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Real Time Touch Gesture Controlled Virtual Keyboard for Physically Disabled

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ABSTRACT: Apart from food, cloth and shelter, communication is also one of the important human needs. All humans have ability to interact with the others. Thousands of people worldwide suffer from such physical disabilities that they cannot even able to communicate. In our society, people with motor impairments are oftentimes socially excluded from their environment. This is unfortunate because every human being should have the possibility to obtain the necessary conditions to live a normal life. Although there is technology to assist people with motor impairments, few systems are targeted for programming environments. In our proposed system, we are going to implement a virtual keyboard using touch gesture control. Here we are using the hand movements of the physically disabled person. In case a patient cannot move his hands efficiently, high sensitivity touch switch is provided. Three switches are provided on the hand of the subject. Using these switches patients can communicate and convey few important messages along with few simple answering messages like YES or NO to the caretaker or third person. We have successfully implemented and verified the results of the system using few trials.

KEYWORDS: Virtual Keyboard, Physically Disabled, Microcontroller, Gesture Control, Resistive Touch Switch.

I. INTRODUCTION

Communication is the ability to interact with the environment which is one of the basic human needs. Millions of people worldwide suffer from such severe physical disabilities that they cannot even meet these basic needs. Even though they may have no motor mobility, however, the sensory and cognitive functions of the physically disabled are usually intact [1]. This makes them good candidates for gesture controlled virtual keyboard technology, which provides a direct electronic interface and can convey messages and commands directly from the human to others. It has the potential to enable the physically disabled to perform many activities, thus improving their quality of life and productivity, allowing them more independence and reducing social costs.

In our society, people with motor impairments are oftentimes socially excluded from their environment. This is unfortunate because every human being should have the possibility to obtain the necessary conditions to live a normal life. Although there is technology to assist people with motor impairments, few systems are targeted for programming environments. We have created a system, called virtual keyboard using gesture control [2, 9, 11, 12, 14]. Here we are using the hand movements of the physically disabled person. In case a patient cannot move his hands efficiently, high sensitivity touch switch is used for operation. Three switches are provided on the hand of the subject i.e. Switch A, switch B, switch C. The patient has to lightly press switch A to select the number corresponding to the messages from the previously stored database. There are 16 different messages which we are providing to the patient. He/she can press the switch A to select the desired number corresponding to the message and thereafter presses switch B to select the message. Patient can go back to main menu or reset by pressing switch C. By pressing switch B and C the user can communicate with third person by conveying simple message YES or NO.

II. LITERATURE SURVEY

Touch-typing or machine writing was invented for mechanical typewriters which had the current QWERTY key layout since 1874 [1, 2]. While this interface is come to age, it survived because of its many positive aspects. Yet it is not feasible for the ever-smaller computing devices that house ever more advanced functionalities. Input to small devices is

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becoming an increasingly crucial factor in development for the ever more powerful embedded market. While this interface is come to age, it survived because of its many positive aspects. Yet it is not feasible for the ever-smaller computing devices that house ever-more advanced functionalities [2]. Great amount of information human can output through the medium of a pen is limited by motor skills rather than by cognitive skills. The brain can learn much quicker and better how to control body parts than the human physique takes to adapt to new requirements.

Over the past 20 years, research that can provide communication and control to individuals with severe motor impairment has increased almost exponentially [10]. While considerable effort has been dedicated to offline analysis for improving signal detection and translation, online studies with the target populations are far less common, there remains a great need for translational studies. Our target while searching and understanding the topic aimed that it must be simple to operate, need minimal expert oversight, be usable by people who are extremely disabled, and provide reliable, long-term performance in complex environments.

2.1. Gesture Control

Humans naturally use gesture to communicate. It has been demonstrated that young children can readily learn to communicate with gesture before they learn to talk. A gesture is non-verbal communication made with a part of the body. Today's world comprises of a large variety of people. Some of them depend on others for their living. But in today's fast world, everyone is busy and there are less people to care for the increasing number of elderly and the physically challenged people. Also these people find it tough to even navigate inside the home without external aids.

