EEE 416 Microprocessors & Embedded Systems Laboratory
July 2023 Level-4 Term-1 Labgroup-C2
Final Project Demonstration

Development of an IOT based Bangla Calendar Clock 3.0

SUBMITTED BY – GROUP 06(C2)

Ameer Hamja Ibne Jamal	Fahim Shahriar Anim	Yeasir Arafat Prodhan	U Mong Sain Chak
1906177	1906178	1906191	1906195

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

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1. Abstract

➢ The basic goal of our project is to incorporate *Time, Weekdays and Bangla Dates* into a unique hardware clock with efficient power management system.

➢ The time and dates will be automatically synchronized with the standard time over the internet at regular intervals since the time synchronization is based on the idea of the Internet of Things.

1. Abstract

➢ Additionally, a Real Time Clock module will ensure that the clock operates in offline mode.

2. Background

Bengali language has a heritage of following its own calendar since ancient times. There have been several attempts to design unique Bangla fonts for digital clock displays.

Several eminent researchers attempted to incorporate a font into segmented displays; nevertheless, the displays were far too complicated.

Their attempt to enhance the design by utilizing an 8x8 dot matrix display turned out to be successful to depict Bangla digits but lacked the adaptability of displaying the complete Bangla date.

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2. Background

In this project, we present a further enhanced cost-effective device large enough to accommodate

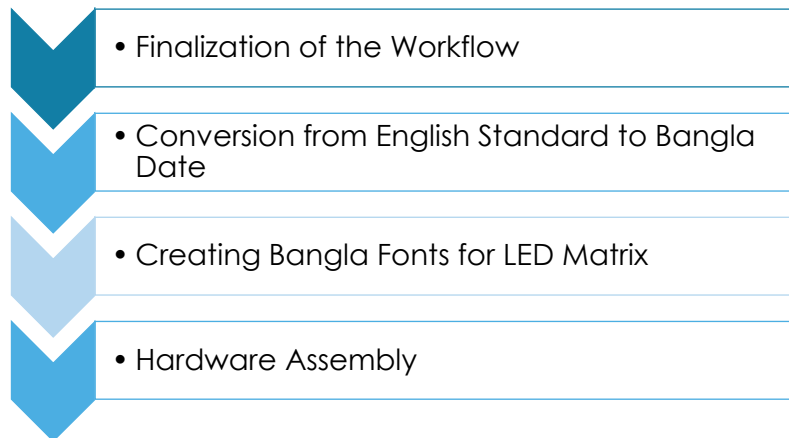**Bangla Date** — According to Bangla Year System

Time — In Bangla digits

Day of the Week — According to Bangla/Standard International Weekday

without using any scroll / fade with advanced power management system with a personalized Bangla font.

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3.1 Design: Problem Formulation (PO(b))
3.1.2 Formulation of Problem

- Finalization of the Workflow
- Conversion from English Standard to Bangla Date
- Creating Bangla Fonts for LED Matrix
- Hardware Assembly

3.1 Design: Problem Formulation (PO(b))
3.1.3 Analysis: Proposed Workflow

Scans and connects to an available open Wi-Fi network or connect to a secure network with appropriate credentials.

Sends API request for the English Time and Date and records the data.

Displays the Appropriate Datas on the LED Matrix.

Periodically refreshes the display with new time and date from the RTC module and syncs with the Internet Provided Date and Time.

In case of a Failure to Connect with the Wi-Fi Signal or to receive the requested data due to network unavailability, the controller fetches the previously recorded data from the RTC module and displays it on the LED matrix until the next sync event.

3.2 Design Methods (PO(a))

Components Needed:

Name	Quantity
Max 7219 LED Display	4
DS1302 Clock Module	1
ESP 8266 wi-fi module	1
Arduino Uno/Nano	1
Battery CR 2032	1
Voltage Regulator	1
AC-DC Adapter	1

3.2 Design Methods (PO(a))

Microcontroller Used

Arduino Uno R3

The Arduino Uno R3 Standard-Quality Edition

- Micro-controller : ATmega328.
- Operating Voltage : 5V.
- Input Voltage (recommended) : 7-12V.
- Digital I/O Pins : 14 (of which 6 provide PWM output).
- Analog Input Pins : 6

3.2 Design Methods (PO(a))

MAX7219 4 Channel Dot Matrix Display Panel

- Driver Chip: MAX7219
- Input Voltage: 3.7 to 5.3 V
- Input Current: 320 mA
- Display Dimensions: 32x32x6 (LxWxH) mm
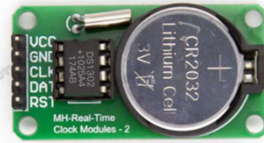
DS1302 Real Time Clock Module

