LAPORAN AKHIR

FINAL PROJECT SISTEM TERTANAM

Disusun oleh:

Iqbal Muchlis 5024201073

Dosen Pembimbing:

Eko Pramunanto, S.T., M.T.

FAKULTAS TEKNOLOGI ELEKTRO DAN INFORMATIKA CERDAS

TEKNIK KOMPUTER

INSTITUT TEKNOLOGI SEPULUH NOPEMBER

SURABAYA

2023

I. PENJELASAN TUGAS

Rancanglah sistem untuk menampilkan jam, kalender, suhu dan alarm dengan karakter pada dot matrix LED 8 x 32 (4 buah matrix LED 8x8), dengan input keyboard USB. Suhu diukur dengan menggunakan sensor suhu analog (seperti LM35 atau yang sejenisnya).

Spesifikasi fitur:

a. mode : run, set jam, set tanggal, set alarm.

b. select set : jam, menit, detik / tgl, bln, thn,

c. 3 waktu alarm dengan text (wajib) + buzzer (optional nilai plus):

- alarm 1: Display NRP

- alarm 2: Display NRP + Nama

- alarm 3: Display text yang diinputkan

Waktu aktif untuk alarm 1, 2 dan 3 bisa diset dengan tanggal, jam, menit dan durasinya dalam detik.

d. Tampilan:

- Kecerahan diatur sesuai kecerahan lingkungan dengan sensor cahaya.

- Jam, menit, detik

- Pada setiap detik ke 10 dan 40 tampilkan tgl-bln-thn selama 3 detik

- Pada setiap detik ke 13 dan 43 tampilkan suhu dengan keterangan ^{o}C (derajad Celcius)

- Pada saat waktu tepat sama dengan waktu seting alarm tampilkan text alarm sesuai durasi setingnya.

- Kecepatan geser tampilan text panjang (running text) adalah 0.5 detik per kolom matrix LED.

- Sebagai tambahan nilai : tampilan berkedip saat berada pada mode seting (input dari keyboard).

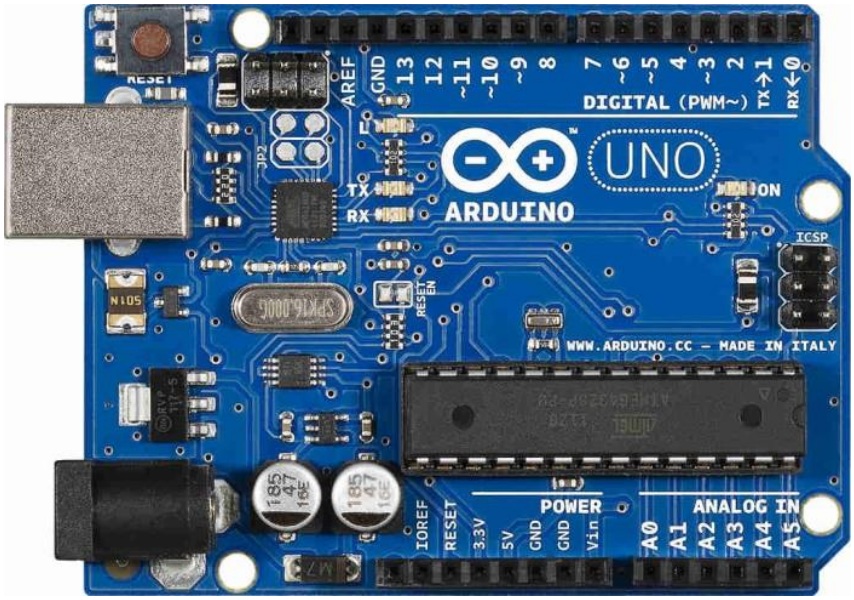
Output:

- 8x32 dot matrix LED

II. ALAT DAN BAHAN

Alat dan bahan yang saya pakai untuk final project ini adalah:

- Arduino UNO

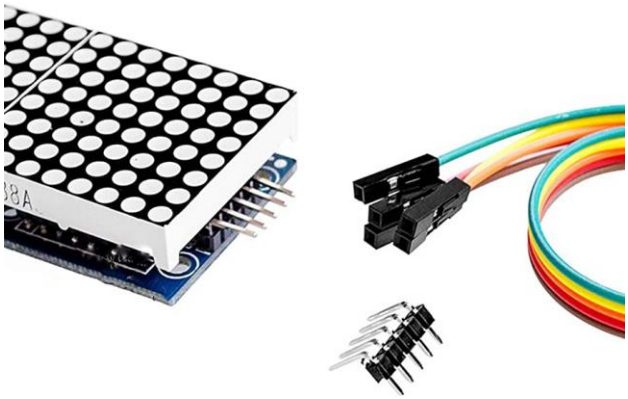


- Keyboard PS/2 Protocol

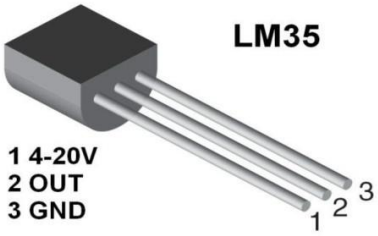
- Female PS/2 Socket

- Active Buzzer

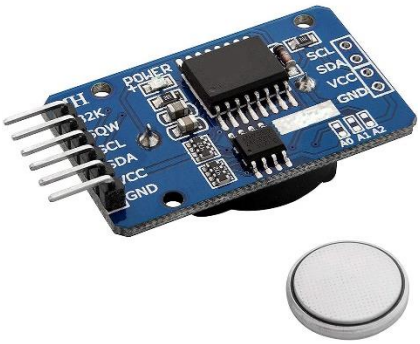
- MAX7219 LED Dot Matrix Module 4-IN-1 32x8



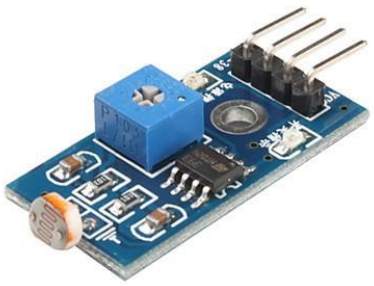
- LM35



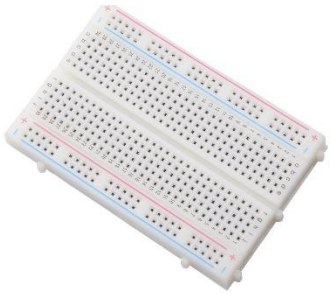
- Real time clock (DS3232)



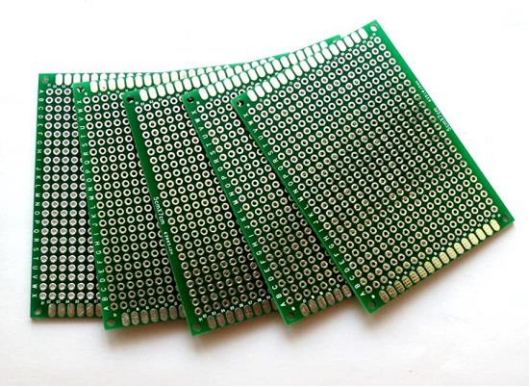
- LDR (Light Sensor Module)



- Breadboard (Untuk bereksperimen)



