Willkommen zu dem zweiten Teil der Bluetooth Display Reihe. Wer das Display des ersten Teils schon fertig aufgebaut hat, wird festgestellt haben, dass man zwar sehr bequem texte eingeben kann, jedoch leider nur immer ein Text eigegeben werden kann und zudem auch noch dieser Text immer wieder neu eingeben werden muss, falls das Display vom Strom getrennt wird. Dies ist auf Dauer mühselig: Wie im ersten Teil schon angekündigt, werden wir im heutigen Teil die Möglichkeit vorsehen, feste Texte im internen EEPROM abzulegen und diese bei Bedarf wieder abzurufen. Wir erweitern dazu unser serielles Menü um folgende Menüpunkte:

- S - Read ALL EEPROM Banks
- E - Erase ALL EEPROM Banks
- W - Write sel. EEPROM Bank
- R - Read sel. EEPROM Bank
- P - Print EEPROM Bank on Display

Wir laden dazu auf unseren Arduino UNO folgenden Code hoch:

```
#include <SPI.h>
#include <Wire.h>
#include <SoftwareSerial.h>
#include <EEPROM.h>
#include <LiquidCrystal.h>
#include <avr/sleep.h>


#define MaxInputBufferSize 20 // maximal 255 Zeichen anpassen an vlcdr
#define EEpromSize 990

#define rLcdChr 20
#define LcdRows 4
#define interval 1000
```

```
// EEprom SpeicherzellenAdressen für Konfiguration
#define EEFadeSeconds  993
#define EEPINA 996
#define EEPINC 997
#define EEPINDD 998

SoftwareSerial mySerial(7, 6); // RX, TX

//LiquidCrystal(rs, enable, d4, d5, d6, d7)
LiquidCrystal lcd(8, 13, 12, 11, 10, 9);

//variables
byte DisplayBankContent = 0;

//Serial Input Handling
char TBuffer;
char Cbuffer[MaxInputBufferSize+1];      //USB Code Input Buffer
String Sbuffer = "";                  //USB String Input Buffer
int value;                          //USB Nummeric Input Buffer
byte Ccount = 0;                      //Number received Chars
byte Inptype = 0;
boolean StrInput = false;
boolean NumberInput = false;
boolean DataInput = false;
boolean EnterInput = false;
byte MenueSelection = 0;

byte SelectedMsg = 0;

//Give Debug Informations over serial Interface
boolean DebugMode = false;
boolean EchoMode = true;

//EEPROM
int eeaddress;              //EEPROM Adress Pointer
byte EEPromBanks = 0;         //Used for Calculating the EEPROM Banks
//SerMnueControl
byte MnuState = 0;          // Maximale Menuetiefe 255 icl Sub
byte Selectedbank =0;

//Real Time Clock
long previousMillis = 0;      // will store last time was measured
long previousMillisB = 0;      // will store last time was measured

//Display Management
boolean DisplayLock = false;
boolean Directprint = false;
byte DirectprintROW = 0;
byte DirectprintLine = 0;
boolean RefreshDisplay = false;
byte FRMCheck = 0; // Used fpr Writing Operations to eeprom so save Wirte cycles

void setup()
```

```
{
 EEPromBanks = EEpromSize / ((rLcdChr) * LcdRows);
 lcd.begin(rLcdChr, LcdRows);
 lcd.clear();
 lcd.setCursor(0, 0);
 lcd.print("    Bluetooth   ");
 lcd.setCursor(0, 1);
 lcd.print("     Display    ");
 mySerial.begin(9600);
 lcd.setCursor(0, 0);
 mySerial.flush();
}



//
################################################################################
###################### //

void loop()

{

SerialcommandProcessor();
Displayprocessor();

}

//
################################################################################
###################### //


void TextHeader(byte rowm)
{
  mySerial.println("Text for Bank " + String( Selectedbank) + " ROW " + String (rowm) + ":");
 }

void SerialcommandProcessor()
{
int a;
Inptype = 0;
Inptype = SerInputHandler();
