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Speech Recognizing Robotic Arm for Writing Process

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Abstract: **The proposed project helpful for handicap person who does not have ability to write due to absence of arm. The lack of writing arm may limit the quality of creative expressions. But same person can speak and that vocal words sense by the microphone processed by the ARM2148 processor which actuate the robotic arm assembly. The robotic arm arrangement with the pen made such that it moves on axial co-ordinates and capable of writing words on the paper. The fastest processing speed of ARM2148 has utilized to achieve high speed of writing operation .This paper describes how the proposed project performs the functions of writing and its results. This project is the ray of hope for physically challenged person.**

Keywords: **Robotic arm, ARM 2148, writing Pen, Handicap, Stepper Motor, net framework, SAPI.**

I. INTRODUCTION

The physically handicap person can use proposed robotic arm for writing operation successfully. The robotic arm assembly consists of microphone. The microphone senses the vocal word from the person and forwards the weak signals. This signals required to be amplified. After the signal conditioning like amplification and ADC signals applied to the computer. The computer processor compares the input signals with predefined library of specific words and sound levels. As the signal levels of spoken word and stored word are matched the control word passed to the robotic assembly. The robotic assembly consists of ARM2148 processor with actuating arrangement of three stepper motors. The stepper motors works in three axis. Generally human arm while writing moves in the three directions. This linear movement of the hand with three different direction achieved by three stepper motors. the received control word from computer has unique address of the word. The memory of ARM2148 has programmed for specific addressing of the words. After getting the word the actuating assembly starts performing the real time operation of writing.

II. BLOCK DIAGRAM DESCRIPTION

The block diagram of robotic arm showing writing skills by speech recognition basically divided into three basic parts where the first part is software, Second part hardware and third is mechanically assembly used for robotic hand .The first part which is software in that the SAPI and .NET FRAME Work is connected through the interoperability bridge were the USB which connected to Hardware.

Fig.1 The Block Diagram of Robotic Arm

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***Software Architecture*:** In the SAPI the voice signal that is taken as audio input through the MIC of Personal computer where the SAPI take it as a voice to text conversion in visual basic it recognize the voice only by number of trials where before the voice to text conversion it is necessary to give blue print to the system to have various location in X, Y and Z axis. The grammar which is wrong it is corrected automatically though the facility available in SAPI .Then output of proper data is created in the Microsoft visual basic studio in C#.

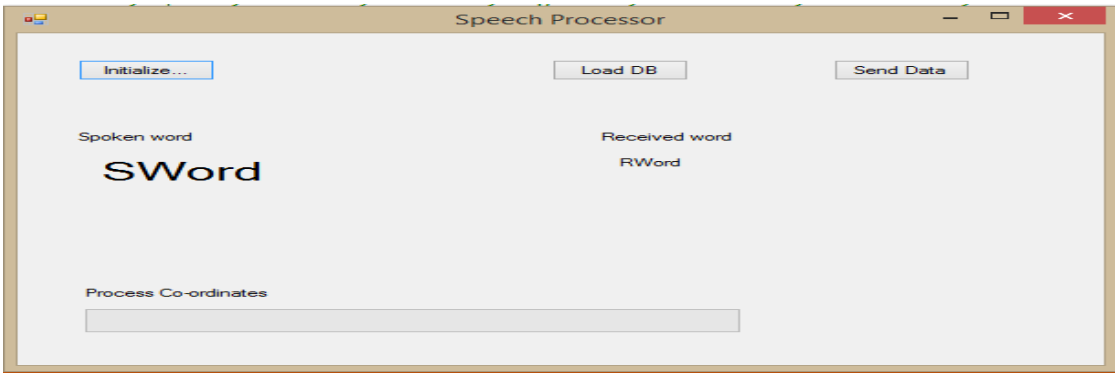

Fig.2 GUI for speech input.

