Ambi-Mon (Ambient Conditions Monitor)

This project uses a Micromite LCD Backpack with a PIC32MX170F256B-50I/SP (28 pin Micromite) programmed in MMBasic (version 5.2 – for now). The LCD Backpack utilises a 2.8" touch screen (240x320).

It has four main displays:

- A digital display of UTC in a large font (hh:mm:ss), date (dd mmm yyyy) and day of the week

- An analogue display of local time, date (ddd ddmm), digital time (hh:mm) and ambient temperature (°C)

- A bar graph of the ambient Barometric Pressure for each of the last 3 hours (measured every 15 minutes) and hourly averages over the last 10 days

- The air temperature measured locally and at up to three remote sites (°C)

- (A fifth display provides a blank screen, with one roaming pixel, for use in night vision conditions).

This document sets out the key features of the hardware, software, operation and setup so that others may use and improve it. It is provided free for personal use and with no guarantees or warrantees.

Special thanks to Geoffg, TassieJim, David Eagle, Lew247 and many others on The Back Shed forum. This project has borrowed many of their ideas and code and it clearly would not have been possible without their efforts.

If you find errors or have comments or suggestions please contact me.

Background

The author is a keen cruising sailor and typically cruises long distances offshore, far out of internet, phone or VHF radio range. In the absence of external weather advice a measure of Barometric (or Atmospheric) Pressure is a good indicator of likely changes in weather.

Atmospheric pressure can also have a direct influence on sea conditions. For example, sustained low pressure systems on the relatively shallow Gippsland Lakes can cause a more than 300mm change in water levels – which may close off river and lake entrances for days. In the tropics cyclonic low pressure systems can cause sea levels to rise significantly and, when combined with high seas and Spring tides, form "king tides" that damage coastal infrastructure and vessels.

A graph provides a visual indication of readings and trends making it easier to interpret in often adverse conditions at sea.

Hardware

The Micromite and MMBasic provide the tools for the project to measure and display atmospheric pressure, temperature and time/date. Since the pressure sensor, a BMP180, also measures temperature accurately this was included. A further three remote temperature sensors (DS18B20) were added, as was a Real Time Clock (RTC) module (a DS3231).

A GPS module for automated accurate time keeping was not included as the author's yacht is aluminium and GPS signals cannot be received in the cabin without an external antenna – an unwanted complication and expense.

The core module housing the Micromite, and connecting it to the sensors, is the "Micromite LCD Backpack" purchased in kit form from Silicon Chip (http://www.siliconchip.com.au/). Note that the "Micromite Plus LCD Backpack" is also available but is a more sophisticated version of the Micromite and is not required for this project.

The connections between the LCD Backpack and the sensors were made using veroboard and the resulting three levels of board were spaced so that the RTC could fit between the Backpack and the veroboard while permitting the whole assembly to fit within a standard jiffy box.

The header connecting the sensor circuits to the backpack is supported by the backpack header while the board connecting to the sensors is supported by the four Backpack screws (note that the

tracks of the two boards run at right angles and hence they are physically and electrically separated. Short wires make the required interconnections).

Whilst all the components can be accommodated in the jiffy box it was observed that the heat generated by the LCD electronics raised the internal temperature by about 3ºC so the BMP180 is located in a small jiffy box about 1m away. This box also houses the three 2.5mm mono sockets to connect to the three remote sensors. The two boxes are connected by a nine-core cable with DB9 connectors (the cores were selected to try to minimise problems if RS232 were inadvertently connected).

Power (5V DC) is supplied via a USB cable connected to the small jiffy box. The connector within the larger jiffy box can be used for a console connection to a PC for changes to the MMBasic program and ICSP connectors enable firmware changes via a PICKit3 or similar.

The one change made to the standard LCD Backpack was to change the trim-pot R1 from 100Ω to 200 Ω so that a dimmer LCD backlight could be achieved. Holes were drilled in the jiffy box adjacent to the trim-pot and nearby reset button so they could be accessed externally by poking a non-conductive screwdriver through the holes (3mm and 1.5mm respectively). (A vertically mounted reset button would make activation easier).

The attached "Ambi-Mon Schematic.jpg" shows the circuit Schematic.

Software

The software uses TassieJim's code for accessing the BMP180 for atmospheric pressure and temperature readings and relies heavily upon sections of Geoffg's "Superclock" project. The Superclock code had many options to make it as generic and flexible as possible – regrettably much of this flexibility has had to be removed to accommodate the new large arrays required to store data while still enabling it to run in this, the smallest, Micromite.

Thus:

- Only a digital clock is offered for UTC

- Only an analogue clock is offered for local time (the digital time and temperature are also shown)

- The configuration of dates and times has been changed so that the user is required to set the local non-daylight saving time (eg Eastern Standard time along the East coast of Australia) and then indicate whether daylight saving time is to be added or not (Superclock automated this). The UTC offset to this standard time is then set. Upon changes in daylight saving the DST Off/On needs to be changed but the local time will change automatically

- The choice of colours has been restricted to suit darkened "night vision" conditions (these can be changed in the code if required).

The file SuperClockFonts.BAS needs to be loaded into the MM's library followed by the attached MMBasic program "Ambi-Mon.bas".

Operation

There are four main displays (plus a fifth blank screen for night time operation):

- UTC time
- Local time
- Barometric Pressure
- Temperature.

These are cycled through sequentially be tapping either the left or right of the touch screen.

Tapping in the centre of the two time screens or the temperature screen leads to the relevant setup screens (see below). The barometric pressure screen has no setup but tapping either the top or bottom of the screen changes the range of pressures shown on the graph. Should a pressure reading lie outside the selected range its colour is highlighted to prompt selection of a more suitable range.

Set Up

The setup options are illustrated on the attached figure {???}. Note that tapping "Cancel" enables one to back out of the setup without altering values until "Save" is tapped. Values are then saved to non-volatile memory for future use, even if power is turned off.

It is best to start by taping in the centre of the Local time analogue clock. This enables setting of:

- Your Local Standard time and date (e.g. Eastern Standard Time for Melbourne and Sydney)
- whether to apply Daylight Saving Time (DST) (=DST On) or not (= DST Off).

The values of `Time$` and `Date$` have to be set to "your Local Standard Time" either by using the console command "`RTC SETTIME yyyy, mm, dd, hh, min, sec`" or via the inbuilt menu by tapping in the centre of the clock and selecting, in turn, "Std Date" and "Std Time".

Then invoke DST = "On" to add 1hr to the local time for DST or "Off". This needs to be changed twice each year at the appropriate times.

`Date$` and `Time$` are stored in the RTC by the "`RTC SETTIME`" command within the code.

Tapping and holding the "Std Time" button for 3+ seconds accesses the option to adjust the RTC aging offset to ensure that it keeps accurate time. A positive value of the adjustment slows the clock.

Taping in the centre of the UTC display enables adjustment of the "UTC offset" which is the time in hours (0.5hr increments) that "your Local Standard Time" occurs before (-ve value) or after (+ve value) UTC (= the old Greenwich Mean Time). The UTC offset need only be set once (unless you change location to a different time zone) and is not effected by daylight saving changes. For example, Sydney and Melbourne have a UTC offset of "-9"

Tapping in the centre of the Temperature screen enables setting of the "Normal" temperature range, that is, an Upper level and a Lower level. Temperatures above this range will be shown in red, below it in blue and within it in green.

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