Early Bird Alarm Clock

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Introduction

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Seattle, WA
Rocket League

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CE ’22 & MCE ’23

San Jose, CA
Madden

Siddharth Sharma
CE ’23

Seattle, WA
Halo

Division of Work

Team Leads

PCB and Design Work

Movement Module

UI Module

Problem:

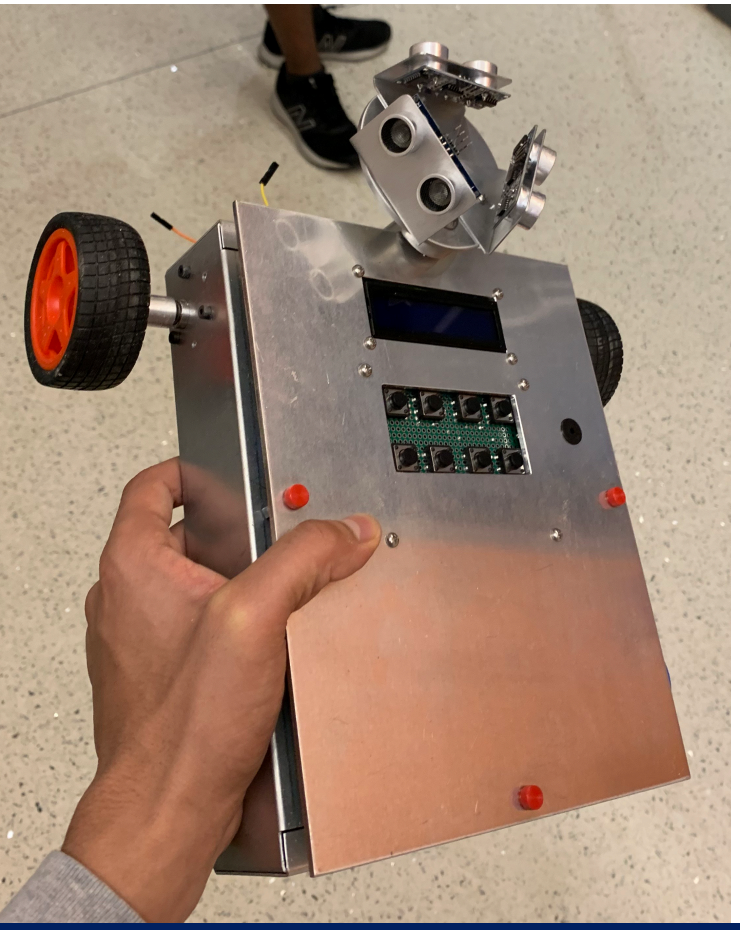
More than one in three adults press the snooze button three times before waking up

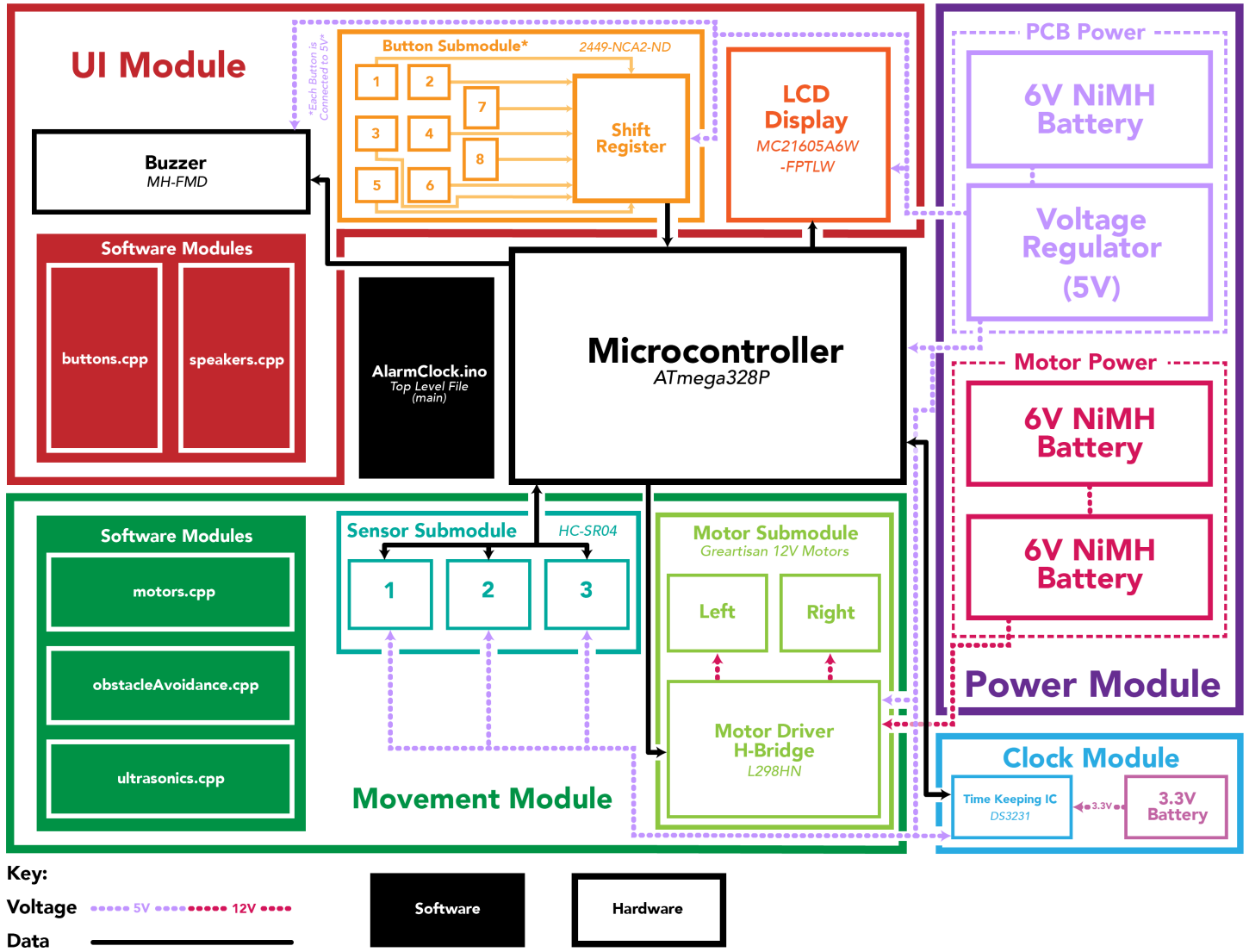
Hitting the Snooze button actually affects your REM Cycles