- The DS1302 trickle-charge timekeeping chip module with battery backup
- A real-time clock/calendar and 31 bytes of static RAM.
- Communicates with a microprocessor via a simple serial interface.
- Real-time clock/calendar provides seconds, minutes, hours, day, date, month, and year information.
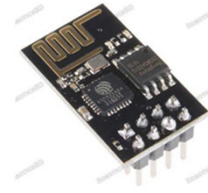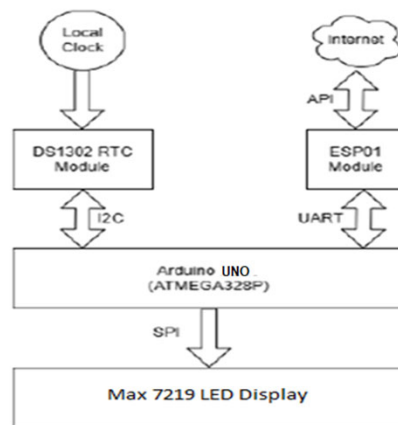
ESP8266 ESP-01 WIFI Wireless Transceiver Send Receive LWIP AP+STA M70

- 802.11 b/g/n Standards
- Wi-Fi Direct (P2P), soft-AP
- 1MB Flash Memory
- Integrated low power 32-bit CPU could be used as an application processor
- A-MPDU & A-MSDU aggregation & 0.4ms guard interval
- Wake up and transmit packets in < 2ms

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3.3 Design: Block Diagram

Block Diagram

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3.3 Design: Circuit Diagram

MAX7219 LED dot matrix display connections

MAX7219 Display	Arduino
VCC	5 V
GND	GND
DIN	11 (MOSI)
CS	3 (SS)
CLK	13 (SCK)
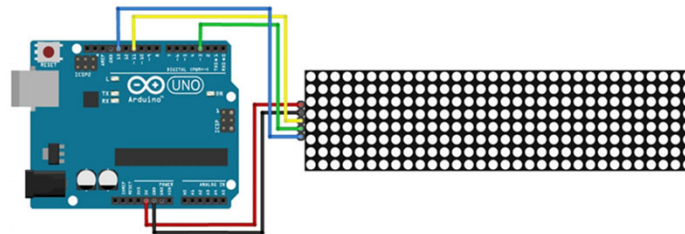
3.3 Design: Circuit Diagram

DS 1302 Real Time Clock Module
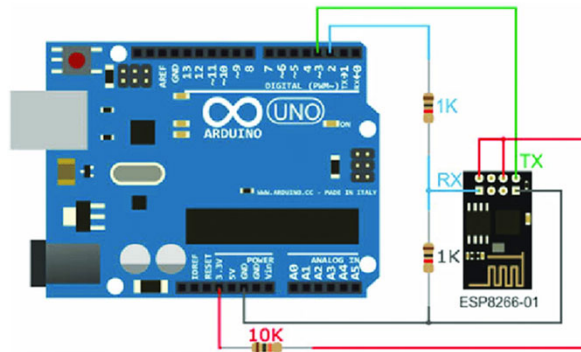

DS1302 RTC Module Pinout

This module has 5 pins:

- **VCC**: Module power supply – 5V
- **GND**: Ground
- **CLK**: Clock pin
- **DAT**: Data pin
- **RST**: Reset (Must be HIGH for active mode / Active High)
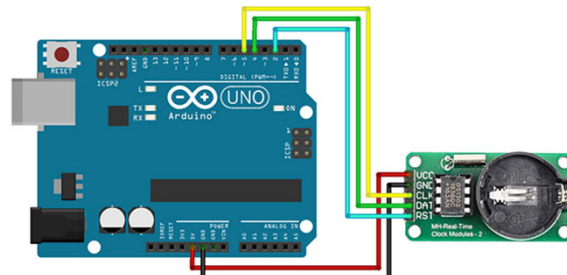
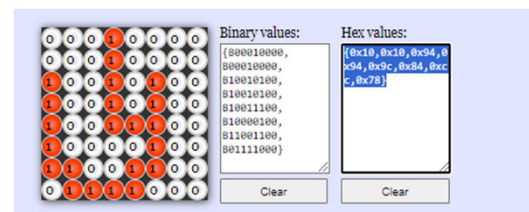# 3.3 Design: Circuit Diagram
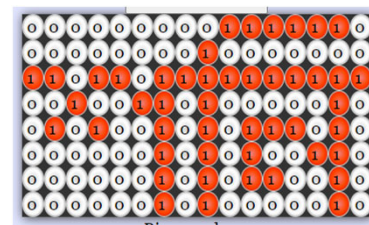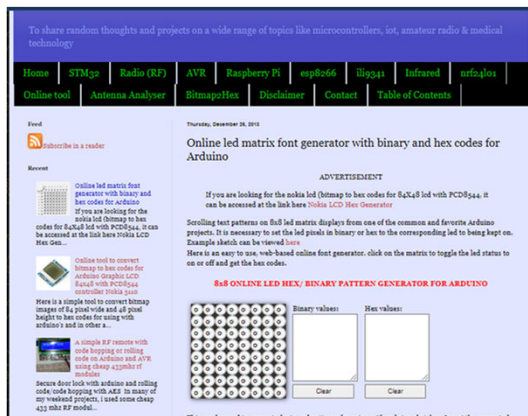
ESP 8266 with Arduino UNO
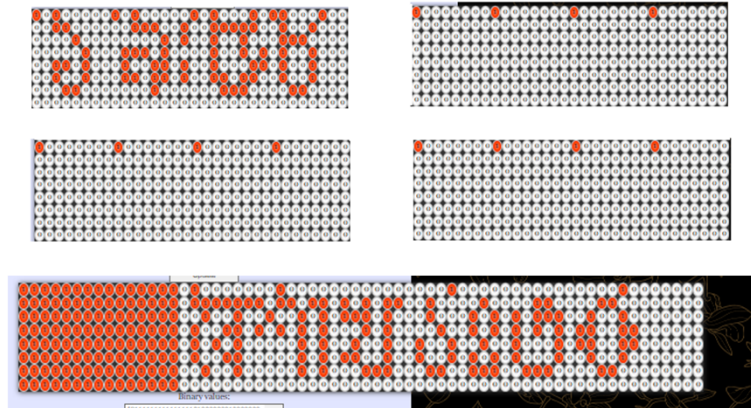
3.4 Design: Simulation

Online LED Matrix Font Generator

3.4 Design: Simulation

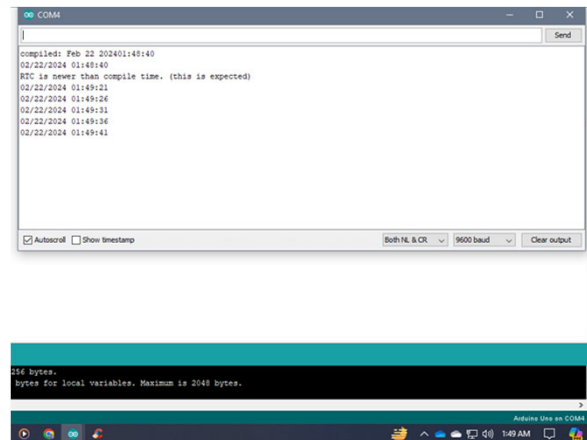**Online LED Matrix Font Generator**

3.4 Design: Simulation

Mapping to Bangla Year System

```
PS C:\Users\Asus\Desktop\EEE 416> .\convert2.exe
5 Falgun 1430 Roj Robibar
```

3.4 Design: Simulation

Interfacing DS 1302 Module

3.4 Design: Code Snippets

Inside conv.h: A Custom Header File for Date Conversion

```
22
23    int EnToBnYear(int year, int month, int date) {
24        int banglaYear = year - 594; // 2017(Gregorian Year) - 594 = 1423(Bangla Year)
25        if ((month > lastMonthIndex) || (month == lastMonthIndex && date > 13)) {
26            banglaYear += 1;
27        }
28        return banglaYear;
29    }
30
31    struct Bdate EnglishToBangla(int gDay, int gMonth, int gYear)
32    {
33        gMonth--;
34        struct Bdate retval;
35        retval.banglaYear = EnToBnYear(gYear, gMonth, gDay);
36
37        int monthDays = totalMonthDays[gMonth];
38        if (gDay <= midMonthDate[gMonth])
39        {
40            if (gMonth == leapYearIndex && isLeapYear(gYear))
41            {
42                monthDays = totalMonthDays[gMonth] + 1;
43            }
44            retval.banglaDate = monthDays + gDay - midMonthDate[gMonth];
45            retval.banglaMonthIndex = gMonth;
46        }
47        else
48        {
49            retval.banglaDate = gDay - midMonthDate[gMonth];
50            retval.banglaMonthIndex = (gMonth + 1) % 12; // banglaMonthsList is 0-based indexed
51        }
```