Gesture means a movement of part of the body, esp. a hand or the head, to express an idea or meaning. Here the project is implemented based on hand gesture [7]. Based on the hand movement key can be selected and used for various operations. Hence gesture movements can be used by both the elderly and the physically challenged people in a user friendly manner for their benefits. The number of research has shown clear signs that gesture controlled technologies are now in the interest of the people. Though there are different aspects and many points to mention from the research, it has been about 30 years of research and researchers have been working continuously on gesture based system.

The different types of gesture are hand gesture; touch gesture, body gesture, Finger point gestures and gestures with voice. Most of the research of the survey use or target the general users of any age [3, 7, 9]. Initially it was mostly for computer users to work on the objects or presentation. Wheelchair users are also highly considered for accelerometer based gesture controlled system. Most of the last 5 years investigations are focused on elderly and disable people. Researches show that gesture based applications can be used for many different things like entertainment, Controlling home appliance, Tele-care, Tele-health, Elderly or Disable care etc.

2.2. Virtual Keyboard

Input to small devices is becoming an increasingly crucial factor in development for the ever more powerful embedded market. Speech input promises to become a feasible alternative to tiny keypads, yet its limited reliability, robustness, and flexibility render it unsuitable for certain tasks and/or environments. Various attempts have been made to provide the common keyboard metaphor without the physical keyboard, to build "virtual keyboards" [4, 6, 10, 12]. This promises to leverage our familiarity with the device without incurring the constraints of the bulky physics.

We define touch-typing as any input method that employs discrete sensors, or sensed areas, or buttons, for one or a set of atomic symbols (letters, digits, or characters) of a language. Examples are the common keyboard, the keypad of a mobile phone, and onscreen keyboards on PDAs. This definition explicitly includes "virtual" buttons that only differ from the surrounding physique in that their extent is sensed by some technique for touch by a finger or pointer [9]. We use the term keyboard, or keyboard metaphor, interchangeably for touch-typing interfaces.

Touch-typing was born with the invention of the mechanical typewriter, and the common QWERTY layout followed us since 1874. Its greatest benefit is that all ten fingers can be used to operate it in very rapid sequential order. The

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interface is not restricted to communicating through a single pen. A seemingly related yet orthogonal benefit derives from the fact that each button generates only one bit of information [2, 10]. So in a sense, a keyboard is an input device with one degree of freedom (1 DOF) 1, a pen or a mouse has 2 DOF (a 2-dimensional surface), and SL operates in 4 DOF (3-dimensional space plus time).

III. BLOCK DIAGRAM

The system contains touch switches, microcontroller, LCD display, Buzzer, relay driver and external circuitry. Microcontroller (89S52) is the heart of system. The system works on the operating voltage 3.5V to 5V and maximum current operating range 100 mA. Fig. 1 shows the block diagram of the system.

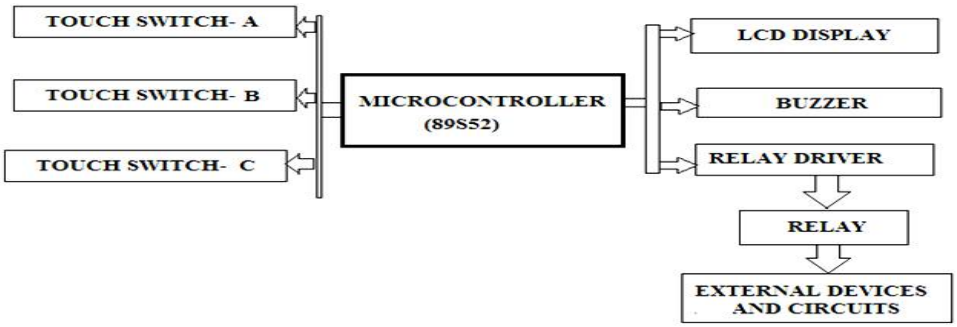

Fig. 1 Block Diagram of the system

The block diagram descriptions of the blocks are following:-

A. Microcontroller:-

Microcontroller is used as the heart of the system. The touch switches are connected to uc using the transistor switch driver circuit. We are using 89s52 microcontroller. The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. All microcontroller pins are connected with external pull up resistors for current sourcing. The microcontroller continuously reads the status of touch switches. If any one of the switch is pressed then respective action is done.