Objective

- Create an alarm clock that will wake you up!
- It will around the room after the alarm is active
- User will have to catch it and solve a math equation to turn it off

Design

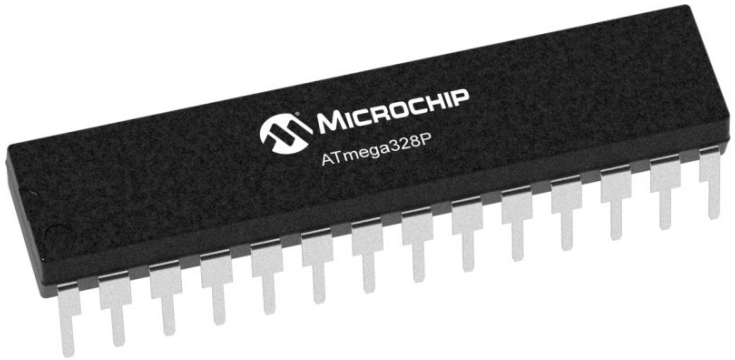



UI Module
Each Button is Connected to 5V
Button Submodule*
2449-NCA2-ND
1
2
3
4
5
6
7
8
Shift Register
LCD Display
MC21605A6W -FPTLW
Buzzer
MH-FMD
Software Modules
buttons.cpp
speakers.cpp
AlarmClock.ino
Top Level File (main)
Microcontroller
ATmega328P
PCB Power
6V NiMH Battery
Voltage Regulator (5V)
Motor Power
6V NiMH Battery
6V NiMH Battery
Power Module
Software Modules
motors.cpp
obstacleAvoidance.cpp
ultrasonics.cpp
Sensor Submodule
HC-SR04
1
2
3
Motor Submodule
Greartisan 12V Motors
Left
Right
Motor Driver H-Bridge
L298HN
Movement Module
Clock Module
Time Keeping IC
DS3231
3.3V
3.3V Battery
Key:
Voltage
5V
12V
Data
Software
Hardware

Design

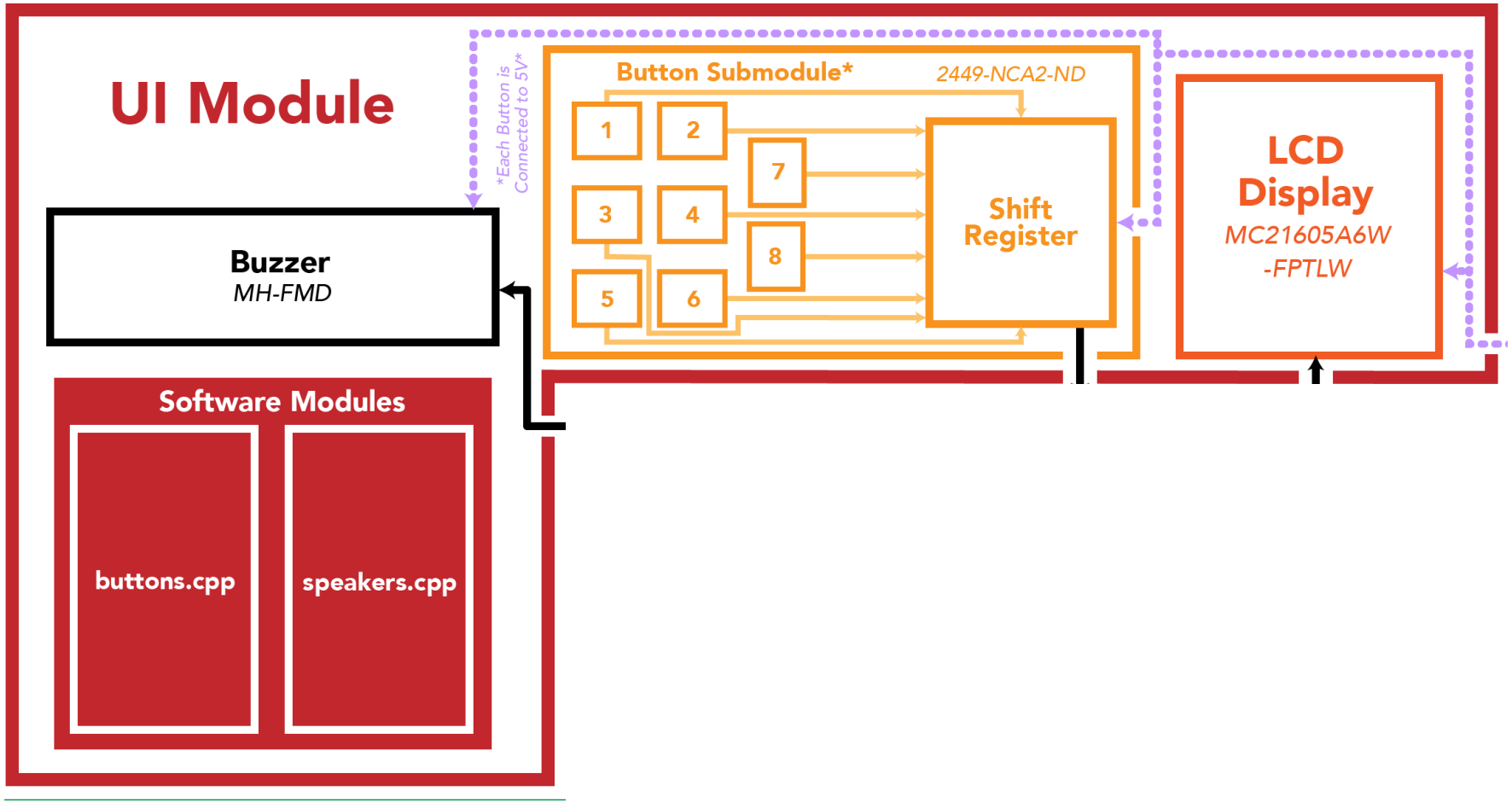
Memory Type: Flash (non-volatile memory)
Memory Size: 32 KB
CPU Speed: 20 MIPS @ 20 MHz
EEPROM: 1 KB