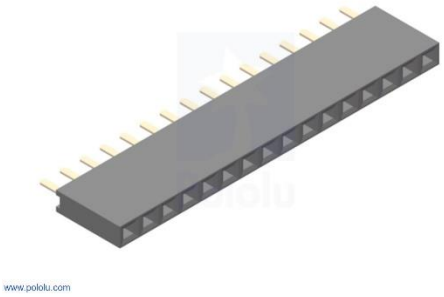
- PCB



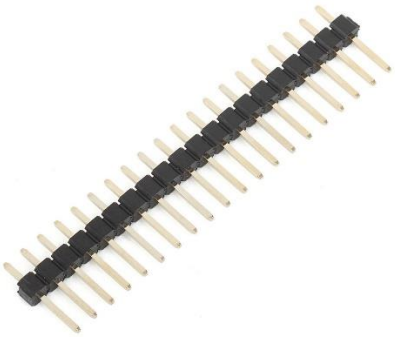
- Solder dan timahnya

- Kaki PCB

- Female to Male Pin Header



- Male to Male Pin Header



- Kabel
  - Male to female

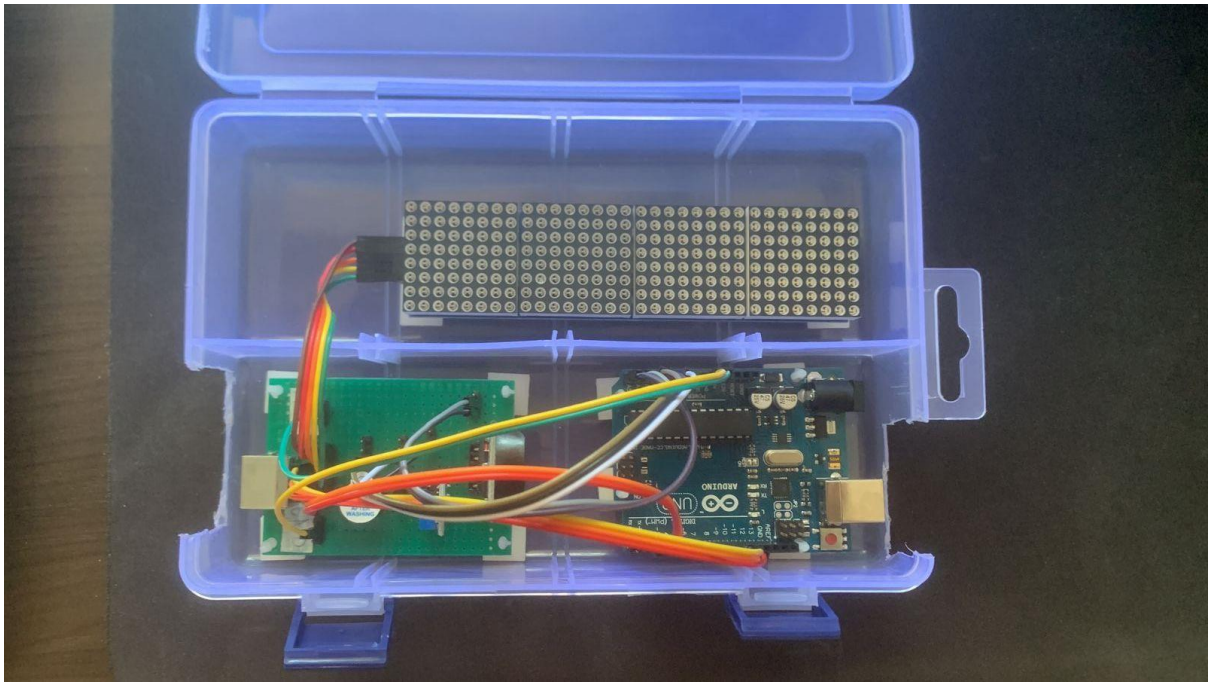
  - Female to female

- Male to male (untuk bereksperimen)

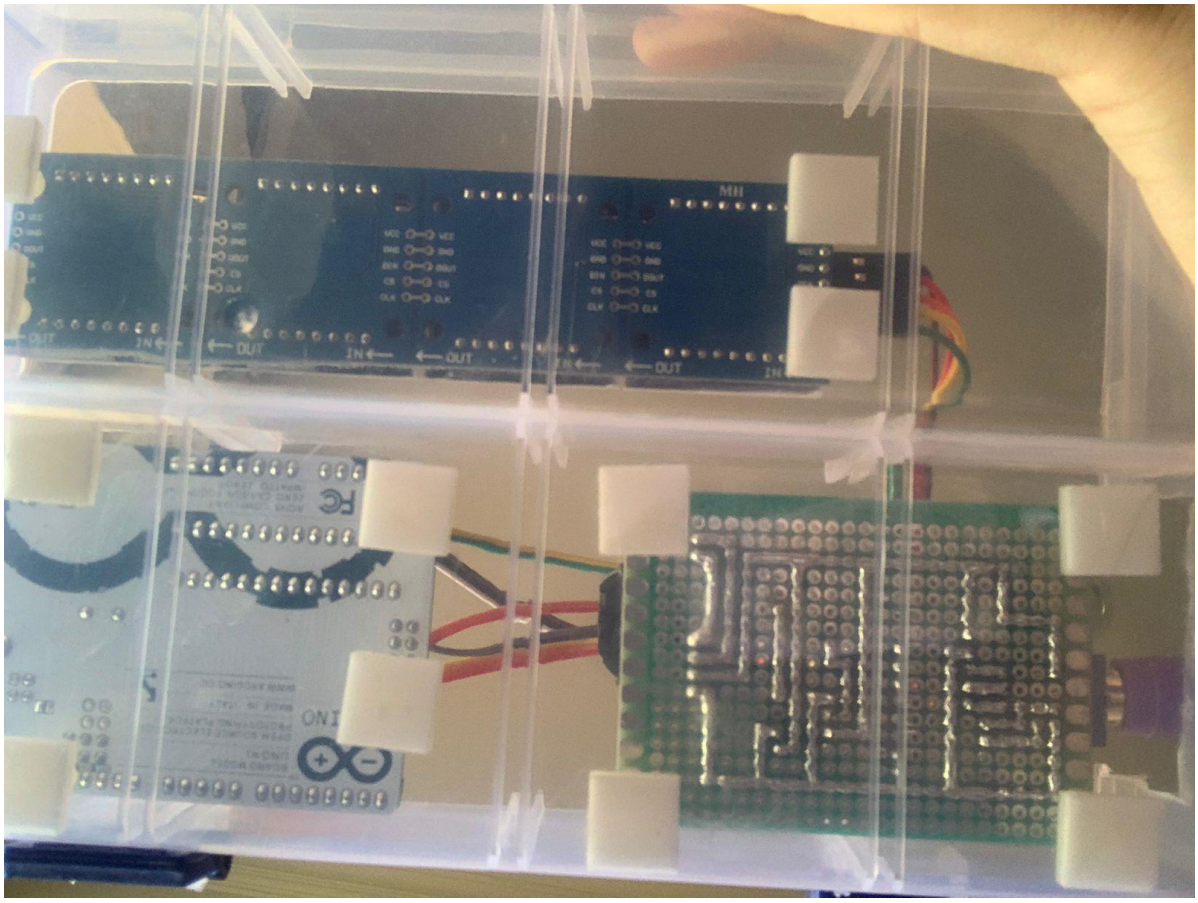
III. RANGKAIAN

Berikut merupakan rangkaian yang telah saya rancang:

- Tampak atas



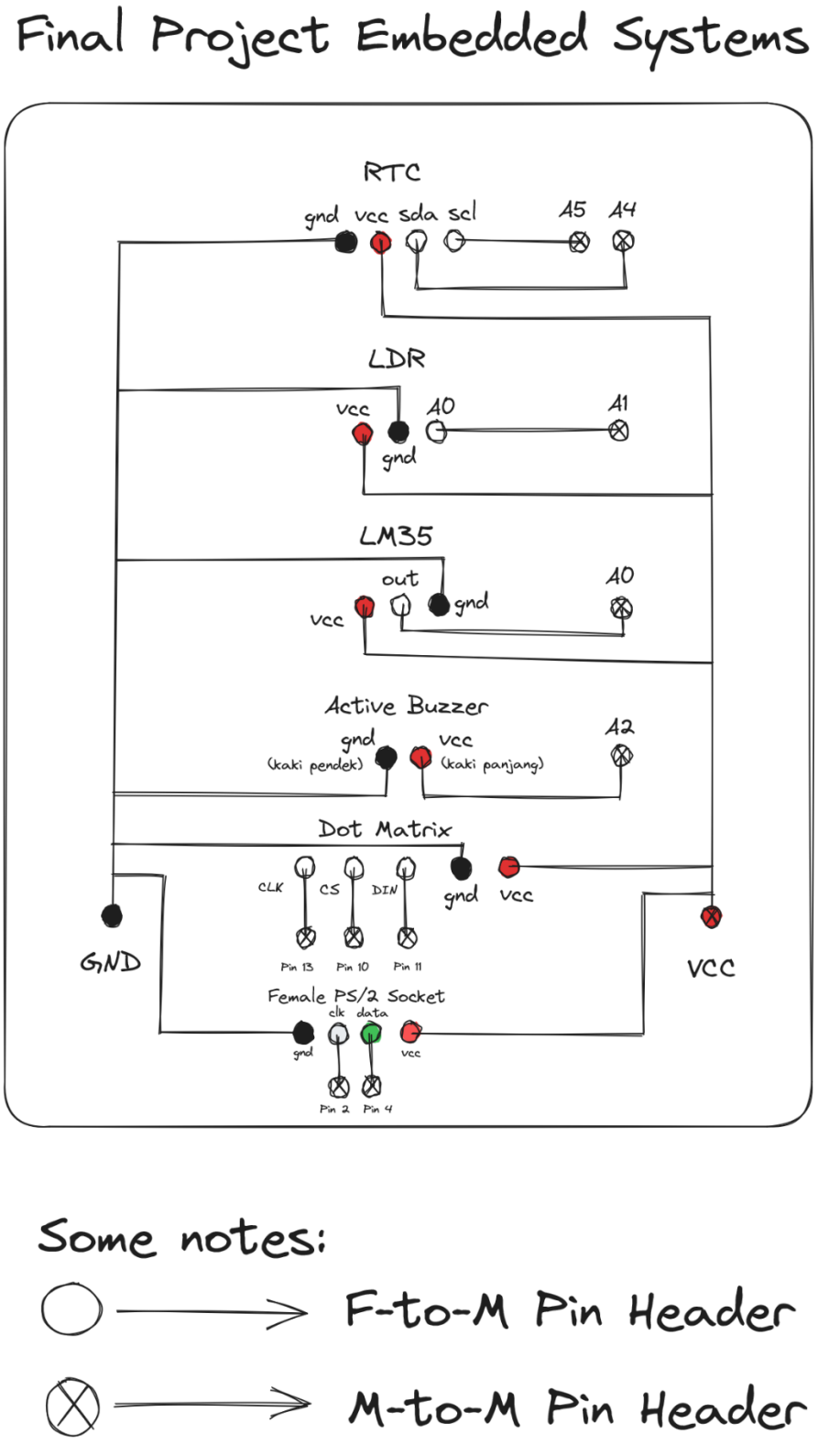
- Tampak bawah



Detail rangkaian:

- Dot matrix
  - VCC disambungkan pada 5v di arduino
  - GND disambungkan pada GND di arduino
  - DIN disambungkan pada pin 11 di arduino
  - CS disambungkan pada pin 10 di arduino
  - CLK disambungkan pada pin 13 di arduino
- LDR
  - VCC disambungkan pada 5v di arduino
  - GND disambungkan pada GND di arduino
  - A0 disambungkan pada A1 di arduino
- Active Buzzer
  - Pin 1 disambungkan pada GND di arduino
  - Pin 2 disambungkan pada 8 di arduino
- RTC
  - VCC disambungkan pada 5v di arduino
  - GND disambungkan pada GND di arduino
  - SDA disambungkan pada A4 di arduino
  - SCL disambungkan pada A5 di arduino
- LM35
  - 4-20V disambungkan pada 5v di arduino
  - GND disambungkan pada GND di arduino
  - OUT disambungkan pada A0 di arduino
- Female PS/2 Socket
  - VCC disambungkan pada VCC di arduino
  - GND disambungkan pada GND di arduino
  - CLK disambungkan pada Pin 2 di arduino
  - DATA disambungkan pada Pin 4 di arduino

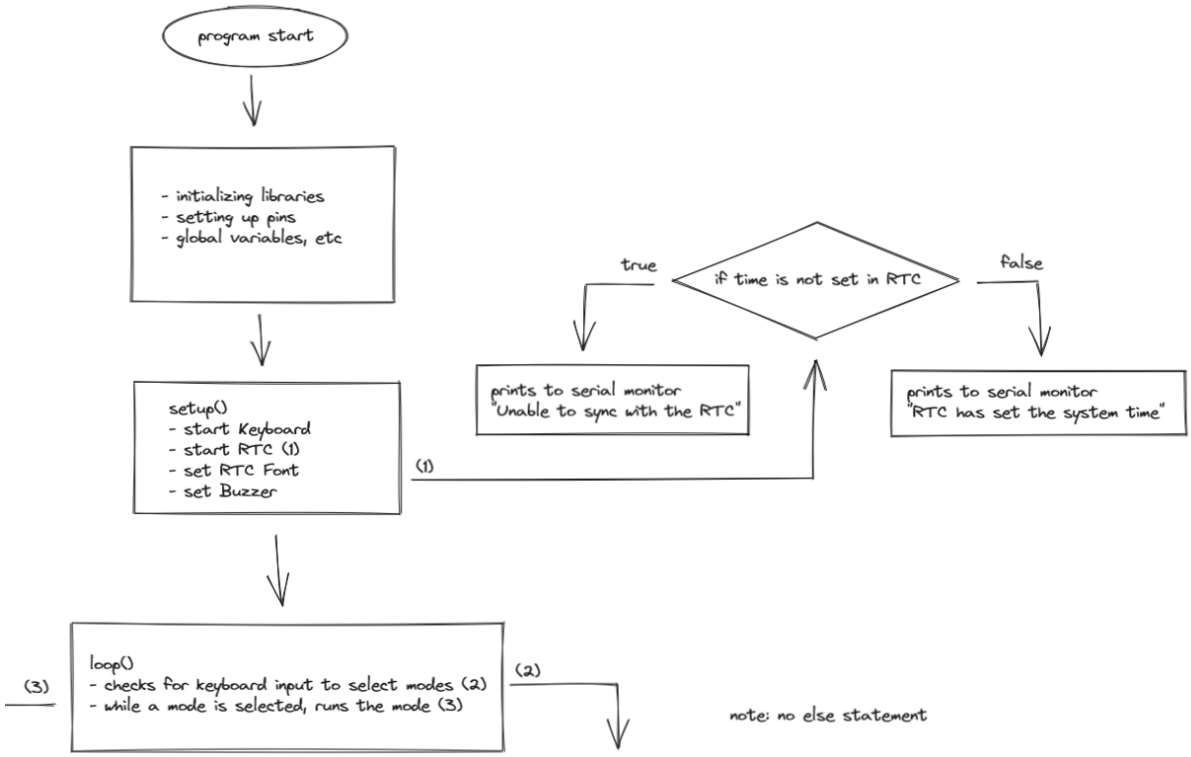
Rancangan pada PCB:



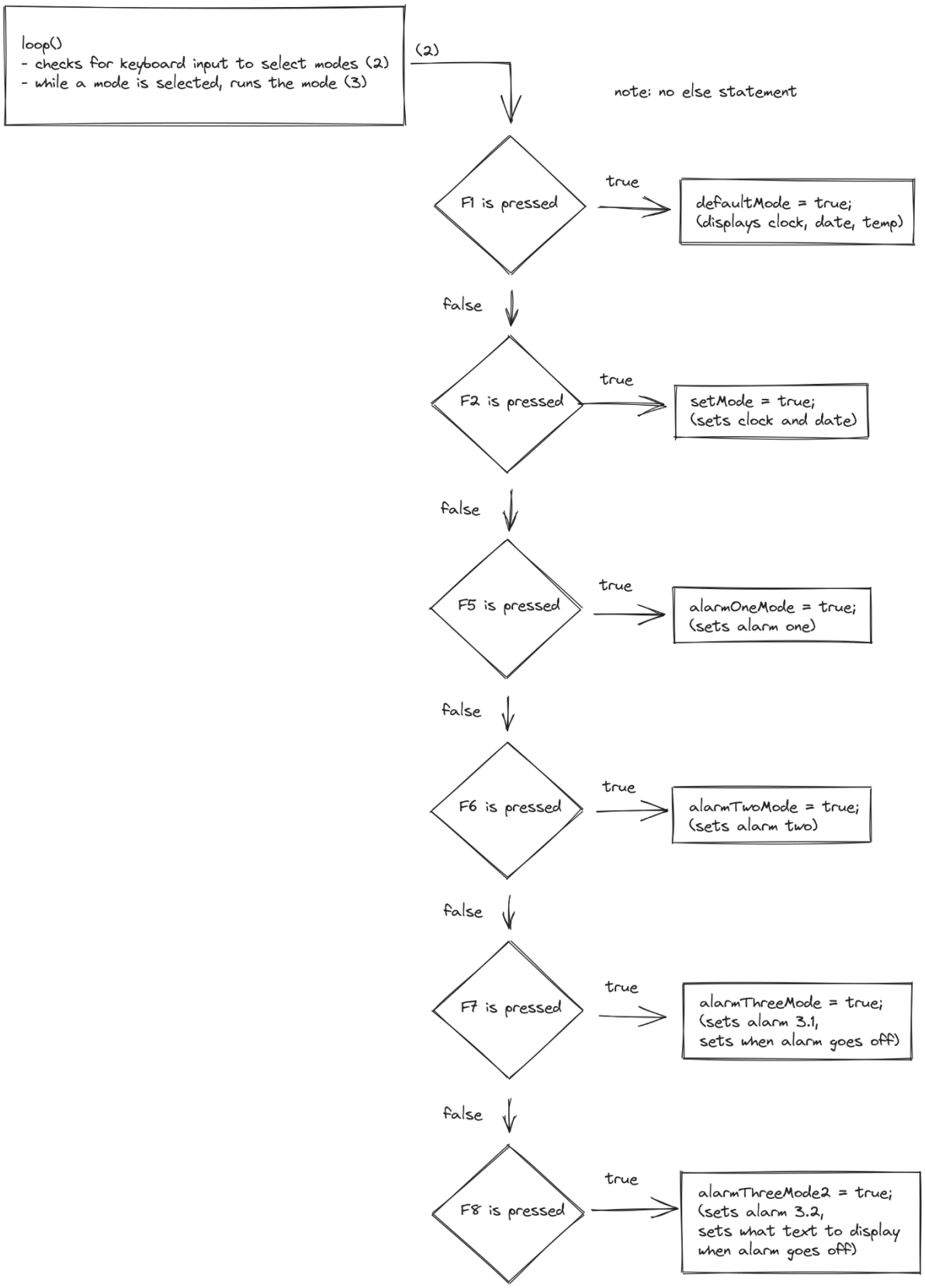
IV. HASIL

- Diagram blok:

