

Voice Based Wireless Industrial Automation With Enhanced Feedback System

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Abstract— The project is aimed at providing integrated voice based control of technologically smart systems of an industry using microcontroller with visual basic interface. Radio frequency identification based multilevel user access provide high security authentication. Staff attendance and data logger were added to the main features of the project. The common functionalities in the industry are autonomously controlled based on voice commands providing a luxury of e-lifestyle for the operator, maintenance engineer, production and workers of several other departments which can be achieved in disabled-friendly environment using low power consumption. Automation of 23 loads with 46 voice commands has been tested. Any number of people can automate the loads with same computer; Accuracy of 95% speech recognition is achieved when user used his own profile while an accuracy of 80% is achieved when other people use user profile. People who were physically challenged such as paralyzed, person who lost their hands and blind people can use the system for automation of industrial loads using their voice commands and thereby find jobs in industries. The common functionalities of industries shall be controlled by giving voice commands through computer.

Keywords—ASR, MEMS, ZIGBEE, RFID

I. Introduction

The Technology advancement in the speech recognition over the past few years results in research oriented activities based operating the equipments based on user voice commands. Some design implementation results in operating the home appliances based on voice command[4], some design implementation results in navigation of physically challenged to their destination based on their voice commands[2], design implementation of robots and forklift navigation based on voice commands[1][3], the reported paper involves automation of industrial loads based on voice commands, Voice based wireless industrial automation system with enhanced feedback system provides a hands-free monitoring and automation of loads in a remote location based on voice commands from a master control station through wireless technology. The proposed project improves the overall reliability of the system by having feedback circuits, which send back the status of the load from the remote location to the master station through wireless technology. Micro-electro mechanical system implementation in the project helps in monitoring the

mechanical stability of the system. The growing need of industries multilevel security access was achieved through Radio frequency identification authentication in the project.

Existing Programmable Logic Control and Supervisory Control And Data Acquiring system has been replaced by microcontroller and Graphical User interface software in the PC. The project supports multi-facet speech recognition so that more than one person can automate the loads from a same PC. Staff attendance using RFID for industries had been provided with pay slip generation on the month end for employees, in order to lessen the workload of human resource department. In order to make it as a automation product for industries, ranging from small scale to large scale, the project aims at developing the application that include both standalone module(PC less) and PC based module.

The reported paper aims at making the voice commands to be customized during application run time, so that user can give their own voice commands for their loads. Data logger implementation in the graphical user interface along with printing capability helps in easy fault diagnosing in the whole system. Automated voice based efficient warning system at the master control station helps the industrial engineers to take timely action before adverse effects. Emergency Stop with alarm indication helps in shut- downing the outputs of whole system and so that ensure high level of secure operation during hazardous situation. Cost and Power consumption of the complete project is low as it uses microcontroller when it compare with Programmable Logic Controller.

The rest of paper is organized as follows section II provides the system overview, section III the hardware design of the project, section IV provides the software design of the project ,section V provides the Results and Discussion and section VI provides Conclusion and Future Work

II. System Overview

A. Voice Commands From User and Processing Stage:

Voice based wireless industrial automation with enhanced feedback system is easy to install, configure to run and maintain. This comprises of the following functional blocks as shown in Figure.1-5. In Figure.1 PC less module Voice input to the microphone is converted into analog voltage and given

to the speech recognition IC HM2007 processed and sent as wireless binary data to the master controller, while in PC based module voice input to the microphone is given to the PC. PC will be installed with the speech recognition software from Microsoft and VB.VB is used to send the serial data to a distant place through zigbee wireless transceiver.

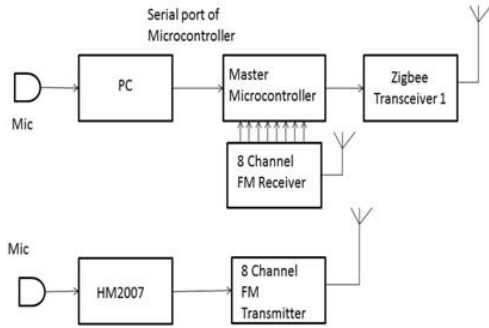


Figure 1. Voice Command From User to PC and PCLess Module

B. Feedback Obtained From Mechanical System Through Accelerometer:

Figure.2 shows that the accelerometer provides analog x,y,z voltage given to analog to digital controller. The ADC converts Analog to digital voltage and given to master controller. From master controller the data transferred to PC. Graphical user interface software in PC end display the tilting position of the mechanical system.



Figure 2. Feedback From Mechanical System

C. Controlling Field Loads Through Microcontroller:

In Figure.3 field data received through wireless receiver and given to microcontroller to take decision on automation of particular load. As the current source to drive relay is limited, A relay driver is used to amplify the current and used to drive the relay to automate the load.

D. Staff Attendance and Multilevel User Authentication:

Figure.4 shows that RFID tags are provide wireless information to the RF card reader. RF card reader provides the UART as well as 26 bit weigand.

E. Current Feedback From Loads In Field:

Figure.5 shows that the current drawn by the load is taken from field through current transformer. Current Transformer is placed in b/w supply and load. Output of the current transformer given to the signal conditioner circuits for processing and converted into digital data. This data is to be transmitted to the master controller through wireless.