3.4 Design: Code Snippets


```
Project_LED-Matrix_draft3    conv.h
1323⊟ void drawShape() {
1324
1325⊟      /*setRow(startDev, endDev, r, value)
1326       startDev - from which division you want to display the character.
1327       endDev - at which division you want to stop.
1328       r - no of the row which is to be set.
1329       value - bit map of that row.
1330      */
1331
1332      // time showing display
1333⊟     for (int i = 0; i <= 7; i++) {
1334        //mx.setRow(3, 3, i, hour_0[i]);
1335        mx.setRow(3, 3, i, hour_0[i]);
1336
1337      }
1338      delay(delay_t);
1339⊟     for (int i = 0; i <= 7; i++) {
1340        mx.setRow(2, 2, i, hour_1[i]);
1341      }
1342      delay(delay_t);
1343⊟     for (int i = 0; i <= 7; i++) {
1344        mx.setRow(1, 1, i, mins_0[i]);
1345      }
1346      delay(delay_t);
1347⊟     for (int i = 0; i <= 7; i++) {
1348        mx.setRow(0, 0, i, mins_1[i]);
1349      }
1350      delay(delay_t);
1351
```

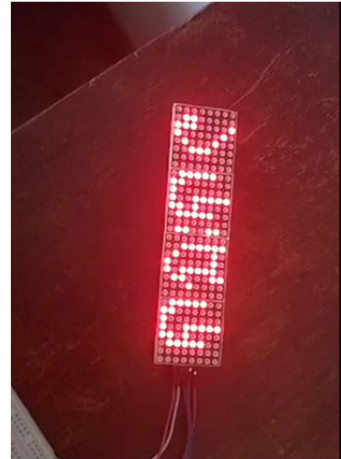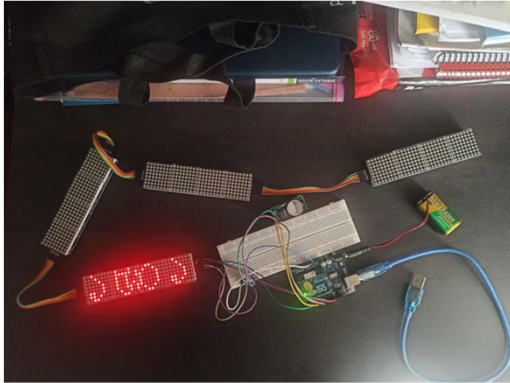**Setting the LED Matrix MAX7219 for showing the Time in hhmm (24 hour format)**

4 Implementation: Demonstration
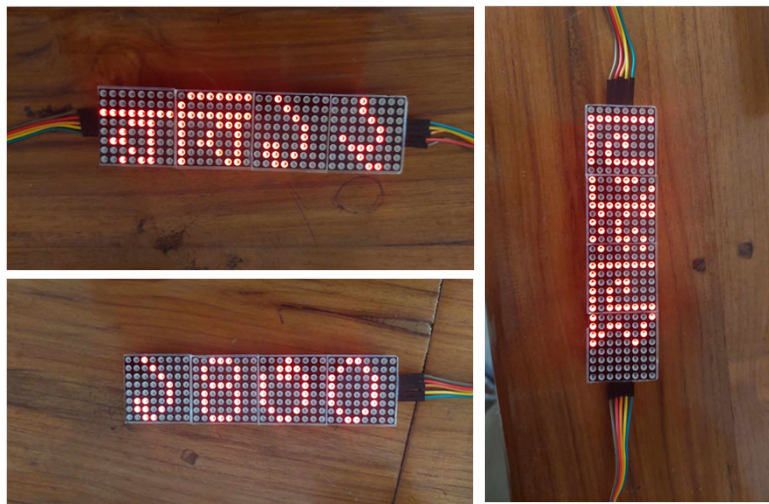
4.1 Implementation: Photo Gallery
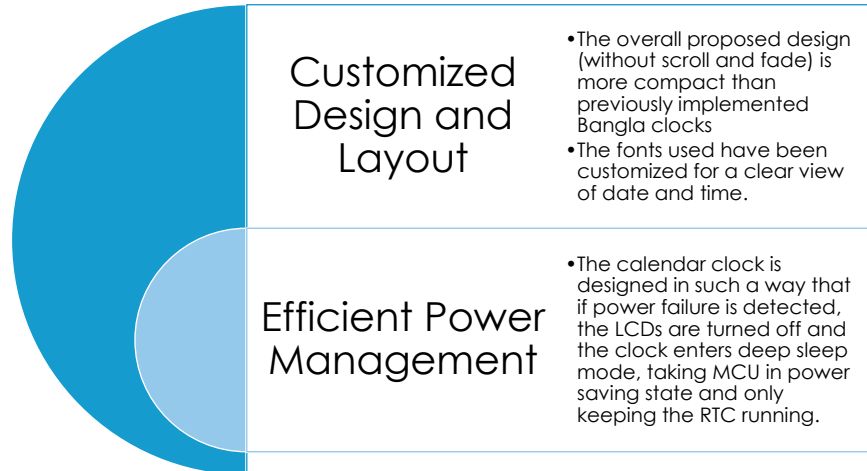
5. Design Analysis and Evaluation