Advantage: Easily programmable



Microcontroller
ATmega328P

Design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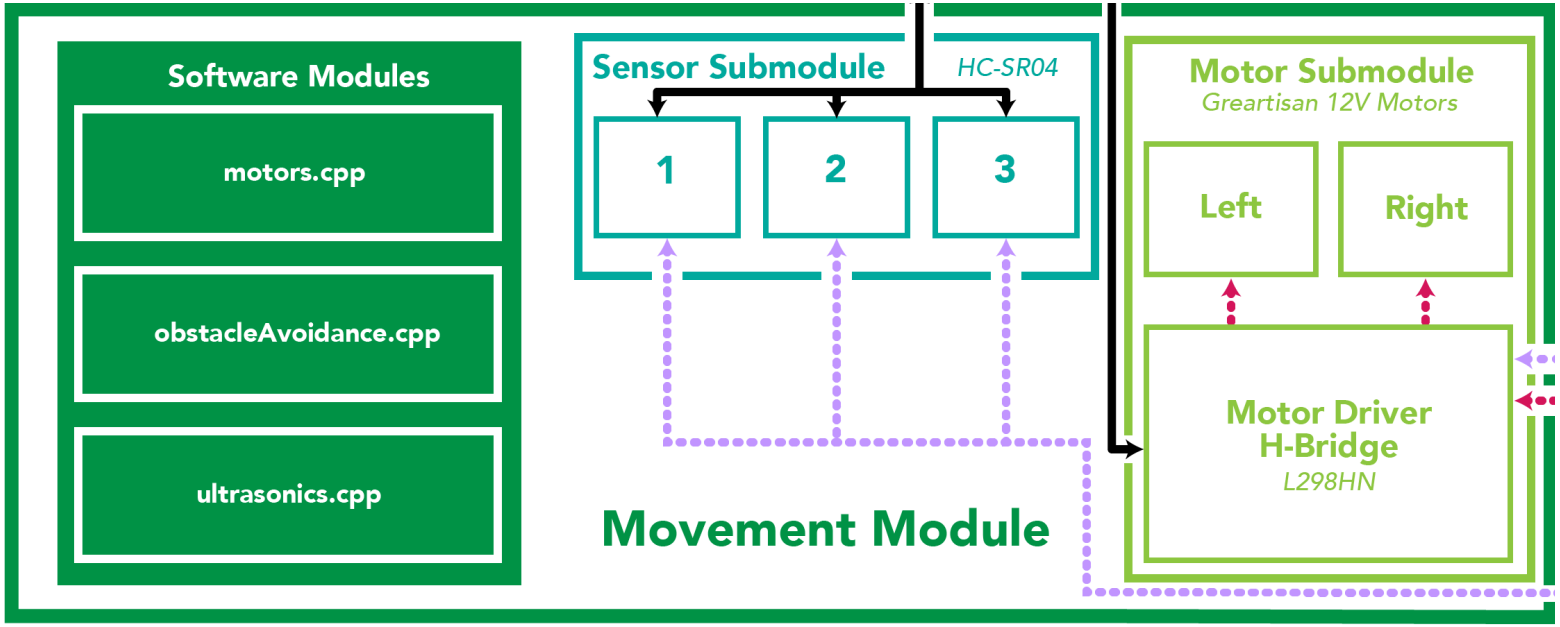
Software Modules
buttons.cpp
speakers.cpp

Design


Software Modules
motors.cpp
obstacleAvoidance.cpp
ultrasonics.cpp
Sensor Submodule
HC-SR04
1
2
3
Movement Module
Motor Submodule
Greartisan 12V Motors
Left
Right
Motor Driver
H-Bridge
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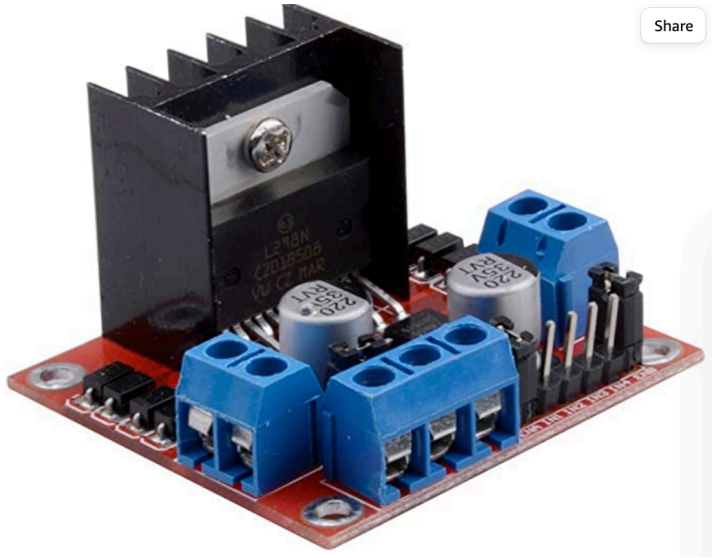
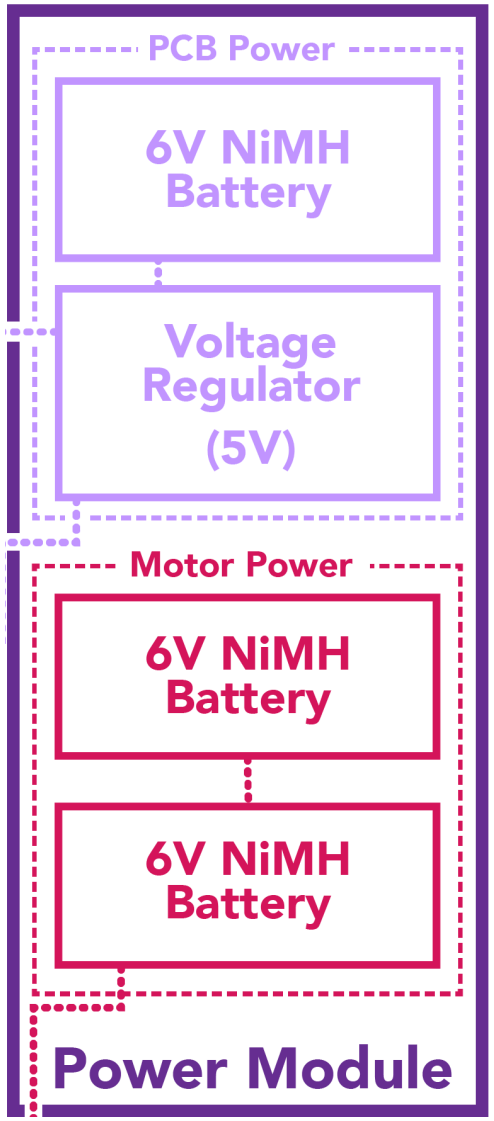
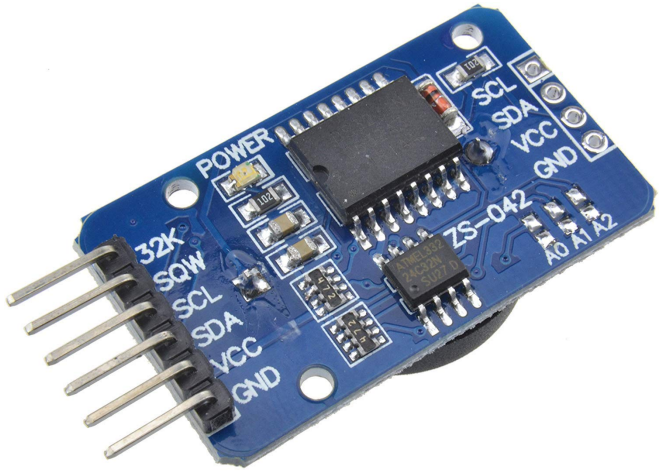
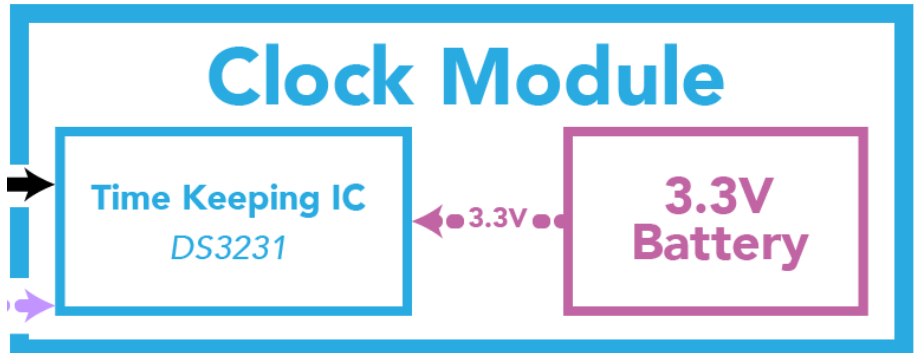