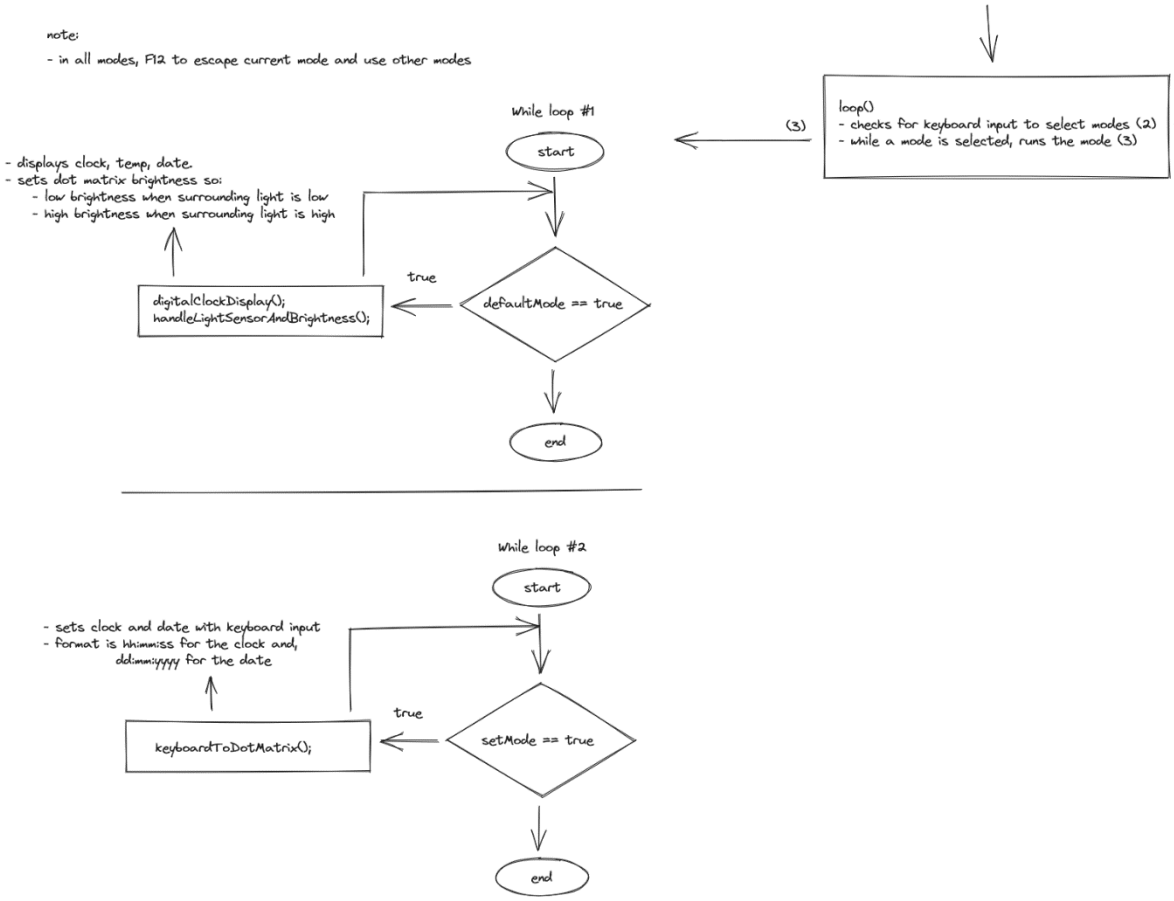
  - Part 1:



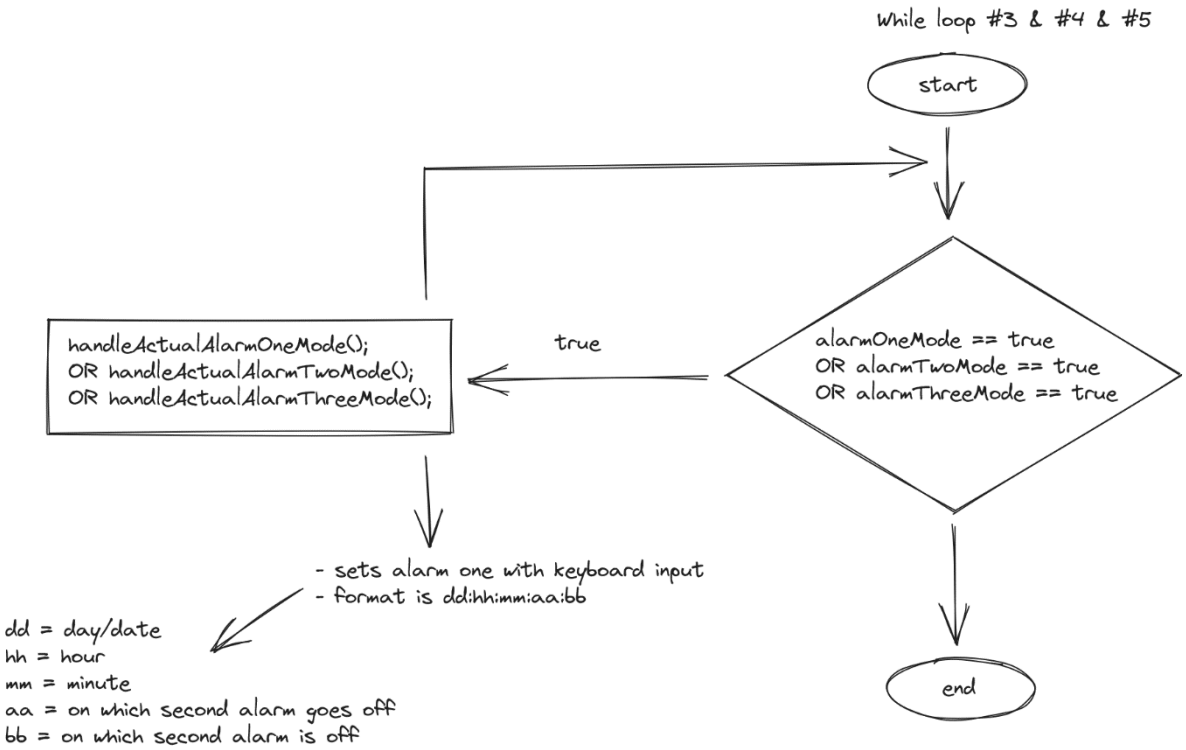
- Part 2:

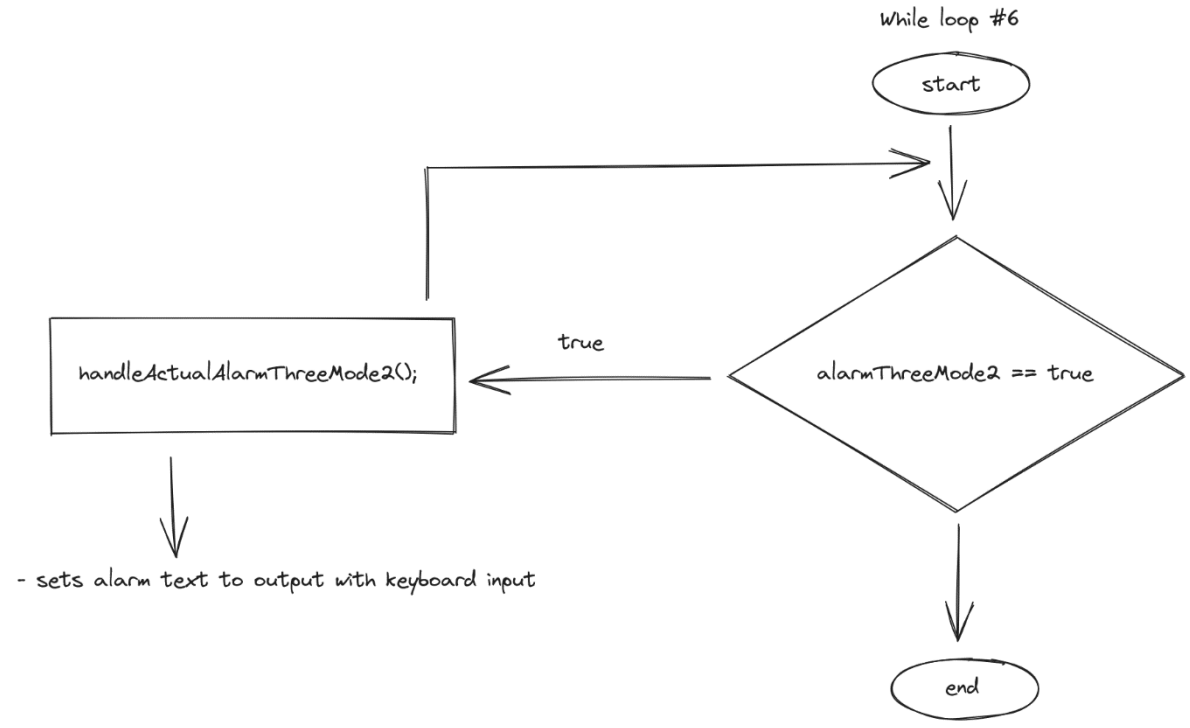

loop()
- checks for keyboard input to select modes (2)
- while a mode is selected, runs the mode (3)
(2)
note: no else statement
F1 is pressed
true
defaultMode = true;
(displays clock, date, temp)
false
F2 is pressed
true
setMode = true;
(sets clock and date)
false
F5 is pressed
true
alarmOneMode = true;
(sets alarm one)
false
F6 is pressed
true
alarmTwoMode = true;
(sets alarm two)
false
F7 is pressed
true
alarmThreeMode = true;
(sets alarm 3.1,
sets when alarm goes off)
false
F8 is pressed
true
alarmThreeMode2 = true;
(sets alarm 3.2,
sets what text to display
when alarm goes off)

- Part 3


note:
- in all modes, F12 to escape current mode and use other modes
loop()
- checks for keyboard input to select modes (2)
- while a mode is selected, runs the mode (3)
(3)
While loop #1
start
- displays clock, temp, date.
- sets dot matrix brightness so:
- low brightness when surrounding light is low
- high brightness when surrounding light is high
true
defaultMode == true
digitalClockDisplay();
handleLightSensorAndBrightness();
end
While loop #2
start
- sets clock and date with keyboard input
- format is hhimmiss for the clock and,
ddimmiyyyy for the date
true
setMode == true
keyboardToDotMatrix();
end

- Part 4


While loop #3 & #4 & #5
start
alarmOneMode == true
OR alarmTwoMode == true
OR alarmThreeMode == true
true
handleActualAlarmOneMode();
OR handleActualAlarmTwoMode();
OR handleActualAlarmThreeMode();
- sets alarm one with keyboard input
- format is dd:hh:mm:aa:bb
dd = day/date
hh = hour
mm = minute
aa = on which second alarm goes off
bb = on which second alarm is off
end


