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FLEX SENSOR BASED HAND-TALK GLOVE

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Abstract : The hand-talk glove also known as sign language translator is very useful device for paralyzed or speech-impaired persons those who can't speak by birth and main objective of this device is to translate hand signs in to talk mode. The hand signs are denoted as folded fingers or strait fingers and if any finger is folded particular sensor generates a variable voltage. This variable voltage will be processed using op-amp IC's by which it generates logic signals for the microcontroller chip. We can use 4 sensors for four fingers and accordingly 4 different signs can be created to generate 4 different voices like get me a glass of water, etc, voice commands can be generated from the multi-channel voice chip. Since it is a prototype model, only one sensor is used for demo purpose and this sensor is attached to the hand glove. When the finger is folded, the controller activates the voice channel through relay by which the pre-recorded voice will be generated through speaker. This is user friendly device that provides voice output for a sign gesture input. Flex sensor is used to create variation in the voltage, to do so a fixed resistor will be connected in series to this sensor to form a potential dividing network. The resistance of the sensor will vary according to its bend position and based on this variation it generates a reference voltage which will be compared with op-amp IC. When the reference voltage increases to greater than fixed potential, comparator output will become high and based on this signal, the controller chip energizes the pre-recorded voice channel. 8- Channel voice record cum play back chip is used, but here only one channel is enough to prove the basic concept. If required 8 different messages can be announced.

Keywords: Main processing unit built with 89c52 microcontroller chip, Flex sensor, rubber hand glove, lm324 op-amp IC, relays, APR33A3 voice record cum play back chip, speaker, power supply unit, etc.

I. 1INTRODUCTION

In today's world, there is a high need for automatic appliances with an increase in standard of living and there is a sense of urgency for developing circuits that would make our life go on easier. This project is designed and developed to help paralyzed people in their needs. Speaking microcontroller makes awareness about the needs of disabled. The person should know how to operate the hand glove that is equipped with flex sensors. The hand glove can be equipped with multiple sensors such that multiple voice messages can be generated from the system. Since it is a prototype model, only one flex sensor is used by which only one voice message will be delivered from the system. In this case the finger must be bended to deliver a voice automatically. When finger is bended, voice IC will give out a sound signal corresponding to the folded finger. Speaking micro controller helps to indicate what the patient needs. A smart assistive device for dumb and deaf people is designed to deliver corresponding voice message according to the signs created by the fingers. When multiple messages are to be delivered, we need multi-channel voice record cum play back chip such that pre-recorded messages will be delivered automatically according to the signs. It is a microcontroller based device, which gives the warn sounds just by using hand gesture sensor, which are given some redefined messages like asking for water, food, etc., here the person can just give the already defined gesture which indicates the sign of Water then the device sounds the same with some output volume. Microcontroller is the heart of the device. It stores the data of needs of a person. This device helps deaf and dumb people to notify their requirements. By this, the person who is near to the disabled person can able to understand their need and help them accordingly. This saves the time to understand each other and makes communication easier. This device is developed and made to provide with a higher advantage producing voice based announcement for the users i.e., the user gets the voice which he is need as and when it is required. “Speech” and “gestures” are the expressions, which are mainly used in communication between humans. In our communication, the use of speech and gestures are completely coordinated. Machine gesture and sign language recognition is about recognition of gestures and sign language using gloves or some other devices.

WORKING PRINCIPLE

- This sensor works on the bending strip principle which means whenever the strip is twisted then its resistance will be changed. This can be measured with the help of any controller.
- This sensor works similar to a variable resistance because when it twists then the resistance will be changed. The resistance change can depend on the linearity of the surface because the resistance will be dissimilar when it is level.
- When the sensor is twisted 45 then the resistance would be dissimilar. Similarly, when this senor is twisted to 900 then the resistance would be dissimilar. These three are the flex sensor’s bending conditions.
- According to these three cases, the resistance will be normal in the first case, the resistance will be double as contrasted with the first case, and the resistance will be four-time when compared with the first case. So the resistance will be increased when the angle is increased.