// 0 keine R�ckgabe
// 1 Nummer
// 2 String
// 3 Data

if ((Inptype > 0) & (!Directprint))
  {
  MenueSelection = 0;
  if ((MnuState < 2) && (Inptype == 2)) {Sbuffer.toUpperCase(); } // For Easy Entering Commands
  if ((Sbuffer == "S") && (MnuState == 0) && (Inptype == 2))      { MenueSelection = 3;}
```

```
// Erasing ALL EEprom Content
if ((Sbuffer == "E") && (MnuState == 0) && (Inptype == 2))      { MenueSelection = 4;}
if ((Sbuffer == "YES") && (MnuState == 1)&& (Inptype == 2))     { MenueSelection = 5;}
if ((Sbuffer != "YES") && (MnuState == 1) && (Inptype == 2))    { MenueSelection = 6;}
//Edit  Selected Content
if ((Sbuffer == "W") && (MnuState == 0) && (Inptype == 2))      { MenueSelection = 7;}
if ((MnuState == 2) && (value  < EEPromBanks) && (Inptype == 1)) { MenueSelection = 8;}
if (MnuState == 3)                                  { MenueSelection = 9;}
if (MnuState == 4)                                  { MenueSelection = 10;}
//Display  Selected Content
if ((Sbuffer == "P") && (MnuState == 0) && (Inptype == 2))      { MenueSelection = 11;}
if ((MnuState == 5) && (Inptype == 1))                      { MenueSelection = 12;}
if ((MnuState == 6) && (Inptype == 1))                      { MenueSelection = 14;}
if ((Sbuffer == "D") && (MnuState == 0) && (Inptype == 2))      { MenueSelection = 15;}
if ((Sbuffer == "Z") && (MnuState == 0) && (Inptype == 2))      { MenueSelection = 16;}
if (MnuState == 9)                                  { MenueSelection = 20;}
if (MnuState == 10)                                  { MenueSelection = 21;}
switch (MenueSelection)
 {
   case 1:
   {
    break;
   }
   case 2:
   {
     break;
   }
   case 3:
   {
    mySerial.println("Read EEEPROM Content:" );
    mySerial.flush();
    for (int a = 0; a < EEPromBanks; a++)
     {
       mySerial.println("EEPROM Memory Bank: " + String(a) );
       mySerial.flush();
       for (int b = 1; b <= LcdRows;b++)
         {
           mySerial.print("Row " + String(b) +": ");
           mySerial.flush();
           for (int c = 0; c <rLcdChr; c++)
              {
                eeaddress = 0;
                eeaddress = (a * (rLcdChr)* LcdRows) + ((rLcdChr) * b) + c;
                value = EEPROM.read(eeaddress);
                mySerial.print(char(value));
                mySerial.flush();
              }
           mySerial.println(" ");
           mySerial.flush();
         }
     }
    Sbuffer = "";
    mySerial.println("No more EEPROM Banks available.");
```

```
  mySerial.flush();
  break;
 }
 case 4:
 {
  value = 0;
  mySerial.print("Erasing EEPROM ");
  mySerial.println("YES/NO:");
  mySerial.flush();
  MnuState = 1;
  Sbuffer = "";
  break;
 }
 case 5:
 {
  value = 0;
 mySerial.print("Erasing EEPROM ");
  mySerial.println("Stand by.");
  mySerial.flush();
  for (int a = 0; a < EEPromBanks; a++)
   {
    //Memory Bank a
    mySerial.println("Clear Bank: " + String(a));
    for (int b = 1; b <= LcdRows;b++)
     {
      for (int c = 0; c <rLcdChr; c++)
        {
          eeaddress = 0;
          eeaddress = (a * (rLcdChr)* LcdRows) + ((rLcdChr ) * b) + c;
          FRMCheck = EEPROM.read(eeaddress);
          if (FRMCheck > 0)
          {
          EEPROM.write(eeaddress,00); // Formatierung
          mySerial.print(".");
          value++;
          delay(30);
          mySerial.flush();
          }
        }
     }
    mySerial.println("");
    mySerial.flush();
   }