While loop #6
start
alarmThreeMode2 == true
true
handleActualAlarmThreeMode2();
- sets alarm text to output with keyboard input
end

- Dengan menggunakan library:
    - Adafruit_GFX.h (https://github.com/adafruit/Adafruit-GFX-Library)
        - untuk mengatur display dot matrix.
    - Fonts/Picopixel.h
        - untuk mengatur font pada dot matrix
    - Max72xxPanel.h (https://github.com/markruys/arduino-Max72xxPanel)
        - helper library untuk menjambati agar Adafruit_GFX.h dapat dipakai untuk mengatur display dot matrix.
    - DS3232RTC (https://github.com/JChristensen/DS3232RTC)
        - untuk mengatur real time clock
    - LM35 (https://github.com/wilmouths/LM35)
        - untuk mengatur sensor temperature agar lebih mudah
    - PS2Keyboard.h (https://github.com/PaulStoffregen/PS2Keyboard)
        - untuk memproses input keyboard.
    - SPI.h
        - untuk fungsionalitas library yang lain.
- Hasil:
    - dapat melakukan semua yang diminta dari spesifikasi fitur pada detail tugas kecuali:
      - berkedip saat mode input
- Code:

```
// how to operate:
// there are 5 different modes,
//
// - (press F1) displays clock, temp, and date mode
// - (press F2) set clock, date mode
//   - here, you can:
//     - ESC to remove/reset output
//     - BACKSPACE to remove output one by one
//     - ENTER to set clock IF format is correct (6 numbers,
hh:mm:ss)
//     - ']' to set date IF format is correct (6 numbers, d:m:yyyy)
// - (press F5) set and displpay alarm one mode
// - (press F6) set and displpay alarm two mode
// - (press F7) set and displpay alarm 3.1 mode
// - (press F8) set and displpay alarm 3.2 mode
//     - ']' to set alarm text to be displayed
// - for F5, F6, and F7
```

```
//     - ENTER to set when alarm happens IF format is correct (10
numbers, dd:hh:mm:aa:bb, aa = on which second alarm goes off; bb =
on which second alarm is off)
// note:
// - in all modes, F12 to escape current mode and use other modes
//
// bugs:
// - when setting clock/date, the length of output permissible
shouldn't be more than 6 (since the format have 6 digits (see ->
hh:mm:ss))
// - etc

#include <SPI.h>
#include <Adafruit_GFX.h>
#include <Max72xxPanel.h>
#include <PS2Keyboard.h>
#include <Fonts/Picopixel.h>
#include <LM35.h>
#include <DS3232RTC.h>

// temp sensor
LM35 lm35(A0);
// RTC
DS3232RTC rtc;
// light sensor
#define lightSensor A1
// buzzer
#define buzzer A2
// keyboard
#define DataPin 4
#define IRQpin 2
PS2Keyboard keyboard;
// dot matrix
// Attach CS to this pin, DIN to MOSI and CLK to SCK (cf
http://arduino.cc/en/Reference/SPI )
#define pinCS 10
#define numberOfHorizontalDisplays 4
#define numberOfVerticalDisplays 1
Max72xxPanel matrix = Max72xxPanel(pinCS,
numberOfHorizontalDisplays, numberOfVerticalDisplays);
// str for displaying keyboard input to dot matrix
char tempStr[50] = "";
char str[50] = "";
// for changing between modes
bool defaultMode;
bool setMode;
bool alarmOneMode;
bool alarmTwoMode;
```

```
bool alarmThreeMode;
bool alarmThreeMode2;
// for setMode and first alarm
char enteredValueEnter[20] = "";
char enteredValueBracket[20] = "";
bool checkEnteredValueBracket;
bool checkEnteredValueEnter;
// for first alarm
String hourFromKeyboard;
String minuteFromKeyboard;
String secondFromKeyboard;
String dayFromKeyboard;
String monthFromKeyboard;
String yearFromKeyboard;
// for second alarm
String hourFromKeyboard2;
String minuteFromKeyboard2;
String secondFromKeyboard2;
String dayFromKeyboard2;
String monthFromKeyboard2;
String yearFromKeyboard2;
// for third alarm
String hourFromKeyboard3;
String minuteFromKeyboard3;
String secondFromKeyboard3;
String dayFromKeyboard3;
String monthFromKeyboard3;
String yearFromKeyboard3;
// for set alarm one and two and three
char alarmOne[30] = "1. 5024201073";
char alarmTwo[30] = "2. 5024201073 Iqbal Muchlis";
char alarmThree[50] = "";
char enteredValueEnterAlarm[20] = "";
bool checkAlarmOneStart;
bool checkAlarmTwoStart;
bool checkAlarmThreeStart;
bool checkEnteredValueEnterAlarmOne;
bool checkEnteredValueEnterAlarmTwo;
bool checkEnteredValueEnterAlarmThree;
String firstDurationFromKeyboard;  // alarm one
String secondDurationFromKeyboard;
String firstDurationFromKeyboard2;  // alarm two
String secondDurationFromKeyboard2;
String firstDurationFromKeyboard3;  // alarm two
String secondDurationFromKeyboard3;



void setup() {
```

```
  Serial.begin(9600);
  pinMode(buzzer, OUTPUT);
  keyboard.begin(DataPin, IRQpin);
  rtc.begin();

  // fixes dot matrix display orientation
  setMatrixDisplayOrientation();
  // set dot matrix brightness, font, size
  // matrix.setIntensity(0);
  matrix.setFont(&Picopixel);
  matrix.setTextColor(1);
  matrix.setTextSize(1);
  // matrix.setTextWrap(boolean w);
  // matrix.setTextColor(uint16_t color, uint16_t backgroundcolor);

  setSyncProvider(rtc.get);  // the function to get the time from
the RTC
  if (timeStatus() != timeSet) {
    Serial.println("Unable to sync with the RTC");
  } else {
    Serial.println("RTC has set the system time");
  }
}

void loop() {
  // check for keyboard input
  if (!keyboard.available()) {
    return;
  }
  char c = keyboard.read();

  if (c == PS2_F1) {  // default mode (clock, temp, date)
    strcpy(str, "");
    matrix.fillScreen(0);
    defaultMode = true;
    setMode = false;
    alarmOneMode = false;
    alarmTwoMode = false;
    alarmThreeMode = false;
  } else if (c == PS2_F2) {  // set clock and date mode
    strcpy(str, "");
    matrix.fillScreen(0);
    defaultMode = false;
    setMode = true;
    alarmOneMode = false;
    alarmTwoMode = false;
    alarmThreeMode = false;
  } else if (c == PS2_F5) {  // set alarm 1
```

```
    strcpy(str, "");
    matrix.fillScreen(0);
    defaultMode = false;
    setMode = false;
    alarmOneMode = true;
    alarmTwoMode = false;
    alarmThreeMode = false;
  } else if (c == PS2_F6) {  // set alarm 2
    strcpy(str, "");
    matrix.fillScreen(0);
    defaultMode = false;
    setMode = false;
    alarmOneMode = false;
    alarmTwoMode = true;
    alarmThreeMode = false;
  } else if (c == PS2_F7) {  // set alarm 3
    strcpy(str, "");
    matrix.fillScreen(0);
    defaultMode = false;
    setMode = false;
    alarmOneMode = false;
    alarmTwoMode = false;
    alarmThreeMode = true;
  } else if (c == PS2_F8) {  // set alarm 3.2
    strcpy(str, "");
    matrix.fillScreen(0);
    defaultMode = false;
    setMode = false;
    alarmOneMode = false;
    alarmTwoMode = false;
    alarmThreeMode = false;
    alarmThreeMode2 = true;
  }

  while (defaultMode == true) {
    digitalClockDisplay();
    handleLightSensorAndBrightness();
  }
  while (setMode == true) {
    keyboardToDotMatrix();
  }
  while (alarmOneMode == true) {
    handleActualAlarmOneMode();
  }
  while (alarmTwoMode == true) {
    handleActualAlarmTwoMode();
  }
  while (alarmThreeMode == true) {
```

```
    handleActualAlarmThreeMode();
  }
  while (alarmThreeMode2 == true) {
    handleActualAlarmThreeMode2();
  }
}

void handleActualAlarmOneMode() {
  if (!keyboard.available()) {
    return;
  }
  char c = keyboard.read();
  // normal text
  matrix.setCursor(0, 6);

  if (strlen(tempStr) > 15) {
    strcpy(tempStr, "");
    matrix.fillScreen(0);
  } else if (c == PS2_F12) {
    strcpy(str, "");
    matrix.fillScreen(0);
    alarmOneMode = false;
  } else if (c == PS2_ESC) {
    // resets dotmatrix screen
    strcpy(tempStr, "");
    matrix.fillScreen(0);
  } else if (c == PS2_DELETE) {
    // for backspace
    int len = strlen(tempStr);
    if (len > 0) {
      tempStr[len - 1] = '\0';
    }
    matrix.fillScreen(0);
  } else if (c == PS2_ENTER) {
    checkAlarmOneStart = true;
    handleSetClockOrDate("enteredValueEnterAlarm");
  } else if (c >= '0' && c <= '9') {
    // updates display based on keyboard input
    strncat(tempStr, &c, 1);
  } else {
    // else if other characters are pressed
    // do nothing
  }
  strcpy(str, "1:");  // Copy the first part of the string into
'str'
  strcat(str, tempStr);
  // matrix.print("°");
  // Serial.println(str);
```

```
  matrix.print(str);
  matrix.write();
}

void handleActualAlarmTwoMode() {
  if (!keyboard.available()) {
    return;
  }
  char c = keyboard.read();
  // normal text
  matrix.setCursor(0, 6);

  if (strlen(tempStr) > 15) {
    strcpy(tempStr, "");
    matrix.fillScreen(0);
  } else if (c == PS2_F12) {
    strcpy(str, "");
    matrix.fillScreen(0);
    alarmTwoMode = false;
  } else if (c == PS2_ESC) {
    // resets dotmatrix screen
    strcpy(tempStr, "");
    matrix.fillScreen(0);
  } else if (c == PS2_DELETE) {
    // for backspace
    int len = strlen(tempStr);
    if (len > 0) {
      tempStr[len - 1] = '\0';
    }
    matrix.fillScreen(0);
  } else if (c == PS2_ENTER) {
    checkAlarmTwoStart = true;
    handleSetClockOrDate("enteredValueEnterAlarm");
  } else if (c >= '0' && c <= '9') {
    // updates display based on keyboard input
    strncat(tempStr, &c, 1);
  } else {
    // else if other characters are pressed
    // do nothing
  }
  strcpy(str, "2:");  // Copy the first part of the string into
'str'
  strcat(str, tempStr);
  // matrix.print("°");
  // Serial.println(str);
  matrix.print(str);
  matrix.write();
}
```

```
void handleActualAlarmThreeMode() {
  if (!keyboard.available()) {
    return;
  }
  char c = keyboard.read();
  // normal text
  matrix.setCursor(0, 6);

  if (strlen(tempStr) > 15) {
    strcpy(tempStr, "");
    matrix.fillScreen(0);
  } else if (c == PS2_F12) {
    strcpy(str, "");
    matrix.fillScreen(0);
    alarmThreeMode = false;
  } else if (c == PS2_ESC) {
    // resets dotmatrix screen
    strcpy(tempStr, "");
    matrix.fillScreen(0);
  } else if (c == PS2_DELETE) {
    // for backspace
    int len = strlen(tempStr);
    if (len > 0) {
      tempStr[len - 1] = '\0';
    }
    matrix.fillScreen(0);
  } else if (c == PS2_ENTER) {
    checkAlarmThreeStart = true;
    handleSetClockOrDate("enteredValueEnterAlarm");
  } else if (c == ']') {
    handleSetClockOrDate("enteredValueBracketAlarm3");
  } else if (c >= '0' && c <= '9') {
    // updates display based on keyboard input
    strncat(tempStr, &c, 1);
  } else {
    // else if other characters are pressed
    // do nothing
  }
  strcpy(str, "3.1:");  // Copy the first part of the string into
'str'
  strcat(str, tempStr);
  // matrix.print("°");
  // Serial.println(str);
  matrix.print(str);
  matrix.write();
}
```

```
void handleActualAlarmThreeMode2() {
  if (!keyboard.available()) {
    return;
  }
  char c = keyboard.read();
  // normal text
  matrix.setCursor(0, 6);

  if (strlen(tempStr) > 15) {
    strcpy(tempStr, "");
    matrix.fillScreen(0);
  } else if (c == PS2_F12) {
    strcpy(str, "");
    matrix.fillScreen(0);
    alarmThreeMode2 = false;
  } else if (c == PS2_ESC) {
    // resets dotmatrix screen
    strcpy(tempStr, "");
    matrix.fillScreen(0);
  } else if (c == PS2_DELETE) {
    // for backspace
    int len = strlen(tempStr);
    if (len > 0) {
      tempStr[len - 1] = '\0';
    }
    matrix.fillScreen(0);
  } else if (c == ']') {
    handleSetClockOrDate("enteredValueBracketAlarm3");
