

BrewManiacEx Manual



Version 0.1 *draft*

Dec. 7 2016

Vito Tai

1.Sensor Configuration

There are two configuration of the BrewManiacEx: single sensor and multiple sensors. Assignment and identifying the sensors before using is necessary for multi-sensor configuration, while it's not necessary for single sensor configuration, in which you have only one sensor and don't have to identify it. You can use one sensor in multiple sensor configuration, but sensor setup is still necessary.

For multi-sensor configuration, the sensor setting must be configured before all other functions.

2.Settings

2.1 PID-PWM

Setting	Values	Description
Constant kP	-100~100	PID parameters (can be auto tuned.)
Constant kI	-100~155	PID parameters (can be auto tuned.)
Constant kD	-100~100	PID parameters (can be auto tuned.)
Sample Time	1500~3500	PID algorithm parameters
WindowSet	4000~7500	PID algorithm parameters. It should be greater than 2x Sample Time
Heat/PWM in Boil	0~100	The default PWM after Boil Point reached.
Sensor Calibration	-5 ~ +5	calibration value of sensor(s)
PID Start	1 ~ 3.5	PID will be applied after the difference of current and setting temperature is smaller than this value. For example, if set point is 65, and PID start is 1.5, then the PID will be applied when the temperature reaches 63.5. Before that, the heating is full-on.

Note1: for multi-sensor configuration, the number of calibration value is the number of sensors.

Note2: PID is used to keep the temperature of mashing only. For boiling stage or the condition that setting point is greater or equal to boiling temperature, the heating is full-on before the boil temperature is reached. After reaching the boil temperature, the heating output is controlled by PWM.

2.2 Unit Parameters

Setting	Values	Description
Temperature Unit	°C/°F	Celsius or Fahrenheit
Disable Delay Start	No/Yes	Yes: Disable Delay Start
Boil Temperature	80-120 C 176-248 F	The temperature regarded as “Boiling”. Note: the setting temperature must be greater or equal to this setting to be regarded as “boiling”. PWM is enabled after the temperature is greater than setting temperature AND Boil temperature.
Pump Cycle	5 ~ 15	
Pump Rest	0 ~ 5	Set this value to NON zero to enable auto pump rest. During mash stages, the pump will run for “Pump Cycle” time and then stop for “Pump Rest” time.
Pump PreMash	OFF/ON	Turn on pump before Mash-in.
Pump on Mash	OFF/ON	
Pump MashOut	OFF/ON	
Pump on Boil	OFF/ON	
Pump Stop Temperature	80-120 C 176-248 F	The temperature to stop pump.
PID Pipe	Passive/ Active	Active: PID control is effective during “Malt-Out”. Passive: No PID temperature control after Mash-out and before “Malt-Out”.
Skip Add	No/Yes	Skip asking “Add Malt”, go direct into first Mashing after “Mash-in” temperature reaches.
Skip Remove	No/Yes	Skip asking “Remove Malt”, go direct into Boiling after mashout.
Skip Iodine	No/Yes	Skip iodine test, go directly to Mashout after last mashing step.
Iodine Time	0-120	The time to wait for iodine test.
Whirlpool	Off/Cool/Hot	The time to run Whirlpool. Off: no whirlpool

		Cool: whirlpool after cooling phase. Hot: whirlpool before cooling phase.
--	--	--

2.3 Sensor Setting

Connect all the sensors, and run sensor setting before all other actions. The maximum number of sensors supported is 5.

There are two steps in sensor setting, **identifying sensors** and assigning **sensor usage**. In the first step, the sensor is identified and assigned to a *number* as its ID. In the second step, the primary sensor for temperature control and the auxiliary sensor reading to be displayed are assigned for each step, including Pre-Mash, Mashing, Boiling, Cooling, Manual mode, and Main screen.

