Proton© Analyser for complex and multi-file projects

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Introduction - how it all began

John Barrat (JohnB on the forum), creator of, a.o, the Fuse Configurator, Library Manager and P-RTOS, posted a message on the Proton© PDS forum, considering a tool to help him get oversight, and insight, in big, mulit-file, projects.
http://www.protonbasic.co.uk/showthread.php/66736-Working-with-big-projects-in-PDS
After exchanging some ideas with John, I started working on it.

He sent me the sources of the P-RTOS project. As test material...(30.000+ lines).
Then I found out that this was full of pre-processor statements.
He offered to build a dedicated program as a front-end for mine.
When he went on holiday I decided to take a crack at it.

What does it do & why would you want to use it?

To start with the latter: if you have projects containing more than one file, it is sometimes hard to keep oversight of what is where. Same if you have large programs with a lot of variables and subroutines (although the Explorer in the IDE does certainly help).

What it does is the following:
- it reads through all the sources that are used in your project
- it picks up
    - all variables and symbols
    - all labels
    - all goto and gosub and their variants, including ASM instructions
    - all macros and $defines
- it records them together with file- and line information of the declaring source

Then it goes all over through the sources again to find out where all items are being referenced.

User interface.
The results are presented as follows:
- at the left a tree with all
    - variables and symbols
    - routines, isr's and labels
    - macros and defines

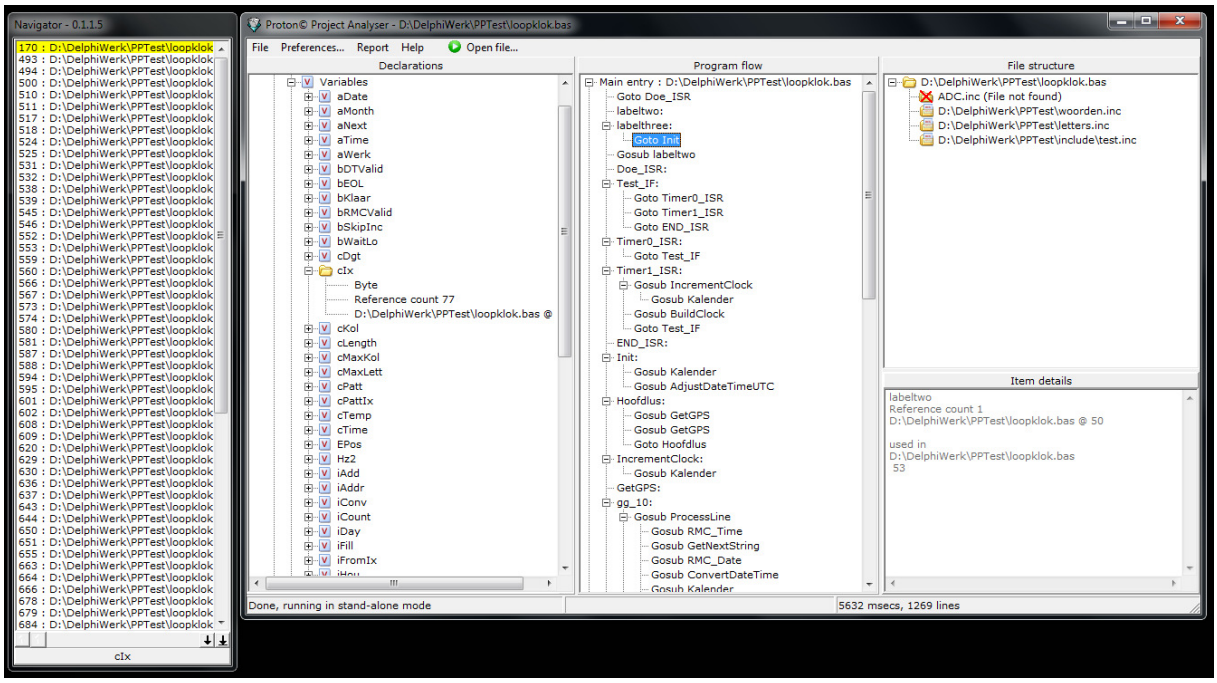
all with
- the file- and line information of the declaring source
- the reference count (not for labels that are not referenced of course)

Sorted in alphabetical order.

