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Pi-Wi: A Smart Teacher for Blind and Deaf

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Abstract: The paper presents the real time implementation of PIWI, a personal virtual assistant using Artificial Intelligence .The proposed system is based on the free python development tools. The prepared software was tested with Linux operating system running on a small cost SBC called Raspberry Pi. Recently clearing doubts has become a major problem mostly among students .This can be solved by PIWI.PIWI: A SMART TEACHER is a personal virtual assistant that provides answer for the asked query in speech as well as text. PIWI was adapted and implemented for real time applications using Wolfram alpha and Google API. PIWI can answer all general, arithmetic and logical questions. Speech to Text, Text to speech and Shell scripting are the three main technologies used here. Queries are asked to the machine which will convert it into text and will search in internet and find the results regarding the asked queries. Using text to speech converter, the machine can be made to provide answers regarding the queries back in speech. It can be also be displayed. This is the advantage of this project which makes an end to googling, referring, books and browsing. In addition, PIWI can also provide Email services.Sound card, Google API, Raspberry Pi, Python, Wolfram Alpha Search Engine and Shell Scripting are used to work out this project.

Keywords: PIWI, RaspberryPi, Wolfram, SSH, VNC.

I .INTRODUCTION

This paper aims to show an efficient implementation of PIWI:A SMART TEACHER with home automation and email services. Low budget minicomputer called Raspberry Pi is used for the implementation using python language. The flat form supports internet communication easily via interface.

Recently googling, referring books and browsing are the key sources for finding answers or to gain information. This is a complicated task as it requires time and doesn't provide correct answers. PIWI is a smart automatic answering machine that provides answers in speech as well as in text. General, arithmetic and logical questions can be cleared and hence is known as personal virtual assistant. PIWI is brought into life using the wolfram alpha search engine in addition with Raspberry Pi .Speech to Text and Text to Speech are the other main technologies used with artificial intelligence.

Google now, Apple siri, Microsoftcortana and yahoo were the frequently used search engines. Wolfram alpha is different from all these as it can provide correct answers to the asked query. Also it's a computational search engine that can provide solution for all the logical and arithmetic questions. Voice recognition capability of PIWI makes searching information more easy .The main aim of this project is to assist a person is never ending quest for information. The currently presented system PIWI preserves all the functionalities such as tasks and services for an individual and is hence called "An Intelligent Personal Assistant".

II.RELATED WORKS

This paper[1] deals with proposing robust solutions ,allowing the system to understand spoken queries automatically transcribed to retrieve relevant answers and to deal with speech recognition errors, misspelling and out of vocabulary words. In[2],a novel 2-section educational learning environment is presented together with the syllabus and curriculam.The platform [2]provides teachers the ability to setup all the study materials, the experiments and the evaluationquestions.An efficient implementation of[3] the Internet Radio Receiver with fast speaker identification functionality.GUIDL system[4] has been proposed as an effective aiding technology that enables inclusion of visually impaired computer users into activities of graphical user interface design.

A real time speech to text conversion system[5] converts the spoken words into text form exactly in the similar way that the user pronounces.With 6m highest visibility and 20degrees maximum wide view,people who suffer from low vision are unable to see words and letters in ordinary newsprint [6] deals with text to speech device that scans and reads Indonesian text book by converting it to audio. When stucked in an unfamiliar place and need assistance, asking assistance through IM service is a warrant that will be delivered to us in time. Hence [7] deals with a supporting system to assist tourist travel in unfamiliar area.

The Raspberry Pi is a credit-card sized personal computer,minicomputer,open source system,running on Linux as operating system.Raspberry Pi is programmed

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with several languages such as python,java,c++,ruby,pearl etc. Raspberry Pi[1] is used to interface search engine and database system.Raspberry Pi 2 [3][4][5][7]supports internet communication via wired or wireless interfaces and can even replace DSP platforms.It is[3] used in the efficient implementation of DSP algorithms.2nd edition of raspberry pi[3] with four core ARM Cortex-A7900MHz processor and 1GB RAM memory is preferred.Signal processing with[3] this open source platform.Python language is choosed for prototyping and developing as it supports arithmetic operations[3][2][5][6][7],there are lot of libraries and packages for signal processing available for python.C++ is also used[3] for hardware and software implementation.GUIDL[4] is interfaced with Intelligent Assistant using this board.Text to Speech synthesizers and aiding concepts are accomplished by[4] Java in order to enable visually impaired programmers to work in actual up-to-date technologies rather than having an isolated aiding system.Google Talk of handheld devices[7] with IM Service is interfaced over Web 2.0 which forms a supporting system to assist tourists.Web 2.0 , the contents and services are available online.Web 2.0[7] standard is used and it is constructed using the manifest via component concept on space VOICEXML system.
The Graphical User Interfaces[4] created by GUIDL system can be translated into desired programming language development environment format by the GUIDL system's mediators with Raspberry pi.Some features or attributes[5] involving MFCC attributes are used to create a database,for recognition of each words[5] based on the human ear perception with raspberry pi.Speech detection system is interfaced with[5] database and Kalman Filter by this minicomputer.Database[5] is created by MATLAB[6] and TIDIGIT dataset with this system by Raspberry Pi yields excellent results.

