CARE-PCR User Manual by Alzter Aquino

1. Introduction to CARE-PCR

1.1. What makes CARE-PCR stand out?

CARE-PCR is a PCR (Polymerase Chain Reaction) machine developed using OpenPCR as a reference. The primary improvement of CARE-PCR over OpenPCR is that it is a standalone device, not requiring an external computer or mobile device for configuration. Additionally, it is battery-operated, allowing it to be used anywhere and anytime. This makes CARE-PCR the ideal thermocycler for extreme remote conditions, perfect for conducting research in remote locations.

1.2. System Overview

CARE-PCR includes the following components:

[Core Heating Loop]
- TES-12704 Peltier
- L298N H-Bridge module
- Arduino MEGA 2560
- Cartridge Heater
- Thermistor

[Connectivity]
- 20x4 LCD Screen
- 4x4 Matrix Keypad
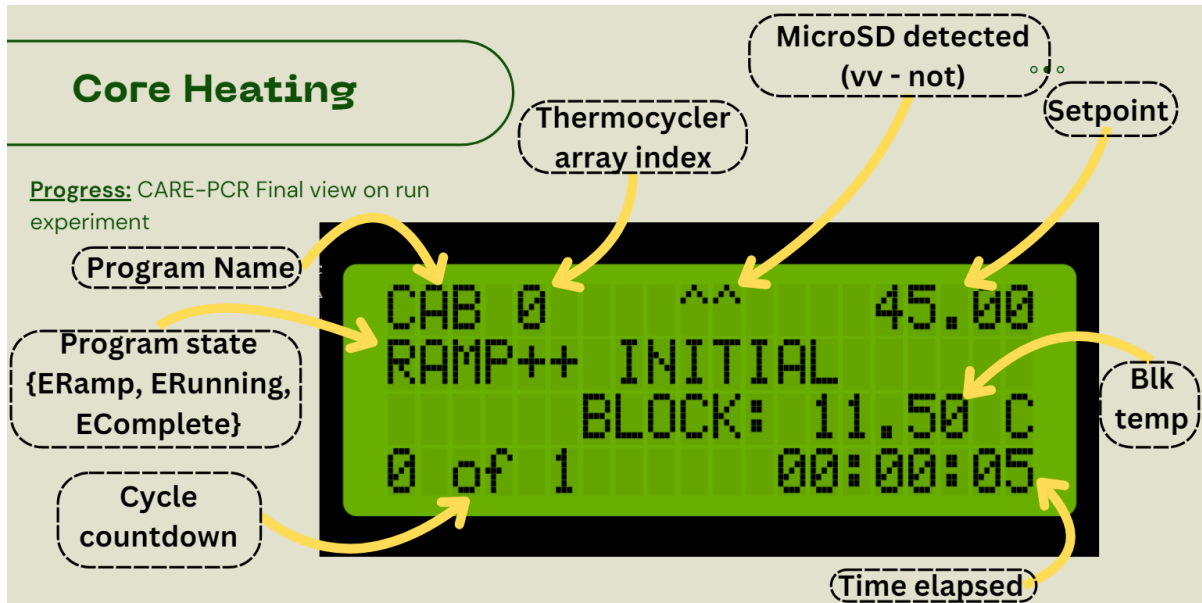- Micro SD card module
- DS1302 RTC module

[Power Module]
- BQ24616EVM
- Swing 5300 4s3p battery pack
- XL4015 Buck converter

[Others]
- CPU cooler
- Heat sink
- 3x3 Aluminum PCR Block (30cm)
- Aluminum adapter plate

1.3. Run Experiment Screen

Core Heating

Progress: CARE-PCR Final view on run experiment

Labels pointing to the display:
- Program Name
- Program state {ERamp, ERunning, EComplete}
- Cycle countdown
- Thermocycler array index
- MicroSD detected (vv - not)
- Setpoint
- Blk temp
- Time elapsed

Display contents:
```
CAB 0        ^^      45.00
RAMP++ INITIAL
         BLOCK: 11.50 C
0 of 1          00:00:05
```

