ME 5643

Integrated Term Project

Mechatronics

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1. Motivation

Who doesn't love watching kids grow up and play around? It's a joy to watch children learn new words. With this thought in mind we have come up with a system that helps kids learn words fun way with interactive sensors and monitors the surrounding environments.

2. Goal

To develop a teaching and monitoring system that gives feedback to children in a fun way and helps them.

3. Theory

We use potentiometer and ADC together to distinguish different alphabets in English. Based on the voltage the wiper terminal creates we determine words and point to the word. As a monitoring System we have a digital thermometer that measures the temperature of the milk bottle. The thermometer would glow "RED" if the temperature is too hot, "BLUE" if it's too cold and "GREEN" if its optimum. We also have a night lamp that would turn on when there is not enough light in the room and turn on a light lamp. The user has freedom to change the color of light.

4.CODE:

```
'
'     {$STAMP BS2}
'     {$PBASIC 2.5}
'
' ================================================================================


' -----[ Program Description ]---------------------------------------


' -----[ Revision History ]------------------------------------------


' -----[ I/O Definitions ]-------------------------------------------

TX                      PIN         5                       ' serial output to LCD

Xaxis                   PIN         6                       ' data from accelerometer

CS                      PIN         0                       'ADC Chip Select
CLK                     PIN         1                       'ADC Clock
Datain1                 PIN         2                       '1st Alphabet
Datain2                 PIN         3                       '2nd Alphabet
Datain3                 PIN         4                       '3rd Alphabet

servoPoint              PIN         15                      'Standard Servo

Correct                 PIN         7



Enable555               PIN         9                       'Reset of 555 timer


' -----[ Constants ]------------------------------------------------


baud                    CON         84                      ' baudrate for the uart protocol

scalecon                CON         13316                   ' scaling factor for accelerometer
' -----[ Variables ]------------------------------------------------
```

```
xraw                VAR         Word
Xo                  VAR         Word
ADC1                VAR         Byte
ADC2                VAR         Byte
ADC3                VAR         Byte
Alpha1              VAR         Nib
Alpha2              VAR         Nib
Alpha3              VAR         Nib

i                   VAR         Byte

nightLamp           VAR         Bit


'peizo

index               VAR         Byte
offset              VAR         Nib

noteLetter          VAR         Byte
noteFreq            VAR         Word
noteDuration        VAR         Word
noteOctave          VAR         Nib
noteDot             VAR         Bit

' -----[ EEPROM Data ]----------------------------------------------------


Notes           DATA        "E", "E", "G", "E", "E", "E", "G", "E", "G", "C", "B", "A",
                            "A", "G", "D", "E", "F", "D", "D", "D", "E", "F", "D", "F",
                            "B", "A", "G", "B", "C", "C", "C", "Q"

Octaves         DATA          7,    6,    7,    6,    6,    6,    6,    7,    6,    6,    6,    6,
                              7,    6,    6,    7,    6,    6,    6,    6,    6,    6,    7,    6,
                              6,    7,    6,    6,    6,    6,    6

Durations       DATA          2,    2,    2,    2,    2,    4,    2,    4,    2,    2,    4,    4,
                              4,    4,    4,    4,    4,    4,    4,    4,    2,    4,    4,    4,
                              4,    4,    4,    4,    4,    4,    2

Dots            DATA          0,    0,    0,    0,    0,    0,    0,    0,    1,    0,    0,    0,
                              0,    0,    0,    0,    0,    0,    0,    0,    1,    0,    0,    0,
                              0,    0,    0,    0,    0,    0,    1

' -----[ Initialization ]------------------------------------------------


setup:
   HIGH TX                                      ' setup serial output pin
```

```
PAUSE 100                                   ' allow LCD to initialize


SEROUT TX, baud, [$19, $0C]          ' cursor on, clear display

'A
SEROUT TX, baud,[$F8,$00,$11,$11,$1F,$11,$11,$0A,$04]

'B
SEROUT TX, baud,[$F9,$00,$0F,$11,$11,$0F,$11,$11,$0F]

