Speech Recognition Based Wireless Automation Of Home Loads With Fault Identification For Physically Challenged

A.K.Gnanasekar, P.Jayavelu and V.Nagarajan

***Abstract*—The design of this project helps in providing a fool proof solution for physically challenged to control their home appliances by giving voice commands through personal computer in a wireless environment. When automating a home load not available in the visible range, Fault identification system in this design helps the user to ensure that their home appliances had gone exactly ON or OFF or undergone FAULT by getting the status from load end, unlike the other design that gets the status at user end which may give a false indication, when power supply is not available for the particular load or when load get open circuited (due to wire discontinuity or open fuse condition). During user screen navigation and controlling home appliances voice output of the current screen information and status of the automated appliances enables visually impaired person to use the system to control their home appliances. Navigation of the screen by giving voice commands enables paralyzed person and person who lost their hands in an unfortunate accident to control their home loads along with normal person. For achieving wireless environment low cost zigbee is used. To provide security based authentication RFID is used. Each home load will be having two commands ON and OFF commands, Automation of 20 loads such as mixer, grinder, TV, refrigerator, fan, light, AC etc…, has been tested by giving 40 voice commands through personal computer. When user creates his own profile and automates the load speech recognition accuracy of more than 90% is achieved. Other people who were allowed to automate the load by the user can use user profile and achieve a speech recognition accuracy of 75% in the same personal computer.**

***Index terms*—RFID, ZIGBEE, ASR**

I. INTRODUCTION

Physically challenged persons find difficulty in power ON/OFF their home loads such as fan, light, AC etc…, they require an attender to do these things. In the absence of the attender their world seems to be more difficult. So a design which can help them to power ON/OFF their home loads even in the absence of an attender will be quite essential. Improvements in speech recognition technology strive to provide a solution for the above said problem [1] .

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This design implementation involves wireless automation of home loads by giving voice commands through personal computer. Drawbacks with the design is that the exact status of the load is not taken and given to the user as a feedback after giving voice commands to automate, so user may think that after giving voice commands the load would have gone ON particularly when the load is not in visible range, but under certain condition such as power failure at the particular load and open circuit condition(due to discontinuity of wire or due to blown out fuse of that equipment) user judgement may go wrong as the status is taken from user end. So a false proof system which gives back the exact status of load by having a fault identification system at the load end is essential.

Some of the other design implementation that use voice commands include [2] this design helps the person with physical disability and elderly to navigate easily within their home in a wheelchair by giving voice commands.[3-5] designed for navigation of robot and forklift by giving voice commands. Some of the voice based design uses a voice recognition chip with integrated or interfaced memory chip that has a drawback of having limited number of voice commands. The reported design Speech Recognition based automation of home loads with fault identification for physically challenged involves automation home loads by giving voice commands in a wireless environment. User can ensure that the load they automate had gone exactly ON or not as it have a fault identification which gives the exact status of the load taken from the load end. The design has RFID based authentication restricting unauthorized person to use the system. Voice output for status of the load and navigation of the screen helps in complete hands-free operation for the user. More people can use the same personal computer for automating the home loads. Building Automation through PLC and touch screen or SCADA is quite costlier in contrast the reported design involves microcontroller with VB interface which is low in cost with reduced power consumption[6-7].

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II. SYSTEM OVERVIEW

A. Voice command transmitted from PC and load status reception given to PC :

Fig.1 shows the block diagram of transmitting the voice command from PC to field through wireless environment using Zigbee Z1 and reception of transmitted load status by fault identification system from distance place using Zigbee Z2. Personal computer is installed with application program such as VB6.0 along with database and speech recognition engine ASRV5.1.

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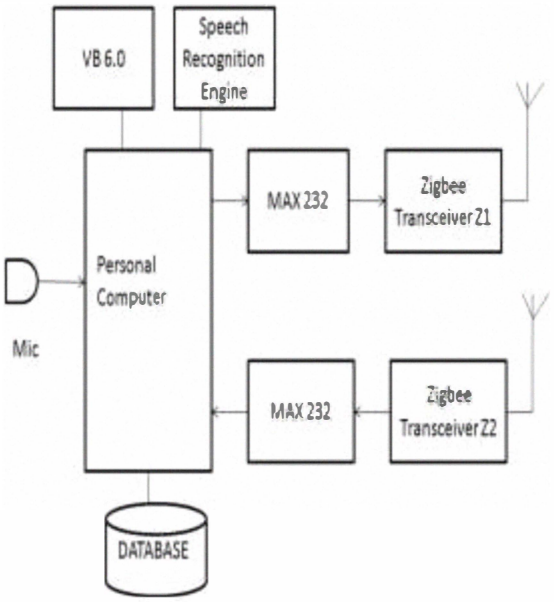

