

E.E. 3334: S01

Software Development

(Tech-SAL)

Kyle Romero
Jacob Smalts
Timothy Monday
Brian Johnson
Colby Sites
Greg John

Adviser: Dr. Parten

12/03/2007

Project Description: Software Development

- To aid in the development in the different elements of the Tech-SAL Programming Language. Specifically:
 - Visual Tech-SAL GUI
 - The Compiler / Translator
 - Tech-SAL IDE
 - Language Capabilities
 - Hardware Control
 - Ease of Use
- Assist with the West Texas Best Program
 - Section 2 members
 - Electronics Scoring Software
 - Section 1 members
 - Return Kit

Project Overview

What is Tech-SAL?

- Texas Tech Semi-Autonomous Language
- Currently Version .7
- The Tech-SAL language is to be used with the MSP430 microprocessor and is used to program motors, servos, and sensors, without having knowledge of programming or knowledge of the MSP430.

-Taken from the Tech-SAL Readme
File
Sites

Tech-SAL

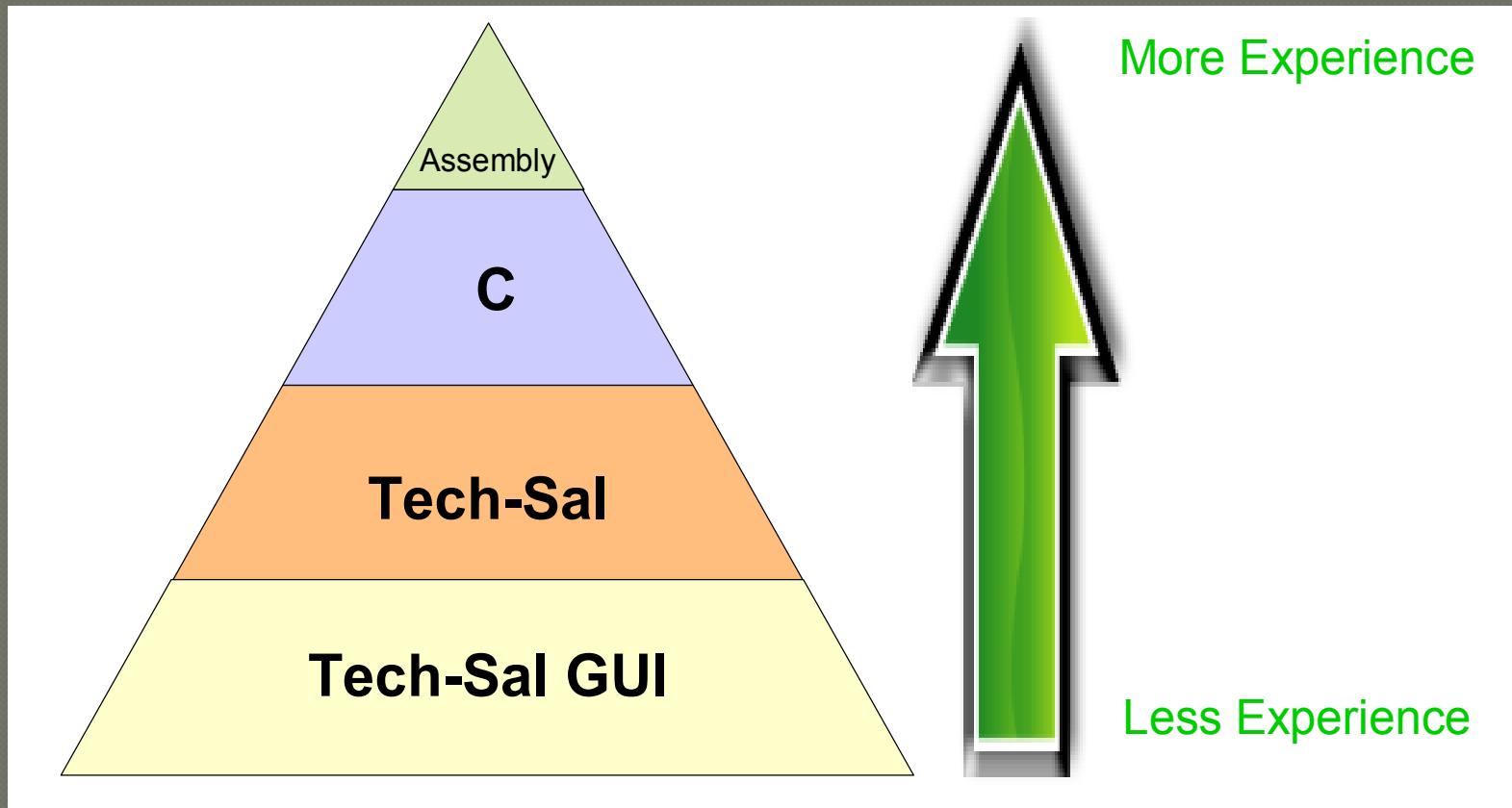
- ◎ Purpose of Tech-SAL:

- “To allow programming of MSP430 based microcontroller systems by presenting an interface that can be easily used with little programming knowledge or experience.”