  } else {
    // eo nothing
    strncat(tempStr, &c, 1);
  }
  strcpy(str, "3.2:");  // Copy the first part of the string into
'str'
  strcat(str, tempStr);
  // matrix.print("°");
  // Serial.println(str);
  matrix.print(str);
  matrix.write();
}

void handleAlarmThreeMode() {
  // char c = keyboard.read();
  // matrix.setCursor(0, 6);
  // if (c == PS2_F12) {
  //   strcpy(str, "");
  //   matrix.fillScreen(0);
  //   alarmThreeMode = false;
```

```
  // }
  // char alarmThreeTextOutput[30];
  // // String alarmThreeText = "i'm alarm 3";
  // // sprintf(alarmThreeTextOutput, "3. %s", alarmThreeText);
  // strcpy(str, "3. input from keyboard");
  // matrix.print(str);
  // matrix.write();

  char c = keyboard.read();
  if (c == PS2_F12) {
    strcpy(str, "");
    matrix.fillScreen(0);
    alarmThreeMode = false;
  }

  strcpy(str, "3. input from keyboard");
  // running text right to left
  for (int i = 50; i >= -45; i--) {
    matrix.fillScreen(0);
    matrix.setCursor(i, 6);
    matrix.print(str);
    matrix.write();
    delay(55);
  }
}

void keyboardToDotMatrix() {
  if (!keyboard.available()) {
    return;
  }
  char c = keyboard.read();
  // normal text
  matrix.setCursor(0, 6);

  if (strlen(tempStr) > 15) {
    strcpy(tempStr, "");
    matrix.fillScreen(0);
  } else if (c == PS2_F12) {
    strcpy(str, "");
    matrix.fillScreen(0);
    setMode = false;
  } else if (c == PS2_ESC) {
    // resets dotmatrix screen
    strcpy(tempStr, "");
    matrix.fillScreen(0);
  } else if (c == PS2_DELETE) {
    // for backspace
    int len = strlen(tempStr);
```

```
    if (len > 0) {
      tempStr[len - 1] = '\0';
    }
    matrix.fillScreen(0);
  } else if (c == PS2_ENTER) {
    handleSetClockOrDate("enteredValueEnter");
  } else if (c == ']') {
    handleSetClockOrDate("enteredValueBracket");
  } else if (c >= '0' && c <= '9') {
    // updates display based on keyboard input
    strncat(tempStr, &c, 1);
  } else {
    // else if other characters are pressed
    // do nothing
  }

  if (checkEnteredValueEnter == true && checkEnteredValueBracket ==
true) {
    setTime(hourFromKeyboard.toInt(), minuteFromKeyboard.toInt(),
secondFromKeyboard.toInt(), dayFromKeyboard.toInt(),
monthFromKeyboard.toInt(), yearFromKeyboard.toInt());
    rtc.set(now());
    Serial.println("time set");
    hourFromKeyboard = "";
    minuteFromKeyboard = "";
    secondFromKeyboard = "";
    dayFromKeyboard = "";
    monthFromKeyboard = "";
    yearFromKeyboard = "";
    checkEnteredValueEnter = false;
    checkEnteredValueBracket = false;
  }
  strcpy(str, "s:");  // Copy the first part of the string into
'str'
  strcat(str, tempStr);
  // matrix.print("°");
  // Serial.println(str);
  matrix.print(str);
  matrix.write();
}

void digitalClockDisplay() {
  uint16_t celciusTemp = lm35.getTemp(CELCIUS);

  char c = keyboard.read();
  if (c == PS2_F12) {
    strcpy(str, "");
    matrix.fillScreen(0);
```

```
    defaultMode = false;
  }
  // digital clock display of the time
  Serial.print(hour());
  printDigits(minute());
  printDigits(second());
  Serial.print(' ');
  Serial.print(day());
  Serial.print('-');
  Serial.print(month());
  Serial.print('-');
  Serial.print(year());
  Serial.println();

  // minute < 10 and second < 10 handler
  int hourNow = hour();
  int minuteNow = minute();
  int secondNow = second();
  // Format minutes and seconds with leading zeros
  char minuteString[3];
  char secondString[3];
  sprintf(minuteString, "%02d", minuteNow);
  sprintf(secondString, "%02d", secondNow);

  // day < 10 and month < 10 handler
  int dayNow = day();
  int monthNow = month();
  int yearNow = year() - 2000;
  // Serial.println(yearNow);
  // Format minutes and seconds with leading zeros
  char dayString[3];
  char monthString[3];
  sprintf(dayString, "%02d", dayNow);
  sprintf(monthString, "%02d", monthNow);

  //
  digitalWrite(buzzer, LOW);

  if (checkEnteredValueEnterAlarmOne == true && dayNow ==
dayFromKeyboard.toInt() && hourNow == hourFromKeyboard.toInt() &&
minuteNow == minuteFromKeyboard.toInt() && secondNow >=
firstDurationFromKeyboard.toInt() && secondNow <=
secondDurationFromKeyboard.toInt()) {
    digitalWrite(buzzer, HIGH);
    Serial.println("alarm one playing111111111111");
    matrix.setCursor(0, 6);
    sprintf(str, "%s", alarmOne);
    if (secondNow > secondDurationFromKeyboard.toInt()) {
```

```
      Serial.println("alarm stopped");
      dayFromKeyboard = "";
      hourFromKeyboard = "";
      minuteFromKeyboard = "";
      firstDurationFromKeyboard = "";
      secondDurationFromKeyboard = "";
      checkEnteredValueEnterAlarmOne = false;
    }
  } else if (checkEnteredValueEnterAlarmTwo == true && dayNow ==
dayFromKeyboard2.toInt() && hourNow == hourFromKeyboard2.toInt() &&
minuteNow == minuteFromKeyboard2.toInt() && secondNow >=
firstDurationFromKeyboard2.toInt() && secondNow <=
secondDurationFromKeyboard2.toInt()) {
    digitalWrite(buzzer, HIGH);
    Serial.println("alarm two playing222222222222");
    matrix.setCursor(0, 6);
    sprintf(str, "%s", alarmTwo);
    if (secondNow > secondDurationFromKeyboard2.toInt()) {
      Serial.println("alarm stopped");
      dayFromKeyboard2 = "";
      hourFromKeyboard2 = "";
      minuteFromKeyboard2 = "";
      firstDurationFromKeyboard2 = "";
      secondDurationFromKeyboard2 = "";
      checkEnteredValueEnterAlarmTwo = false;
    }
  } else if (strlen(alarmThree) > 0 &&
checkEnteredValueEnterAlarmThree == true && dayNow ==
dayFromKeyboard3.toInt() && hourNow == hourFromKeyboard3.toInt() &&
minuteNow == minuteFromKeyboard3.toInt() && secondNow >=
firstDurationFromKeyboard3.toInt() && secondNow <=
secondDurationFromKeyboard3.toInt()) {
    digitalWrite(buzzer, HIGH);
    Serial.println("alarm three playing33333333333333333");
    matrix.setCursor(0, 6);
    sprintf(str, "%s", alarmThree);
    if (secondNow > secondDurationFromKeyboard3.toInt()) {
      Serial.println("alarm stopped");
      strcpy(alarmThree, "");
      dayFromKeyboard3 = "";
      hourFromKeyboard3 = "";
      minuteFromKeyboard3 = "";
      firstDurationFromKeyboard3 = "";
      secondDurationFromKeyboard3 = "";
      checkEnteredValueEnterAlarmThree = false;
    }
  } else if (secondNow >= 10 && secondNow <= 13 || secondNow >= 40
&& secondNow <= 43) {
```

```
    matrix.setCursor(0, 6);
    // sprintf(str, "%02d-%s-%s", yearNow, dayString, monthString);
    sprintf(str, "%s-%s-%02d", dayString, monthString, yearNow);
  } else if (secondNow >= 13 && secondNow <= 16 || secondNow >= 43
&& secondNow <= 46) {
    // get temp, centers font, delay so temp is stable
    matrix.setCursor(10, 6);
    sprintf(str, "%d °C", celciusTemp);
    delay(500);
  } else {
    // Create the formatted time string
    matrix.setCursor(3, 6);
    sprintf(str, "%02d:%s:%s", hourNow, minuteString, secondString);
  }

  if (checkEnteredValueEnterAlarmOne == true && dayNow ==
dayFromKeyboard.toInt() && hourNow == hourFromKeyboard.toInt() &&
minuteNow == minuteFromKeyboard.toInt() && secondNow >=
firstDurationFromKeyboard.toInt() && secondNow <=
secondDurationFromKeyboard.toInt()) {
    // running text right to left
    for (int i = 50; i >= -45; i--) {
      matrix.fillScreen(0);
      matrix.setCursor(i, 6);
      matrix.print(str);
      matrix.write();
      delay(55);
    }
  } else if (checkEnteredValueEnterAlarmTwo == true && dayNow ==
dayFromKeyboard2.toInt() && hourNow == hourFromKeyboard2.toInt() &&
minuteNow == minuteFromKeyboard2.toInt() && secondNow >=
firstDurationFromKeyboard2.toInt() && secondNow <=
secondDurationFromKeyboard2.toInt()) {
    // running text right to left
    for (int i = 50; i >= -100; i--) {
      matrix.fillScreen(0);
      matrix.setCursor(i, 6);
      matrix.print(str);
      matrix.write();
      delay(55);
    }
  } else if (checkEnteredValueEnterAlarmThree == true && dayNow ==
dayFromKeyboard3.toInt() && hourNow == hourFromKeyboard3.toInt() &&
minuteNow == minuteFromKeyboard3.toInt() && secondNow >=
firstDurationFromKeyboard3.toInt() && secondNow <=
secondDurationFromKeyboard3.toInt()) {
    // running text right to left
    for (int i = 50; i >= -50; i--) {
```

```
      matrix.fillScreen(0);
      matrix.setCursor(i, 6);
      matrix.print(str);
      matrix.write();
      delay(55);
    }
  } else {
    matrix.print(str);
    matrix.write();
    matrix.fillScreen(0);
  }
}

void handleLightSensorAndBrightness() {
  // changes brightness according to light sensor
  if (analogRead(lightSensor) < 100) {
    // terang banget
    matrix.setIntensity(10);
  } else if (analogRead(lightSensor) < 200) {
    // terang
    matrix.setIntensity(8);
  } else if (analogRead(lightSensor) < 500) {
    // normal
    matrix.setIntensity(5);
  } else if (analogRead(lightSensor) < 800) {
    // gelap
    matrix.setIntensity(3);
  } else {
    // gelap banget
    matrix.setIntensity(0);
  }
}

void setMatrixDisplayOrientation() {
  // Adjust to your own needs
  //  matrix.setPosition(0, 0, 0); // The first display is at <0, 0>
  //  matrix.setPosition(1, 1, 0); // The second display is at <1,
0>
  //  matrix.setPosition(2, 2, 0); // The third display is at <2, 0>
  //  matrix.setPosition(3, 3, 0); // And the last display is at <3,
0>
  //  ...
  //  matrix.setRotation(0, 2);    // The first display is position
upside down
  //  matrix.setRotation(3, 2);    // The same hold for the last
display
  matrix.setRotation(0, 1);
  matrix.setRotation(1, 1);
```

```
  matrix.setRotation(2, 1);
  matrix.setRotation(3, 1);
}

void printDigits(int digits) {
  // utility function for digital clock display: prints preceding
colon and leading 0
  Serial.print(':');
  if (digits < 10)
    Serial.print('0');
  Serial.print(digits);
}

void handleSetClockOrDate(String enteredValue) {
  if (enteredValue == "enteredValueEnter") {
    strcat(enteredValueEnter, tempStr);
    Serial.println(enteredValueEnter);

    // grab hour,minute,second from enteredValueEnter
    hourFromKeyboard = String(enteredValueEnter).substring(0, 2);
    minuteFromKeyboard = String(enteredValueEnter).substring(2, 4);
    secondFromKeyboard = String(enteredValueEnter).substring(4, 7);
    Serial.println(hourFromKeyboard);
    Serial.println(minuteFromKeyboard);
    Serial.println(secondFromKeyboard);

    if (!(hourFromKeyboard.length() == 0) &&
!(minuteFromKeyboard.length() == 0) && !(secondFromKeyboard.length()
== 0)) {
      checkEnteredValueEnter = true;
      Serial.println("defined");
    } else {
      Serial.println("hour is undefined");
    }


    // end of input
    strcpy(tempStr, "");
    strcpy(enteredValueEnter, "");
    matrix.fillScreen(0);
  } else if (enteredValue == "enteredValueBracket") {
    strcat(enteredValueBracket, tempStr);
    Serial.println(enteredValueBracket);

    // grab day,month,year from enteredValueBracket
    dayFromKeyboard = String(enteredValueBracket).substring(0, 2);
    monthFromKeyboard = String(enteredValueBracket).substring(2, 4);
    yearFromKeyboard = String(enteredValueBracket).substring(4, 8);
    Serial.println(dayFromKeyboard);
```