B. Touch Switch:-

Touch switches are high impedance switches. We are using resistive touch switch in our project for gesture control which is in the form of crystal oscillator. These switches are based on the fact that the human tissues have a great amount of water and salt, something that makes it conductive. These switches have not any type of environmental effects like temperature, moisture, humidity etc. The switches are used here to select the key of virtual keyboard to communicate with the external world [15]. We are using resistive touch switch here. The resistance touch switch is based on the fact that human tissues (like the skin) have a great amount of water and salt, something that makes it conductive. Fig 2 is depicting the resistive touch switch.

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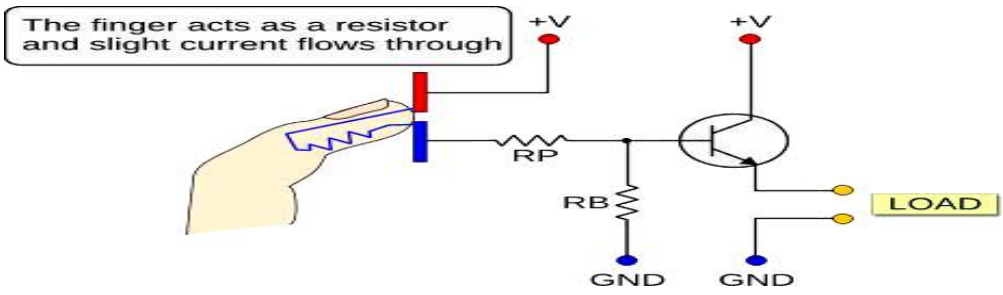

Fig. 2 Resistance touch switch [15]

This is the most basic type of touch switch, in its simplest form. A transistor is used as a switch. The RB resistor keeps the base to ground when no electrode is touched, so it does not float. The RP resistor is for protection, in case that the electrodes are short-circuited, and it prevents an over current that will probably toast the transistor. If one of the electrodes is touched, nothing will happen. But if both electrodes are touched together, then a small amount of current will flow through the skin to the base of the transistor. The transistor will then go from cut-off to saturation, and current will flow from the CE region to the LOAD. This method is straight forward and no more info is needed. There are numerous different ways to implement a resistance touch switch, with transistors, 555, 741, CMOS etc. Super simple, super reliable are the advantages of it. Not very flexible in design and two electrodes required are the disadvantages of it.

C. LCD Display:-

LCD display is used to display the message allocated to respective key of virtual keyboard. We are using 16*2 LCD display.

D. Buzzer:-

Buzzer is an audio signalling device which may be mechanical, electromechanical, or piezoelectric. After pressing any key of virtual keyboard, the buzzer gets till the reset switch is pressed. It basically used by the physically disabled person to give the command or request for help when required.

E. Relay:-

Relay is an electrically operated switch. It is basically used for the A.C operating devices or circuits. To control the A.C devices relay act as a switch. We are using ice cube relay for controlling the door, light, fan, doorbell etc. in our project.

IV. SYSTEM IMPLEMENTATION AND WORKING

4.1. Circuit Diagram

The primary unit of the system consists of microcontroller AT89S52. The microcontroller is the heart of the system. The stored data and processing is done by the controllers only. The resistive switch we are using for taking input. It acts as the touch switch. The touch switches are coupled with Darlington pair to give required current. LCD (16*2) is the output displaying unit. Switch A, B and C are input, it senses the touch and give pulse output to the controller unit. The controller performs the operation according to the specified code. The crystal oscillator is used to give clock pulse to the digital microcontroller IC. Buzzer is used to give the alert to the third person when user pressed the touch switch. Fig 3 is showing the circuit diagram of the system.