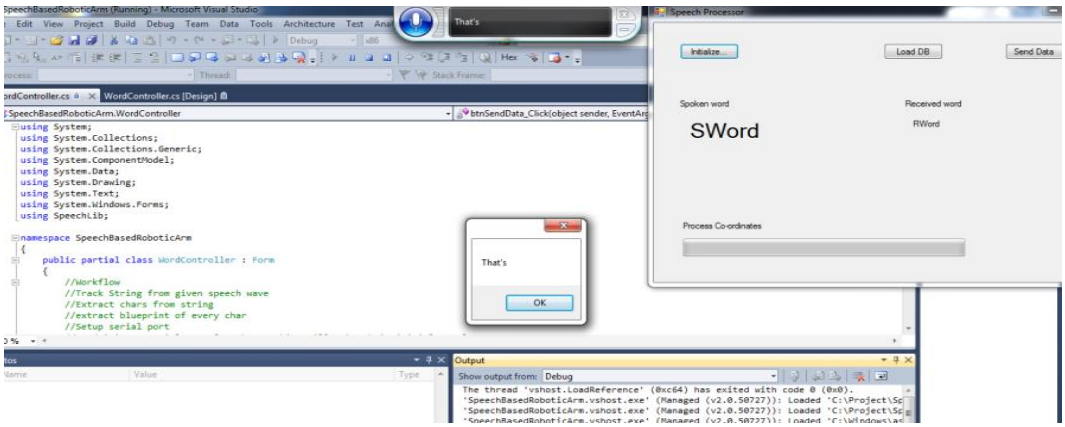

Fig.3 Result after recognizing the word

Above figure 2 and figure 3 shows the GUI developed using Microsoft visual basic studio in C#. The spoken word is match with the previously stored library and the control word has passed to the ARM 2148 processor to actuate the Motor assembly. Following flow chart indicates the steps taken for recognizing the spoken word

The flow chart for processing word and steps taken is as shown above.

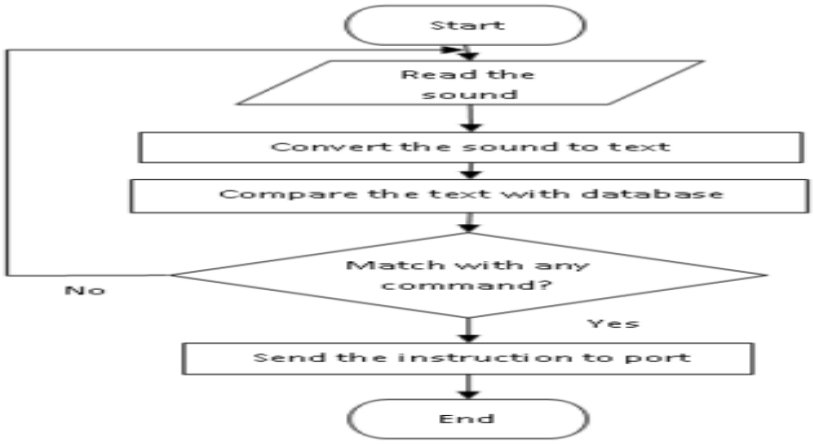

Fig.4 Flow chart for word recognization

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Step 1: Start the process.

Step 2: Read the sound.

Step 3: Convert the sound into Text.

Step 4:Compare the text with database.

Step 5:Match with any word

Step 6: Send the instruction to port

Step 7: End

***Electronic Driver Architecture*:** The FT232 interfaces the computer generated control word to the processor. The processor LPC2148 has the fastest operation speed. The real time operation of writing and speaking has to be performed simultaneously. The inbuilt memory is 512KB sufficient for the program storage. The processor has 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at the maximum clock rate. It required 3.3 volt supply for the operation. To operate the motors isolator plays the important role to protect the circuit from high voltage hazards. Port 1 has used here to interface motors with the processor. Following diagram shows the circuit diagram.