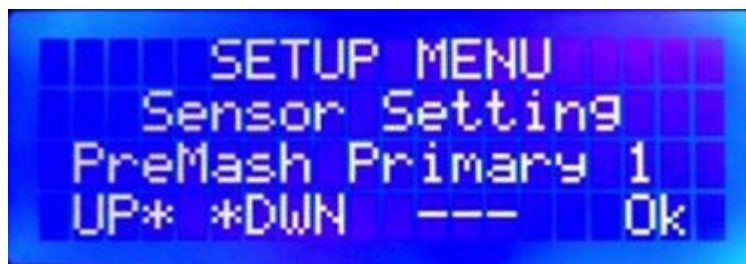
Step 1: assign sensors



Assign the sensor to the number displayed, #1 in this picture. Use up/down to change sensors. The last 8 digits of the sensor address and current temperature reading is displayed. *To get updated temperature reading, use UP/DOWN to change to other sensors and get latest reading.*

Step 2: Assign sensor usage

Only two readings can be displayed on the 20x4 LCD, and the **primary** one is used in temperature control while the **auxiliary** one is for display only. The primary and auxiliary sensors can be set for the following stages: Pre-Mash, Mashing, Boiling, Cooling, Manual Mode, and Main screen. The reading of primary sensor is always the number at **TOP** or **LEFT**.



Note: if temperature controled sparge water heating control is applied, the secondary reading is always the sensor assigned to sparge water temperature during Mashing.

2.4 Sparge Water Heating Control

The advantage of using sparge water heating control is that the sparge heater and main heater will run ***exclusively*** so that they can share one 120V/20A GFI socket(loop).

The heating of sparge water can be temperature controlled or not. If the temperature control is not applied, the heating is ON when the main heating is OFF. The temperature of sparge water should be controlled manually or by other controller. The temperature controll options is only available for multi-sensor configuration.

Setting	Values	Description
Enable	No/Yes	disable/enable the sparge water heating control
Temp. Ctrl	No/Yes	Whether or not to control the temperature of spage water heating
Sparge Sensor	1-[max sensor id]	the sonsor id for sparge water
Sparge Temp	75 ~ 80C	the desired temperature for sparge water
Temp. Diff	0.5 ~ 2.0 C	the temperature range to keep

3. Manual Mode and PID autotune

3.1 Manual Mode

In manual mode, the heating and pump is controlled manually.

The time starts running when the temperature reaches setting point, and it will be reset when the setting temperature is changed 1 degree away.

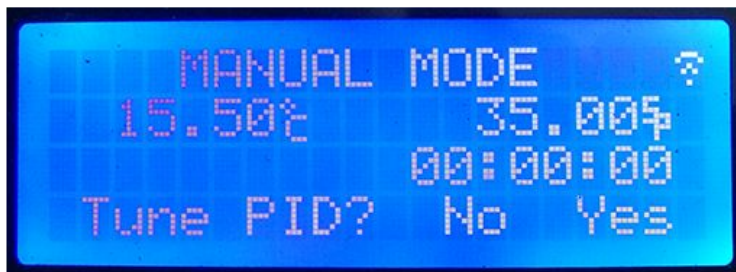
Press “Heat”(Enter) and “Pump”(Start) buttons to set Count-down timer. The time display will blink to indicate the edit mode. Press “Heat”(Enter) and “Pump”(Start) again to finish count-down editing mode. The count down will begin when the setting temperature is reached. After count down finishes, there will be buzzing sound and the time starts to cout “up”.

3.2 PID AutoTune

The PID autoTune is used to derive the kP, kI, and kD values. To run PID AutoTune,

1. Add water
- 2.Enter Manual Mode, set the desired tempeture to the temperature you usually mash at.

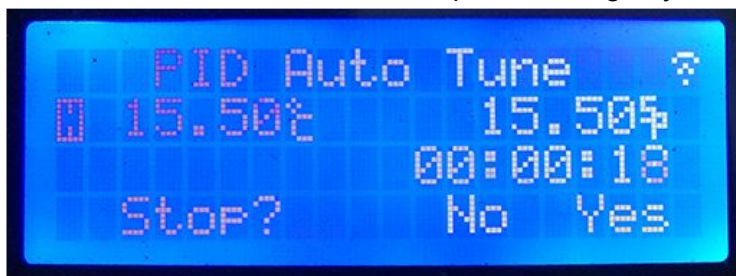
3. After the set point is reached, **LONG PRESS** the “Heat” button, and answer “Yes” to enter PID AutoTune.