'C
SEROUT TX, baud,[$FA,$00,$0E,$11,$01,$01,$01,$11,$0E]

'D
SEROUT TX, baud,[$FB,$00,$0F,$11,$11,$11,$11,$11,$0F]

'E
SEROUT TX, baud,[$FC,$00,$1F,$01,$01,$1F,$01,$01,$1F]

'R
SEROUT TX, baud,[$FD,$00,$11,$09,$05,$0F,$11,$11,$0F]

'T
SEROUT TX, baud,[$FE,$00,$04,$04,$04,$04,$04,$04,$1F]

LOW Enable555


' -----[ Program Code ]----------------------------------------------------
Main:

    IF(IN8 = 1) THEN
      nightLamp = nightLamp ^ 1
    ENDIF

    IF(nightLamp = 1) THEN
    HIGH    Enable555
    DO UNTIL noteLetter = "Q"
      READ Notes + index, noteLetter

      LOOKDOWN noteLetter, [   "C",   "d",   "D",   "e",   "E",
                               "F",   "g",   "G",   "a",   "A",
                               "b",   "B",   "R",   "Q"        ], offset

      LOOKUP offset,           [ 4186, 4435, 4699, 4978, 5274,
                               5588, 5920, 6272, 6645, 7040,
                               7459, 7902,      0,      0        ], noteFreq
```

```
        READ Octaves + index, noteOctave
        noteOctave = 8 - noteOctave
        noteFreq = noteFreq / (DCD noteOctave)

        READ Durations + index, noteDuration
        noteDuration = 1000 / noteDuration

        READ Dots + index, noteDot
        IF noteDot = 1 THEN noteDuration = noteDuration * 3 / 2

        FREQOUT 10, noteDuration, noteFreq

        index = index + 1
      LOOP
    ELSE
      GOSUB Play
      LOW Enable555
    ENDIF

    GOTO Main


' -----[ Subroutines ]------------------------------------------------

dispReverse:

HIGH CS
LOW CS
LOW CLK
PULSOUT CLK, 210
SHIFTIN Datain3,CLK,MSBPOST,[ADC3\8]
IF (ADC3<32) THEN
   SEROUT TX, baud,[$0]    'A
   Alpha3 = 0
ELSEIF(ADC3<64) THEN
   SEROUT TX, baud,[$1]    'B
   Alpha3 = 1
ELSEIF(ADC3<96) THEN
   SEROUT TX, baud,[$2]    'C
   Alpha3 = 2
ELSEIF(ADC3<128) THEN
   SEROUT TX, baud,[$3]    'D
   Alpha3 = 3
ELSEIF(ADC3<160) THEN
   SEROUT TX, baud,[$4]    'E
   Alpha3 = 4
ELSEIF(ADC3<192) THEN
```

```
   SEROUT TX, baud,[$4F] 'O
   Alpha3 = 5
ELSEIF(ADC3<224) THEN
   SEROUT TX, baud,[$5]   'R
   Alpha3 = 6
ELSEIF(ADC3<256) THEN
   SEROUT TX, baud,[$6]   'T
   Alpha3 = 7
ENDIF


HIGH CS
LOW CS
LOW CLK
PULSOUT CLK, 210
SHIFTIN Datain2,CLK,MSBPOST,[ADC2\8]
IF (ADC2<32) THEN
   SEROUT TX, baud,[$0]   'A
   Alpha2 = 0
ELSEIF(ADC2<64) THEN
   SEROUT TX, baud,[$1]   'B
   Alpha2 = 1
ELSEIF(ADC2<96) THEN
   SEROUT TX, baud,[$2]   'C
   Alpha2 = 2
ELSEIF(ADC2<128) THEN
   SEROUT TX, baud,[$3]   'D
   Alpha2 = 3
ELSEIF(ADC2<160) THEN
   SEROUT TX, baud,[$4]   'E
   Alpha2 = 4
ELSEIF(ADC2<192) THEN
   SEROUT TX, baud,[$4F] 'O
   Alpha2 = 5
ELSEIF(ADC2<224) THEN
   SEROUT TX, baud,[$5]   'R
   Alpha2 = 6
ELSEIF(ADC2<256) THEN
   SEROUT TX, baud,[$6]   'T
   Alpha2 = 7
ENDIF

HIGH CS
LOW CS
LOW CLK
PULSOUT CLK, 210
SHIFTIN Datain1,CLK,MSBPOST,[ADC1\8]
IF (ADC1<32) THEN
```

```
   SEROUT TX, baud,[$0]    'A
   Alpha1 = 0
ELSEIF(ADC1<64) THEN
   SEROUT TX, baud,[$1]    'B
   Alpha1 = 1
ELSEIF(ADC1<96) THEN
   SEROUT TX, baud,[$2]    'C
   Alpha1 = 2
ELSEIF(ADC1<128) THEN
   SEROUT TX, baud,[$3]    'D
   Alpha1 = 3
ELSEIF(ADC1<160) THEN
   SEROUT TX, baud,[$4]    'E
   Alpha1 = 4
ELSEIF(ADC1<192) THEN
   SEROUT TX, baud,[$4F] 'O
   Alpha1 = 5
ELSEIF(ADC1<224) THEN
   SEROUT TX, baud,[$5]    'R
   Alpha1 = 6
ELSEIF(ADC1<256) THEN
   SEROUT TX, baud,[$6]    'T
   Alpha1 = 7
ENDIF

RETURN



dispStraight:

HIGH CS
LOW CS
LOW CLK
PULSOUT CLK, 210
SHIFTIN Datain1,CLK,MSBPOST,[ADC1\8]
IF (ADC1<32) THEN
   SEROUT TX, baud,[$41]    'A
   Alpha1 = 0
ELSEIF(ADC1<64) THEN
   SEROUT TX, baud,[$42]    'B
   Alpha1 = 1
ELSEIF(ADC1<96) THEN
   SEROUT TX, baud,[$43]    'C
   Alpha1 = 2
ELSEIF(ADC1<128) THEN
   SEROUT TX, baud,[$44]    'D
   Alpha1 = 3
```

```
ELSEIF(ADC1<160) THEN
   SEROUT TX, baud,[$45]    'E
   Alpha1 = 4
ELSEIF(ADC1<192) THEN
   SEROUT TX, baud,[$4F]    'O
   Alpha1 = 5
ELSEIF(ADC1<224) THEN
   SEROUT TX, baud,[$52]    'R
   Alpha1 = 6
ELSEIF(ADC1<256) THEN
   SEROUT TX, baud,[$54]    'T
   Alpha1 = 7
ENDIF


HIGH CS
LOW CS
LOW CLK
PULSOUT CLK, 210
SHIFTIN Datain2,CLK,MSBPOST,[ADC2\8]
IF (ADC2<32) THEN
   SEROUT TX, baud,[$41]    'A
   Alpha2 = 0
ELSEIF(ADC2<64) THEN
   SEROUT TX, baud,[$42]    'B
   Alpha2 = 1
ELSEIF(ADC2<96) THEN
   SEROUT TX, baud,[$43]    'C
   Alpha2 = 2
ELSEIF(ADC2<128) THEN
   SEROUT TX, baud,[$44]    'D
   Alpha2 = 3
ELSEIF(ADC2<160) THEN
   SEROUT TX, baud,[$45]    'E
   Alpha2 = 4
ELSEIF(ADC2<192) THEN
   SEROUT TX, baud,[$4F]    'O
   Alpha2 = 5
ELSEIF(ADC2<224) THEN
   SEROUT TX, baud,[$52]    'R
   Alpha2 = 6
ELSEIF(ADC2<256) THEN
   SEROUT TX, baud,[$54]    'T
   Alpha2 = 7
ENDIF

HIGH CS
LOW CS
```