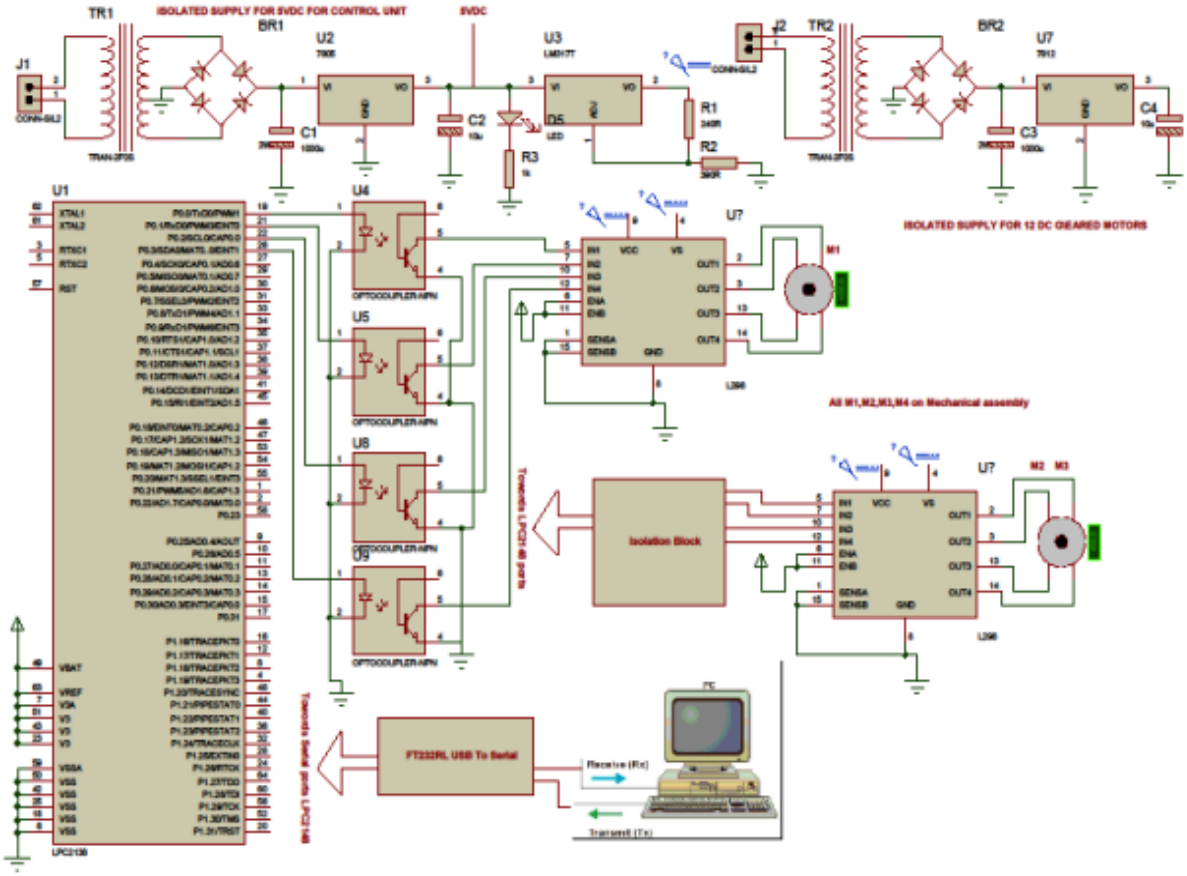

Fig.5 Circuit Diagram of Robotic Arm.

Mechanical Assembly: The mechanical assembly consists of the stepper motors with pen holder. The human writing gestures generally moves into the different directions. The three motors with the rack and pinion gear arrangement achieve the desired movements. The main requirement is to work all three motors simultaneously and actuate the pen to write expected word by moving in three axis. One motor is performing pick and place movement of the pen. Other two motors are moving on horizontal and vertical direction on the paper. The flow chart indicates the working of motors and the process of writing word.

