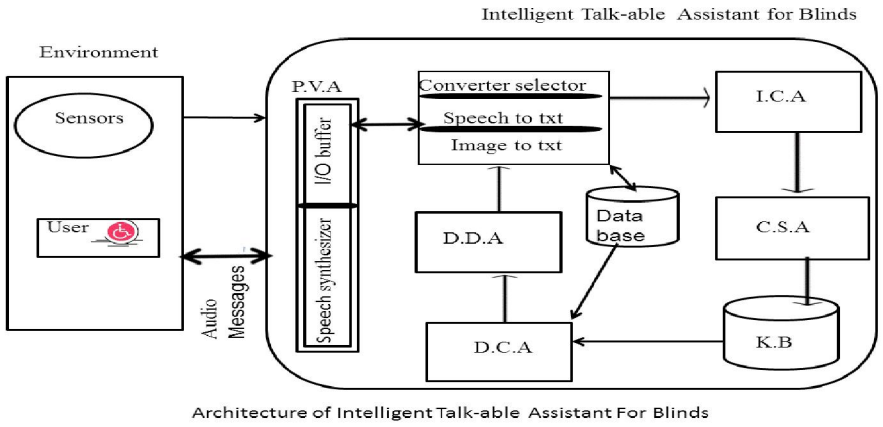

Figure 2 : Architecture of Intelligent Talk-able Assistant for Blind

Room front right corner is reserved with a camera that is adjusted to the top of the wall. It captures images from 3-D environment automatically and on user's demand by pressing the button on clutch. Speaker and microphone are fitted on the top left corner of the room. One ear speaker and micro phone that are connected with clutch is an optional way of communication between system and user.

ITAB consists of software components that act as intelligent agents to accomplish the tasks. Figure 2 shows the inner detail about the system's working and its components interaction. The system consists of following major components.

3.1 Perception vector agent (PVA)

ITAB uses sensors to get input from environment. (1) A movable camera is mounted on the top of the trial room's right corner as well as on the clutch that captures 3-D images continuously or on user's demand respectively. Camera sends captured images to the laptop that contains the ITAB software that help to get the exact skin tone color by using sampling mechanism [13] and facial

appearance of the user that is further used for selection of suitable wearable items. (2) Gait detector is a sensor that used to detect the walking style of the user [5]. This device consists of pressure sensors which are laid on some metallic surface. The user walks on this device bare footed and the pressure sensor detects the pressure of human foot from different angles and provides information like size, flat footed .This information is then sent to the ITAB system so that system can select appropriate shoes for the user. The walking device is provided by different lights: green color when nobody is walking on the device, blue when someone is walking on it and the system is getting information without any error, and red color when someone is walking and the system is not getting the correct input. A voice message is sent through speaker saying "Walk again".

User communicates with system either by using the trial room's speaker and microphone or one ear speaker and microphone connected with clutch. Instructions are provided by the ITAB to user with the speaker that guides the user how to interact with the system and what type of information system expects from user. System asks question regarding personal information, type of category and function.

User provides its personal (gender, height, weight, waist, and favorite color) and category selection information (dress, shoes, hair style, jewelry, glasses) relevant to event (causal, formal, sports, party) by using microphone.

Input from all sensors (image, data) and users (voice) are received by the perception vector that acts as an interactive agent with other agents of ITAB and user also. It consists of two components (a) I/O Buffers is a temporary storage for all input perception (voice, image, sensory input) and as well as output also. It contains input and output buffer that is used for the storage of input data from environment sensors and user and output data from convertor selector respectively (b) Speech synthesizer is a Text to speech system [10] with English language that converts the text into speech by producing artificial human voice. Speech synthesizer has its own database that is used to store all text description. By combining the pieces of text from the database Speech synthesizer is delivered audio messages to the user that can be listened by using speaker.