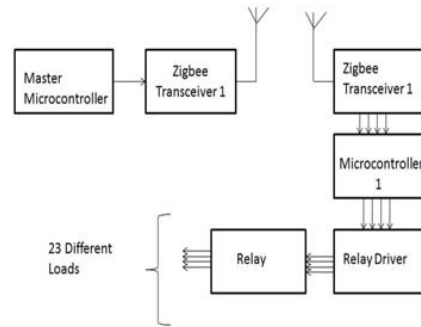


Figure 3. Controlling Field Loads Through Microcontroller

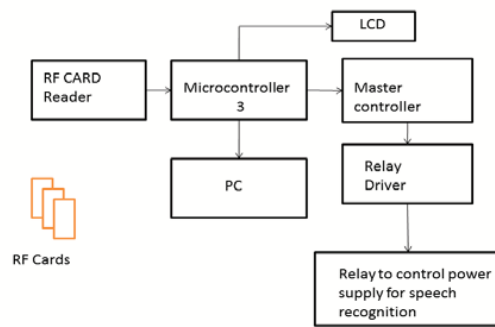


Figure 4. RFID based staff attendance and authentication

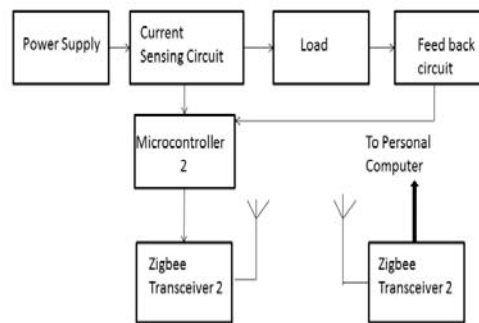


Figure 5. Current feedback from loads in field

III. Hardware Design

Hardware Design comprises of the power supply, microcontroller module and that of the industrial load control module. Figure 6,7,8 shows the schematic of the three module.

A. Power Supply Schematic

Figure.6 power supply schematic is shown, that provide the necessary voltage and current for the master controller board. As shown unregulated DC voltages were taken at 7805 voltage regulator IC pin no.1 while ground is obtained from pin no.2 of the IC and +5v Dc is obtained from pin no.3. +5V regulated, +12V unregulated and ground were taken as the power input for the overall design.

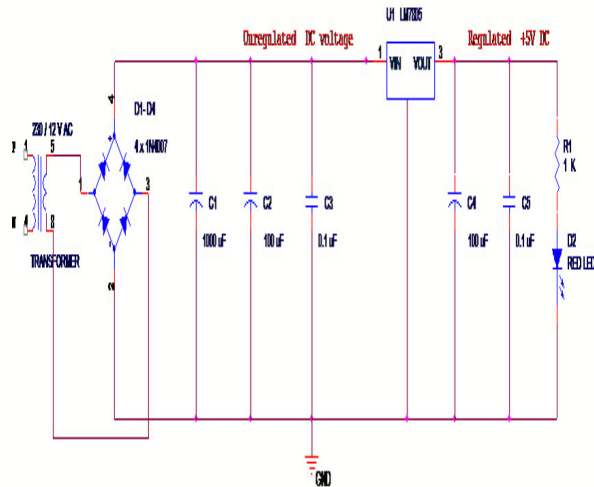


Figure 6. Power Supply Schematic

B. Microcontroller Schematic

Figure.7 shows the microcontroller schematic diagram. P89V51RD2 is used in the design

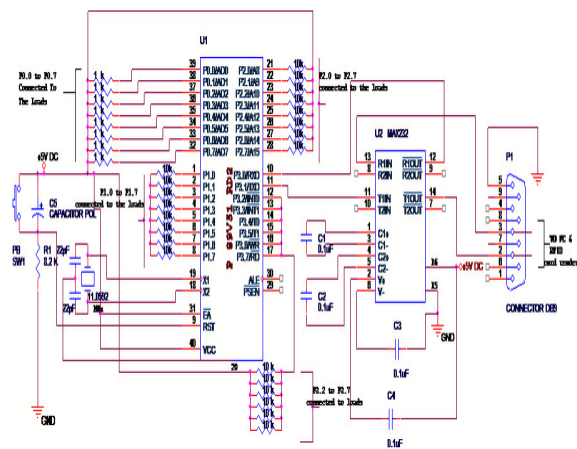


Figure 7. Microcontroller Schematic

C. Relay Driver Schematic

Figure.8 shows the relay driver circuit, as the current output from the microcontroller is limited; current amplification has to be done so relay drivers are used to actuate the relay. LED is connected in parallel to the relay coil for indicating the status of relay. When a freewheeling diode is connected across the relay coil will secure the LED from high current during relay energizing and de-energizing periods.