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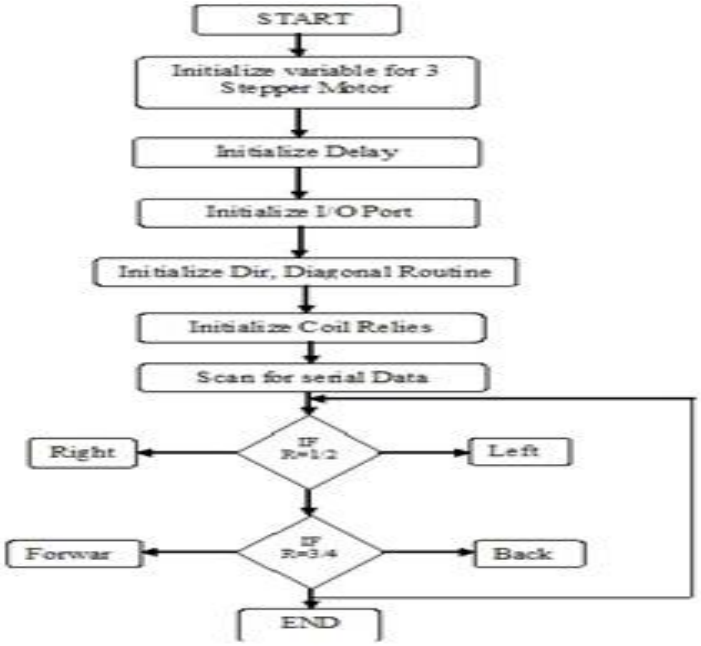

Fig.6 Flow chart for actuating the motors.

Step 1: Start

Step 2: Initialize of Motors X, Y, Z and Delay i/p, o/p port

Step 3: According to word given through the processor

Step 4: Wait for the Data from USB Serial Communication

Step 5: Direction of Motors in X, Y, Z axis move as per data for Direction Left, Right, Up and Down

Step 8: Stop

The enable pin and two output pins Port 1of the processor behaving as shown in above truth table.

TABLE I : The Motor A Truth Table

ENA	IN1	IN2	Description
0	N/A	N/A	Motor A is off
1	0	0	Motor A is off (floating/coasting)
1	0	1	Motor A is on and turning backwards
1	1	0	Motor A is on and turning forwards
1	1	1	Motor A is stopped (brakes)

TABLE II: Motor B Truth Table

ENB	IN3	IN4	Description
0	N/A	N/A	Motor B is off
1	0	0	Motor B is off (floating/coasting)
1	0	1	Motor B is on and turning backwards
1	1	0	Motor B is on and turning forwards
1	1	1	Motor B is stopped (brakes)

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Figure 7 is the image of developed robotic arm system indicating the various sections

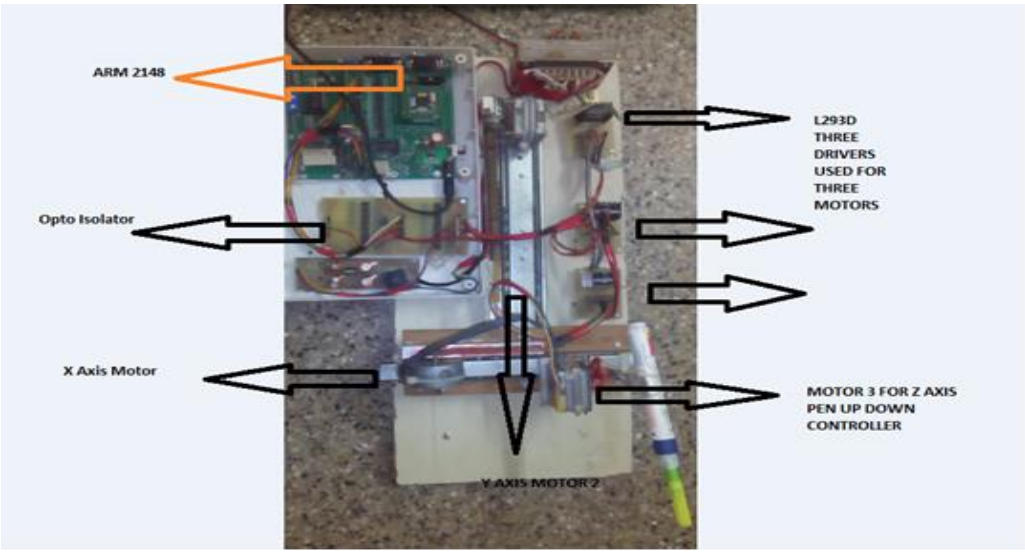

Fig.7 Developed Robotic arm System

III. PERFORMANCE OF THE SYSTEM

The First trial for the single user has taken for 18 different words. Above table 3 shows the spoken word and the received word by the system. The reorganization process has scope for the development where the word 'EYE' has considered as a 'I'. The cognizance has taken to make system capable for differentiating similar pronouncing words.