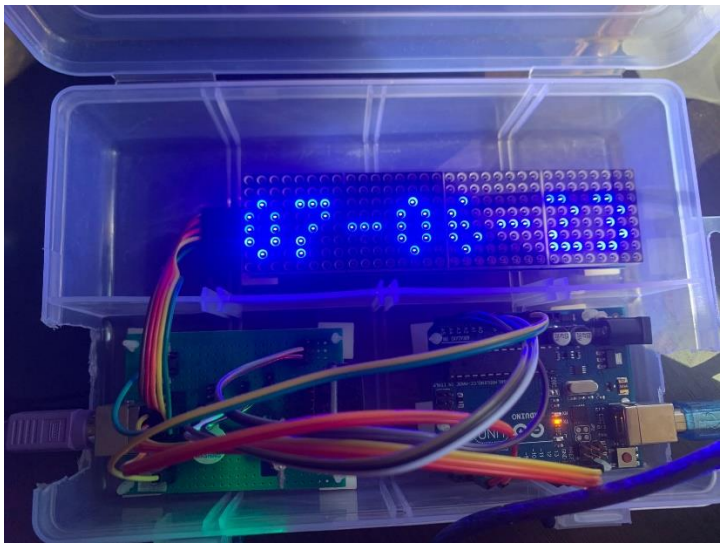
```
    Serial.println(monthFromKeyboard);
    Serial.println(yearFromKeyboard);

    if (!(dayFromKeyboard.length() == 0) &&
!(monthFromKeyboard.length() == 0) && !(yearFromKeyboard.length() ==
0)) {
      checkEnteredValueBracket = true;
      Serial.println("defined");
    } else {
      Serial.println("hour is undefined");
    }


    // end of input
    strcpy(tempStr, "");
    strcpy(enteredValueBracket, "");
    matrix.fillScreen(0);
  } else if (enteredValue == "enteredValueEnterAlarm") {
    strcat(enteredValueEnterAlarm, tempStr);
    Serial.println(enteredValueEnterAlarm);
    if (checkAlarmOneStart == true) {
      // grab day,hour,minute,firstDuration,secondDuration from
enteredValueEnterAlarm
      dayFromKeyboard = String(enteredValueEnterAlarm).substring(0,
2);
      hourFromKeyboard = String(enteredValueEnterAlarm).substring(2,
4);
      minuteFromKeyboard =
String(enteredValueEnterAlarm).substring(4, 6);
      firstDurationFromKeyboard =
String(enteredValueEnterAlarm).substring(6, 8);
      secondDurationFromKeyboard =
String(enteredValueEnterAlarm).substring(8, 10);
      Serial.println(dayFromKeyboard);
      Serial.println(hourFromKeyboard);
      Serial.println(minuteFromKeyboard);
      Serial.println(firstDurationFromKeyboard);
      Serial.println(secondDurationFromKeyboard);

      // validate if new variable (enteredValueEnterAlarm) is empty
or not
      if (!(dayFromKeyboard.length() == 0) &&
!(hourFromKeyboard.length() == 0) && !(minuteFromKeyboard.length()
== 0) && !(firstDurationFromKeyboard.length() == 0) &&
!(secondDurationFromKeyboard.length() == 0)) {
        Serial.println("heloooo11111111111");
        checkEnteredValueEnterAlarmOne = true;
        Serial.println("defined");
      } else {
```

```
        Serial.println("undefined");
      }
      checkAlarmOneStart = false;
    } else if (checkAlarmTwoStart == true) {
      // grab day,hour,minute,firstDuration,secondDuration from
enteredValueEnterAlarm
      dayFromKeyboard2 = String(enteredValueEnterAlarm).substring(0,
2);
      hourFromKeyboard2 =
String(enteredValueEnterAlarm).substring(2, 4);
      minuteFromKeyboard2 =
String(enteredValueEnterAlarm).substring(4, 6);
      firstDurationFromKeyboard2 =
String(enteredValueEnterAlarm).substring(6, 8);
      secondDurationFromKeyboard2 =
String(enteredValueEnterAlarm).substring(8, 10);
      Serial.println(dayFromKeyboard2);
      Serial.println(hourFromKeyboard2);
      Serial.println(minuteFromKeyboard2);
      Serial.println(firstDurationFromKeyboard2);
      Serial.println(secondDurationFromKeyboard2);

      // validate if new variable (enteredValueEnterAlarm) is empty
or not
      if (!(dayFromKeyboard2.length() == 0) &&
!(hourFromKeyboard2.length() == 0) && !(minuteFromKeyboard2.length()
== 0) && !(firstDurationFromKeyboard2.length() == 0) &&
!(secondDurationFromKeyboard2.length() == 0)) {
        Serial.println("heloooo2222222222");
        checkEnteredValueEnterAlarmTwo = true;
        Serial.println("defined");
      } else {
        Serial.println("undefined");
      }
      checkAlarmTwoStart = false;
    } else if (checkAlarmThreeStart == true) {
      // grab day,hour,minute,firstDuration,secondDuration from
enteredValueEnterAlarm
      dayFromKeyboard3 = String(enteredValueEnterAlarm).substring(0,
2);
      hourFromKeyboard3 =
String(enteredValueEnterAlarm).substring(2, 4);
      minuteFromKeyboard3 =
String(enteredValueEnterAlarm).substring(4, 6);
      firstDurationFromKeyboard3 =
String(enteredValueEnterAlarm).substring(6, 8);
      secondDurationFromKeyboard3 =
String(enteredValueEnterAlarm).substring(8, 10);
```