  mySerial.println("");
  mySerial.println("Finished. "+ String(value) + " Bytes cleared");
  mySerial.println("");
  mySerial.flush();
  Sbuffer = "";
  MnuState = 0;
  break;
 }
 case 6:
 {
```

```
 value = 0;
 Sbuffer = "";
 MnuState = 0;
 mySerial.println("OP abort.");
 mySerial.flush();
 break;
}
case 7:
{
mySerial.println("EEPPROM Bank Number (0-" + String(EEPromBanks-1) + "):");
mySerial.flush();
MnuState = 2;
value = 0;
Sbuffer = "";
break;
}
case 8:
{
Selectedbank = value;
TextHeader(1);

MnuState = 3;
Sbuffer = "";
value = 0;
break;
}
case 9:
{
WriteEEPROM(Selectedbank,1);
TextHeader(2);
value = 0;
MnuState = 4;
Sbuffer = "";
break;
}
case 10:
{
WriteEEPROM(Selectedbank,2);
value = 0;
MnuState = 0;
Sbuffer = "";
TextHeader(3);
mySerial.flush();
value = 0;
MnuState = 9;
Sbuffer = "";
break;
}
case 11:
{
value = 0;
mySerial.println("EEPPROM Bank Number (0-" + String(EEPromBanks-1) + "):");
MnuState = 5;
```

```
Sbuffer = "";
mySerial.flush();
break;
}
case 12:
{
SelectedMsg = value;
DisplayBank(value);
break;
}
case 13:
{
value = 0;
mySerial.println("EEPPROM Bank Number (0-" + String(EEPromBanks-1) + "):");
MnuState = 6;
Sbuffer = "";
mySerial.flush();
break;
}
case 14:
{
 a = value;
 if ( a < EEPromBanks)
 {
 mySerial.println("Memory Bank: " + String(a) );
 mySerial.flush();
 for (int b = 1; b <= LcdRows;b++)
  {
    mySerial.print("Row " + String(b) +": ");
    mySerial.flush();
    for (int c = 0; c <rLcdChr; c++)
     {
       eeaddress = 0;
       eeaddress = (a * (rLcdChr)* LcdRows) + ((rLcdChr) * b) + c;
       value = EEPROM.read(eeaddress);
       mySerial.print(char(value));
       mySerial.flush();
     }
    mySerial.println(" ");
    mySerial.flush();
  }
 } else
  {
   mySerial.println("Value out of Range.");
   }

 value = 0;
 Sbuffer = "";
 MnuState = 0;
 break;
}
case 15:
{
```

```
// Direct pPrint to Display
Directprint = true;
mySerial.println ("Directprint ON.");
if (Directprint)
{
DirectprintROW = 0;
DirectprintLine = 0;
lcd.clear();
lcd.cursor();
lcd.blink();
}
value = 0;
Sbuffer = "";
MnuState = 0;
break;
}
case 16:
{
value = 0;
Sbuffer = "";
MnuState = 0;
break;
}
case 20:
{
WriteEEPROM(Selectedbank,3);
value = 0;
MnuState = 0;
Sbuffer = "";
TextHeader(4);
mySerial.flush();
value = 0;
MnuState = 10;
Sbuffer = "";
break;
}
case 21:
{
WriteEEPROM(Selectedbank,4);
value = 0;
MnuState = 0;
Sbuffer = "";
break;
}
default:
{
  mySerial.println("-------Smart Bluetooth Display 1.0------");
  mySerial.println("S - Read ALL EEPROM Banks");
  mySerial.println("E - Erase ALL EEPROM Banks");
  mySerial.println("W - Write sel. EEPROM Bank");
  mySerial.println("R - Read sel. EEPROM Bank");
  mySerial.println("P - Print EEPROM Bank on Display");
  mySerial.println("----------------------------------------");
```

```
        mySerial.println("D - Direct Print");
        mySerial.println("----------------------------------------");
        mySerial.println("Type Cmd and press Enter");
        mySerial.flush();
        MnuState = 0;
        value = 0;
        Sbuffer = "";
       }
    }
   } // Eingabe erkannt
}

void WriteEEPROM(byte FBank,byte FRow)
{
byte Writecounter;

Writecounter = 0;
 mySerial.print("Saving ");
      for (int c = 0; c <rLcdChr; c++)
        {
         eeaddress = 0;
         eeaddress = (FBank * (rLcdChr)* LcdRows) + ((rLcdChr) * FRow) + c;

         value = EEPROM.read(eeaddress);
         if (Sbuffer[c] != value)
         {