Share

Design


PCB Power
6V NiMH Battery
Voltage Regulator (5V)
Motor Power
6V NiMH Battery
6V NiMH Battery
Power Module

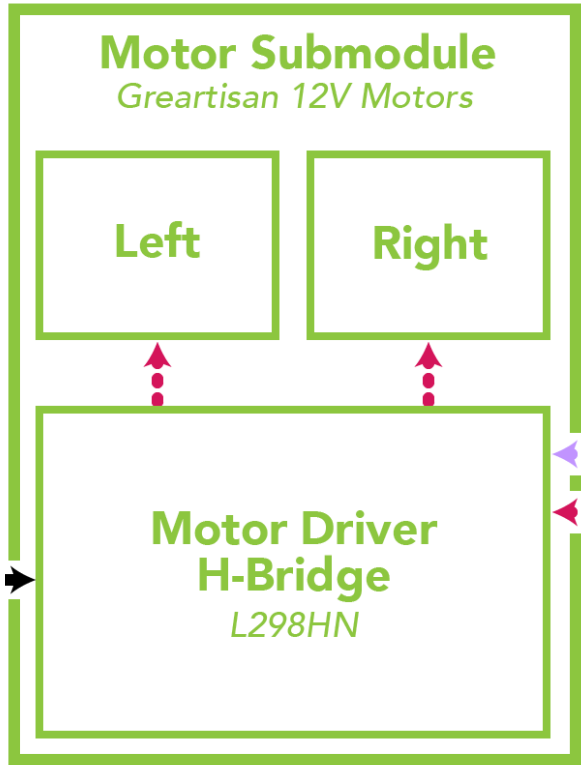
Design


POWER
32K
SQW
SCL
SDA
VCC
GND
SCL
SDA
VCC
GND
ZS-042
A0 A1 A2


Clock Module
Time Keeping IC
DS3231
3.3V
3.3V
Battery

Major Design Choices:

- Motors: Greartisan DC 12V 10RPM
  - Need enough Torque
  - 12V Motors -> need to have RPM
    - Chose 200RPM
  - Gear Box on the motors
  - 2 Leads so it can work with our motor driver



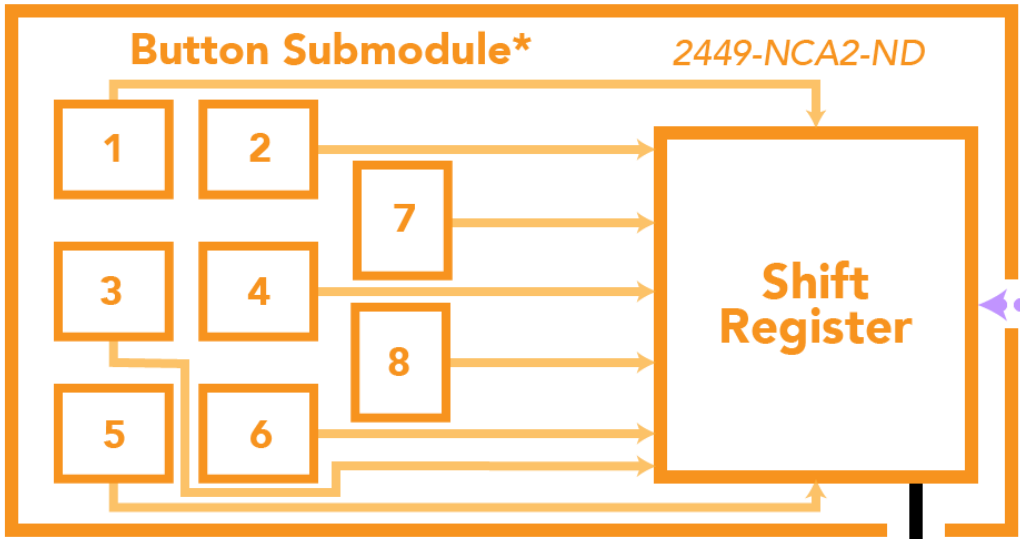
Major Design Choices:

- LCD vs. LED + LCD
  - Made sense to save I/O pins on the Microcontroller since we have to accommodate for sensors, motors, RTC, display, etc.
  - Easy to work with 16x2 display and also RTC
  - Helped with Debugging what was happening
    - saw sensor readings on the LCD display
    - Able to test button readings

LCD Display
MC21605A6W -FPTLW

Major Design Choices:

- Shift Register
  - Once again, needed to save pins
  - Parallel in, Serial out
  - Helps go from 8 inputs to 4 inputs