Fig.1 Wireless data transmission from PC & reception to PC

B. Controllingthe home loads and fault identification system:

Fig.2 shows the reception of voice commands from transmitter; the voice command is received by Z1 and given to the master microcontroller, when command matches with the data stored in microcontroller drives a relay through a relay driver.

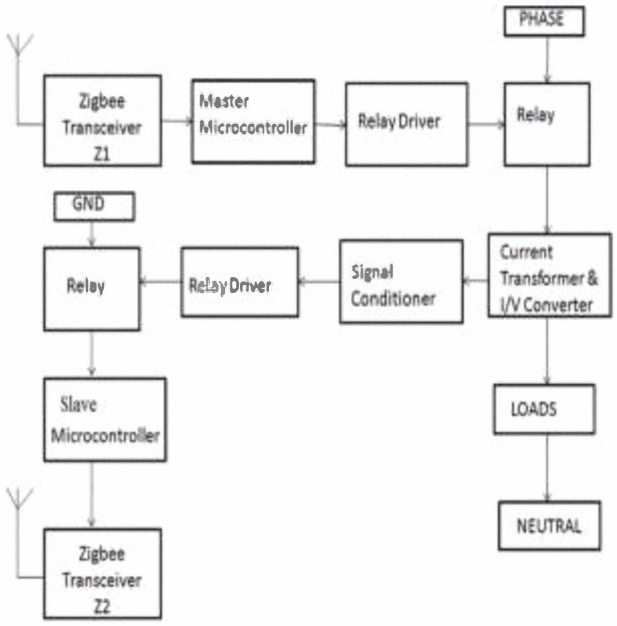

Fig.2 Controlling home loads and fault identification system

Fault identification comprises of current sensing circuit, Signal conditional circuit and slave microcontroller. 230 V AC phase terminal is routed through the relay in series with the current transformer, which in turn connected in series with the home loads and neutral terminal. Thus whenever home load get powered on through relay by master microcontroller, current through the load is sensed by the current transformer. The sensed current is converted to voltage and the voltage signal is made available to the slave microcontroller through signal conditioner circuit. Output of the signal conditioner circuit drive the relay through the relay driver. GND signal routed through the relay given to slave microcontroller and fault identification status data is transmitted through zigbee Z2.

C. User Authentication by RFID:

RFID based security authentication is shown in Fig.3, RFID tags are given to authenticated user, the RFID tag data is received through card receiver and given to the microcontroller. The microcontroller gives the UART data to the personal computer through the line driver circuit which uses MAX 232 as line driver IC.