- ◎ Tech-SAL consists of:

- Tech-SAL language specifications (AKA code rules)
- Tech-SAL translator
- Tech-SAL IDE

Tech-SAL



Tech-SAL: Start of Semester

- All Files Contained in .Zip Archive
- Features:
 - Tech-SAL Translator
 - Syntax Checker (Basic)
 - Visual Tech-SAL GUI
 - Readme File

Tech-SAL: End of Semester

- Redistributable .msi package

- Organized File Structure

- Features:

- Tech-SAL IDE
 - Tech-SAL Translator
 - Visual Tech-SAL GUI
 - Syntax Highlighting / Checking
 - .tsal File Extension
 - Full Documentation
 - Start Menu Directory

Installation Package

Tech-SAL '.msi' Package

- Built Using Visual Studio 2005
- Works with Microsoft Windows
- Installs to organized directory
- Handles Registry
 - Tech-SAL IDE
 - .tsal File Extension

Tech-SAL '.msi' Package



Tech-SAL IDE

Tech-SAL IDE: About

- Written in C# with Visual Studio 2005
- Designed to be Central Hub of Tech-SAL Project
- Incorporates all other components of project into one easy to use system.

Tech-SAL IDE: Features

- Open / Save .tsal Code Files
- Tech-SAL Syntax Highlighting
- Built in Translator Output
- Easy to Use Toolbar
- Tray Icon
- Access to all Documentation
- Visual Tech-SAL GUI Link
- SALConfig.txt File Control

Tech-SAL IDE: Features (Unused)