TABLE III: Comparison of Spoken word and Received word

Sr.No.	Words Spoken	Received Words
1	One	One
2	Buy	Buy
3	That	That
4	How	How
5	All	All
6	Five	Five
7	Eight	Eight
8	Nine	Nine
9	What	What
10	But	But
11	My	My
12	Is	Is
13	V	V
14	B	B
15	I	EYE
16	Police	Police
17	you	you
18	R	R

The same word trial has repeat with three users. The table 4 consists of trials taken for words with the success percentage of received words for multiple users. For the word 'V' first user has taken three attempts. The two attempts for word 'Police' second user has taken. Similar for user three for both the word

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TABLE IV: Comparison of Spoken word with multiple users

Sr.No.	Words Spoken	User 1		User 2		User 2	
		No det.	success	No det.	succes	No det.	succes
1	One	0	100%	0	100%	0	100%
2	Buy	0	100%	0	100%	0	100%
3	That	0	100%	0	100%	0	100%
4	How	0	100%	0	100%	0	100%
5	All	0	100%	0	100%	0	100%
6	Five	0	100%	0	100%	0	100%
7	Eight	0	100%	0	100%	0	100%
8	Nine	0	100%	0	100%	0	100%
9	What	0	100%	0	100%	0	100%
10	But	0	100%	0	100%	0	100%
11	My	0	100%	0	100%	0	100%
12	Is	0	100%	0	100%	0	100%
13	V	3	70%	0	100%	1	90%
14	B	0	100%	0	100%	0	100%
15	I	2	80%	0	100%	0	100%
16	Police	2	80%	2	80%	1	90%
17	you	0	100%	0	100%	0	100%
18	R	0	100%	0	100%	0	100%
Succes Rate			89%		96%		97%

Succes Rate Identifiction and No. of No detection(No Det.)of the Spoken cammands

After receiving the word processor plays the important role of actuating the motors. The controlled linear displacement of the pen has achieved by the stepper motors. The synchronized working of two motors is performing the operation of writing arm on the X and Y axis. The writing arm works (writes) on the three axes. The X axis for the horizontal lines. Y axis for the vertical lines and Z axis for the diagonal projections which has achieved by combine functioning of two motors. Above vector diagram indicates the vector projections of writing arm. The maximum values on all three axes are five(i.e A=5). The writing process i.e. projections of the pen are move in according to values of 'A'. The initial position of the pen is at '0' for every character. By getting the strings value from the control unit pen moves in X,Y and Z axis respectively. For every alphabet the synchronization of all axes have such maintained to make the character readable.

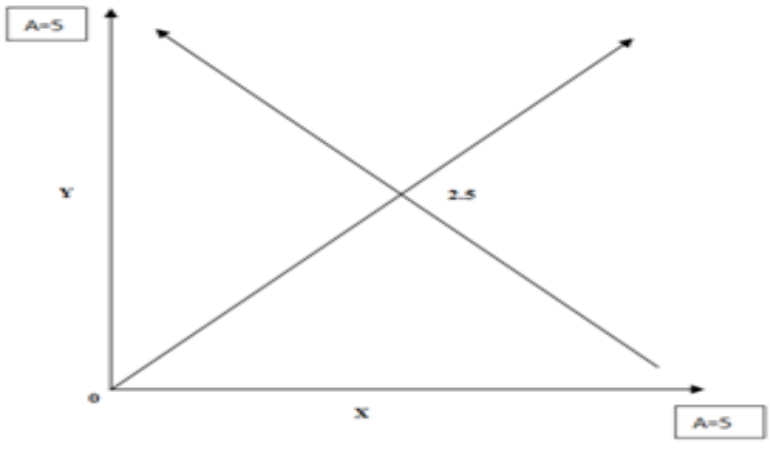

Fig.8 Direction of the Motor Movement with Amplitude

The table 5 consists of word, character position in the respective word, unique control word value obtained by the control unit, initial position of the pen, values of A taken to perform writing process according to respective axis and remark indicates the direction of movement of the pen. The above table indicates performance of the actuating assembly for random words