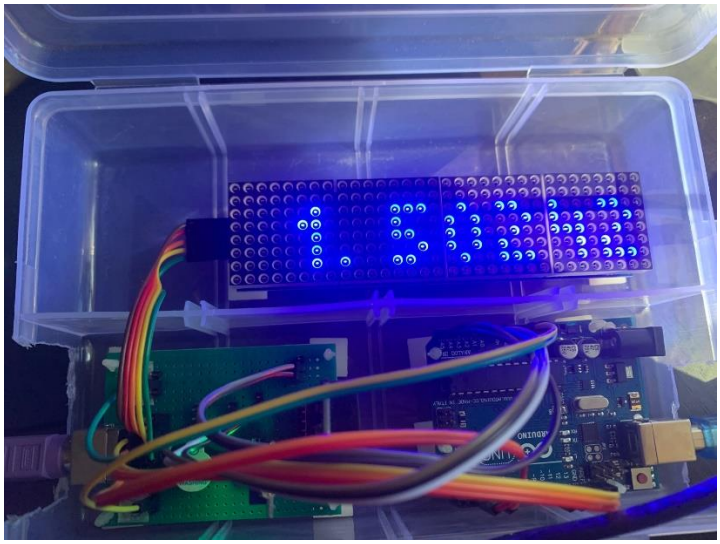
```
      Serial.println(dayFromKeyboard3);
      Serial.println(hourFromKeyboard3);
      Serial.println(minuteFromKeyboard3);
      Serial.println(firstDurationFromKeyboard3);
      Serial.println(secondDurationFromKeyboard3);

      // validate if new variable (enteredValueEnterAlarm) is empty
or not
      if (!(dayFromKeyboard3.length() == 0) &&
!(hourFromKeyboard3.length() == 0) && !(minuteFromKeyboard3.length()
== 0) && !(firstDurationFromKeyboard3.length() == 0) &&
!(secondDurationFromKeyboard3.length() == 0)) {
        Serial.println("heloooo333333333333333333333");
        checkEnteredValueEnterAlarmThree = true;
        Serial.println("defined");
      } else {
        Serial.println("undefined");
      }
      checkAlarmThreeStart = false;
    }

    // end of input
    strcpy(tempStr, "");
    strcpy(enteredValueEnterAlarm, "");
    matrix.fillScreen(0);
  } else if (enteredValue == "enteredValueBracketAlarm3") {
    strcat(enteredValueEnterAlarm, tempStr);
    strcpy(alarmThree, enteredValueEnterAlarm);
    Serial.println(alarmThree);

    // end of input
    strcpy(tempStr, "");
    strcpy(enteredValueEnterAlarm, "");
    matrix.fillScreen(0);
  }
}
```

- Hasil display

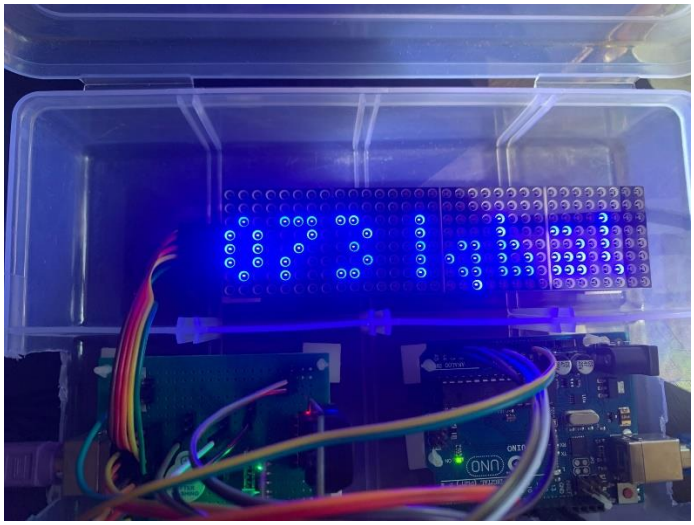
    - clock, yang dimana pada saat detik 10, 13 dan 40, 43 akan tampil kalender dan suhu



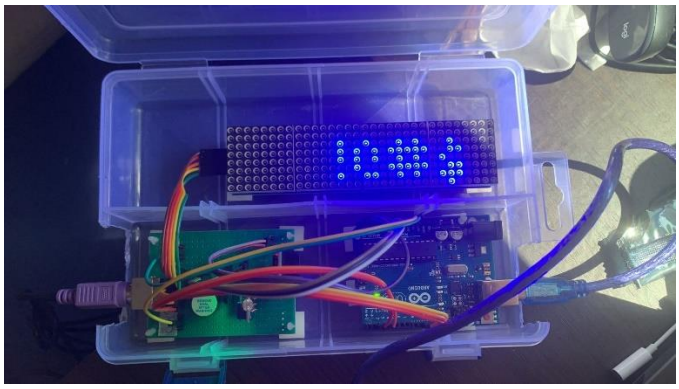
- display pada saat alarm 1 bernyala



- display pada saat alarm 2 bernyala



- display pada saat alarm 3 bernyala (menampilkan simbol !@#$)



V. KESIMPULAN

Walaupun fitur utama sudah saya kerjakan, hasil akhirnya masih memiliki beberapa kekuranga, seperti:

- Durasi alarm yang diset tidak sepenuhnya akurat karna display menunggu scrolling sepenuhnya sblm mematikan alarm tersebut.

- Pada saat mode set alarm 3.2 apabila melakukan enter empty string “” akan tercacat menjadi string yang akan dioutput pada alarm ketiga nanti.

- Saat setting clock/date, seharusnya input tidak boleh lebih dari 6 digit, tetapi user sekarang dapat melakukan lebih dari 6 digit.

- LM35 tidak stabil.

- Saat mode input, display tidak kedap kedip.

- Pada saat modeSet untuk set semua alarm dan set clock/date biasa, apabila input dari keyboard melebihi batas dari display dotmatrix, input tidak kelihatan, menyulitkan user untuk melakukan penyetelan.