         EEPROM.write(eeaddress,Sbuffer[c]);
         mySerial.print(".");
         Writecounter++;
         }
        }
      mySerial.println(" " + String (Writecounter) + " Bytes written.");

}


void ClearCBuffer ()

{
 for (byte a= 0; MaxInputBufferSize -1;a++)
  Cbuffer[a] = 0;
  }


byte SerInputHandler()

{
byte result = 0;
int c;
int d;
int a;
int b;
result = 0;
```

```
if (CheckforserialEvent())
   {
    if ((NumberInput) and not (DataInput)and not (StrInput))     //Numbers only
      {
      Sbuffer = "";
      value = 0;
      StrInput = false;
      NumberInput = false;
      DataInput = false;
      EnterInput = false;
      a = 0;
      b = 0;
      c = 0;
      d = 0;
      Sbuffer = Cbuffer; // Zahl wird AUCH ! in SBUFFER übernommen, falls benötigt.
      if (Ccount == 1) { value  = Cbuffer[0]- 48 ; }
      if (Ccount == 2) {
        a = Cbuffer[0] - 48 ;
        a = a * 10;
        b = Cbuffer[1] - 48 ;
        value = a + b;
        }
      if (Ccount == 3) {
        a = Cbuffer[0] - 48 ;
        a = a * 100;
        b = Cbuffer[1] - 48 ;
        b = b * 10;
        c = Cbuffer[2] - 48 ;
        value = a + b + c;
        }
      if (Ccount == 4) {
        a = Cbuffer[0] - 48 ;
        a = a * 1000;
        b = Cbuffer[1] - 48 ;
        b = b * 100;
        c = Cbuffer[2] - 48 ;
        c = c * 10;
        d = Cbuffer[3] - 48 ;
        value = a + b + c + d;
        }
      if (Ccount >= 5)
        {
         Sbuffer = "";
         value = 0;
         Sbuffer = Cbuffer;
         ClearCBuffer;
         result = 2;
        } else
        {
         ClearCBuffer;
         Ccount = 0;
         result = 1;                                  //Number Returncode
         NumberInput = false;
```

```
        StrInput = false;
        DataInput = false;
        EnterInput = false;
        Ccount = 0;
        return result;
        }
     }
    if ((StrInput) and not (DataInput))                    //String Input only
     {
      Sbuffer = "";
      Sbuffer = Cbuffer;
     value = 0;
     StrInput = false;
     NumberInput = false;
     DataInput = false;
     EnterInput = false;
     Ccount = 0;
     ClearCBuffer;
     result = 2;                                  //Number Returncode
     }
    if (DataInput) {
     Sbuffer = "";
     Sbuffer = Cbuffer;
     value = 0;
     StrInput = false;
     NumberInput = false;
     DataInput = false;
     EnterInput = false;
     Ccount = 0;
     ClearCBuffer;
     result = 3;                                  //Number Returncode
     }
     if ((EnterInput) and not (StrInput) and not (NumberInput) and not (DataInput))
     {
     Sbuffer = "";
     value = 0;
     Ccount = 0;
     ClearCBuffer;
     result = 4;                                  //Number Returncode
     }

  NumberInput = false;
  StrInput = false;
  DataInput = false;
  EnterInput = false;
  Ccount = 0;
  return result;

 }
return result;
  //End CheckforSerialEvent
}
```

```
// Eingabebuffer


boolean CheckforserialEvent()
{
  while (mySerial.available()) {
    // get the new byte:
    TBuffer = mySerial.read();
    if (TBuffer > 9 && TBuffer < 14)
      {
       Cbuffer[Ccount] = 0;
       TBuffer =0;
       if (EchoMode)
        {
         mySerial.print(char(13));
         mySerial.flush();
        }
        if (Directprint)
         {
         mySerial.println("");
         DirectprintLine = 0;
         DirectprintROW = DirectprintROW + 1;