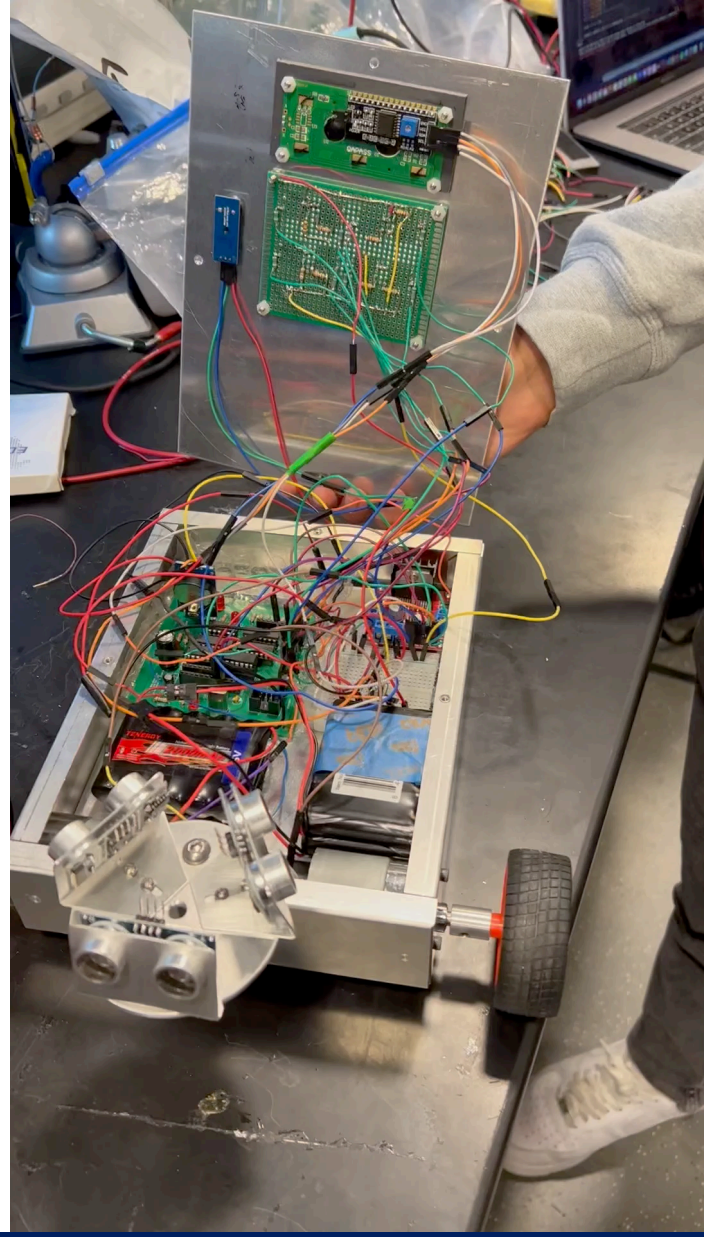


RV Tables:

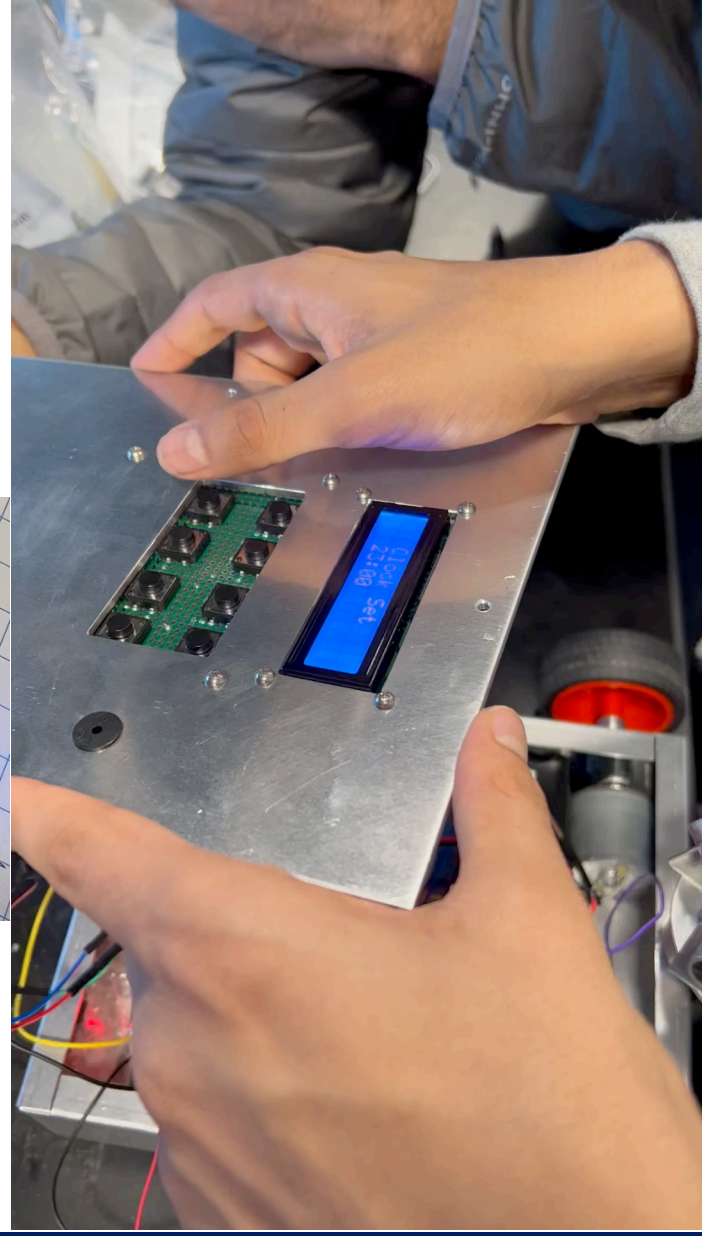
- **Progress is important**
- Helped with testing while working
- Made sure we achieved an objective rather than set a time limit for each thing
- We also worked from the bottom up, made sure we built our way up to the top
- Worked on each thing separately and then put things together

Project Build

- Aluminum Build from Machine Shop
- Wires, wires, wires!
- Turns heavier than 90 deg