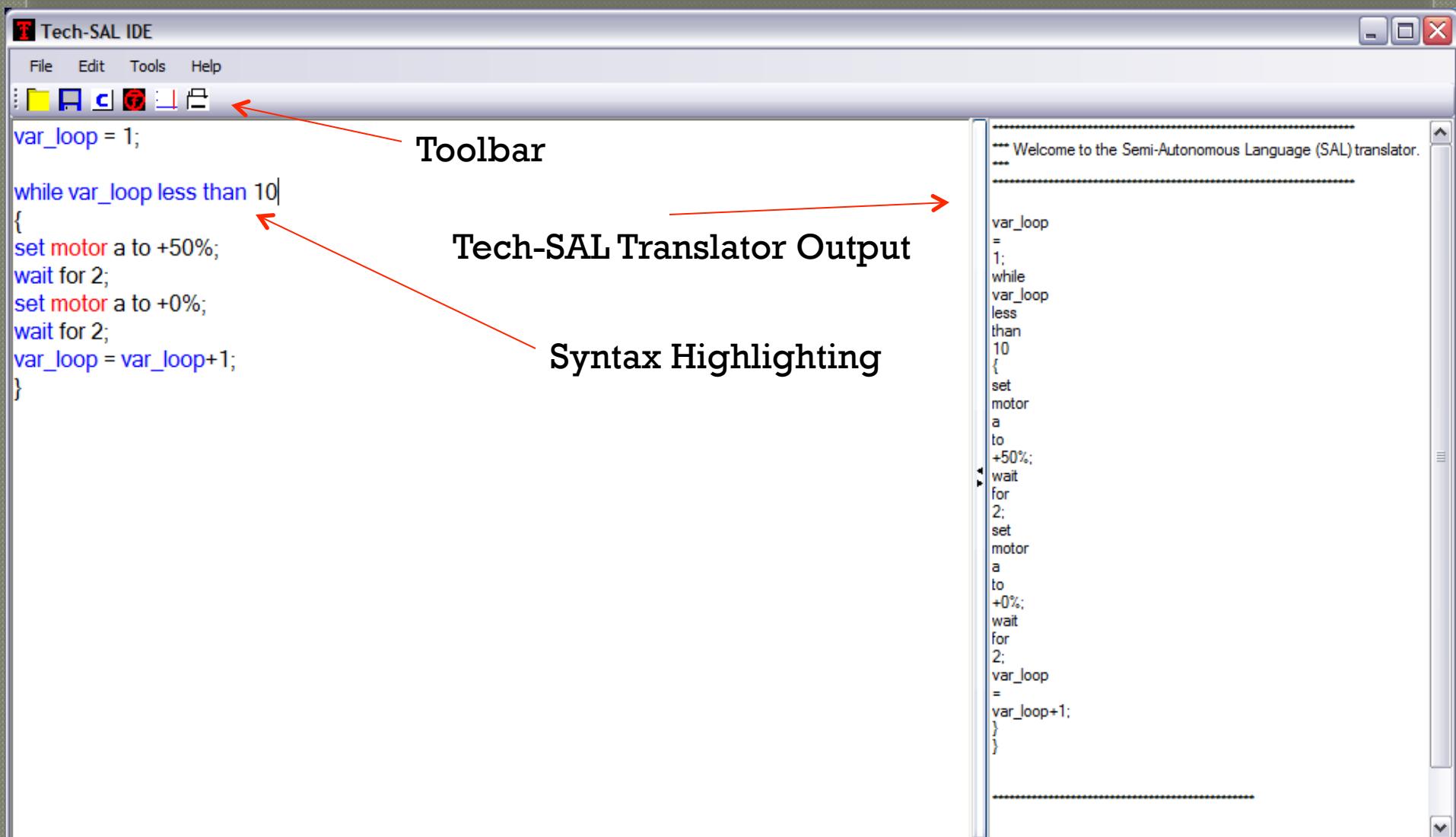
- Update Tool

- Provided in package with documentation, ready to be used

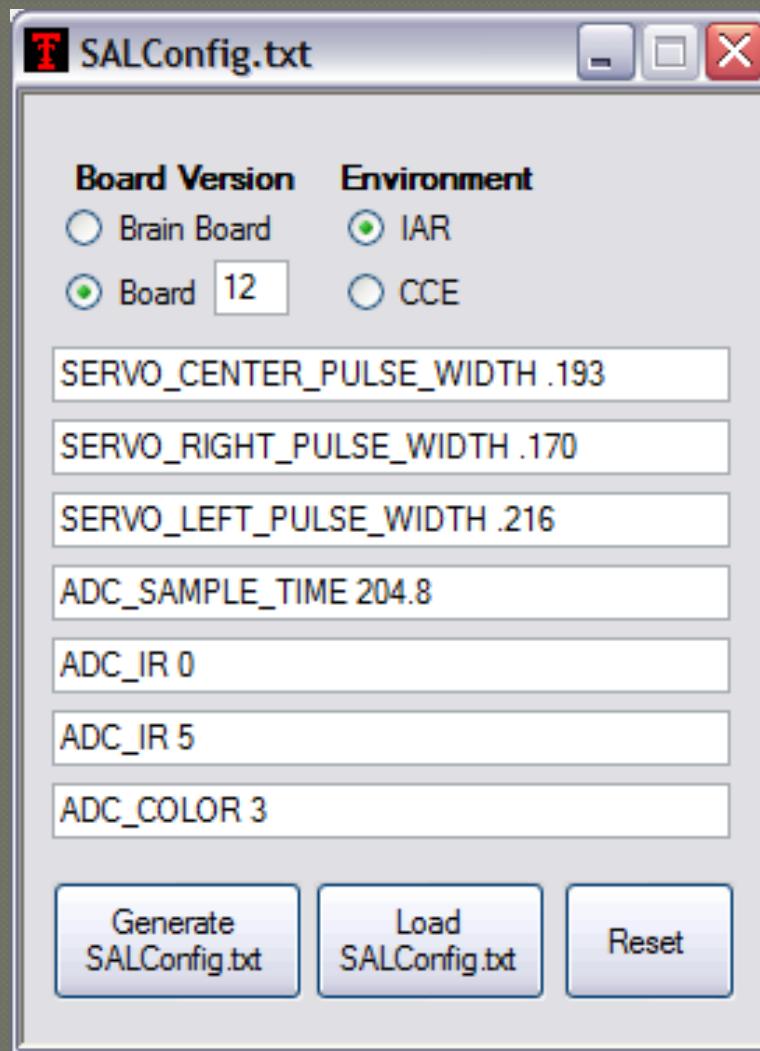
- Graphical Boot Strap Loader