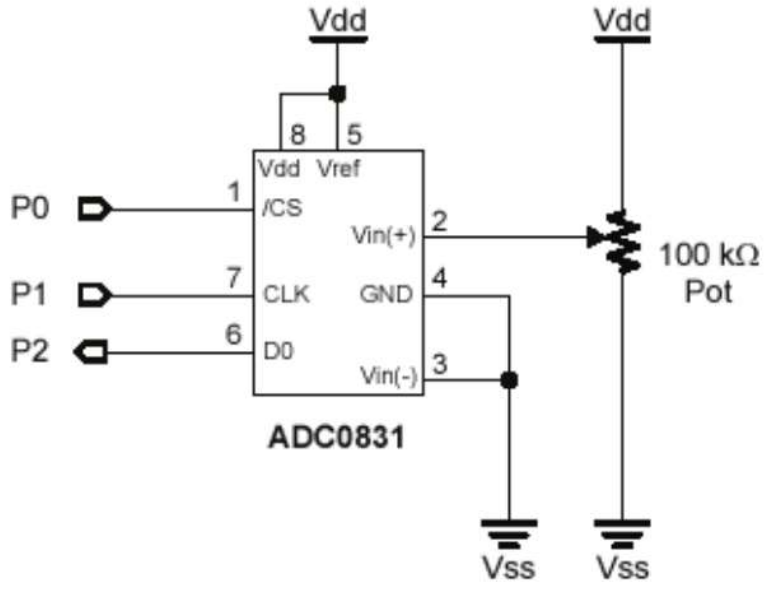
```
LOW CLK
PULSOUT CLK, 210
SHIFTIN Datain3,CLK,MSBPOST,[ADC3\8]
IF (ADC3<32) THEN
   SEROUT TX, baud,[$41]    'A
   Alpha3 = 0
ELSEIF(ADC3<64) THEN
   SEROUT TX, baud,[$42]    'B
   Alpha3 = 1
ELSEIF(ADC3<96) THEN
   SEROUT TX, baud,[$43]    'C
   Alpha3 = 2
ELSEIF(ADC3<128) THEN
   SEROUT TX, baud,[$44]    'D
   Alpha3 = 3
ELSEIF(ADC3<160) THEN
   SEROUT TX, baud,[$45]    'E
   Alpha3 = 4
ELSEIF(ADC3<192) THEN
   SEROUT TX, baud,[$4F]    'O
   Alpha3 = 5
ELSEIF(ADC3<224) THEN
   SEROUT TX, baud,[$52]    'R
   Alpha3 = 6
ELSEIF(ADC3<256) THEN
   SEROUT TX, baud,[$54]    'T
   Alpha3 = 7
ENDIF

RETURN


gotoCOD:
   FOR i = 1 TO 100
      PULSOUT servoPoint, 180
      PAUSE 20
   NEXT
   RETURN

gotoCAT:
   FOR i = 1 TO 100
      PULSOUT servoPoint, 360
      PAUSE 20
   NEXT
   RETURN

gotoBAT:
   FOR i = 1 TO 100
```

```
        PULSOUT servoPoint, 540
        PAUSE 20
    NEXT
    RETURN

gotoDOE:
    FOR i = 1 TO 100
        PULSOUT servoPoint, 720
        PAUSE 20
    NEXT
    RETURN


gotoRAT:
    FOR i = 1 TO 100
        PULSOUT servoPoint, 900
        PAUSE 20
    NEXT
    RETURN


gotoBEE:
    FOR i = 1 TO 100
        PULSOUT servoPoint, 1080
        PAUSE 20
    NEXT
    RETURN


compareWord:
'COD
IF((Alpha1=2) AND (Alpha2=5) AND (Alpha3=3) )THEN
    GOSUB gotoCOD
    HIGH Correct

'CAT
ELSEIF((Alpha1=2) AND (Alpha2=0) AND (Alpha3=7)) THEN
    GOSUB gotoCAT
    HIGH Correct

'BAT
ELSEIF((Alpha1=1) AND (Alpha2=0) AND (Alpha3=7)) THEN
    GOSUB gotoBAT
    HIGH Correct

'DOE
ELSEIF((Alpha1=3) AND (Alpha2=5) AND (Alpha3=4)) THEN
    GOSUB gotoDOE
```