4. The PID AutoTune will be performed to get the best parameters which can keep the temperature steady at current temperature.



5. When the process is finished, the parameters are stored automatically. The controller will be back to Manual mode. You can stop the tuning anytime before it finishes.



Note:

The PID AutoTune derives the parameters by kicking the target to either way and seeing how far and how quick it goes. Therefore, the parameters derived is best for the condition it runs. To get the best result, use the same volume of water as your brew size, and put your device at the place where you usually brew. Running PUMP is also recommended if the pump is on during mashing, which is usually true.

4. Brew with Automatic mode

Automation is the heart of BrewManiacEx controller. The brew process starts from heating striking water to optimal whirlpool and cooling. It prompts for user interactions, including:

- Malt In
- Malt Out
- Iodine test
- Hop throwing

4.1 Setup Automation

Before starting automation, the mash schedule, boil time, and hop time need to be specified. To edit the automation procedure, enter "Setup" then select "Automation".



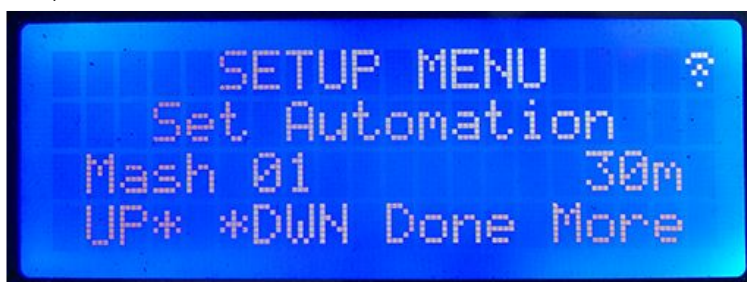
The first editing item is temperature of "Mash In", or the temperature of striking water.



Then, specify the first mash step temperature:



and, the rest time.



After entering the time by **Up/Down** buttons, press "**Done**"(Start button) if this is the final mash step(rest), or "**More**"(Enter button) if more rests are needed. Repeat the input of temperature and time until all steps are input or maximum 6 steps are input.



Then mashout temp and time:



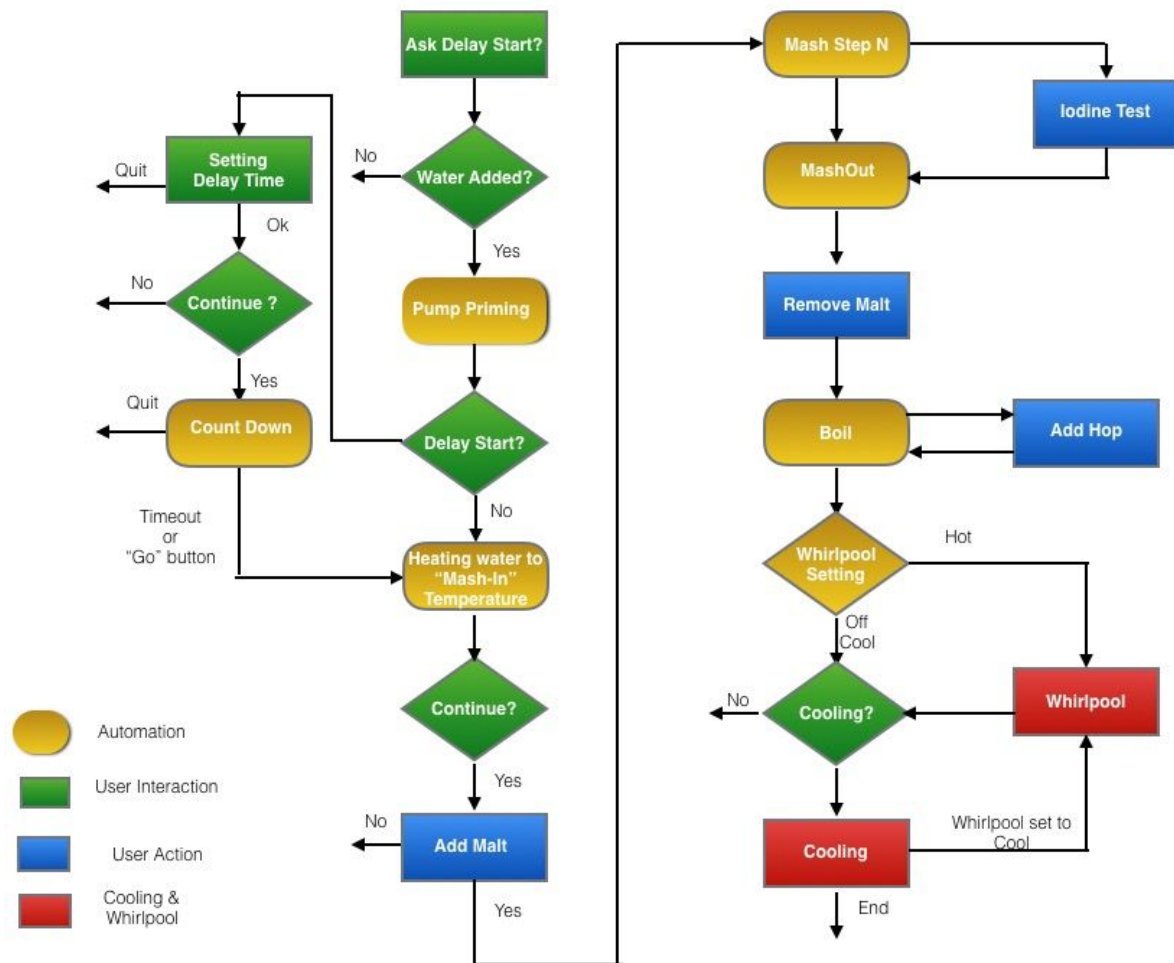
Input number of hops, **Boil Time**, and the time of each hop.