- 5.1 Novelty
- 5.2 Design Considerations (PO(c))
- 5.3 Investigations (PO(d))
- 5.4 Limitations of Tools (PO(e))
- 5.5 Impact Assessment (PO(f))
- 5.6 Sustainability and Environmental Impact Evaluation (PO(g))
- 5.7 Ethical Issues (PO(h))

5.1 Novelty

	Customized Design and Layout	•The overall proposed design (without scroll and fade) is more compact than previously implemented Bangla clocks •The fonts used have been customized for a clear view of date and time.
	Efficient Power Management	•The calendar clock is designed in such a way that if power failure is detected, the LCDs are turned off and the clock enters deep sleep mode, taking MCU in power saving state and only keeping the RTC running.

5.2 Design Considerations (PO(c))

◦ 5.2.1 Considerations to public health and safety

- ◦ Ergonomic design for comfortable use.
- ◦ Electrical safety standards adherence.
- ◦ Minimization of radiation exposure.
- ◦ Clear user instructions for safe operation.
- ◦ Compliance with relevant regulations.
- ◦ Accessibility features for diverse users.
- ◦ Durable construction to prevent hazards.

5.2 Design Considerations (PO(c))

◦ 5.2.2 Considerations to environment

◦ Environmentally friendly materials.
◦ Energy-efficient design.
◦ End-of-life recycling considerations.
◦ Minimal, recyclable packaging.
◦ Lifecycle analysis for eco-friendly practices.
◦ Compliance with environmental regulations.

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5.2 Design Considerations (PO(c))

5.2.3 Considerations to cultural and societal needs

◦ Cultural sensitivity in design.
◦ Localization for regional variations.
◦ Accessibility for diverse users.
◦ Community engagement in development.
◦ Inclusive design principles.
◦ Educational value for cultural awareness.

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5.4 Limitations of Tools (PO(e))

- Technical constraints may limit functionality.
- Compatibility issues with hardware/software.
- Cost constraints impacting tool selection.
- Learning curve affecting development pace.
- Vendor lock-in restricting future flexibility.
- Limited maintenance and support availability.
- Scalability challenges for future growth.
- Customization constraints for specific needs.
- Security vulnerabilities pose risks.
- Regulatory compliance may require additional effort.

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5.5 Impact Assessment (PO(f))

- Global manufacturing of Bangla Calendar Clock can increase cultural recognition of Bangla Language across the globe.

- Reduction in use of materials which are not environment friendly or replacing those with environment friendly materials may set the trends for future mass production.

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5.6 Sustainability Evaluation (PO(g))

- 5.5.1 Assessment of Societal and Cultural Issues
  - Cultural Sensitivity: Consideration of cultural norms and values to ensure the Digital Bangla Clock and Calendar aligns with user preferences and respects cultural heritage.
  - Language Localization: Assessment of language requirements to provide a user interface in Bangla, accommodating linguistic diversity and enhancing accessibility for Bangla-speaking users.
- 5.5.2 Assessment of Health and Safety Issues
  - Electrical Safety: Assessment of electrical components and design to ensure compliance with safety standards, minimizing risks of electric shocks or fire hazards for user protection.
- 5.5.3 Assessment of Legal Issues
  - Regulatory Compliance: Evaluation of legal requirements and standards applicable to electronic devices, ensuring conformity with regulations related to product safety, electromagnetic interference, and environmental impact.