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TABLE V: Displacement of motors on Axis X-Y-Z

WORD:		**CHARACTER : I**	**POSITION:**	**Control word: 011244211533**
AXIS	X	Y	Z	REMARK
UTILIZATION	2	1	0	
INITIAL VALUE	X0	Y0	Z0	
DISPLACEMENT AT AMPLITUDE 'A'	X0 TO X5	Y0	0	Horizontal line (→)
	X5 TO X2.5	Y0	0	Horizontal half line (←)
	X2.5	Y0 TO Y5	0	Vertical line (↑)
	X2.5 TO X0	Y5	0	Horizontal half line (←)
	X0 TO X5	Y5	0	Horizontal line (→)
WORD:		**CHARACTER : G**	**POSITION:**	**Control word: 011224411325**
AXIS	X	Y	Z	REMARK
UTILIZATION	3	2	0	
INITIAL VALUE	X5	Y0	Z0	
DISPLACEMENT AT AMPLITUDE 'A'	X5 TO X0	Y0	0	Horizontal line (←)
	X0	Y0 TO Y5	0	Vertical line (↑)
	X0 TO X5	Y5	0	Horizontal line (→)
	X5	Y5 TO Y0	0	No line (..)
	X5	Y0 TO Y2.5	0	Vertical half line (↑)
	X5 TO X2.5	Y2.5	0	Horizontal half line (←)
WORD:		**CHARACTER : H**	**POSITION:**	**Control word: 0443114335**
AXIS	X	Y	Z	REMARK
UTILIZATION	1	2	0	
INITIAL VALUE	X0	Y0	Z0	
DISPLACEMENT AT AMPLITUDE 'A'	X0	Y0 TO Y5	0	Vertical line (↑)
	X0	Y5 TO Y2.5	0	Vertical half line (↓)
	X0 TO X5	Y2.5	0	Horizontal line (→)
	X5	Y2.5 TO Y5	0	Vertical half line (↑)
	X5	Y5 TO Y0	0	Vertical line (↓)
WORD:		**CHARACTER : T**	**POSITION:**	**Control word:** 0112445133
AXIS	X	Y	Z	REMARK
UTILIZATION	1	1	0	
INITIAL VALUE	X0	Y0	Z0	
DISPLACEMENT AT AMPLITUDE 'A'	X0 TO X2.5	Y0	0	No line (..)
	X2.5	Y0 TO Y5	0	Vertical line (↑)
	X2.5 TO X0	Y5	0	Horizontal half line (←)
	X0 TO X5	Y5	0	Horizontal line (→)

With reference to table 5 the actual results after performing the writing operation is as shown in figure 9

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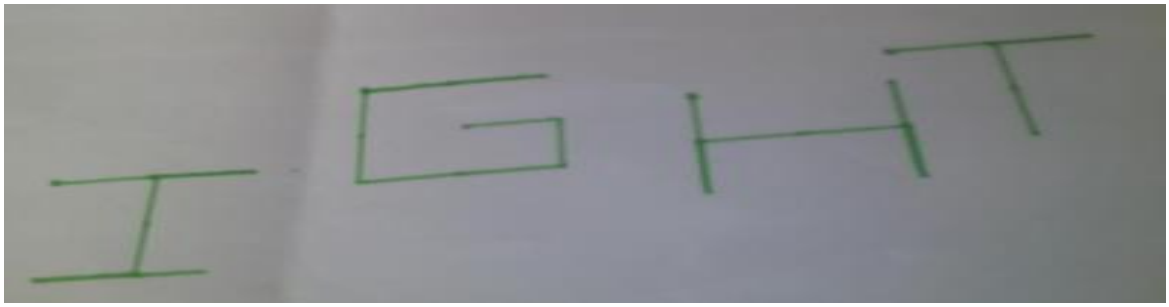

Fig. 9 Actual characters written by the writing arm

IV. CONCLUSION

The capacity of human being to express in the form of writing should not be hampered due to accidental cause. the proposed project gives 'helping ' hand for such people to come up and above the valley of darkness. The results designate the success of robotic arm. With the help of described project the handicap person can write and express the views and opinion in the written manner.

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