         if ( DirectprintROW > 3)
         {
                Directprint = false;
                lcd.noCursor();
                lcd.noBlink();
                Sbuffer = "";
                value = 0;

          } else
         {
         lcd.cursor();
         lcd.blink();
         lcd.setCursor(0,DirectprintROW);
         }
         }
       EnterInput = true;
       return true;
    } else if (TBuffer > 47 && TBuffer <58 )
     {
      if ( Ccount < MaxInputBufferSize)
        {
          Cbuffer[Ccount] = TBuffer;
          Ccount++;
          if ((Directprint))
            {
              lcd.print(char(TBuffer));
              DirectprintLine = DirectprintLine + 1;
              if ( Ccount > MaxInputBufferSize -1)
              {
```

```
            lcd.noCursor();
            lcd.noBlink();
            } else {
            lcd.cursor();
            lcd.blink();
            }
         }
       if (EchoMode) {
       mySerial.print(char(TBuffer));
       mySerial.flush();
       }
     } else {mySerial.print("#"); }
  //Number Input detected
  NumberInput = true;
  }
  else if (TBuffer > 64 && TBuffer < 123 )
  {
   if ( Ccount < MaxInputBufferSize)
     {
       Cbuffer[Ccount] = TBuffer;
       Ccount++;
       if ((Directprint))
        {
          lcd.print(char(TBuffer));
          DirectprintLine = DirectprintLine + 1;
          if ( Ccount > MaxInputBufferSize -1)
          {
            lcd.noCursor();
            lcd.noBlink();
            } else {
            lcd.cursor();
            lcd.blink();
            }
         }
       if (EchoMode) {
       mySerial.print(char(TBuffer));
       mySerial.flush();
       }
     } else {mySerial.print("#"); }
  //Character Char Input detected
  StrInput = true;
 }
else if ( (TBuffer == 127 )  |  (TBuffer == 8 ) )
    {
          if ( DirectprintLine > 0 )
          {
          DirectprintLine = DirectprintLine - 1;
          lcd.setCursor(DirectprintLine, DirectprintROW);
          lcd.print(" ");
          lcd.setCursor(DirectprintLine, DirectprintROW);
          }
          if (( DirectprintLine == 0 ) & ( DirectprintROW > 0 ))
          {
```

```
            DirectprintROW = DirectprintROW - 1;
            DirectprintLine = rLcdChr -1;
            lcd.setCursor(DirectprintLine, DirectprintROW);
            }
     if ( Ccount > 0)
      {
        Ccount--;
        Cbuffer[Ccount] = 0;
        if ((Directprint))
         {
           if ( Ccount > MaxInputBufferSize -1)
           {
             lcd.noCursor();
             lcd.noBlink();
             } else {
             lcd.cursor();
             lcd.blink();
             }
         }
        if (EchoMode) {
        mySerial.print("-");
        mySerial.flush();
        }
      }
  }
else
  {

    if ( Ccount < MaxInputBufferSize)
     {
       Cbuffer[Ccount] = TBuffer;
       Ccount++;
        if ((Directprint))
         {
           DirectprintLine = DirectprintLine + 1;
           if (TBuffer < 128) {lcd.print(char(TBuffer)); } else  {lcd.print(String(TBuffer)); }
           if ( Ccount > MaxInputBufferSize -1)
           {
             lcd.noCursor();
             lcd.noBlink();
             } else {
             lcd.cursor();
             lcd.blink();
             }
         }
        if (EchoMode) {
        mySerial.print(char(TBuffer));
        mySerial.flush();
        }
     } else {mySerial.print("#"); }
  //Data Input detected
  DataInput = true;
  }
```