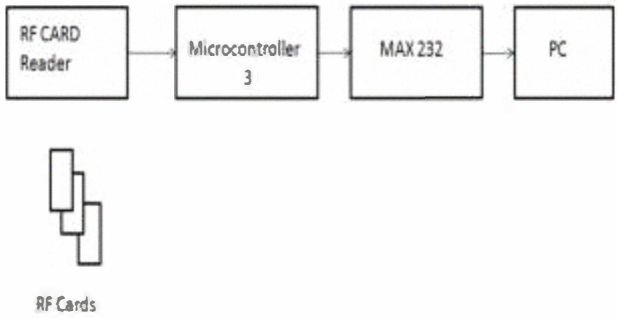

Fig.3 User authentication by RFID

III. HARDWARE DESIGN

A. Power Supply Schematic:

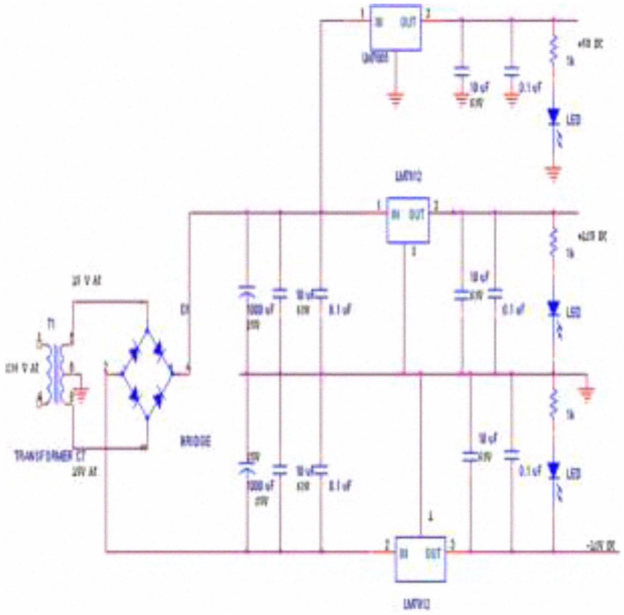

Fig.4 Power supply schematic

Hardware design consists of the power supply, master microcontroller with Z1 zigbee interface, slave microcontroller module & fault identification with Z2 Zigbee interface.

Fig.4 shows the power supply schematic generation of +12V,-12V DC and GND is essential for the signal conditioner circuit. While +5V DC and GND is essential for the Master microcontroller and slave microcontroller. Regulated DC voltages are obtained by using LM7812, LM7912 and LM7805 voltage regulator IC. 3.3V DC for zigbee is provided by using zener regulator.

B. Speech data transmission and fault identication data reception at the PC end:

Fig.5 shows interfacing of PC with Zigbee Z1 and Z2 through MAX 232 line driver to two communication ports of the PC. Two USB to serial converter is used at the PC end when USB port is used.

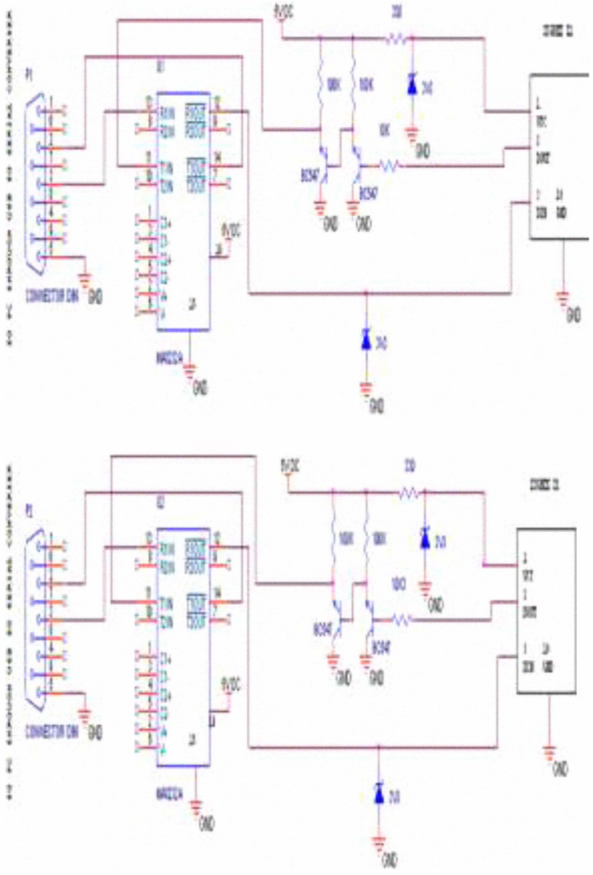

Fig.5 Speech data transmission and fault data reception at PC end

C. Master Microcontroller with zigbee interface Z1 for reception of voice command transmitted from PC end:

In Fig.6 Zigbee Z1 is interfaced with microcontroller for reception of voice commands transmitter from PC end. P89V51RD2 NXP microcontroller is used as master microcontroller with XBEE pro 2.5 GHz as Zigbee Z1. The microcontroller does not require separate burner kit for burning the program into the kit.

D. Relay Driver Schematic:

Fig.7 show relay driver schematic, the current given by theMicrocontroller is very low to automate the relay so a relay Driver for current amplification is essential. ULN 2003 is used as a relay driver that has 7 channels. A replica of 4 boards having the same circuit is used for automation of 20 loads.