II. LITERATURE REVIEW

The paper titled "Modelling of Sign Language Smart Glove Based on Bit Equivalent Implementation Using Flex Sensor" presents a novel sensor-based system that aims to facilitate communication for individuals with speech or hearing disabilities. The paper addresses the issue that not everyone can understand sign language and proposes a solution using a smart glove equipped with flex sensors.

The glove incorporates five flex sensors placed on each finger, representing binary bits. This configuration allows for a total of 32 different options, enabling the wearer to form various signs and gestures. The proposed model eliminates the need for additional sensors, thereby reducing production costs significantly.

The authors highlight that their sensor-based approach outperforms vision-based methods in terms of accuracy and efficiency. By using the smart glove, individuals who do not understand sign language can easily communicate with those who have speech or hearing impairments.

The paper was published in the 2022 International Conference on Wireless Communications Signal Processing and Networking (WiSPNET) and was included in the IEEE Xplore database on May 9, 2022. The paper's INSPEC Accession Number is 21727655.

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The proposed system has the potential to break down communication barriers and empower individuals with disabilities, allowing them to interact more effectively with the world around them.

III. METHODOLOGY

This chapter explains about the overall function of the circuit and as per the circuit diagram, the process begins with Flex sensor. As described in the previous chapter, the flex sensor is nothing but a variable resistor and its resistance will be varied according to its bend position. Now with the help of a fixed resistor connected in series with sensor, we can generate a variable voltage from its reference point. The flex sensor and fixed resistor both must be configured in potential dividing network, means one end of the sensor must be connected to the +5V source point and the other end must be connected to the one end of resistor. The other end of resistor must be connected to the ground. The output taken from the midpoint is known as reference voltage and this voltage varies according to the bend position of flex

sensor. For example, if the sensor is in straight condition, assume that its resistance will be 20k and when a 10k resistor is connected in series to this sensor, the output voltage or reference voltage can be calculated by using this formula. R2 divided by R1 + R2 X Vcc. R1 is flex sensor, R2 is 10k and Vcc is +5V. Based on this formula, 10/20+10 X 5 = 1.6V, this is the reference voltage. If the sensor is bended, assume its resistance is 10K and as per the above equation, the reference voltage will be 2.5v. Likewise the reference voltage will be generated and it will be varied .

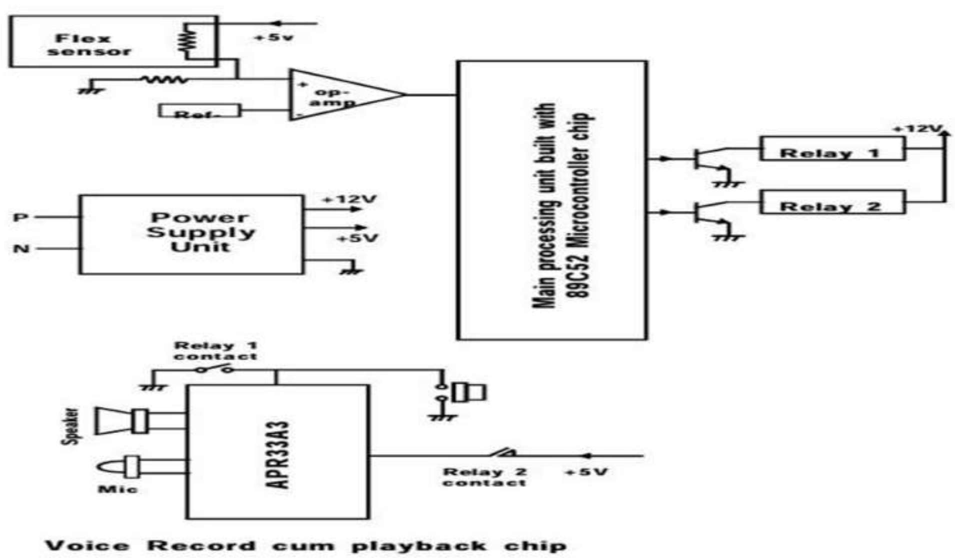

Fig:3.1 Flex Sensor Based Hand Glove Block Diagram

Major building blocks: Main processing unit built with 89c52 microcontroller chip, Flex sensor, rubber hand glove, lm324 op-amp IC, relays, APR33A3 voice record cum play back chip, speaker, power supply unit, etc.