The automation setting is saved. Therefore, if the same recipe is brewed, it is not necessary to setup again.

4.2 Running Automation

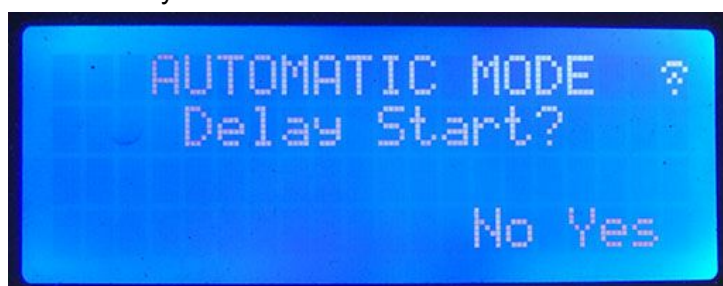
The automation will run through the brew process that is specified by the automation setup. When user interaction is needed, it will alert.



During the automated processes, like mashing and boil, additional control is possible. For example, the mash step can be skipped, and the pump during mashing and boiling can be controlled manually.

Automatic Brewing Screens:

- Delay Start



If "Disable Delay Start" is set to "NO", you will have the option to delay-start the brew.

- Edit Delay Start Time



Use Up/Down to change the delay time. 15min a step.

- Delay Start Waiting



The brew process will begin after the time counts to zero.

Go: start immediately.

Quit: quit the brew.

- Mashing



Up/Down: adjust the setting temperature.

PmPus (Pump & Pause): Press to toggle pump.

Long press to Pause the brew.

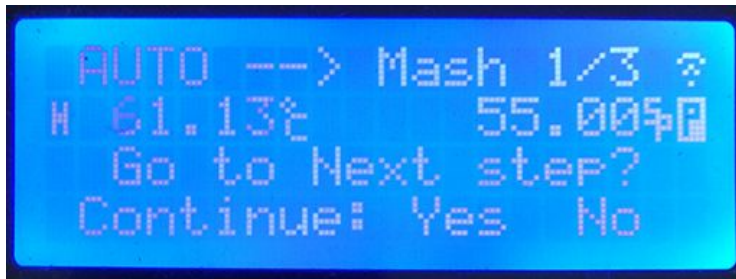
STP: long press to skip this step.

- Paused



Paused mash step. The brew is paused until "Exit" pressed. The timer is stop, as well as the pump and temperature control(heating).