1.4. Keypad

Since the Keypad layout was not changed, use this as a guide for navigating through CARE-PCR. Figure below shows the supposed keypad input layout vs. the actual keypad layout. '>' is forward and '<' is backward. 'ABC' is used for choosing options for navigation.
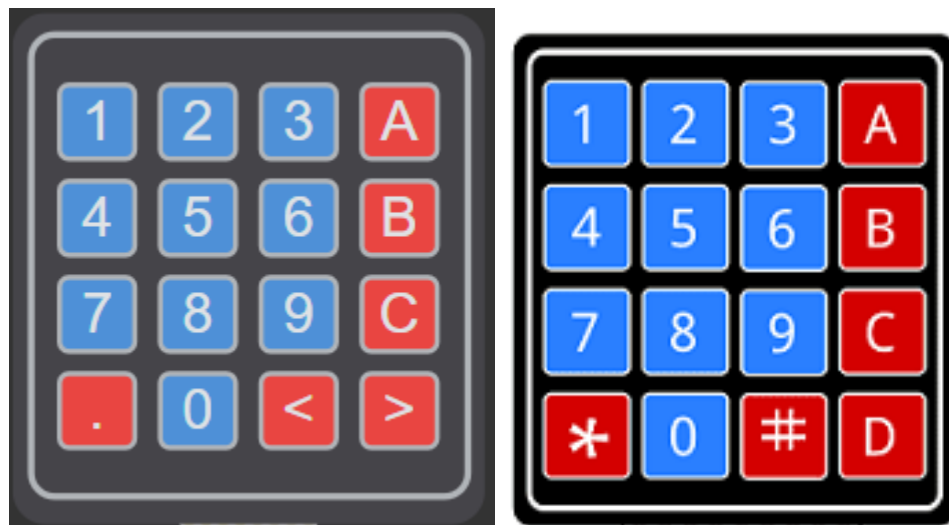
1.5. Thermocycling Parameters

Only 3 experiments can be saved at a time. Once the arduino was restarted, all changes will not be saved.

1.6. Code user flow
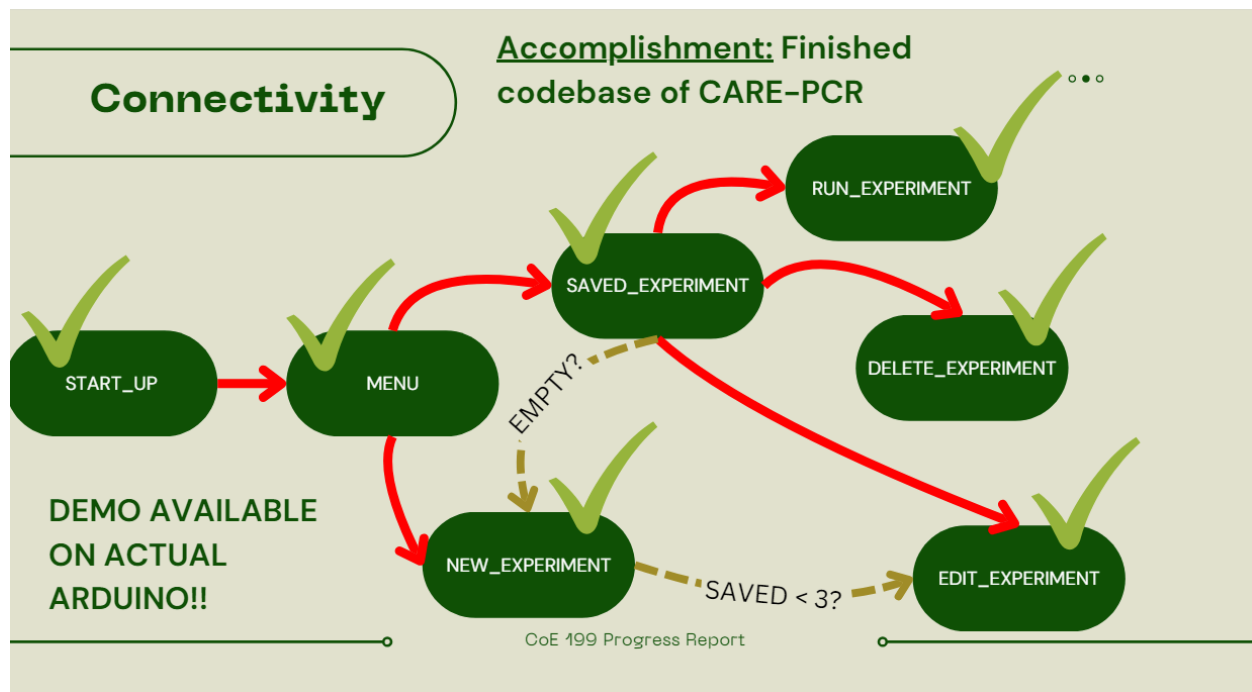
2. Operating Procedure

Disclaimer: CARE-PCR is not yet tested for running a DNA sample. Most likely, it will still cause condensation on its samples as thermocycling operation begins. The limit of the system is also limited up to 80°C.

1. Connect DC Barrel Jack, located at right bottom, to a **4s battery pack**.
2. The device will turn on automatically and the start up sequence will show up on the screen.
3. User will be asked if saved experiments or new experiment (There is one single pre-saved experiment that can be deleted but the device only supports 3 operations)
4. If a new experiment was chosen, thermocycling parameters can be set by the user and after that all experiments will be redirected to this.

5. At the run experiment, stand-by and watch thermocycling.
6. When thermocycling is complete, the figure below will show up. Press '>' or 'D' to proceed at the second figure below. The data will be automatically saved at the micro SD card as 'HHMMSS.csv' where it is the time of the day the thermocycling began.

7. Data can be exported using a micro SD card reader and it is up to you what you will do with the data! We recommend creating a plot into it and creating something like the figure below. It is plotted using matlab.