6. Reflection on Individual and Team work

6.1 Individual Contribution of Each Member

6.2 Mode of TeamWork

6.3 Diversity Statement of Team

6.4 Log Book of Project Implementation

6.1 Individual Contribution of Each Member

Teammate ID	Task
1906177	• Conversion of English to Bangla Dates • Hardware Assembly
1906178	• LED mapping of Bangla Fonts • Hardware Assembly
1906191	• Fetching Date/Time Using DS 1302 • Hardware Assembly
1906195	• Fetching Date/Time Using ESP8266 • Hardware Assembly

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6.2 Mode of TeamWork and Diversity

Inclusive Collaboration: Valuing every member's input and celebrating diversity of ideas and backgrounds.

Cross-Functional Teams: Leveraging diverse skill sets for comprehensive problem-solving.

Collaborative Technology: Utilizing tools for seamless communication and inclusivity across locations.

Flexible Work Arrangements: Allowing remote work and flexible hours to accommodate diverse needs.
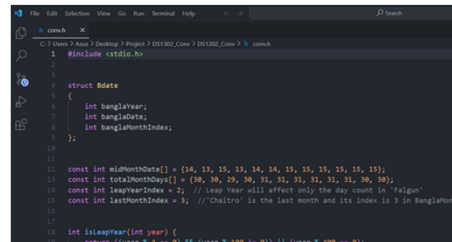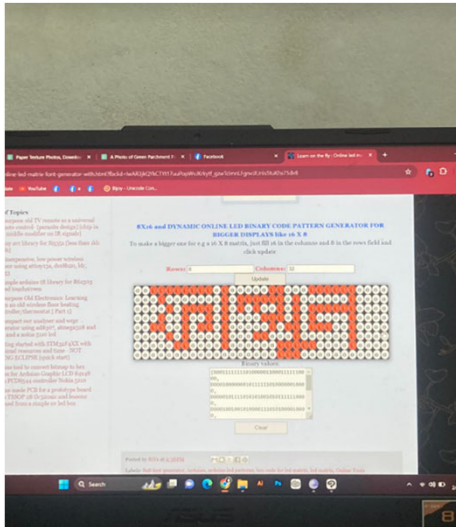
Training and Development: Investing in diversity training to promote understanding and respect.

Accountability and Feedback: Establishing clear expectations and providing regular feedback for all members.

Celebration of Diversity: Recognizing and celebrating unique contributions from diverse team members.

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6.3 Logbook of Project

7 Communication to External Stakeholders (PO(j))

1. Github Link:
   https://github.com/arafatshovon/Bangla-Calender-Clock-3.0

8. Project Management and Cost Analysis (PO(k))

1. Bill of Materials

Name Of the Product	Units ordered	Per Unit Cost	Total cost
Max7219 4-Channel Dot Matrix Display Panel	4	545	2180
DS1302 Real Time Clock MOdule	1	190	190
ESP8266 Wi-Fi module	1	215	215
DC-DC 3A Buck step down Power Supply Module 5-12V to 3.3V	1	160	160
Arduino Uno	1	1069	1069
	2. Calculation of Per Unit Cost of Prototype		3814

4. Timeline of Project Implementation

Topic	Date
Project Selection	December 22, 2023
Workflow finalization	January 10, 2024
Group Discussion 1	January 17, 2024
Components Purchase	January 20, 2024
Group Discussion 2	February 10, 2024

9. Scope for Future Improvisation (PO(I))

Adding a PIR motion sensor can further increase Power Efficiency, ensuring the clock LED's are on only when the PIR senses an object.

Introduction of a voice and small scale sound system can help visually impaired people.

10. References

[1] Sengupta, Nitish. "Land of two rivers: A history of Bengal from the Mahabharata to Mujib." Penguin UK, 2011.

[2] M. S. Arefin, M. A. Dewan, M. I. Khan, and M. S. Islam, "Designing a 24-segment display for Bengali numerical digits and characters," in Proc 3rd International Conference on Electrical and Computer Engineering ICECE, 2004, pp. 549-552.

[3] M.A. Kader, A. Al Monsur, M. Moinuddin, Sayed Allmah Iqbal, Mohammad Shah Alamgir, "Bengali character based digital clock using 8×8 dot matrix display", in Proc of 2nd Int'l Conf on Electrical Engineering and Information & Communication Technology (ICEEICT) 2015.

[4] M.A. Kader, Raquib Uddin, Maher Abdullah, "Bengali character based digital clock using 13 segment LED display", in Proc of 17th International Conference on Computer and Information Technology (ICCIT) 2014.

THANK YOU