Device[6] is developed by Raspberry Pi 2 with 900MHz processor speed.Three modules[6] are present here- Image processing module,Words correction module and Voice processing modules which are interfaced using this.Indonesian Language Dictionary is also interfaced.
This[2] has two sections,1st section operates on tiny Pi & 2nd on an online server.The online platform[2] was developed using the PHP programming language,from version 5.4 &up,and MySQL database version 5.4,using a combination of technologiesto enhance user interface.Ituses a Linux Operating System capable of running the above PHP,Apache& MySQL versions and[2] is publically accessible via internet.This[2] uses latest Linux Raspbian distribution 2014 version to implement the educational learning environment with Python 2.7 programming language inconjuction with the wxPython toolkit.
The proposed system[1] provides ubiquitous Question and Answering information to customers about corporate services and commercial products and supporting different user's devices such as PC desktops or mobile phones.A database[1] is created in which the questions and answers regarding the products or services are stored and hence is able to provide relevant information for the spoken or asked queries.An efficient implementation of the Internet Radio Receiver[3] with fast speaker identification functionality by direct implementation of identification functionality on the embedded system assuming that the information of speaker may continuously change eg. for each[3] and every second using internet communication.This system[3] process the input audio signal and display the information about the current speaker in real time that is at the same time when the input audio signal is being displayed.GUIDL system[4] has been proposed as an effective aiding technology that enables inclusion of graphical user interface design and it implements many aiding concepts that make creation of graphical user interface suitable for visually impaired.It can be made more accessible by proposing an Intelligent Assistant[4] to which the visually impaired people can ask questions in the form of natural language compared to browsing through instruction manuals which makes getting the right answer easier and quicker.

A real time speech recognition system[5] is implemented in order to convert the speech to text information in any noiseous environment using a Bidirectional NonstationaryKalman Filter especially in the applications of Natural Language Processing by a speech to text converter .People who suffer from low vision aren't able to read properly and hence a system is imposed that helps the visually impaired easy to hear what is written on an A4 sheet thus minimizing the difficult of reading by capturing the images[6] on A4 sheet with a camera and delivering it as speech via text to speech synthesizer.The proposed system[7] helps tourists to ask information via Web2.0 platform by making a Gtalk call to the server provides the relevant information about the unfamiliar or unknown places.The speech commands[7] are converted into text commands and thereby executing this command to post the message ID account on Web2.0 website and in return, a call is made from the IM to the tourist.Online server provides in [2] ,software support by allowing for administrated exchange of educational material incorporating rich text,multimedia and custom applications as a means to familiarize oneself with scientific concepts and creating questionnaires for student evaluation.The platform[2] updates educational environment and supports multiple schools and educational groups each one with their own individual requirements. This[2]enables the teachers to introduce and modify educational materials.Automates collection[2] of data from students using particular educational materials (result of evaluation questions).Educators[2] can either keep their educational contribution for exclusive use by their students or publicise their work allowing a more widespread use of it.

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A database[1] is created with a set of different canonical questions and their corresponding answers and these canonical questions are again divided into a set of question paraphrases as negative and positive.If the question[1] asked to the system is one among the positive paraphrase, it delivers the answer else when the question asked belongs to the negative paraphrase, no answer is delivered.In [3] speaker model generation tool was developed and two options are to generate the model from data stream or from file saved on the hard disc and the data processing in the presented system includes :

- Periodic collection,decoding and playing the Internet radio data.
- Feature extraction from the decoded data.
- Calculation of features log-likelihood under each speaker model from the database.
- Selection of the best match and displaying the result.

In this stage, a database system is created by recording some speech samples and stored in .wav format using MATLAB and thereby training the database[5] system inorder to understand the uttered words from speaker in addition with an acoustic model.It can[5] detect the uttered word that is compared with the stored speech sample and after filtering through a Kalman Filter reduces noise and provides the output as text.A text to speech device is included that consist of three modules, Image Processing Module that can set the object position,focus and illumination camera thereby taking pictures and converting into text,Word Correction Module[6] that make corrections to the output image,Voice Processing Module changes the text to sound and process it with physical characteristics.The system[7] is proposed by forming a handheld device to which answers can be asked via Web2.0 platform, ported to Googletalk for providing answers through two modes, one through speaking mode through which an answer in return is provided from the IM via speaker and the other through database mode by which the answer is returned in the form of a text message to the tourist from IM.