- Skip Mash Step



The mash step can be skipped by LONG PRESS the “STP” button. Press “YES”, and the step is skipped.

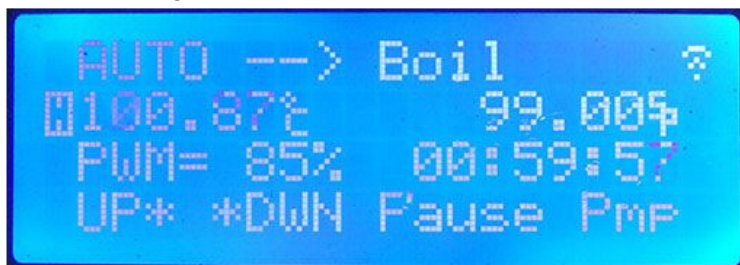
- Before Boiling



Up/Down: adjust target temperature.

Pmp: toggle pump.

- Boiling



Up/Down: adjust target temperature or PWM.

Pause: pause timer. The timer will be paused, but the heating control remains active. Use this to extend boil time when needed.

Pmp: toggle pump.

Note: Only when the temperature is higher than **Target Temperature and Boil Temperature**, the heating is controlled by PWM and the PWM value will be shown.

4.3 Automation Resumption

If a brew is not ended “normally” before Boiling stage finishes, the brew is considered “unfinished”, and BrewManiacEx will ask for resumption when entering automation.

The system will try to resume from last step.

5. Web Interface

5.1 Serving page



BrewManiacEx will try to connect to previously connected network at startup. If the connection is successful, the IP address will be shown. If it can't connect to the network, it will stay at "Setup Network.." screen and setup a network named "bm". Using a computer or phone to connect to that "bm" network, and specify the WiFi network and optional password. If BrewManiacEx connects the network successfully, it will show the IP address on LCD.

The web interface can be accessed by browsers that supports HTML5 and SSE(ServerSideEvent), like **Chrome** and **Safari**. Microsoft IE and Edge are **not** compatible for lack of SSE support at the moment of this writing.

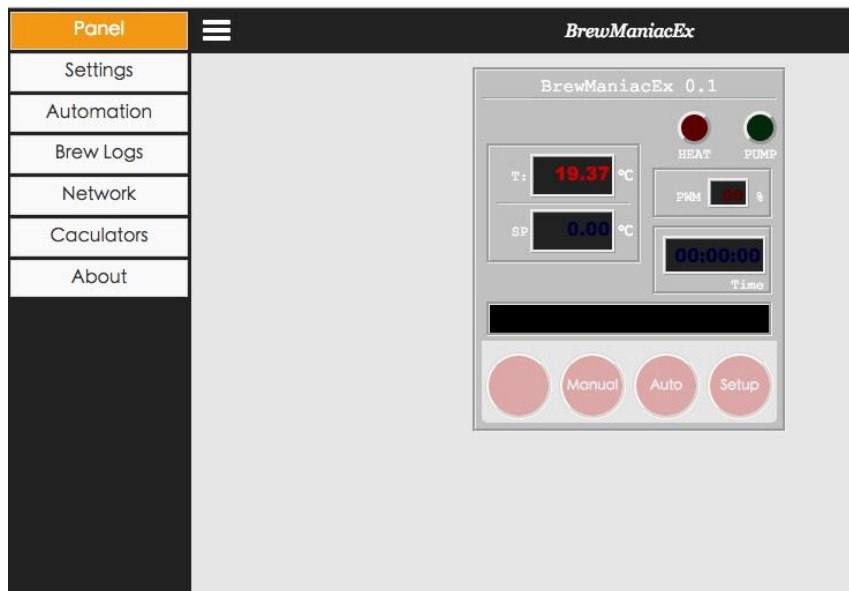
The hostname, default to 'bm', can be used if mDNS is supported by your phone or computer, which is true for Apple's products. The serving page can be access by

<http://bm.local>

or

[http://\[IP Address\]](http://[IP Address])

- Main/Panel



This tab is used to control and watch the status of BrewManiacEx. There is a "cover" above the buttons to prevent fat fingers.

NOTE: it is not recommended to control the brew remotely.