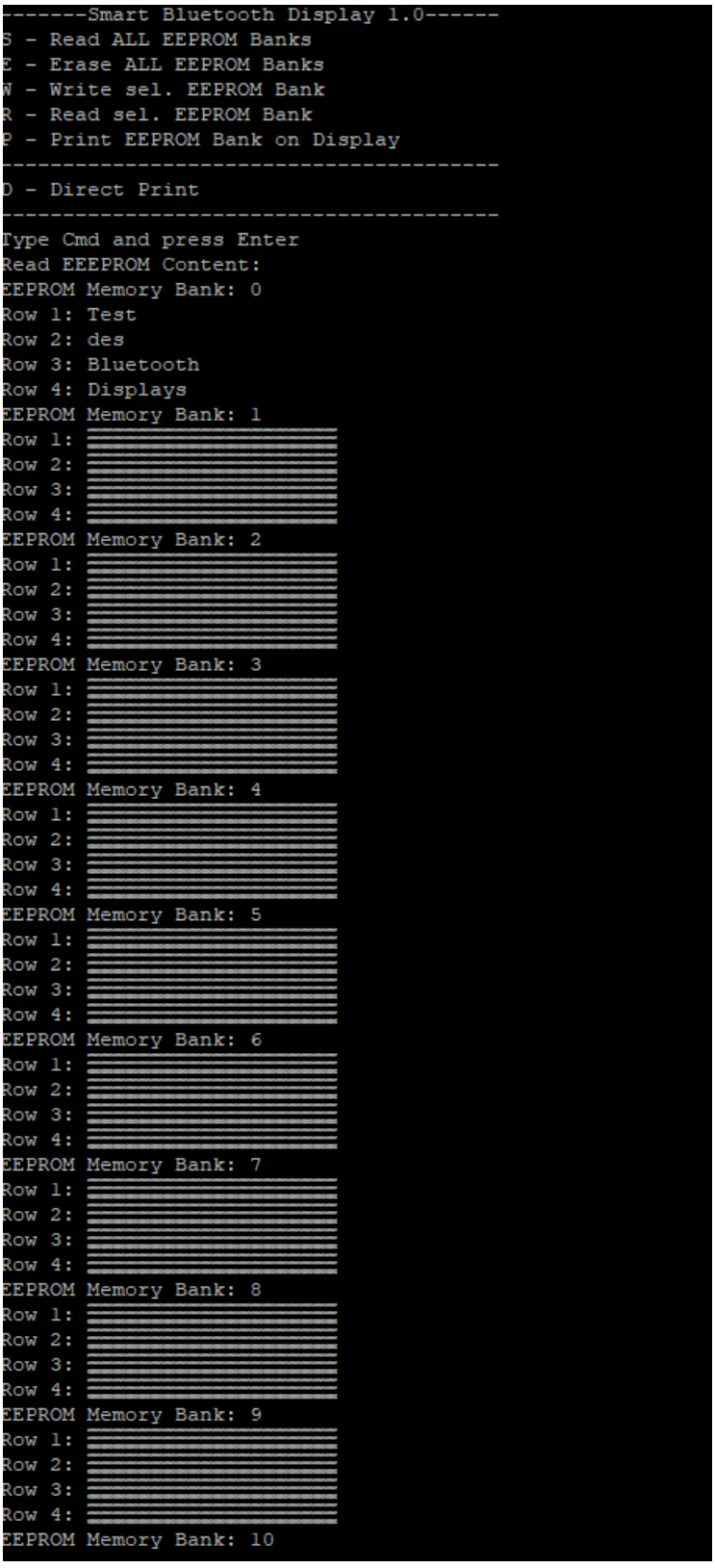
```
    return false;
    }
  return false;
  }

void Displayprocessor()  // Bei Blauem Display wird auf Scrollfunktion verzichtet, da das nur
"schmiert"
{
if (RefreshDisplay)
 {
   lcd.clear();
   RefreshDisplay = false;
     for (int b = 1; b <= LcdRows;b++)
           {
             lcd.setCursor(0, b -1);
             mySerial.print("Row " + String(b) +": ");
             for (int c = 0; c <rLcdChr; c++)
                {
                  eeaddress = 0;
                  eeaddress = (DisplayBankContent * (rLcdChr)* LcdRows) + ((rLcdChr) * b) + c;
                  value = 0;
                  value = EEPROM.read(eeaddress);
                  if (value > 31) // Sonderzeichen nicht anzeigen
                  {
                  delay(100);
                   lcd.print(char(value));
                   } else
                 { lcd.print(char(32)); }
                }

           }
  }
}



void DisplayBank ( byte cobank)
 {
     if (cobank  < EEPromBanks )
     {
     RefreshDisplay = true;   // Initalize Display Output
     DisplayBankContent = cobank;
     mySerial.println("Bank " + String(cobank) + " is displayed on LCD");
     MnuState = 0;
     Sbuffer = "";
     value =0;
     mySerial.flush();
     } else
          {
            mySerial.println("Bank not available.");
            value = 0;
            MnuState = 0;
            Sbuffer = "";
```

```
            mySerial.flush();
          }
}
```