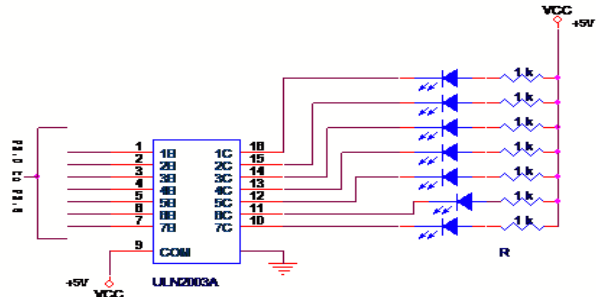


Figure 8. Relay Driver Schematic

D. Current Feedback Schematic

Figure.9 shows the Current Feedback Schematic Diagram. The Current through the load is sensed using a Current Transformer of Ratio 100:1 which then fed through Signal conditioner circuit for making compatible voltage levels for microcontroller input.

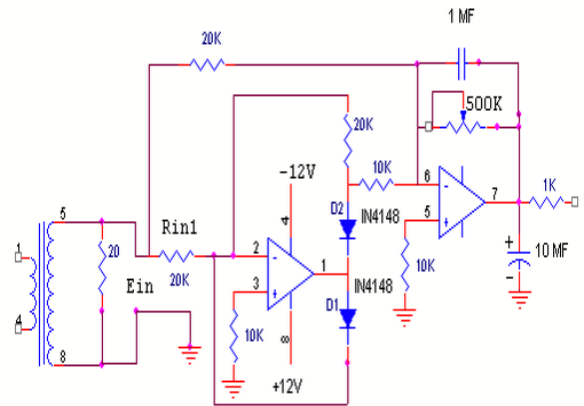


Figure 9. Current sensing schematic

IV. Software Design

Software design involves the programming the microcontroller and the programming the PC for Graphical user interface and Data Base Management System, the microcontroller programming is done with C language while the GUI is by Visual Basic and Data Base Management System is by MSACCESS integration with VB.



v. Results And Discussion

A. Voice Based Automation Of Loads:

Overall 23 loads connected has been automated with 46 voice commands at a accuracy of 95% as shown in Figure.10. RED colored command buttons shows that the loads are in OFF condition while GREEN colored command buttons shows the load are ON condition.

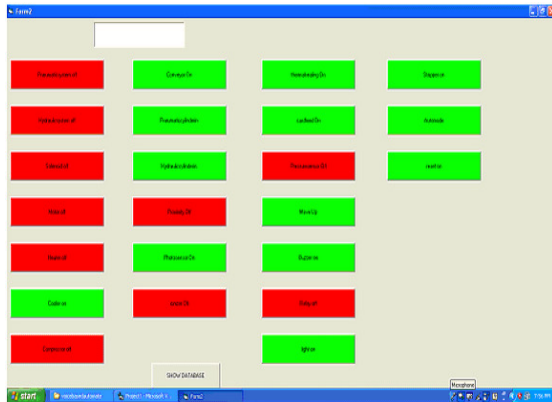


Figure 10. Voice based automation of loads

B. Staff Attendance and Multilevel User Authentication::

Staff attendance system based on RFID has been implemented as shown in Figure.11. The logon time of the employer who operate the machines using voice commands were recorded for future reference. This screen can be accessed only by HR personal and Service personality as they have higher level in multilevel user authenticated by RFID.

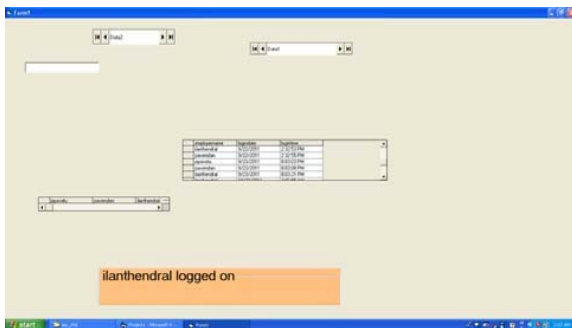


Figure 11. Staff attendance and multilevel user authentication

C. Data Logger:

Data logger that provides easy analysis of fault occurrence has been implemented as shown in Figure.12. The Status of the load ON/OFF and the time slot of fault occurrence were recorded. Deletion of those records were possible by the

operator. Multilevel user authentication for viewing this GUI screen is provided by RFID for Maintenance personalities in Industries.

vi. Conclusion And Future Work

A Voice Based wireless Industrial automation with high reliability and security was built and implemented. The overall system is cost effective when compared with the existing PLC and SCADA counterpart in industries. Future work entails making the system to be in Online and Improved user friendly GUI.

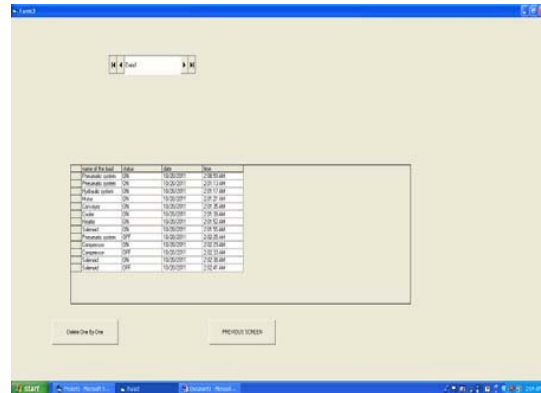


Figure 12. Data logger

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