A Cost Effective Communication Device Using Morse Code for Disabled People

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Abstract— Morse Code is an efficient tool for communicating with the disabled people especially those with speech impairments and a variety of neuromuscular diseases like multiple sclerosis and muscular dystrophy. It is quite difficult to implement morse code with people having severe physical restriction as in the severe cases of Cerebral Palsy. This paper aims at designing of a device which can help such patients with their basic day to day communication. The proposed device can recognize even a slight movement of finger as the dots and dashes of Morse code, alerting patient's caretaker about anything that needs his attention.

Key words: Morse code, Adaptive Switches, RS232, Muscoskeletal sensors

I. INTRODUCTION

Communication is the most basic requirement of a human being. But unfortunately this basic need is not fulfilled in the life of disabled people. Lack of communication creates various problems for the patient. Speech disabled people can use symbolic languages to express themselves. But this condition gets worsened with the people having multiple disabilities like severe physical restriction along with verbal disabilities as in case of cerebral palsy, multiple sclerosis etc. To assist such people, Morse code has always proved itself to be a great tool. Morse code is a method of transmitting information as a series of on-off tones, lights, or clicks that can be directly understood by a listener or observer without any special equipment. A variety of adaptive switches and scanning devices are developed for this purpose. But some are limited to help people having considerable amount of mobility, while others are limited due to cost and complexity of instrument. Hence cost, complexity of the device and adaptability of the device with the user are the key points to be considered.

Initially, there was a problem of stable input speed with Morse code devices. Many algorithms like Adaptive Unstable Speed Prediction (AUSP), Least Mean Square (LMS) etc. have been proposed to overcome this difficulty. This paper aims at a cost effective and simple device which will help in communicating with such people and thus will help their caretakers to know about their basic needs.

II. SYSTEM DESCRIPTION

The dimensions of device are ergonomically designed such that from a child to an adult everyone can use it with ease. The main components of the system are:

(1) Input Device
(2) User Interface
(3) Central control unit and display unit.

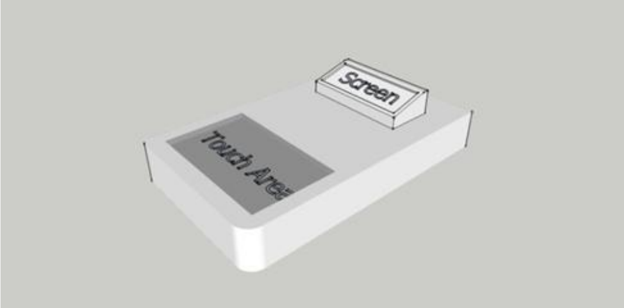

Fig. 1: Basic design of device

A. *Input Device:*

Input Device is specially designed for accepting small and unstable input gestures from physically challenged user and it reliably predicts the user command which will be transferred to control unit via wired or wireless means depending on the setup used by user. The control surface of input device is a multi-touch surface designed to track N input points, usually 5 to 10 points.

This coordinate information is transmitted to an onboard processor which calculates the mean of these coordinates using Mean Coordinate Algorithm as stated in section III(C) and tracks the movement of fingers or palm of user on the surface, by sampling the mean coordinate at regular intervals and comparing previous and current values using Input Algorithm, an output i.e. command for control unit can be generated by comparison.

Apart from control touch surface the input device will have USB or RS232 interface for programming, debugging and testing or charging (if running on rechargeable cells).

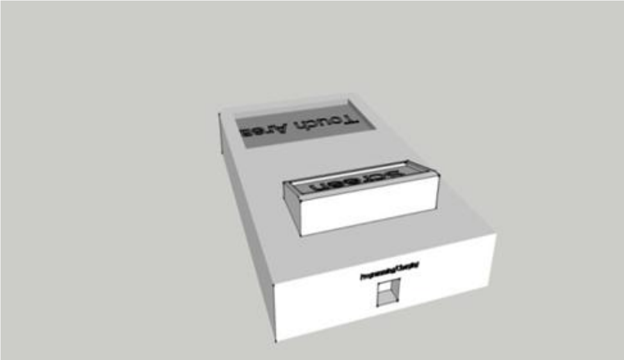

Fig. 2: USB Slot in the device

There is an onboard LCD screen through which the device features can be customized such as varying the sensitivity of device, enabling and disabling haptic feedback on device, knowing the battery status of device.

The 3 basic gestures of device are:
Swipe left: To send a Morse code 'dash'
Swipe right: To Send a Morse code 'dot'
Swipe down: To disregard previous input and clear last entry in command buffer.

B. *User Interface:*

The user interface will have two sections:

(1) 1-Input screen: The gesture input from user will be displayed here so user can decide if its correct or not and change the input.

(2) 2-Display section: The relevant information according to inputs will be displayed here. Display Section will have 8 sections each marked with a useful word such as food, water etc. its picture and its accompanying morse code. The user can generate these codes from input device which then can be fed in control unit and control unit can alert the user's care taker.

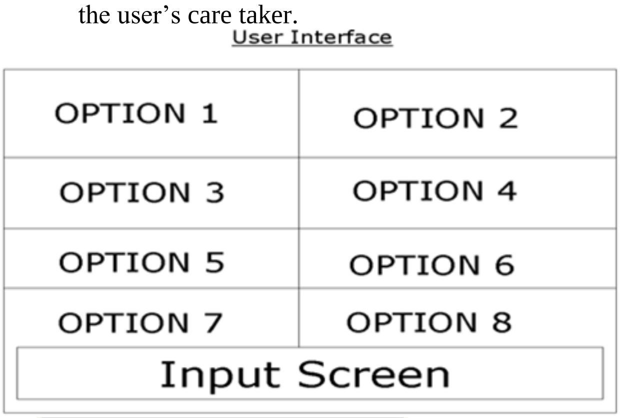

Fig. 3: User Interface

C. *Central Control Unit:*

The central control unit consisting of a microcontroller will process all the inputs from input device, and display the output as designed using a character LCD, computer or any suitable device.