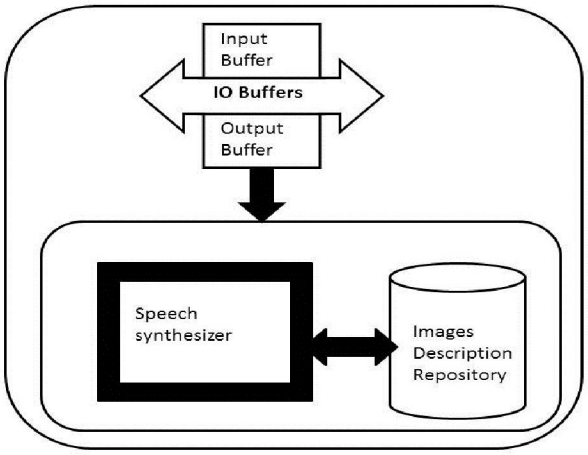

Figure: 3 Perception vector agent

Figure 3 : Perception Vector Agent

3.2 Converter Selection (CS)

PVA sends the perception input from I/O buffer to the Converter selector. First it saves a copy of user's image into database so that it can use that image for further processing during the next phases. Then Converter selector checks the format of the input whether it's an image or speech. Then on the basis of the input format it forwards data to the speech to text converter and image to text converter respectively. CSA uses existing models and algorithm for input conversion according to the format. Image to text converter uses the hamming trace transform method to extract the user's facial features [12].

The hamming trace transform method is combination of concept of Trace transform, Fourier transform and circus function to detect the facial feature from the target image. Skin tone is measured using the sampling mechanism [13] based on object detection by using machine learning approach.

AdaBoost algorithm is used for machine learning process. All the voice messages from the user are entertained by the speech to text converter that is used SPOC text to speech system [14].This system is used hidden Markov models for speech recognition that converts the speech into text.

3.3 Information Collector Agent (ICA)

All the text information from images and voice messages is sent back to the CSA that further transfers this data to the information collector agent. ICA extracts its desiring information like, gender, sex, height, weight, waist, skin color tone, favorite color, flat footed, foot size, high sole, and event nature from the data and forwards the information to the Category selector agent.

3.4 Category selector agent (CSA)

CSA manages different wearable items categories like dress, shoes, jewelry, and glasses on the basis of events nature, size, and seasonal stuff. Events can be wedding, party, sports day, convocation etc. Size can be small, medium, large and extra-large that depends upon height of the user. Seasonal stuff is categorized according to winter, summer and spring. CSA selects the wearable items category On the basis of event nature and personal information (gender, height, size, skin tone) that it received from ICA. CSA accesses the knowledge base that keeps record of all the items according to gender, color, size, event nature and seasonal stuff. Knowledge base is used predicate logic for the storage and retrieval commodities. Figure 4 shows example which uses rule to store an item into Knowledge base. Similar rules are used for the storage of all accessories.

CSA sends queries to the knowledge base so that it can show list of desiring items. Figure 5 shows the retrieval rule of dresses on the basis of price, color, size and event category e.g. party, wedding, causal etc. Similar rules are used for the suggestion of jewelry, shoes, glasses, hairstyles commodities.

```
STARTRULE "Gents Dress Categories"
IF selected-Category = "DP" /* Dress pent */
AND Waist (DP) <= 32
AND Length <= 42
AND Seansonal_Stuff (DP) = "Cotton"
AND Stuff_Print(DP) = "Lining"
THEN
Store the item as summer wear lining dress pants of medium size with blue color
```

Figure 4 : Rule to Store Dress Pant Items into Gents Dress Categories

3.5 Decision Consultant agent (DCA)

DCA receives a list of selected wearable items from the knowledge base system on the basis of CSA provided information. If there is no match found according to user's specified color then knowledge base itself delivers list of same items in same size but with different colors. DCA gets user image from the user data base and checks all items on user's image and sends that images to the DDA.

3.6 Decision Dispatcher Agent (DDA)

DDA performs two main tasks. (a) Best suitable item decision. DDA receives all images from the DCA and saves them into its own decision support system data base. DSS has capability to make comparisons by using Hamming Distance Algorithm [13] among all images and choose one of them that are more suited to the appearance of the user. Hamming Distance Algorithm uses XOR operator for making comparison between two images. It also sends the images to the converter selector that again converts the images description into text and forwards to the VPA.