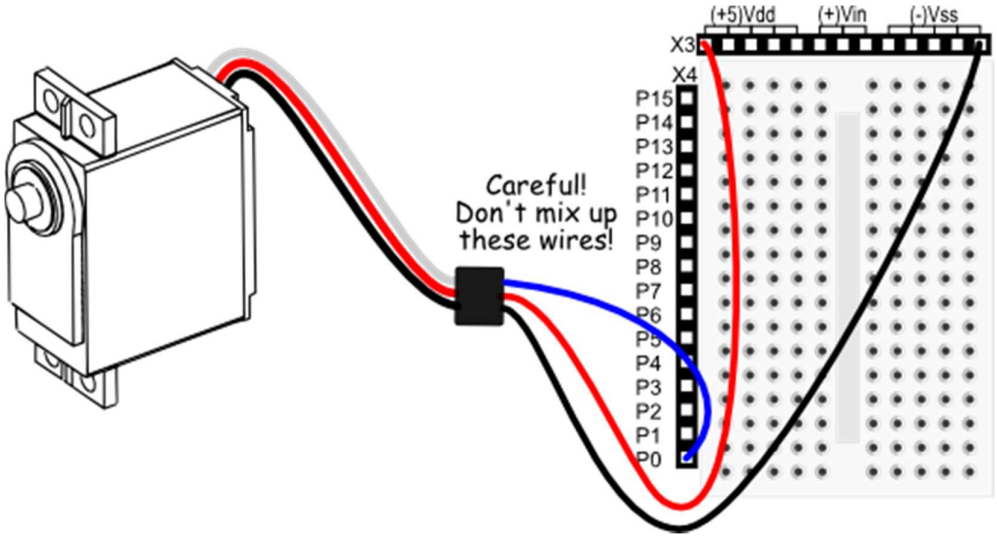
```
   HIGH Correct

'RAT
ELSEIF((Alpha1=6) AND (Alpha2=0) AND (Alpha3=7)) THEN
   GOSUB gotoRAT
   HIGH Correct

'BEE
ELSEIF((Alpha1=1) AND (Alpha2=4) AND (Alpha3=4)) THEN
   GOSUB gotoBEE
   HIGH Correct

'NONE
ELSE
   LOW Correct

ENDIF

RETURN


Play:



   ' your code here
   PULSIN Xaxis, 1, xraw
   Xo=xraw**scalecon-508
   DEBUG HOME, SDEC Xo , CR, SDEC xraw

   IF (Xo.HIGHBIT = 1) THEN
      SEROUT TX, baud,[$0C,$9A]
      'SEROUT TX, baud,[$6,$0,$2,$1,$3,$4,$5]
      GOSUB dispReverse
   ELSE
      SEROUT TX, baud,[$0C,$87]
      GOSUB dispStraight
      'SEROUT TX, baud,[$43,$41,$54,$52]
   ENDIF

   GOSUB compareWord

RETURN
```