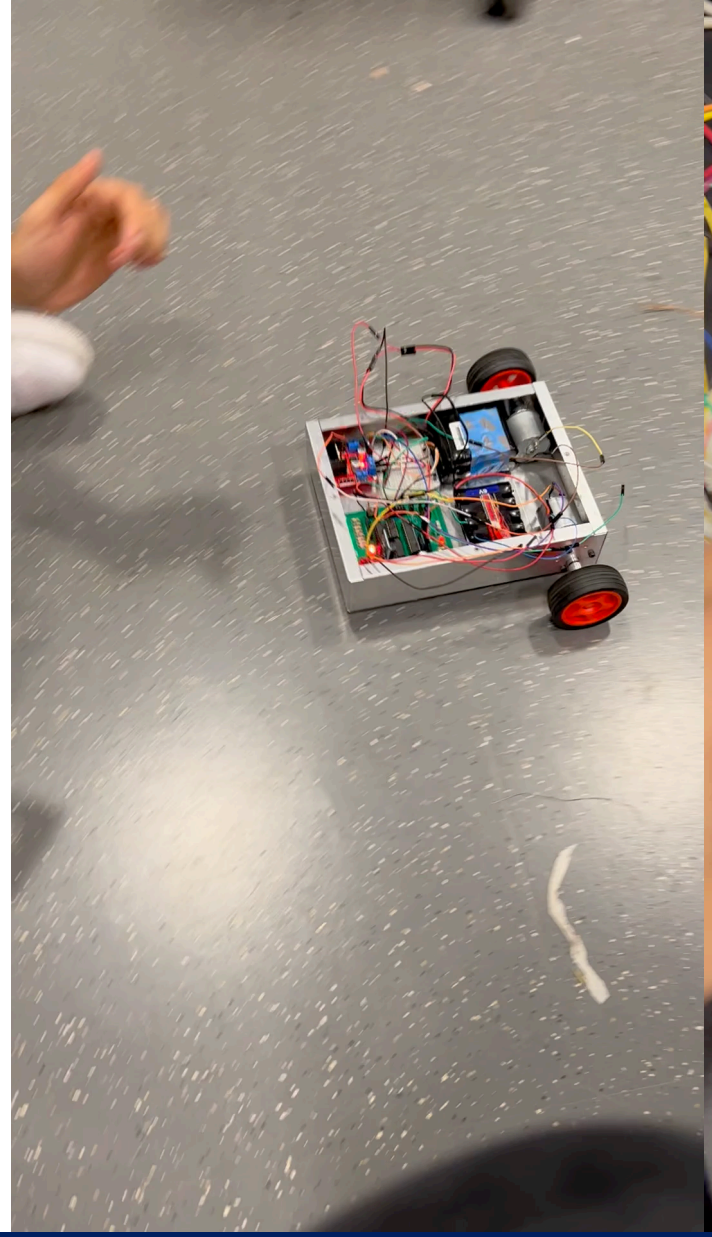


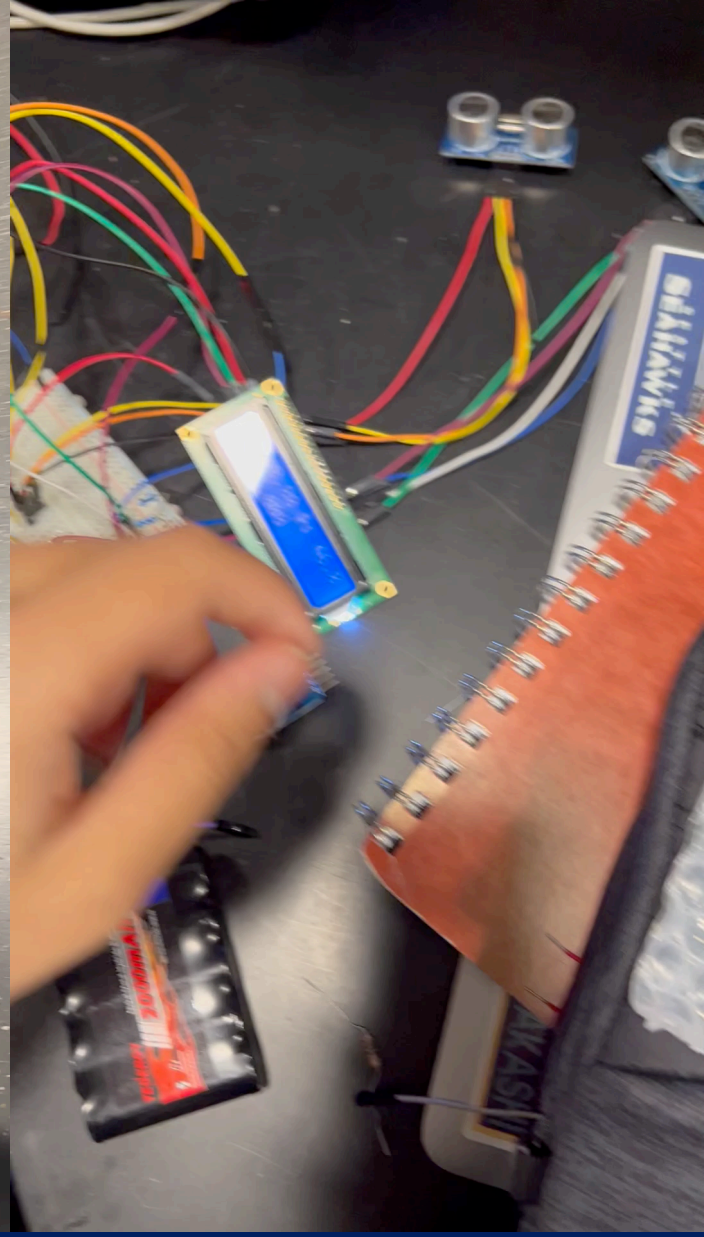
Functional Tests
UI Module



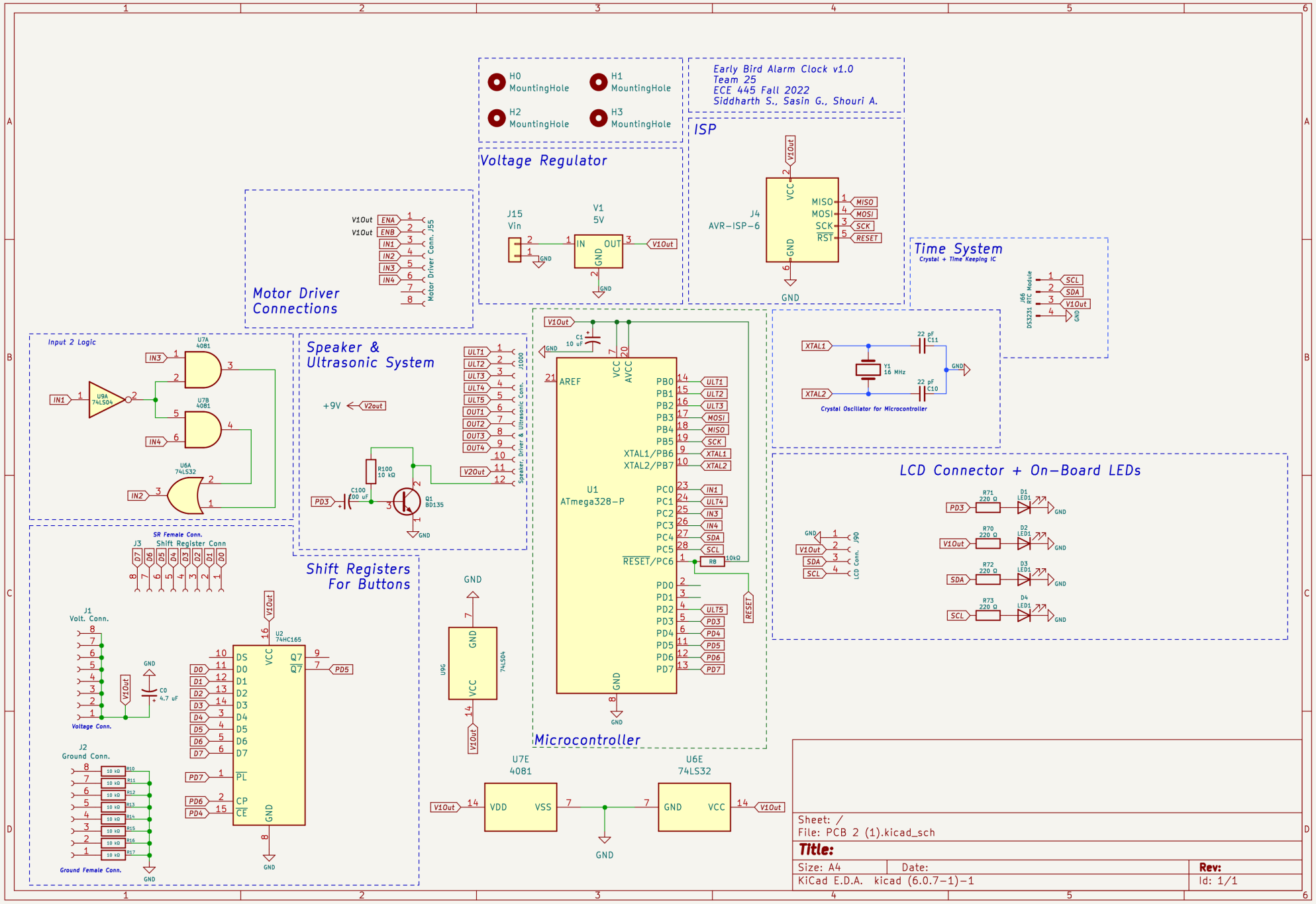
Functional Tests Movement Module

Main issue – shorting issues because of aluminum case were a big thing when debugging, we did not want to risk closing the top with the wires everywhere.