- Coded but not fully tested or debugged

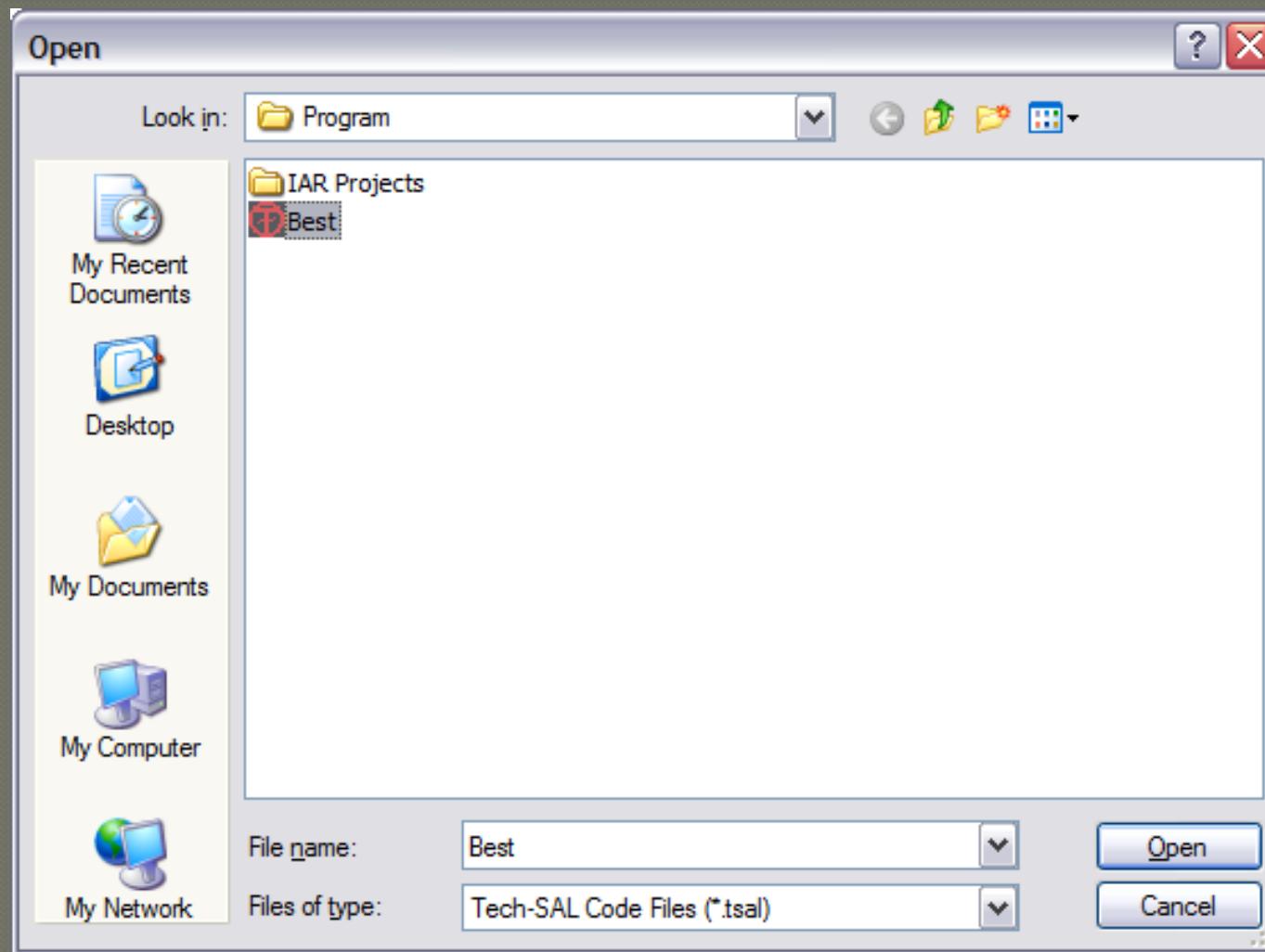
Tech-SAL IDE In Action



SALConfig.txt Menu

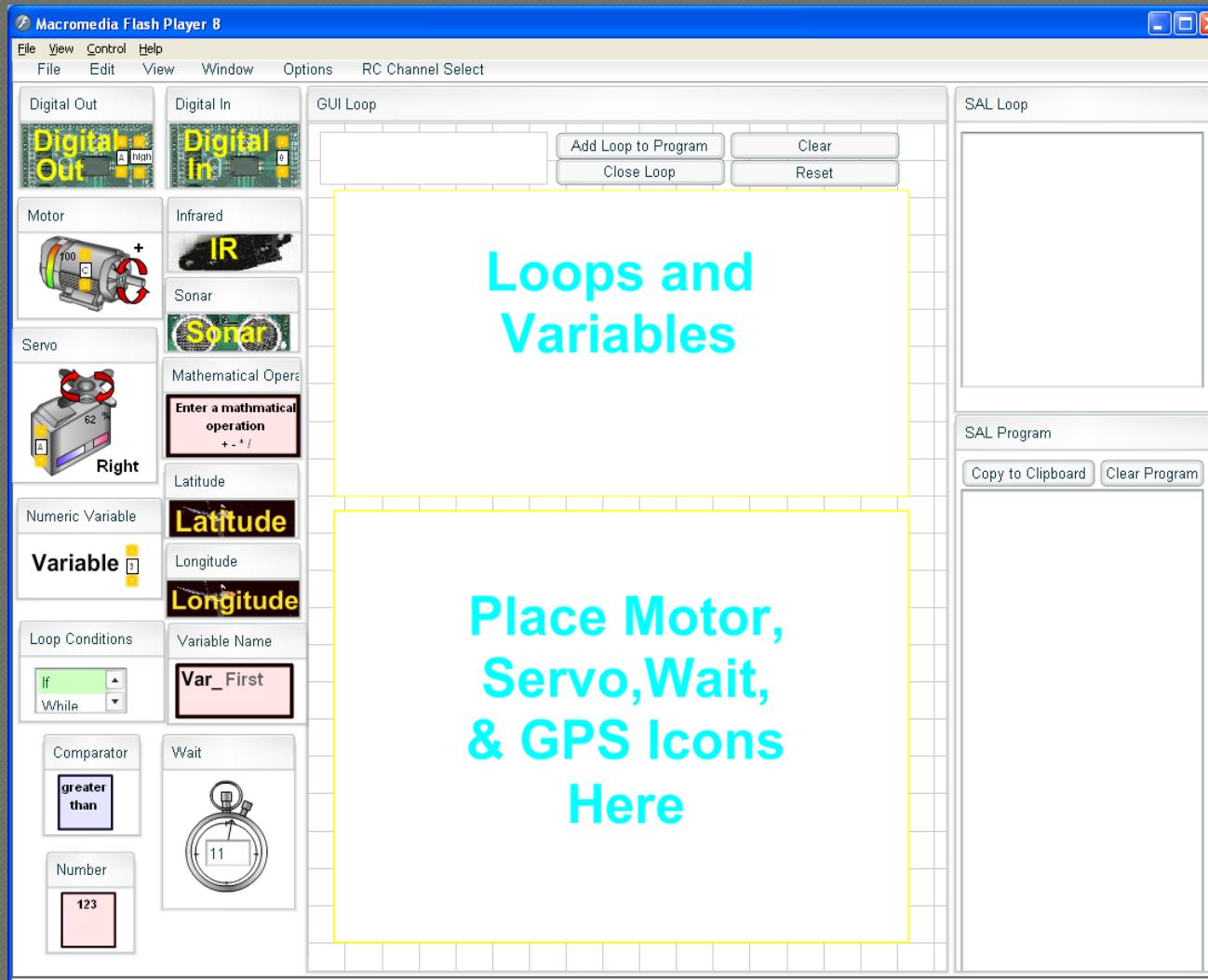


Tech-SAL IDE: Open Dialog



Visual Tech-SAL Interface