VPA transfers text information to the speech synthesizer that informs the user about all images description verbally so that user can share its own choice because may be there is color conflict between user and DSS chosen item. (b) When user is satisfied by the DDA then order placement is also responsibility of DDA. DDA sends the selected items number to the counter system so that they can pack accessories for the user.

In this way, ITAB helps the vision impaired persons to choose best commodities according to their physical appearance and nature of functions. In absence of any human assistant (friend, relative, care attendant) vision impaired person can buy desired accessories with best color combination and matching.

```
STARTRULE "Dress Suggestion"
IF User (Trial_1) = B
AND Requested_Item (B) = "Dress"
AND Gender (B) = "Fair"
AND Height (B) = 42
AND Event_Category (Requested_Item) =  X
AND Requested-Color(X) = "Seagreen"
AND Requested_Stuff  = "Spring"
AND Requested_Size = "Medium"
AND Price_Range = 5000
THEN
Display <-= Selected_Dress_list with seagreen color
Suggest <= Display (other newly fashioned items list with other related shades /colors)
```

Figure 5 : Rule for Dress Suggestion.

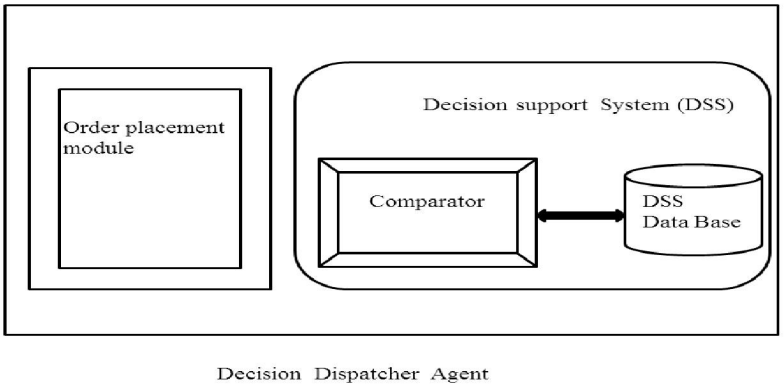

Figure 6 : Decision Dispatcher Agent

4 Case Studies

In this case study we are considering two different scenarios that show the assistance of ITAB for the vision impaired people. Let's consider a shopping mall that is using ITAB software as a shopping assistant for blind people.

Tina a blind girl wants to purchase a party wear. As she enters into the trial room the camera captures image to get her skin tone and facial appearance and sends it to the system. System welcomes Tina and takes personal information like what is your name? Tell me about your gender (male, female), height (either above or below 5.5 feet, or either above or below 6), size (small, medium, large, extra-large), favorite color (red, green, blue, white, sea green, black, skin, purple, magenta, etc.), type of items (dress, shoes, jewelry, hair styles, glasses), seasonal stuff (summer, winter, spring), nature of event (causal , wedding, party , formal) and price range . Tina tells that she is a female with height below 5.5 feet. She needs a sea green party dress in medium size within range of five thousand for spring season.

After taking all necessary information from Tina PVA forwards this information from input buffer to the CSA. CSA activates the desiring speech to text convertor and image to text convertor respectively. ICA extracts all necessary information like gender, height, size, color, item size and price range and send to the CSA so that it can easily interact with the knowledge based that is populated on the basis of item type, seasonal stuff, event nature, size, price range, and color.

ICA sends query to the KB system that shows all the party dresses with medium size and within Tina's price range and sea green color with chiffon, crinkle chiffon stuff. Figure 5 shows the extraction of sea green party dresses from the female portion of accessories from the knowledge base. All the retrieved list of dresses is forwarded to the DCA that gets Tina's image from the user data base and apply all dresses to the Tina's image.

All the images then transfer to the decision support system of DDA that tells about each dress description with new trends like heavy embroidery with quelott, light ribbons work with trouser, stone

work frock with choridar pajama by using the speech synthesizer.

DSS also makes comparisons between all images and tells Tina that the dress with light stone work is looking more beautiful than other dresses. Tina finally selects lightly embroidered dress long shirt with trouser for party.