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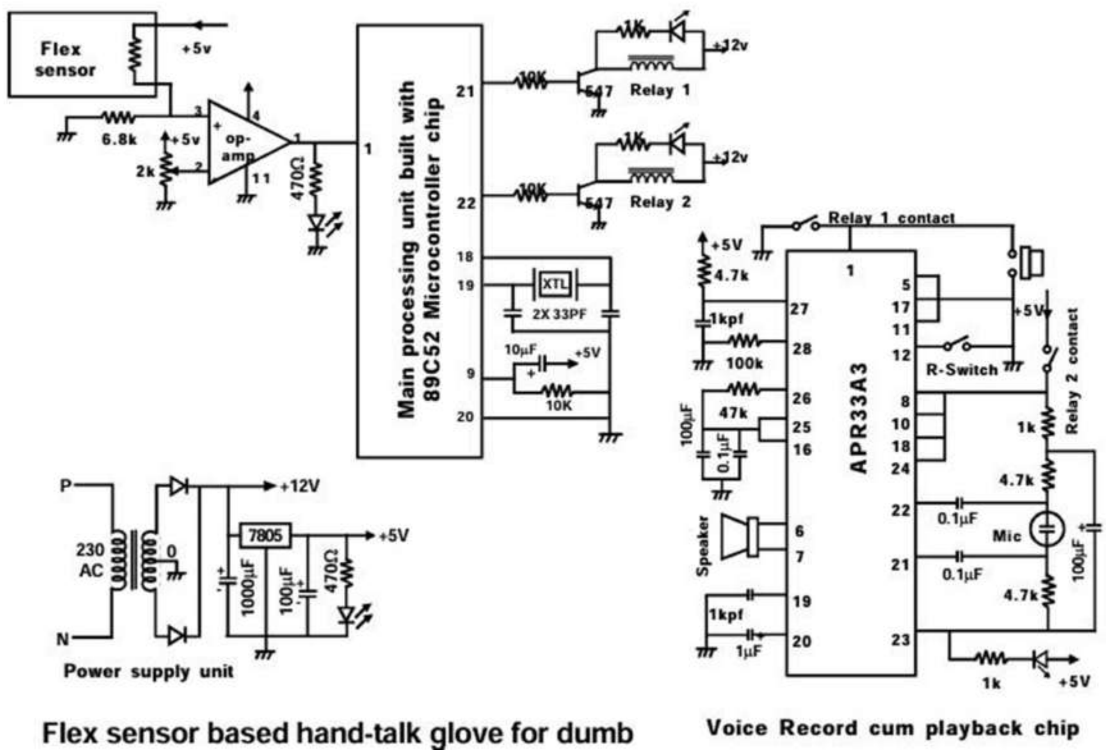

\Fig.3.2 **Circuit Diagram For Flex Sensor Hand Based**

IV. SOFTWARE DETAILS

HOW TO PROGRAM 89C51 – PROCEDURE

Developing software and hardware for micro controller based Embedded systems involves the use of a range of tools that can include editors, assemblers, Compilers, debuggers, simulators, emulators and Flash/OTP programmers. To the Newcomer to micro controller development it is often not clear how all of these Different components play together in the development cycle and what differences There are for example between Trainer kits, emulators and simulator. The basic operations that are involved in above micro controller development cycle are:

1. Writing Micro controller Code.
2. Translating the Code.
3. Debugging the code.

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writing micro controller code:

Software Code for a micro controller is written in a programming language of choice (often Assembler or C). This source code is written with a standard ASCII text editor and saved as an ASCII text file. Programming in assembler involves learning a micro controller's specific instruction set (assembler mnemonics), but results in the most compact and fastest code. A higher-level language like C is for the most part independent of a micro controller's specific architecture, but still requires some controller specific extensions of the standard language to be able to control all of a chip's peripherals and functionality. The penalty for more portable code and faster program development is a larger code size (20%...40% compared to assembler).