SCHEMATIC


Early Bird Alarm Clock v1.0
Team 25
ECE 445 Fall 2022
Siddharth S., Sasin G., Shouri A.
H0 MountingHole
H1 MountingHole
H2 MountingHole
H3 MountingHole
Voltage Regulator
J15 Vin
V1 5V
IN
OUT
GND
V1Out
ISP
J4 AVR-ISP-6
VCC
MISO
MOSI
SCK
RST
RESET
Motor Driver Connections
V1Out ENA
V1Out ENB
IN1
IN2
IN3
IN4
J55 Motor Driver Conn.
Time System
Crystal + Time Keeping IC
J66 DS3231 RTC Module
SCL
SDA
Input 2 Logic
U7A 4081
U7B 4081
U9A 74LS04
U6A 74LS32
Speaker & Ultrasonic System
+9V
V2out
R100 10 kΩ
C100 100 uF
Q1 BD135
PD3
ULT1
ULT2
ULT3
ULT4
ULT5
OUT1
OUT2
OUT3
OUT4
J1000 Speaker, Driver & Ultrasonic Conn.
C1 10 uF
AREF
VCC
AVCC
U1 ATmega328-P
PB0
PB1
PB2
PB3
PB4
PB5
XTAL1/PB6
XTAL2/PB7
PC0
PC1
PC2
PC3
PC4
PC5
RESET/PC6
PD0
PD1
PD2
PD3
PD4
PD5
PD6
PD7
R8 10kΩ
RESET
Microcontroller
XTAL1
XTAL2
Y1 16 MHz
22 pF C11
22 pF C10
Crystal Oscillator for Microcontroller
LCD Connector + On-Board LEDs
J90 LCD Conn.
R71 220 Ω
R70 220 Ω
R72 220 Ω
R73 220 Ω
D1 LED1
D2 LED1
D3 LED1
D4 LED1
SR Female Conn.
J3 Shift Register Conn
Shift Registers For Buttons
J1 Volt. Conn.
Voltage Conn.
C0 4.7 uF
J2 Ground Conn.
Ground Female Conn.
R10
R11
R12
R13
R14
R15
R16
R17
10 kΩ
U2 74HC165
DS
D0
D1
D2
D3
D4
D5
D6
D7
PL
CP
CE
Q7
U9G 74LS04
U7E 4081
VDD
VSS
U6E 74LS32