Nachfolgend werden die durch die Menüerweiterung entstandenen neuen Befehle erklärt.

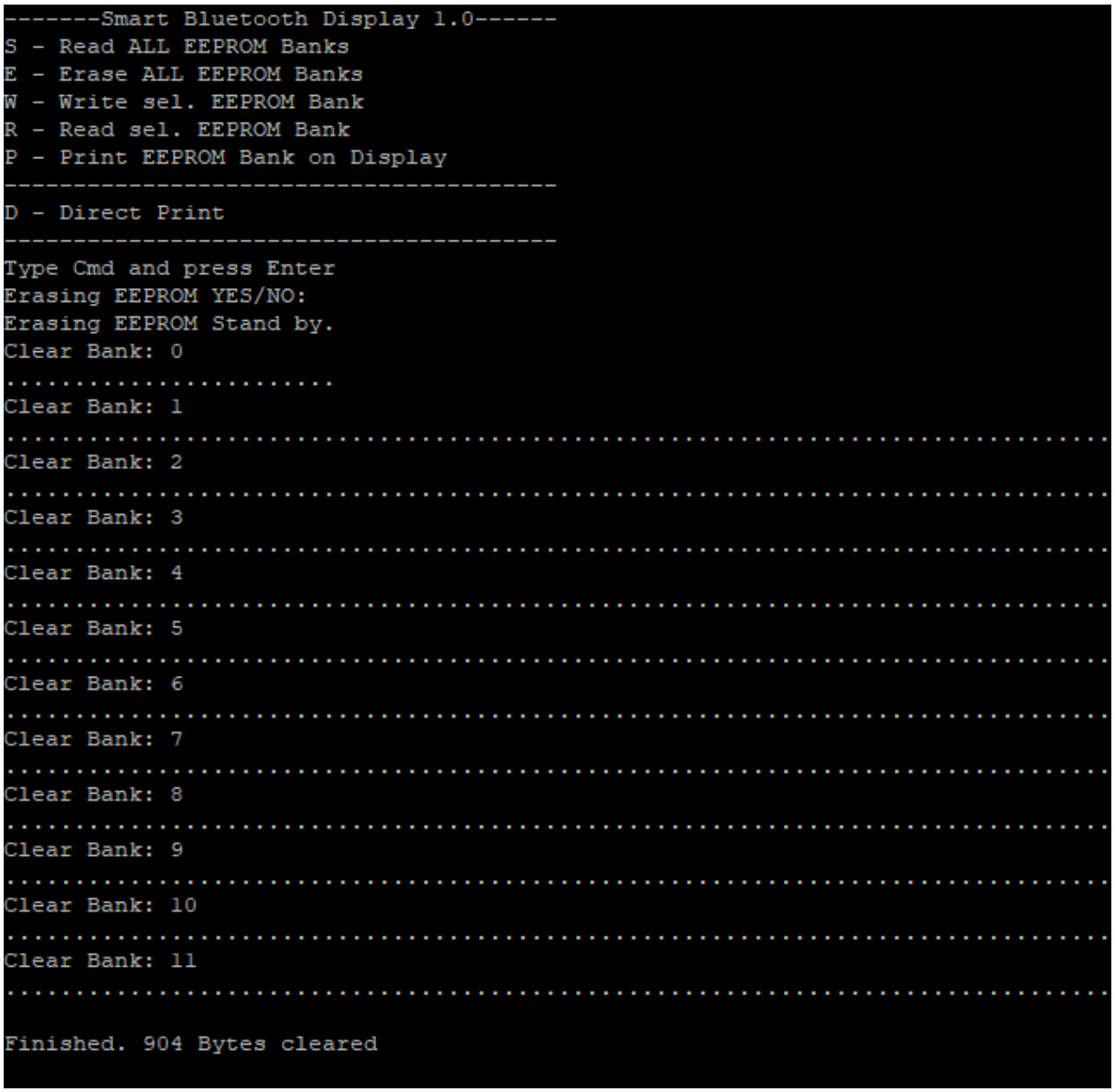
- S - Read ALL EEPROM Banks

Durch Eingabe von „S“ und Enter werden alle verfügbaren Speicherplätze und deren Inhalt anzeigezeigt.Bei einem 4x20 Zeichen Display und der Standardkonfuguration sind das 11 Speicherplätze. In folgendem Screenshot ist Bank 1 belegt:



- E - Erase ALL EEPROM Banks

Über den Menüpunkt „E“ kann uns sollte beim erstmaligen Gebrauch des Displays der interne EEPROM „formatiert“ werden als auch später im Gebrauch ALLE Speicherbänke gelöscht werden. Ein „Formatierungsvorgang“ sieht auf der Menüoberfläche dann so aus:



- W - Write sel. EEPROM Bank

Wenn ein bestimmter Text einer bestimmten Speicherbank zugeordnet werden soll, kann dieser über den Menüpunkt „M“ in dieser gespeichert werden. Nach Auswahl der gewünschten Speicherbank werden alle Display-Reihen abgefragt.

```
------Smart Bluetooth Display 1.0------
S - Read ALL EEPROM Banks
E - Erase ALL EEPROM Banks
W - Write sel. EEPROM Bank
R - Read sel. EEPROM Bank
P - Print EEPROM Bank on Display
----------------------------------------