Document Re-Ranking Algorithm minimizing the precision loss is the SVM ^RANK algorithm[1] which is a pairwise algorithm that trains the list of relative orders for a given query and thereby converting it into a pair of querywise constraints and then selects the relative order at highest priority corresponding to the asked query.
GMM EM[3] (Gaussian Mixture Model Expectation Maximum) and MFCC (Mel Frequency Cepstral Coefficients) algorithms are used for speaker recognition functionality.Layout Interference algorithm[4] is used for programming a GUIDL System.
Speech Detection Algorithm[5] is used to separate the words taken by the microphone,Speech Disclosure Algorithm is used for the separation of each words by processing the stored speech samples in the database frame by frame with a simple loop operation using MATLAB and the BidirectionalNonstationaryKalman Filter Algorithm are used.
OCR Algorithm[6] is used for capturing the of text format by image processing and converts into speech .In this,[7] a specific algorithm can be used for the programming code involved in the conversion processes .JSON algorithm[2] is preferred for bi directional communication via REST-like API.This[9] deals with intelligent assistant MIA the OS used was Raspbian and it was not handfree use of keyboard and mouse inevitable this disadvantage is overcome by PIWI.

III. SYSTEM DESIGN

The best part of Pi-Wi is less requirement of hardware components.The components used are very cheaper and easily available.Raspberry Pi 3 Model B is used as the core component.Sound card is used to capture the audio and to make it noiseless.Internet connectivity is required.HDMI VGA cable is used for display as well as Raspberry Pi LED screen can be used Headset is used for recording audio,audio playback and to hear answers The physical connection of Pi-Wi is as shown below.

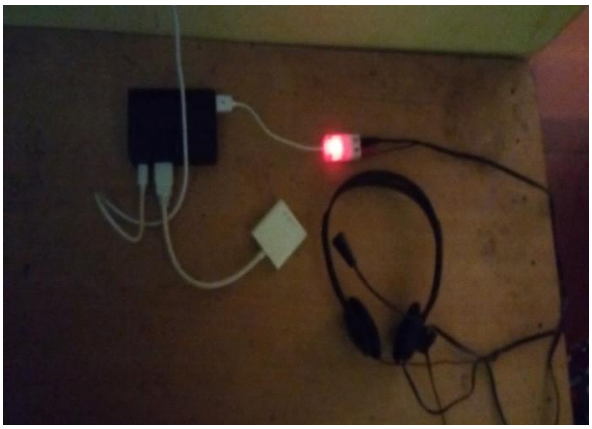

Fig 1: Physical connection

The major difference from [9] it was not handfree system and home automation was not possible because of outdated operating system.Pi-Wi works using Jessie,whichis the latest version in Raspberry Pi operating system.Thetools SSH and VNC are used to make Pi-Wi handfree and more user friendly.

The main steps that come under software are the following:

- Setting static IP address
- OS configuration
- Socket connection
- API connection
- Speech to text
- Search engine access
- GPIO access
- JSON frame work

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- Text to speech
- Shell script for start up

IP addresses can be either static or dynamic.Static IP is used here. Static IP addresses never change. They serve as a permanent Internet address and provide a simple and reliable way for remote computers to contact. This helps to transmit voice over internet.Raspbian should be updated to the new stable version of Debian, which is called Jessie,to improve performance and flexibility, particularly as regards the control of system processes and at the same time Jessie adds a bunch of changes and improvements to the desktop user interface.WIFI connection of Raspberry comes under socket connection.System should be connected to a good internet connectivity for fast response. Just as a graphical user interface makes it easier for people to use programs,application programming interfaces make it easier for developers to use certain technologies in building applications.Wolfram alpha and google API connection comes under this.Speech to text conversion is the process of converting spoken words into written texts.The steps involved are shown in the fig 2.Epiphany is replaced with google in search engine access for getting the accurate answers.LED connectivity is done through GPIO access.LED blinks when the query is been captured and also during the delivery of answer.JSON framework is completely a back end process.Text to speech helps in converting the text to audio that is done by Shellscripting which will be helpful for the blind.

The system is completely handsfree which is done by the SSH and the VNC.SSH allows to remotely access the command line of Raspberry Pi from another computer (as long as they are both on the same network). This removes the requirement to have an external monitor connected to Pi.VNC is a graphical desktop sharing system that will allow to remotely control the desktop interface of Raspberry Pi from another computer. This will come in very handy as one get rid of the external monitor connected to Pi. SSH is enabled bydefault on Raspbian Jessie which is done using the raspi-config utility. Knowing the IP address of Pi, is required for remote connection with SSH and its done by opening the terminal and typing a command which will prompt for a password.Same procedure is involved in setting VNC along with creating a new configuration and downloading VNC viewer.The Pi should be rebooted after the process. Now with SSH (allows remote access to the terminal) and VNC (allows to remotely control the Raspberry Pi's desktop interface) installed, the external monitor is optional.Thehandsfree system is very efficient for the physically challenged people like deaf and blind.A blind can easily sent mails using this system which is never possible in real life without a braille keyboard.So the requirements of many hardware components can be reduced which makes the system cost effective.