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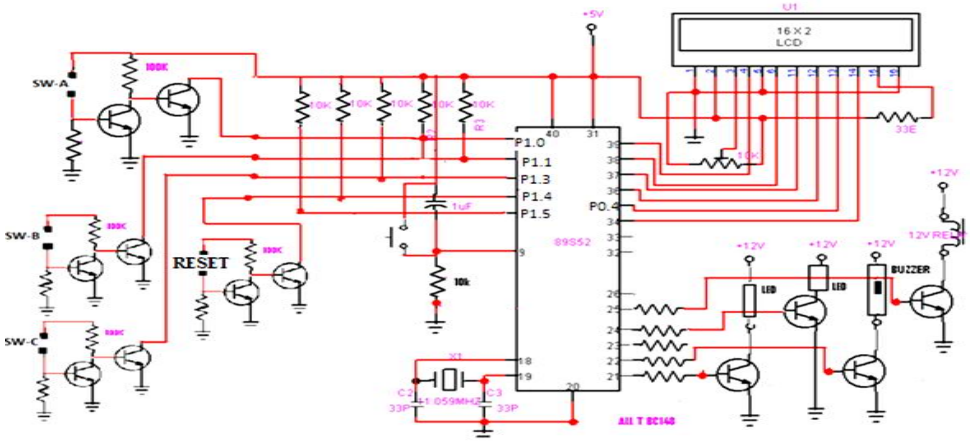

Fig. 3 Circuit Diagram of the system

4.2. Working of the System

The switch box being used to control the messages for displaying them is placed on the bed of the patient or any accessible area within his bed where he can touch the switch. The patient can access the switch with his fingers and even his toes. By switching on the system we get a default message- “Virtual Keyboard”. By lightly pressing switch A the patient can select the number corresponding to the desired message which he wants to convey the second person. Once the desired number from 1 to 16 is selected by pressing switch B, the message will be displayed on the LCD. Fig 4 presents the complete implemented system.

Fig. 4 Complete Implemented System

We want to display the message of the patient on the LCD screen. The user is provided with an earlier stored message database. He can select the message from this database. When the power is supplied to the system it displays a message “VIRTUAL KEYBOARD”. Fig. 5 is showing the initial displayed message.

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Fig. 5 LCD displaying "Virtual Keyboard Display"

After that the user is asked to "ENTER NEW MESSAGE". The patient is provided with three switches. He looks at the serial number of the message which he wants to display. The patient presses switch A until that serial number is reached. Fig 6 is displaying the ""ENTER NEW MESSAGE".

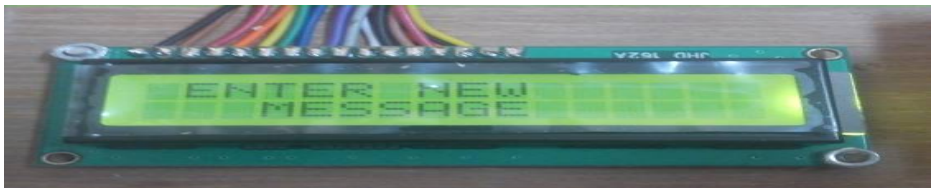

Fig. 6 LCD displaying "Enter new message"

The user can press switch B to select the message. The message is displayed on the LCD screen. After that the buzzer starts ringing .The third person listens the buzzer and will be alerted. This message is also displayed to the patient. If a wrong message has been displayed, the patient can press the reset switch i.e. switch C. The user can again select the message by this method. The patient can also get into a conversation with the third party using this system. He can reply by pressing switch B for 'NO'. The user can reply "YES" by pressing switch C. Patient can fulfil his basic needs by using this system. He can ask for water, Food, T.V on/off, Bathroom and Bed fold/unfold etc. with the help of this system. Table 1 is depicting the key and the corresponding messages.