Translating the code:

Next the source code needs to be translated into instructions the micro controller can actually execute. A microcontroller's instruction set is represented by "op codes". Op codes are unique sequences of bits ("0" and "1") that are decoded by the controller's instruction decode logic and then executed. Instead of writing op-codes in bits, they are commonly represented as hexadecimal numbers, whereby one hex number represents 4 bits within a byte, so it takes two hex numbers to represent 8 bits or 1 byte. For that reason a micro controller's firmware in Machine-readable form is also called Hex-Code and the file that stores that code Hex-File.

Debugging the Code

A debugger is a piece of software running on the PC, which has to be tightly integrated with the emulator that you use to validate your code. For that reason all emulator manufacturers ship their own debugger software with their tools, but also compiler manufacturers frequently include debuggers, which work with certain emulators, into their development suites

ADVANTAGES

1. One of the advantages of an embedded system is to decrease power consumption and space.

2. All embedded systems that are based on micro controller have low power consumption in addition to some form of I/O, COM port and ROM all on a single chip.

CHIP BURNING PROCESS

The process of chip burning depends up on the compiler kit, the CA51 Compiler Kit for the 8051 micro controller family supports all 8051 derivatives including those from companies like Analog Devices, Atmel, Cypress Semiconductor, Dallas Semiconductor, Goal, Hynix, Infineon, Intel, OKI, Philips, Silicon Labs, SMSC, ST Microelectronics, Synopsis, TDK, Temic, Texas Instruments, and Winbond. The following components are included in the CA51 8051 C-compiler & Assembler Kit:

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C51 'C' Compiler

The Keil C51 'C' Compiler for the 8051 micro controller is the most popular 8051 'C' compiler in the world. It provides more features than any other 8051 'C' compiler available today. The C51 Compiler allows you to write 8051 micro controller applications in C that have the efficiency and speed of assembly language. Language extensions in the C51 Compiler give you full access to all resources of the 8051. C51 translates C source files into a re-locatable object module. When the DEBUG control is used, the object file contains full symbolic information for debugging with the µVision3 Debugger or an in-circuit emulator. In addition to the object file, the C51 Compiler generates a listing file, which optionally may include symbol table and cross-reference information.

Features

- Nine basic data types, including 32-bit IEEE floating-point
- Flexible variable allocation with bit, data, b data, I data, x data, and p data memory types
- Interrupt functions may be written in C
- Full use of the 8051 register banks
- Complete symbol and type information for source-level debugging
- Use of AJMP and ACALL instructions
- Bit-addressable data objects
- Built-in interface for the RTX51 real-time operating system
- Support for dual data pointers on Atmel, AMD, Cypress, Dallas Semiconductor, Infineon, Philips, and Triscend micro controllers
- Support for the Philips 8xC750, 8xC751, and 8xC752 limited instruction sets
- Support for the Infineon 80C517 arithmetic unit

A51 Macro Assembler

The A51 Assembler is a macro assembler for the 8051 family of micro controllers. It supports all 8051 derivatives. It translates symbolic assembly language mnemonics into relocatable object code where the utmost speed, small code size, and hardware control are critical. The macro facility speeds development and conserves maintenance time since common sequences need only be developed once. The A51 assembler supports symbolic access to all features of the 8051 architecture. The A51 assembler translates assembler source files into a relocatable object module. The DEBUG control adds full symbolic information to the object module and supports debugging with the µVision3 Debugger or an in-circuit emulator. In addition to object files, the A51 assembler generates list files, which optionally may include symbol table and cross reference information.