- Settings

Panel

Settings

Automation

Brew Logs

Network

Caculators

About

BrewManiacEx

Settings

PID — PWM

Constant kP	27
Constant kI	-46
Constant kD	56
Sample Time	1500
WindowSet	5000 ms
Heat/PWM in Boil	85 %
Sensor Calibration	0°C
PID Start	1.5 °C

Unit Parameters

Temperature Unit	°C
Disable Delay Start	Yes
Boil Temperature	99 °C
Pump Cycle	15 minutes
Pump Rest	0 minutes
Pump PreMash	Off
Pump on Mash	ON
Pump MashOut	ON
Pump on Boil	Off
Pump Stop Temperature	105°C
PID Pipe	Active
Skip Add	NO
Skip Remove	NO
Skip Iodine	YES
Iodine Time	0
Whirlpool	Off

Sparge Water Heating Control

Control Sparge Heating	Off
Temperature Control	Off
Sensor Index	1
Target Temperature	78°C
Temp. Difference	0.1

- Automation

Panel

Settings

Automation

Brew Logs

Network

Caculators

About

BrewManiacEx

Automation

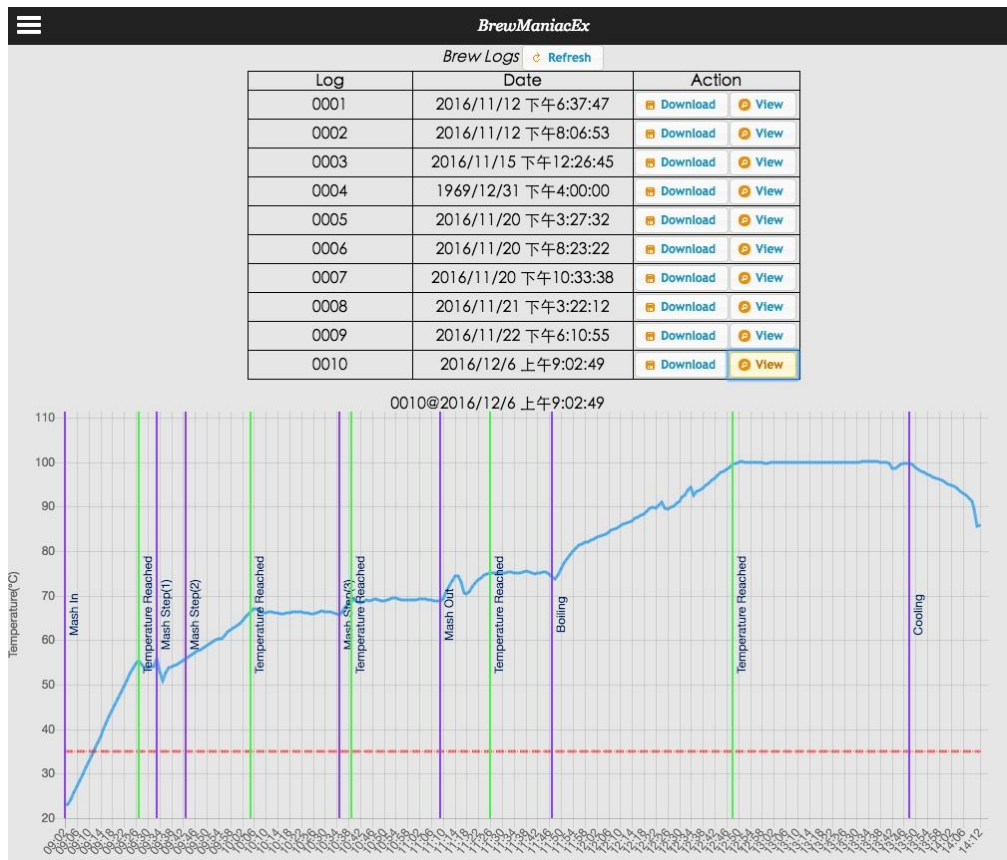
Mash Schedule

Rest	Temperature	Time
Mash In	55°C	-
Mash Step 1	55 °C	10 min
Mash Step 2	66 °C	30 min
Mash Step 3	69 °C	30 min
Mash Out	75°C	20 min

Boil & Hop

Boil Time	60 min
Hop#1	45 min
Hop#2	20 min
Hop#3	5 min

- Brew Logs



• Network Settings

BrewManiacEx

Panel [Settings](#) [Automation](#) [Brew Logs](#) **[Network](#)** [Caculators](#) [About](#)

Network Settings

Host/Network Name

Always need password ☐

New User Name

New Password

Retype new Password

User Name

Password

The serving page can be password-protected if “Always need password” option is checked. It is not protected by default.