Flash GUI v 2.0



Tech-Sal Versions

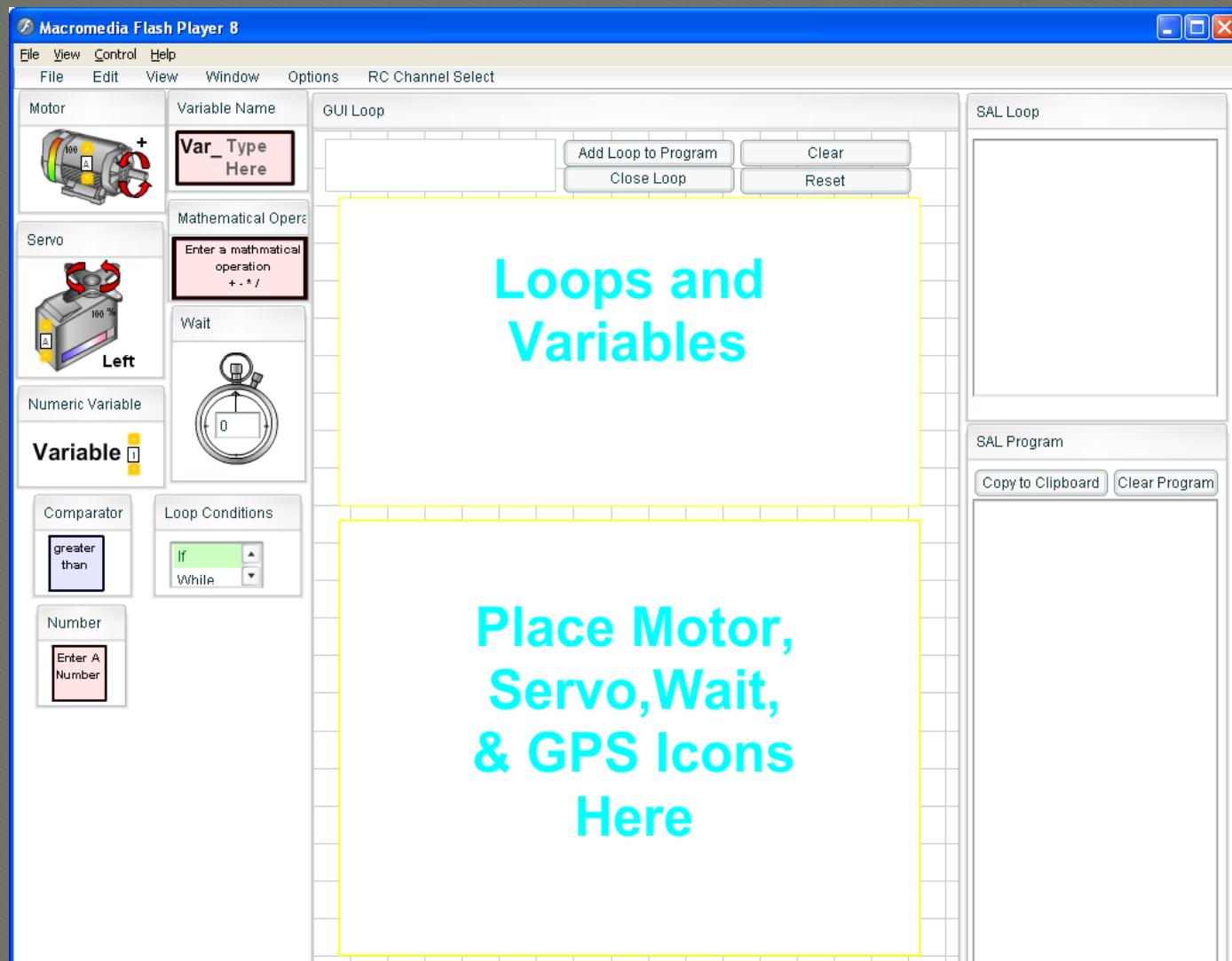
BEST Tech-Sal

- No Programming Experience Needed
- Only Basic Functions
 - No IR, Digital, GPS, Optical