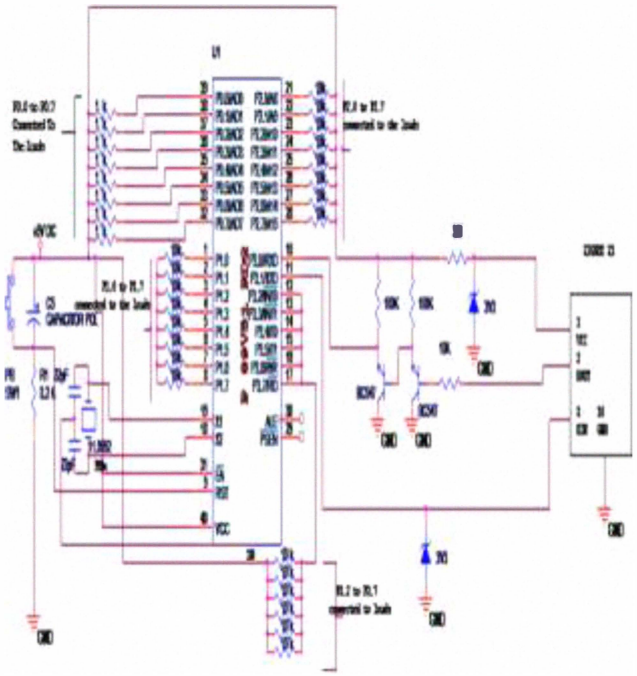

Fig.6 Master Microcontroller with zigbee Z1 interface

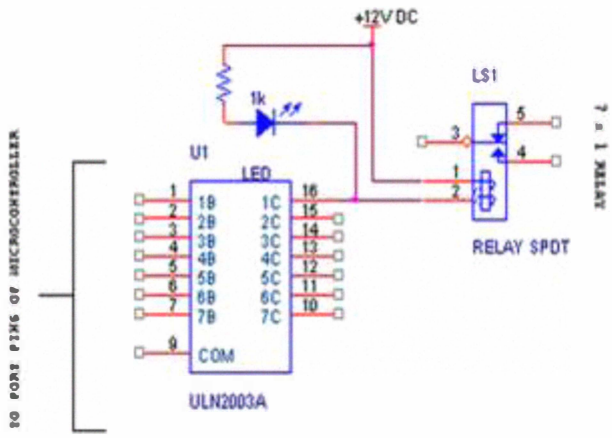

Fig.7 Relay driver schematic

E. Automation of home loads,Fault identification system with slave microcontroller interfaced to transmit status of load through Zigbee Z2:

Fig.8 shows current sensing circuit interfacing with slave microcontroller and zigbee Z2 schematic. After load gets automated by giving voice commands the current through the load is sensed by the current transformer which is in series with the load. The current output is converter into voltage by shunting the Current transformer with resistor. The voltage signal is amplified by the signal conditioner circuit and drives the relay connected to the output. Gnd is routed to the slave

microcontroller through the relay forcing the particular pin to go low. The same circuit has to be repeated for all 20 loads. Zigbee Z2 is interfaced to the slave microcontroller to transmit the data to the PC available at the user end [8].