Table 1.Results

Key selection	Action/ Message
1	NICE TO SEE YOU
2	I WANT TEA
3	BATHROOM
4	BRING WATER
5	FOOD
6	FAN TURN ON/OFF
7	MAKE A CALL
8	COME BACK AGAIN
9	TV ON/OFF
10	BED FOLD/UNFOLD
11	I WANT TO REST
12	Come After Some Time
13	Light On/Off
14	YES
15	NO
16	Do Not Disturb
SW-A	Key selection
SW-B	Message display/NO
SW-C	Reset/YES

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4.3. Work Flow of the System

A. Algorithm:

- Start
- System displays the message 'Virtual Keyboard'.
- Patient is provided with an earlier stored message database.
- He/she looks at the serial number of the message which he wants to display.
- Then he selects the numbers by pressing Switch 'A'.
- After he gets the number, he presses Switch 'B'.
- The desired message is displayed on the LCD screen.
- After the message is displayed, a buzzer will start ringing.
- The third person will hear the buzzer and will be alerted.
- He will stop the buzzer and sees the message displayed on the LCD.
- He will perform the required action.
- The user can also get into conversation with a person.
- He can reply by pressing Switch 'B' for NO and Switch 'C' for YES.
- If a wrong serial number is selected the message displayed will be different from the desired message.
- The user can go back to home by pressing Switch 'C' and select the number again.
- Stop

B. Flow Chart:

Fig. 7 is depicting the flow chart of the system.

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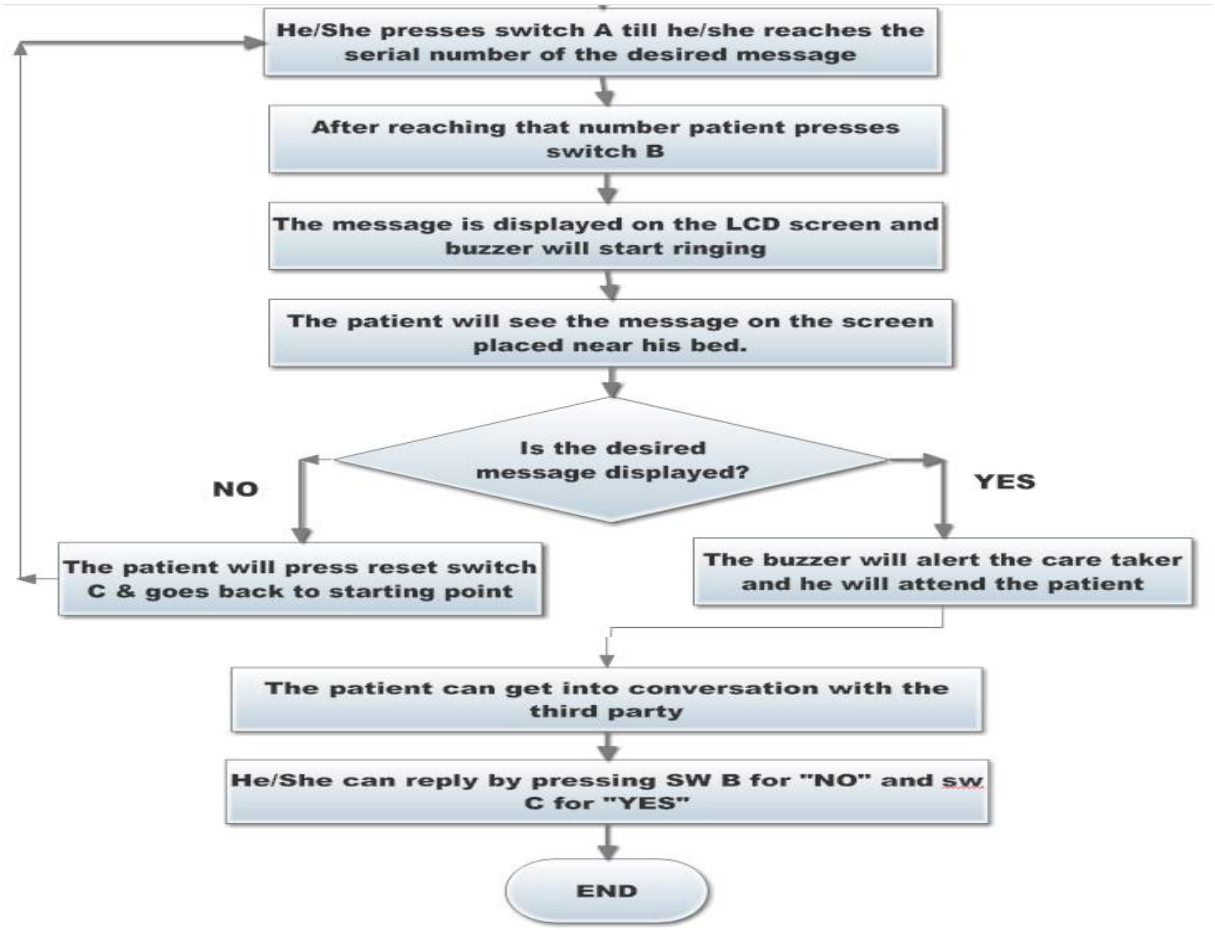