- Brain Board Compatible

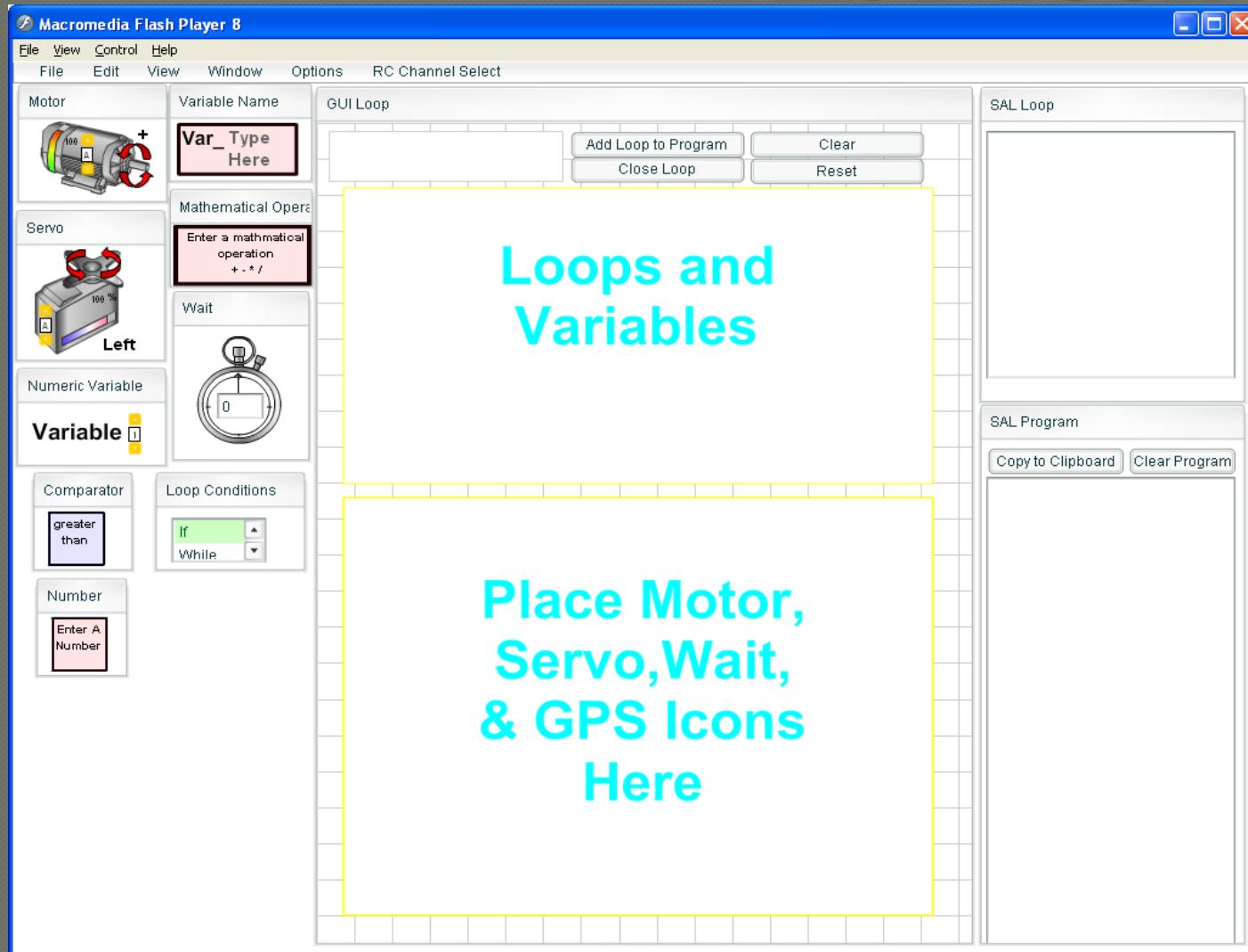
Full Tech-Sal

- Basic Programming Experience Needed
- Take Full Advantage of Hardware Functions
- Compatible with versions 8,10,12 and Brain Board