5. Electronic Circuits

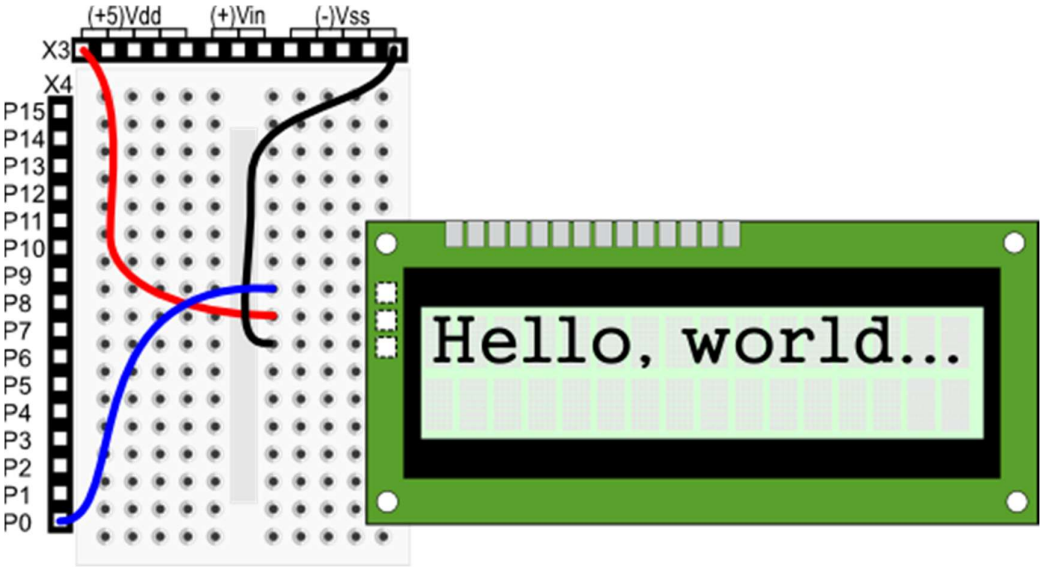
ADC:



Servo Motor:



LCD:



6. Bill-of-material

Component	Cost/Piece in USD	Quantity	Cost
Basic Stamp 2	99.95	1	99.95
Potentiometer	0.3	3	0.9
ADC	1.3	3	3.9
Standard servo	15	1	15
Bicolor LED	1.5	1	1.5
555timer	0.5	1	0.5
LCD display	5	1	5
Accelerometer	3	1	3
Resistor pack	10	1	10
Wire spool	5	3	15
Battery	1.2	1	1.2
Total cost	$142.75		$155.95

7. Improvements

Using all the alphabets, in the English Language.
Increasing the number of words that can be learnt.
Making the system more robust.
Coding can be optimized for better efficiency.
Use of EEPROM to save memory.
Displaying pictures on the LCD.

8. Future Development

ABC: Automatic Barrier Constructor

```
' {$STAMP BS2}
' {$PBASIC 2.5}

IR_detect1  VAR  Bit
servo  PIN 14
GATE VAR Bit
prevGATE VAR Bit

LOW 7

LOOP1:
  prevGATE = GATE
  'PAUSE 50
  FREQOUT 7, 1, 38500
  IR_detect = IN8
  IF IR_detect = 0 THEN
    GATE = GATE ^ 1
  END

  IF (GATE = 1  AND prevGATE = 0) THEN
    FOR i = 1 TO 1000
      PULSOUT servo, 600
    NEXT
    PAUSE 5000
  ELSEIF (GATE = 1  AND prevGATE = 0) THEN
    FOR i = 1 TO 1000
      PULSOUT servo, 900
    NEXT
    PAUSE 5000
  ENDIF
GOTO LOOP1
```