µVision3 IDE

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The µVision3 IDE from Keil Software combines project management; make facilities, source code editing, program debugging, and complete simulation in one powerful environment. µVision3 helps you get programs working faster than ever while providing an easy-to-use development platform. The editor and debugger are integrated into a single application and provide a seamless embedded project development environment.

V. WORKING PRINCIPLE:

The project centers around a sign language interpretation system, employing a rubber hand glove equipped with a flex sensor—a low-cost variable resistor sensitive to bending. This sensor, with interchangeable pins (P1 and P2), finds applications in diverse fields like gaming, data gloves, motion tracking, and biomedical devices. The embedded system relies on an 89C52 microcontroller interfaced with the flex sensor via an LM324 op-amp IC. The flex sensor's resistance, directly tied to its bending degree, facilitates gesture detection.

Within the project framework is the APR33A3 voice record cum playback chip, featuring independent voice channels. For demo purposes, one channel is utilized. This chip enables the recording and playback of voice messages, with a focus on enhancing clarity through digital recording.

The microcontroller, a critical component, executes the program written in machine language, translating hand gestures into voice messages. Emphasizing the role of microcontrollers in control systems, their computing and communication capabilities drive changes in instrumentation. Microcontrollers are lauded as dedicated tools for specific tasks, storing programs in ROM, with modifications requiring erasure and reprogramming using a chip burner.

VI. RESULTS AND DISCUSSION

The project incorporates an electronic digital sound recording and playback device with eight independent voice channels, allowing for a variety of recorded messages. The use of a flex sensor, a microcontroller, and a voice chip makes the system versatile and capable of delivering specific voice messages based on recognized hand gestures.

The system uses a combination of speech and gestures to facilitate communication, making it accessible and efficient for users. The flex sensor's flexibility in recognizing finger movements and the voice playback chip's ability to produce predefined messages contribute to the overall effectiveness of the device.

- The device address communication challenges for individuals with hearing and speech impairments
- Discusses the effectiveness of flex sensors and voice playback for accessibility. Gesture Recognition Technology:
- Analyzed the pros and cons of using a flex sensor for hand gesture recognition. Explore the advantages of gesture-based communication over other methods.
- Explores the role of the microcontroller in processing signals from the flex sensor. Discusses how the microcontroller stores user-specific data for a personalized experience.

- Evaluated the significance of the multi-channel voice chip in delivering pre-recorded messages.
- Considered expanding channels for a broader range of messages.

VII. CONCLUSION AND FUTURESCOPE

The project work on “Flex sensor based hand-talk glove” is completed successfully and results are found to be satisfactory. In this project work, only one flex sensor is used to prove the basic concept practically, but for real time applications, 5 sensors can be used to generate 5 different messages. This is enhancement of this project work which will be carried in our future work.

The flex sensor project holds significant potential for future advancements and expansion. One avenue for development involves enhancing the system's gesture recognition capabilities by incorporating additional sensors or exploring advanced flex sensor technologies for improved sensitivity and accuracy. The integration of machine learning algorithms could enable the system to adapt to users' unique signing styles, providing a more personalized and responsive experience. Wireless communication modules, such as Bluetooth or Wi-Fi, could be integrated to enhance portability. Real-time feedback mechanisms, like haptic or visual cues, may assist users in refining their gestures and improving communication accuracy. Mobile application integration, supporting tutorials and user customization, could further enhance the system's functionality. Expanding language support, ensuring accessibility features, and enabling gesture customization are other promising directions. Collaborations with healthcare professionals for rehabilitation or communication assistance applications could further broaden the impact of the project. By exploring these future prospects, the flex sensor project has the potential to contribute significantly to assistive technology and human-computer interaction.

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