Full Tech-Sal



BEST Tech-Sal



GUI Improvements

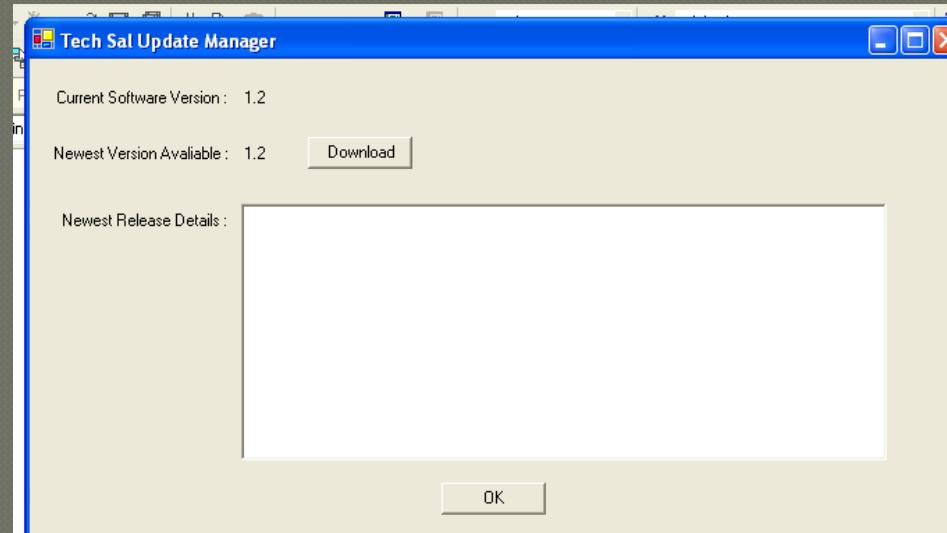
- Show Only Needed Icons In Best Version
- Create a Simple, Redistributable, and Installable Package
- Allow Addition of Non-Loop Code
- Change GUI Generated Code (.-> ;)
- Wrapped Up in Flash Projector (.exe)

Tech-Sal Update Tool

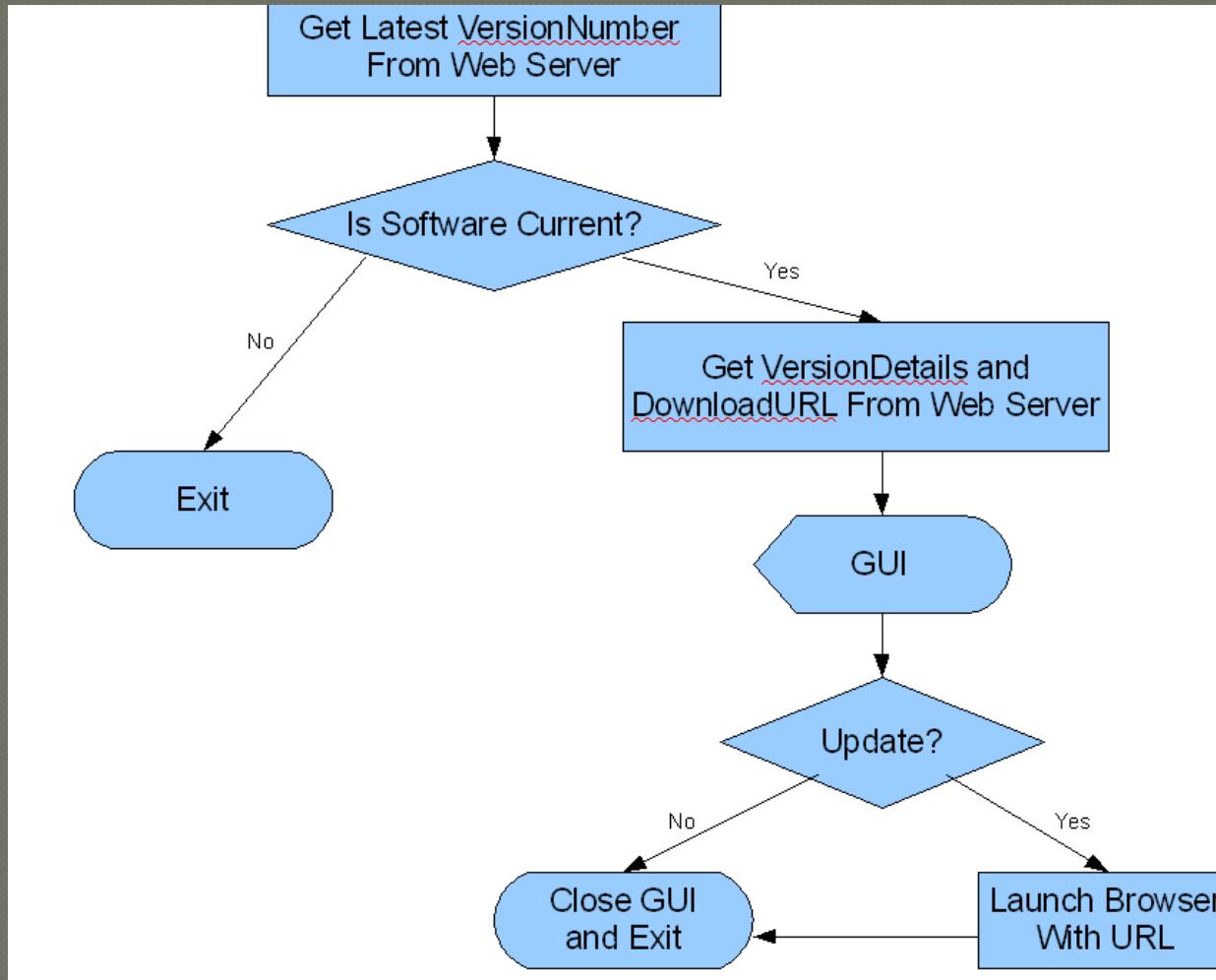
- Automate The Software Update Process
- BEST
- Integrate With IDE
- Check For Update Every Time IDE is Opened
- Non-Evasive if There is No update Available
- Alerts to New Version