Fig. 7 Flow chart of the working of the system

V. RESULT AND DISCUSSION

5.1. Results

We can store many number of messages in the program according to the need and requirement of the patient. Desired output results in conveying the message from a physically challenged person to their environment like assistance/nurse/friends/relatives. Table 2 shows results of few pressed numbers and the corresponding message stored in the database for the patient's use.

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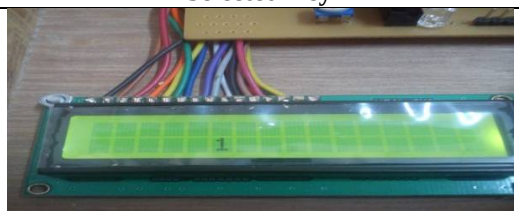
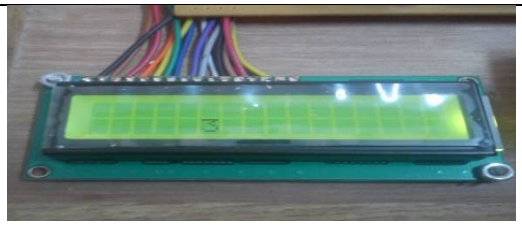
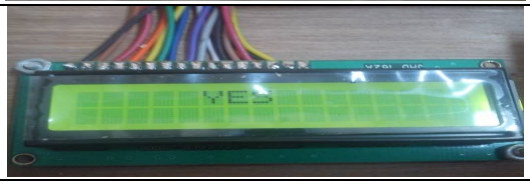
Table 2.Results

Selected Key	Display
	
	
	
	
	
	

5.2. Discussion

The implemented system is a multitasking device that is user friendly even for physically challenged people like deaf, dumb and the people suffering from motor neuron disease for conveying his message to the outside world. It can be used to control the home appliances by further interfaces. This can be used as voice enabled communicator and the patient in case of emergency also. It can use to play simple video game and in military application for controlling the

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weapons. Hence, we can say that by using this system physically challenged people find ease of operation as the system is user friendly and portable.

VI. CONCLUSION

Hence we can conclude that with the help of hand gestures we have developed a virtual keyboard. The system developed can be used for communication purpose. Earlier stored messages are selected by these control signals and displayed on LCD screen. By using this system physically challenged people find ease of operation as the system is user friendly and size is small. In this proposed system we used different hand gesture for multiple applications .We placed three switches on the patient's hand. Patient is asked to scroll the switch to the desired number to select the earlier stored message database .After that he/she is asked to confirm it by pressing another switch .Patient can return back to the main menu by pressing the switch 'C'. Further improvement in the implemented system can be done with the addition of few more communication modules like GPS and GPRS for wireless connectivity of the system. For continuous surveillance video camera can be added to the system. It will give us live streaming of the physically disabled person. In near future computer with biological sensor and thought recognition software will come, just as keyboard and mouse.

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