D - Direct Print
----------------------------------------
Type Cmd and press Enter
EEPPROM Bank Number (0-11):
Memory Bank: 0
Row 1: Test
Row 2: des
Row 3: Bluetooth
Row 4: Displays
```

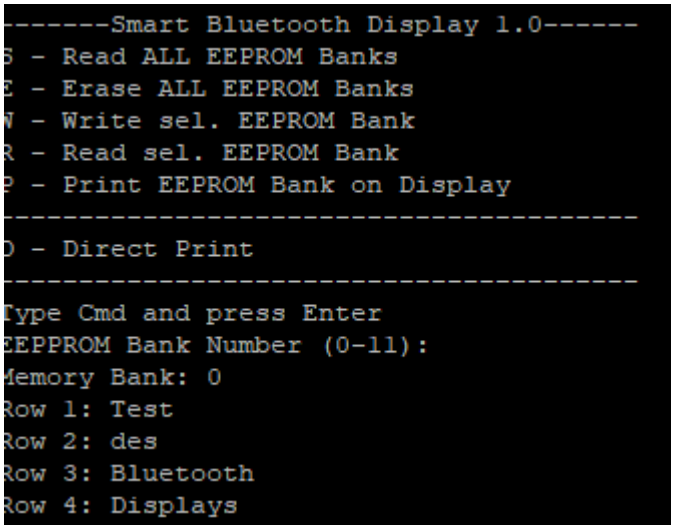
- R - Read sel. EEPROM Bank

Wenn ein bestimmter Text einer bestimmten Speicherbank ANGEZEIGT aber nicht auf dem Display ausgegeben werden soll, kann dieser über den Menüpunkt „R“ in angezeigt werden.

```
------Smart Bluetooth Display 1.0------
S - Read ALL EEPROM Banks
E - Erase ALL EEPROM Banks
W - Write sel. EEPROM Bank
R - Read sel. EEPROM Bank
P - Print EEPROM Bank on Display
----------------------------------------
D - Direct Print
----------------------------------------
Type Cmd and press Enter
EEPPROM Bank Number (0-11):
Memory Bank: 0
Row 1: Test
Row 2: des
Row 3: Bluetooth
Row 4: Displays
```

- P - Print EEPROM Bank on Display

Wenn ein bestimmter Text einer bestimmten Speicherbank auf dem LCD Display ausgegeben werden soll, kann dieser über den Menüpunkt „P“ , nach Auswahl der Speicherbank auf dem Display auegegeben werden.



Ich wünsche viel Spaß beim Nachbauen und wie immer bis zum nächsten Mal.