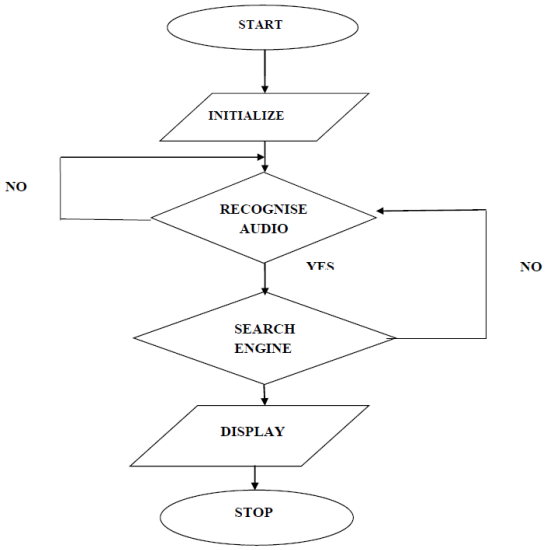

Fig 2: Flowchart

IV. EXPERIMENTAL RESULTS

The core steps involved in the project are recognition of audio,search engine access and retrieval of answer as text and speech.After doing the connection the python terminal is opened.The command cd PiWi is given inorder to change the OS directory to PiWi directory after that the command ./shell PiWi.sh is given and press enter.This command is used for running the program stored in respective files.The Pi-Wi starts responding as

"Welcome,you can ask your query"

After this response the query is asked through the microphone in headset and after recognizing the audio search engine access is performed through coding, if the audio is clearly recognized then after accessing the answer it is delivered to the user as audio and display.Only the accurate answer is answered the description of answer will be only displayed. If audio is not recognized,recognition of audio is again performed.Output was obtained accurately. Fig 3shows the terminal which shows the displayed correct answer.The above mentioned commands were used, after that question asked was 'integral of cotx' and the corresponding answer 'log sin x+C' was displayed correctly

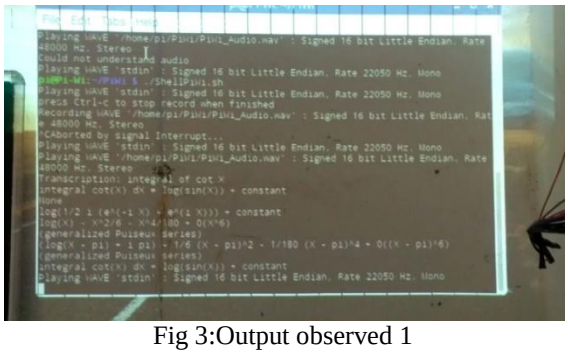

Fig 3:Output observed 1

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Fig 4 shows the terminal displaying answer for mistaken accent.The above mentioned commands were used, after that the question asked was '7 minus 3' but displayed was '7 class 3' as the question asked was in incorrect accent.So it cannot display the correct answer.

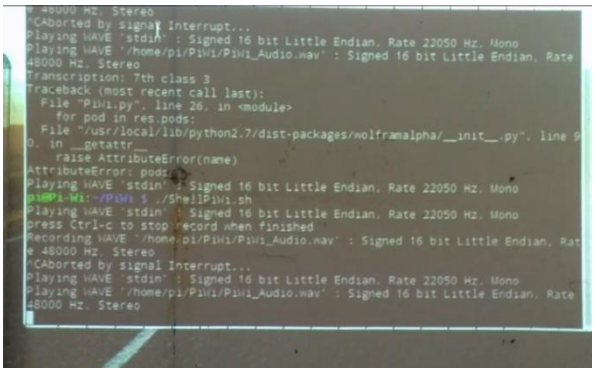

Fig 4: Output observed 2

V. CONCLUSION

PIWI has got a low cost architecture working on a SBC called Raspberry Pi,an ARM based board. The Pi is connected to WIFI through Ethernet. Then speak to PIWI and it will convert it to text and using skimming and sniffing algorithms it will find the best answer. The answer will be given back as audio via a text to speech convertion.A blind can use this system without the need of a braille keyboard, they can get answer as speech for a question asked and similarly deaf can ask a question and gets the solution back as text on display. PIWI has got many advantages and can bring a new revolution to the present world.

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