The username, password, and hostname can be changed in “Network Settings” page. To chagne the setting in “Network Settings” page, the correct username and password must be provided. **The change of network settings will be effective after next power on.**

Default values,

Host Name: bm

UserName: brewmaniac

Password: rdwhahb

- Calculators

The screenshot shows the BrewManiacEx web interface with a dark header and a light gray body. It features several calculator sections:

- Volume:** Radio buttons for L, gal (selected), and qt.
- Weight:** Radio buttons for kg and lb (selected).
- Temperature:** Radio buttons for °C (selected) and °F.
- First Wort SG:** A table with rows for Grains (lb), Mash Water (gal), and FW SG.
- Hydrometer:** A table with rows for Gravity (1.040), Temperature (70 °C), Corrected at (20 °C), and Corrected SG (1.062).
- Refractometer:** A table with rows for Reading (%), Wort Correction (1.04), and Corrected SG.
- Boil off:** A table with rows for Current Gravity (1.0), Current Volume (6 gal), Desired SG (1.0), New Volume (--gal), Desired Volume (gal), and New SG (--).

5.2 Update page

5.2.1 Firmware update

!!BE CAREFUL!! Uploading wrong image might brick your controller.

The firmware can be updated by uploading new *.bin file from browser at this url

<http://bm.local:8008/systemupdate>

5.2.2 Web file update

!!BE CAREFUL!! Messing up the files might result in misbehavior of BrewManiacEx.

To access the SPIFFS file sytem, use the url,

<http://bm.local:8008/filemanager>

Be care not to mess up the files.

Be Warnned! Dangerous!!!

Dangerous!!! Don't read the following content

*There is a way to format the file system by which all the files and logs will be gone. The url is at
<http://bm.local/format-spiiffs>*

Dangerous!!! Don't read the content bbefore

5.2.3 Automatic OTA Update

This server is not yet ready for now.

By access the url, BrewManiacEx will check the availability of new firmware and new web page files.

<http://bm.local/update>

If BrewManiacEx can't find the files, the update page will be present when main page is accessed. The data files can be downloaded from the network instead of using SPIFFS tool.

Appendix

A1.Q&A

Q1: PID AutoTune.

A1: Check the detail at this page:

<http://brettbeauregard.com/blog/2012/01/arduino-pid-autotune-library/>

Q2: First Wort Gravity?

A2: The first wort gravity is calculated based on 80% yield of grain, so it's a approximate value.

Brix of First Wort = (grain in kg) * 0.8 / [(grain in kg) * 0.8 + (water in L)]

Conversion from Brix to Gravity:

$SG = 1 + (Brix / (258.6 - ((Brix / 258.2) * 227.1)))$

Q3: Zero crossing relay and heater switch.

A3:

Zero crossing relays switch ON/OFF when the voltage crosses zero, which introduces a lag or delay. If both the main heater and sparger heater are controlled by zero crossing relays, it should be fine because they will be turned on and off at the same time when the voltage crosses zero. However, if one of the relay isn't zero crossing and switches immediately, it might result in overload of power when the turned-off zero crossing relay "waits" the voltage to cross zero and the non zero crossing relay turns on immediately.

A minum 10ms delay between heater switch is introduced to solve this issue. The delay might sometimes extends over 100ms because of the limitation of software structure.

Q4: Time in brew logs.

A4: The real clock time will be recorded in the brew log as long as the time is known when the brew starts. BrewManiacEx will try to get time from the internet, NTP servers, at startup. If that fails, it can still get time from the computer or phone that connects to it. Therefore, connect to BrewManiacEx before the brew starts so that it can get the time of your computer or phone if it doesn't have internet access.