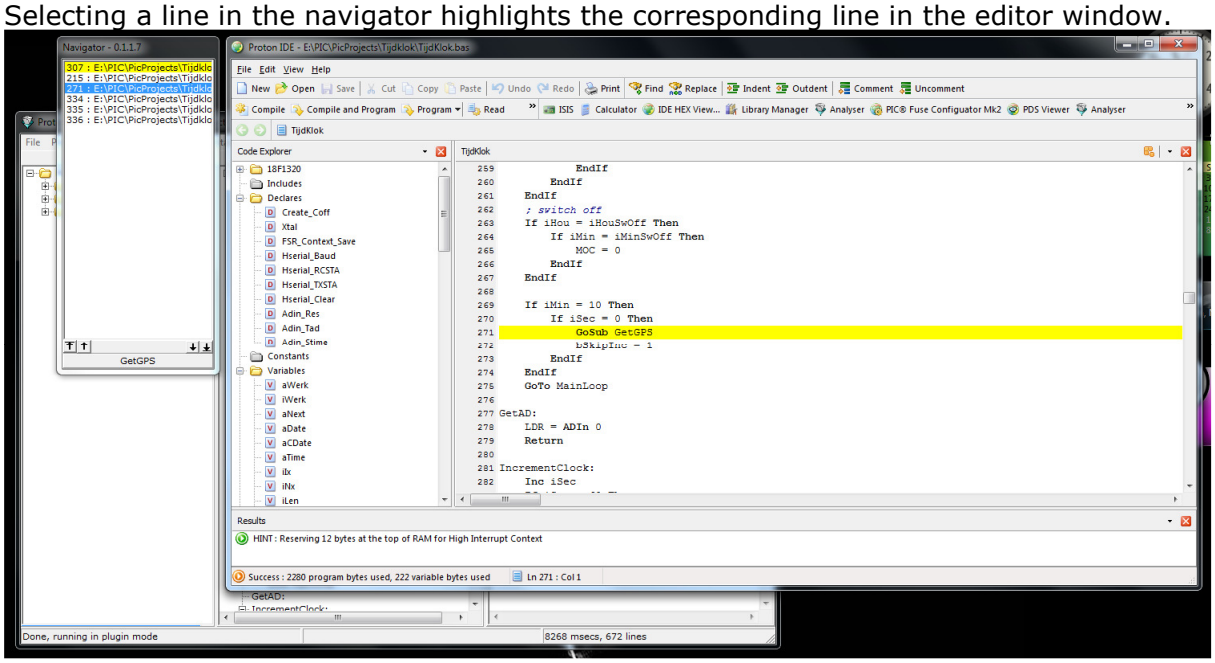
The analyser uses a separate program, the Navigator, to allow you to navigate through the Program Flow (when run in stand alone mode) or the open file in the PDS editor (when run in plugin mode).

In the first picture you see the analyser in stand alone mode.
The navigator is on the far left and can be dragged where you want it to be.
(Both the analyser and the navigator store their position and size when closing).
The top line has a different color because this is the line that references the declaration of the item you have selected.
The left panel of the analyser window holds a list of 'items' (variables, symbols, labels, routines, ISR's, macro's and $defines).
'Items' are selected by clicking the name of the item.

The middle panel holds the Program Flow. Here all items, except the top one, are clickable.
The upper right panel holds the file structure. Clicking an item will open it in the editor of your choice (see Preferences for that).
The lower right panel shows detailed information of an 'item' or a node in the Program Flow. This is updated as you 'hover' over either one of the panels.



In the next picture you see the analyser when used as a plugin.
The main difference in plugin mode is that navigation is in the PDS editor window.
Selecting a line in the navigator highlights the corresponding line in the editor window.



Now it may be that you select a line in an include file. If it is opened in a tab in the IDE, this tab will become the 'current' tab. If it is not opened in the IDE, it will be loaded and it will become the 'current' tab. After closing the analyser you will be asked if you want the files opened by the analyser to be closed.

About the Program Flow.
This is a tree, starting at the beginning of the first file.
It shows all labels, Goto's and Gosub's.
Note that e.g. Branch is treated as a Goto.