DDA order place module forwards the selected dress bar code to the counter system and places order for the dress.

Figure 7 : Party Dress Selection for Tina

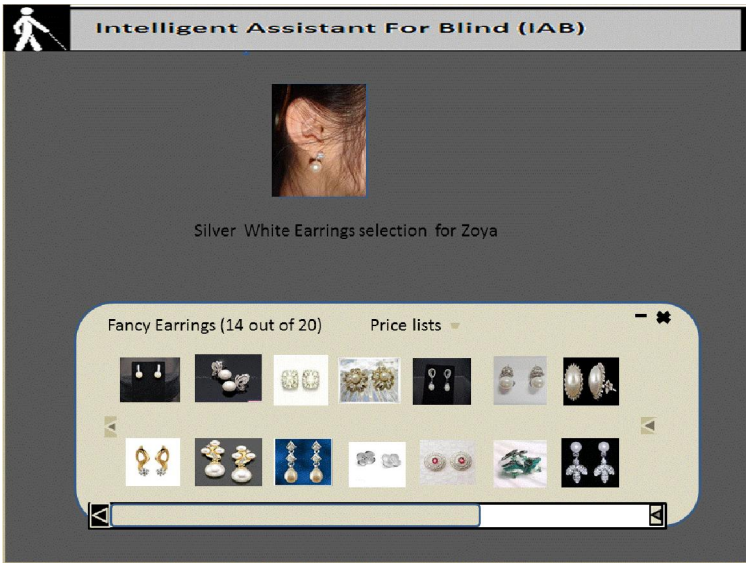

Figure 8 : Earring Selection for Zoya

Zoya is a blind girl that visits shopping mall for the selection of jewelry. After the entrance into the trial room ITAB welcomes Zoya and captures her image for getting her appearance. ITAB takes personal information by asking questions what is your name? Tell me about your gender (male, female), what item do you want to buy(dress, shoes, jewelry ,hair styles, glasses) On the basis of item type ITAB asks more questions like favorite color (red, green, blue, white, sea green, black, skin, purple, magenta, etc.), nature of event (causal , wedding, party , formal) , shape of earrings (round, oval, tree, long, circle, rectangle)and price range . Zoya tells that she is a girl that needs stylish and fancy earrings in small round shape within range of three thousand for formal use in any color. After taking all necessary information from Zoya PVA forwards this information from input buffer to the CSA. CSA activates the desiring speech to text convertor and image to text convertor respectively. ICA extracts all necessary information like gender, item type, size,, item shape and price range and sends to the CSA so

that it can easily interact with the knowledge base that is populated on the basis of item type, seasonal stuff, event nature, size, price range, and color. ICA sends query to the KB system that shows all small size fancy and stylish earrings in round shape within Zoya price range. Figure 7 shows the extraction of fancy earrings from the female portion of accessories in knowledge base. ITAB tells Zoya about the look, material, color combination and price of every earring. Finally system suggests a very stylish silver and off-white pearl earring for Zoya that she can wear with almost all dresses.

5. Conclusion and Future Work

Assistive technology is trying to increase the limited sovereignty of vision impaired persons by introducing new devices and intelligent software assistants. These assistants support blinds in reading, writing, walking, face recognition as well as boost up their confidence level. Still blind people are dependent for the selection of their daily commodities and shopping. Thus, we are also contributing in this era by proposing and implementing the ITAB system that help them in selecting their daily wearable items by using Knowledge based system ,image processing techniques and text to speech technology. A trial room is equipped with hardware support like camera, speaker, microphone, and gait detector. System uses Hamming Trace Transform method and sampling mechanism to extract facial expression and skin tone respectively from user's image. SPOC based speech to text system is used for voice to text conversion. Rules using Predicate logic are used to extract the desiring wearable items from Rule based Knowledge based system. Furthermore, a Decision Support system makes comparisons using Hamming Distance Algorithm between user's best getups. Speech synthesizer provides detail information about each item so that user can easily make decision according to his/her own choice. In this way ITAB facilitates vision impaired person to select their commodities with open choice and independently.

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