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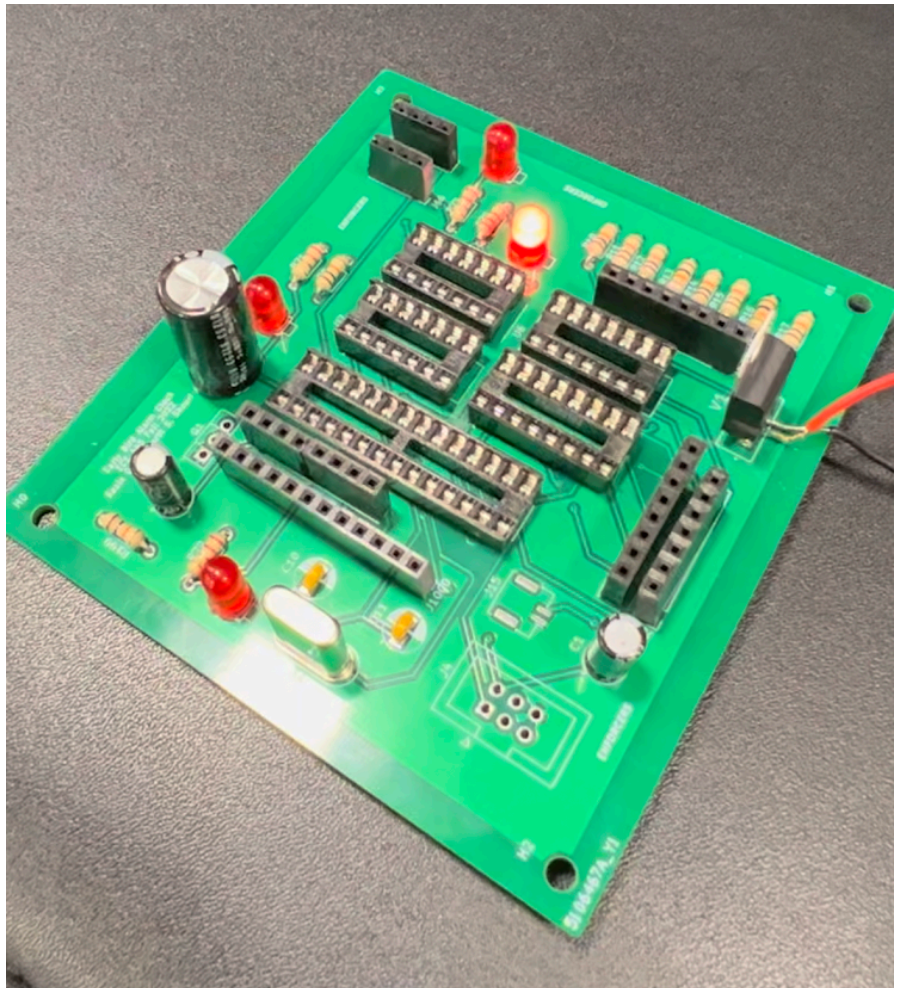
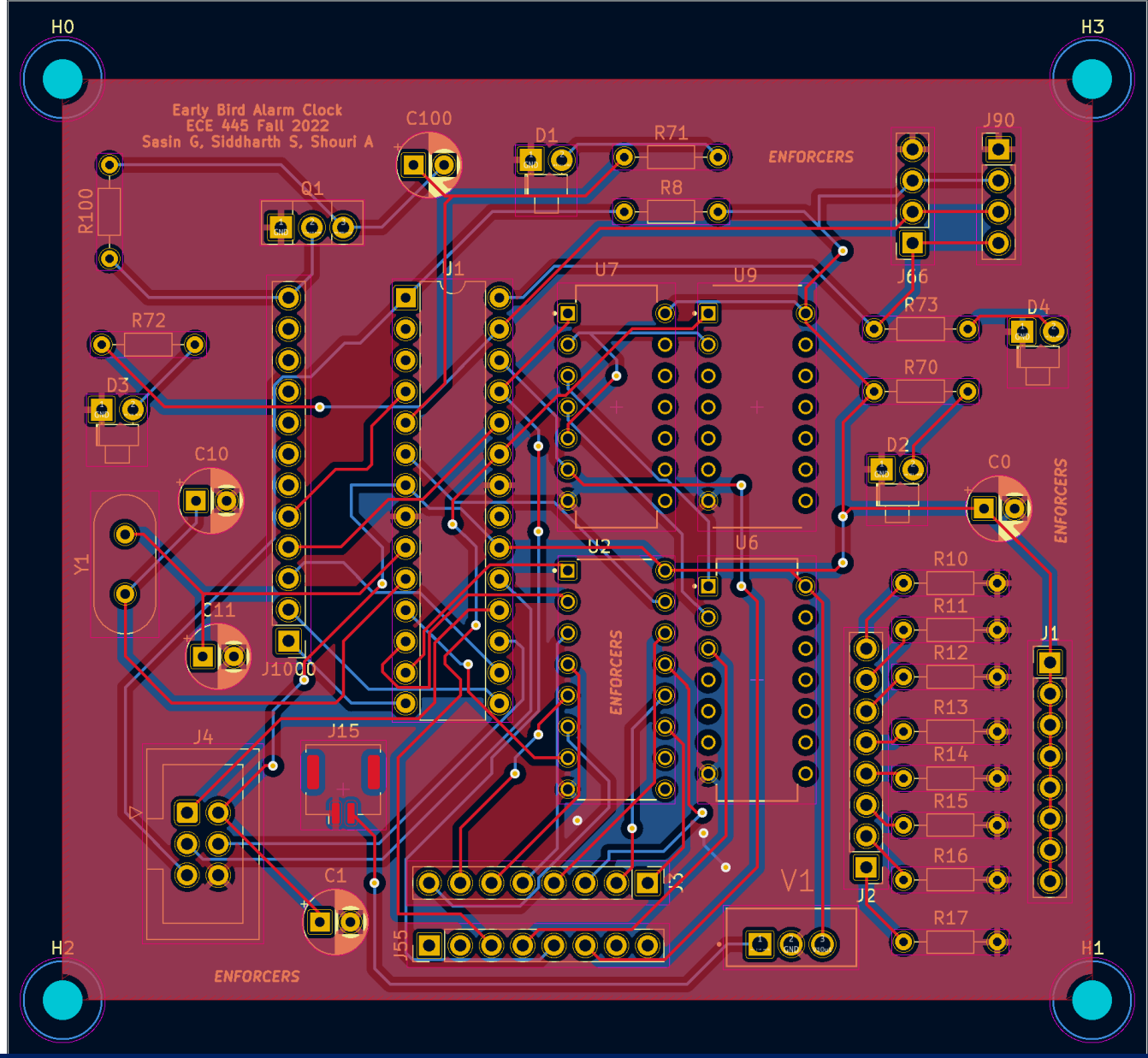
PCB




H0
H3
Early Bird Alarm Clock
ECE 445 Fall 2022
Sasin G, Siddharth S, Shouri A
C100
D1
R71
ENFORCERS
J90
R100
Q1
R8
J1
U7
U9
J66
R72
R73
D4
D3
R70
C10
D2
C0
Y1
U2
U6
R10
C11
R11
J1000
R12
J1
R13
J4
J15
R14
R15
C1
R16
V1
J2
R17
J55
H2
H1

Successes

- PCB Worked first try, definitely some changes could have been made
- Easily “debug”-able – added LEDs to tell which signals are sent
- Sensor and Motors worked well with PCB

Challenges

- Trouble with LCD I2C, Pull up resistors on SDA/SCL
- Wanted to add more V-out ports
- Shift Register
- Communicating with Machine Shop and general deadlines

Conclusion & Revisions

- A few more days!
- All aluminum body was causing shorting issues
- More time to work with UI and interrupts
- Revise movement algorithm
- We all worked together really well and have a good grasp of each aspect of the project
- Meetings were successful as we did not set a time limit for the meeting but rather an objective to tackle at the meeting.

Ethics

- Made sure our car did not go too fast to hurt anyone or anything
- Speaker level was just right as it was loud enough to wake up someone and not hear their ears