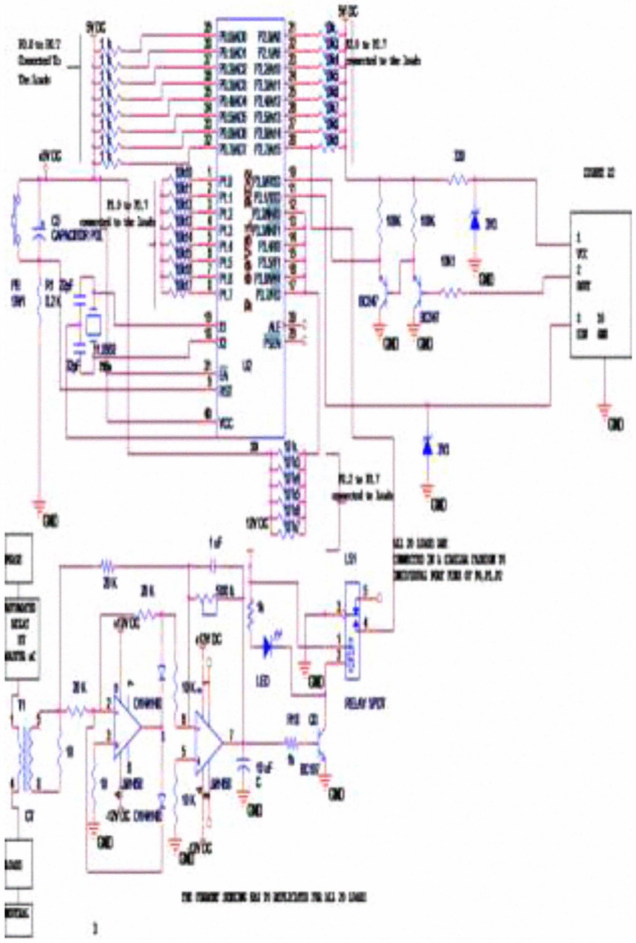

Fig.8 Wireless transmission of load status through Zigbee Z2

IV. SOFTWARE DESIGN

Graphical User Interface screens were created with VB6.0, the voice commands has been stored using MSACCESS available in VB6.0. Microcontrollers were programmed in C language. Keil C compiler is used to convert the C language program into Hex code. Flash programming software is used to flash the program into the microcontroller. ASRV5.1 is used as speech recognition engine. Fig.9 shows flashing the program into the microcontroller.

V. RESULTS AND DISCUSSION

A. Automation of loads with fault identification

20 loads were connected with fault identification system. Fig.10 shows the automation of 20 loads with fault indication. Automation of these loads were achieved with a speech recognition accuracy of more than 90%.

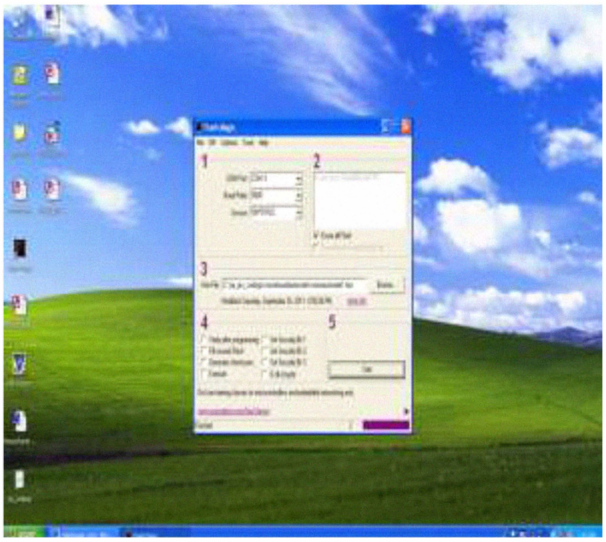

Fig.9 Flashing the program into microcontroller

Fig.10 Automation of home loads with fault identification

Green colored command button indicates the load is ON while yellow colored command button indicates the load is OFF and red colored command button indicates the load is under Fault condition which may arise due to power failure condition or open circuit condition(due to wire discontinuities or blown out fuse). Voice output about the status of the load is provided to the user [9-10].

B. User Authentication using RFID:

Fig.11 shows the user authentication using RFID, Voice output is provided to the user about authentication and screen

information. Once user get authenticated he will navigated to the automation screen within 3 seconds.

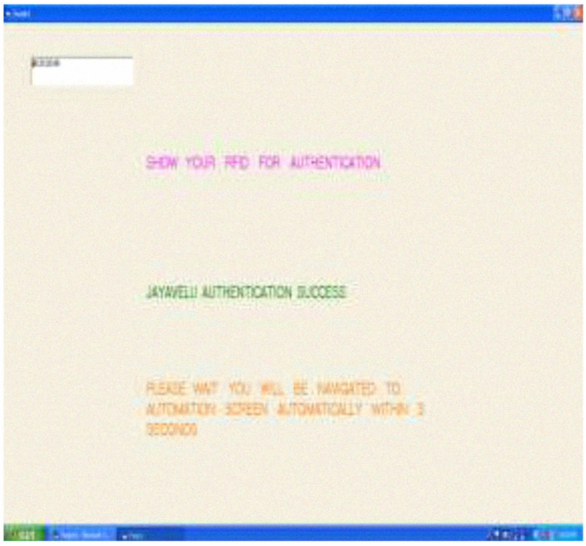

Fig.11 User authentication using RFID

VI. Conclusion And Future

Speech Recognition Based wireless automation of home load with fault identification was built and tested with microcontroller and VB interface. As microcontroller is used it is of low power and low cost in contrast with PLC and SCADA counterpart. Future work is to make the complete system to be available to user in online environment and automation of loads by giving voice commands through mobile phone.

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