III. ALGORITHMS USED

The algorithms used with the device are simple and easy to understand. The terms used in the algorithms are as follows:

– N: Index of Sampling of coordinates of Touch Surface
– T: Sampling Time
– x_n (NT): The value of n^{th} coordinate at time NT.
– Error sum: Summation of deviation in mean coordinate values during calibration time.
– Error: The error value in input values.

A. *Mean Coordinate Algorithm:*

Step 1: The X -coordinates of n input surface is sensed by input surface.

Step 2: The mean coordinate computed at time NT is given by formula

$$X_{Mean}(NT) = \frac{\sum_{n=0}^{n} x_n(NT)}{n} \qquad (1.1)$$

Step 3: IF (NT<Calibration Time)
Call Error Computation
Else
Call Input

Step 4: Repeat Step 1.

B. *Error Computation Method:*

Step 1: Calculate the difference in mean coordinates sampled using formula
dev(N)= $|X_{Mean}(NT) - X_{Mean}((N-1)T)|$ (1.2)

Step 2: if (NT<Calibration Time)
Errorsum=$\sum_{N=0}^{N} dev(N)$ (1.3)
Call Mean Coordinate

Step 3: The average of Error is computed by the formula
Error=$\frac{ErrorSum}{N}$ (1.4)

Step 4: End

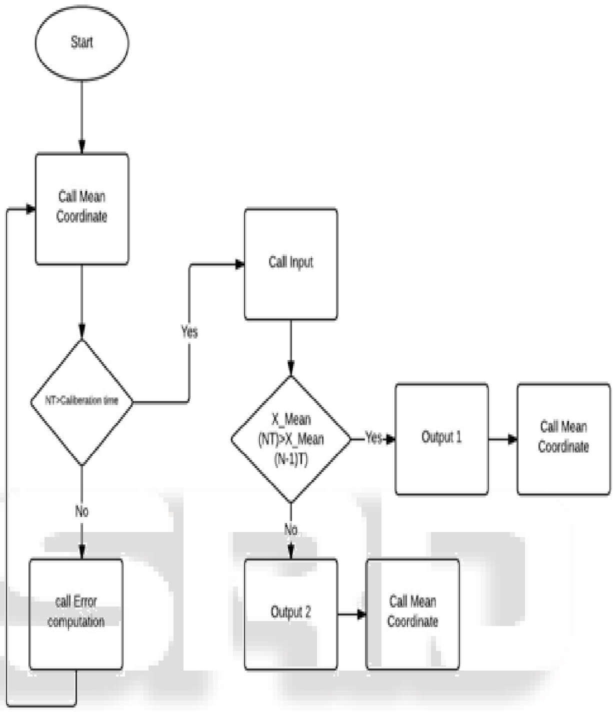

Fig. 4: Block diagram of algorithms

C. *Input Algorithm:*

Step 1: Get Value of $X_{Mean}(NT)$ and $X_{Mean}((N-1)T)$

Step 2: IF (|X_{Mean} (NT) +Error-X_{Mean} (N-1) T| > Threshold)
(
IF ($X_{Mean}(NT)$>$X_{Mean}(N-1)T$))

SET INPUT=Right
Call Mean Coordinate
Else
IF ($X_{Mean}(NT)$<$X_{Mean}(N-1)T$))
SET INPUT=LEFT
Call Mean Coordinate
)

Step 3: Call mean Coordinate.

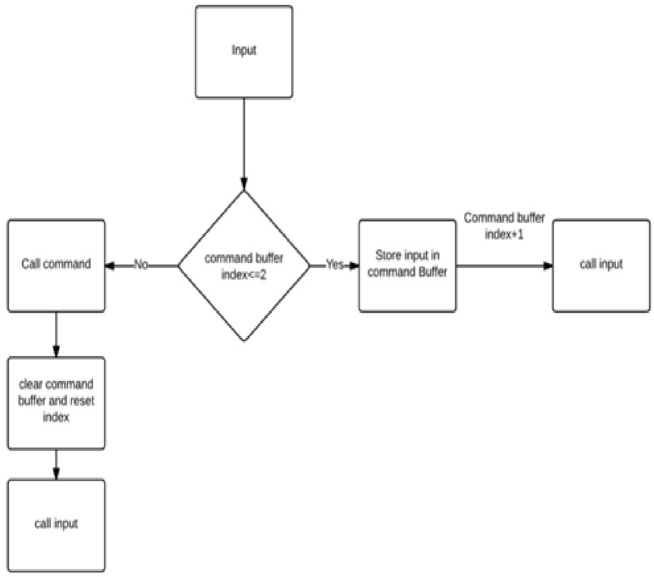

Fig. 5: Block diagram with input buffer

IV. RESULT

The algorithms and functionality proposed in this paper will be instrumental in designing a low cost solution for physically and verbally challenged patients in their communication and rehabilitation needs.

V. CONTINGENCIES

The further expansion of device will include foray of sensors such as breath pattern sensor, muscoskeletal sensors, EEG etc. to not only act as a communication device but a complete health monitoring system, elevating patient's quality of life. Also android application can be used to make the caretaker aware of the needs of disabled person if not present nearby.

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