What it also shows is the 'indirect' GoSub structure.
Say, you have a routine ABC that calls DEF and this one calls GHI.
When Gosub ABC is encountered, DEF and GHI are inserted in the flow, looking like this

```
aLabel1:
        Gosub ABC
                Gosub DEF
                        Gosub GHI
when DEF is encountered
aLabel2:
        Gosub DEF
                Gosub GHI
```

Conditional compilation

Some of you may use it, others not.
The analyser will invoke a pre-processor when it encounters directives for conditional compilation, so only the lines that meet the conditions are passed to the analyser.

Output

All information is stored in a report file.
It can be viewed by clicking View>the filename of the report.
When the pre-processor was invoked there are two more output options:
- the generated .bas file. This is a file that contains all lines from the original source and the includes after evaluating the conditions. You can load it in the IDE when running in plugin mode. It is saved to disk so you could also use it later.
- the tracking output of the pre-processor.
This contains, pretty technical, data on the evaluations the pre-processor performed. It is meant for those people that want to debug their pre-processor statements. (It was a great help for me when building the pre-processor, why not tidy it up and include it.)

How to use the analyser

There are two ways to use it:
- as a plugin
- as a standalone program

As a plugin:
As soon as you launch the analyser, it will ask you if this is the 'main' file of your project.
Selecting the right file is important because it determines the information you get. If you have an included file in the 'current' tab in the IDE, the analyser will only process that one.
Press 'Cancel' to select your 'main' file as the current tab.
The popup can be disabled through the Preferences menu.

As a standalone program:
Start the analyser, click File>Open to select the file you want to process.
Again you are asked to confirm if this is a 'main' project file.

Preferences

There are three preferences.
The first one is easy: you can select the program that will be used if you click a filename.

The second is a bit more complex and needs some explanation.
Consider the phenomena 'Define' and 'Macro'.
Both are is essence nothing more than text-replacing techniques.
In P-RTOS, JohnB has a $Define 'Forever' that reads 'Until 1 = 0'.
A Macro is like building your own function, using parameters.
Every time the compiler encounters a reference to a $Define or Macro, it just picks up the text and inserts it in the source.
You would not like to see 'Forever' in the window with the program flow (because it does not alter the flow).
But a $Define or Macro might contain one or more Gosub's.
And that is part of the program flow. Sometime you might want to see that, sometimes not.

The preference 'Show invoking Define/Macro' has three options:
- Always
- Never
- Only when it contains GoSub/Call

If you change the 'Show Define and Macro' the program will repeat the analysis of the program flow to reflect the new value. Enabling/disabling options can also be done using a popup menu (right click on the program flow).
This popup menu also gives you the opportunity to hide/show unreferenced labels in this tree.

The third relates to the warning popup regarding the 'main' file. You can disable or enable it here.

Notes

1: Make sure your program compiles. The Proton© Analyser may crash if your program contains errors.
2: The syntax of the Basic language does not prevent recursive calling, but a microcontroller will most certainly reset itself.
To prevent the analyser from crashing, a maximum of 16 stack levels is allowed, after that it just stops and shows a warning.

Known errors

At this moment there is one known error. And I don't have a clue of how to fix it.
When a Gosub is encountered, the Proton© Analyser tries to locate a label 'above' the Gosub in order to have in the correct place in the program flow window.
Consider this:

```
label1:
      statements
      if <condition> then Return
      more statements
      Return

Gosub A_Routine

Main_program_loop:
      Gosub label1
      Goto Main_program_loop
```

Now clearly, "Gosub A_Routine" will never be executed, but there's no way the analyser will 'know' that. Checking a 'Return' in a previous line will not help, because it may be a conditional return as in the example above. Please understand, the analyser works from top to bottom, not backwards.
At this moment, the Proton© Analyser just considers it to be part of the routine called "label1".

Technical details

Files:
- Main program: ProtonAnalyser.exe
- Navigator: ProtonAnalyserNavigator.exe. This won't run as a separate program, it must be called by the analyser.
Preferences:
- ProtonAnalyserPreferences.txt (please don't do manual changes, they might not work).

Output directory:
_Output: This directory is created in the directory of your main program. It contains all output.

Final words

Thanks to Roger and Peter for sending me input. It was disturbing how easy it is to forget the differences in programming style and the effects it has on this program.
And of course thanks for John for the interesting email-discussions we had over this project, his input, the icons, his offer to build a dedicated pre-processor (that he didn't have to build in the end), the help with the plugin api and the help file. But most of all for the code he sent me for a critical part of this project.
Last, but not least, thanks Lester for PDS.