Tech-Sal Update Tool

- Server/Client Based System
- Retrieve Newest Version (string)
- Retrieve Download URL and Release Details



Update Utility Flowchart (Client)



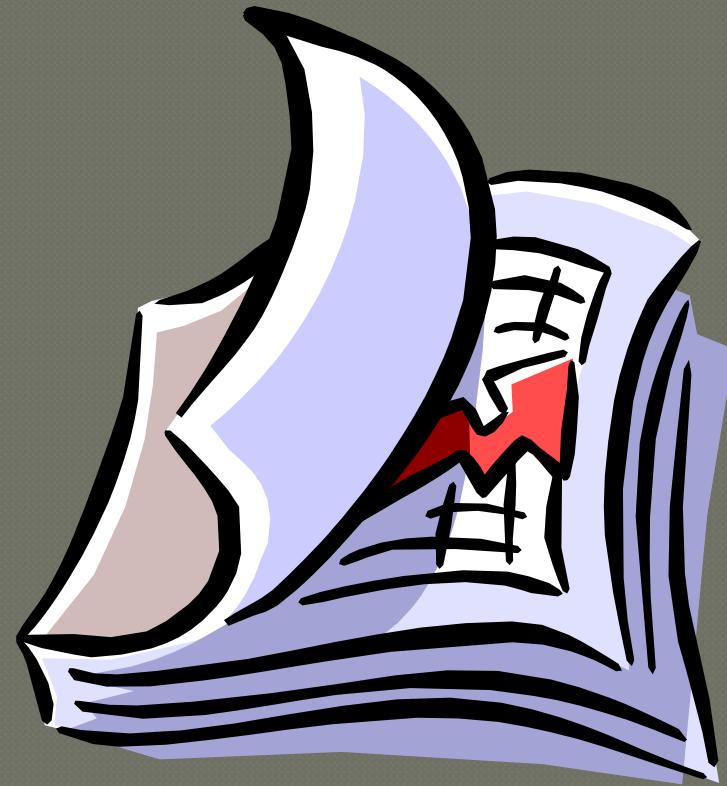
Documentation

- Visual Tech-SAL

- Step-By-Step Instruction Manual

- Update Utility

- Step by Step Server Setup Guide in IIS



CCE Compatability

IAR to CCE Migration

- Different intrinsics.h files.
- IAR has predefined interrupt state (istate_t)
- Different ISR structure.
- Registered defined differently.

Different intrinsics.h

```
#if defined(__IAR_SYSTEMS_ICC__)
    s=__get_interrupt_state();
    __disable_interrupt();
#elif defined(__TI_COMPILER_VERSION__)
    s=__get_SR_register();
    __disable_interrupts();
#endif
```

```
#if defined(__IAR_SYSTEMS_ICC__)
    __set_interrupt_state(s);
#elif defined(__TI_COMPILER_VERSION__)
    __bis_SR_register(s);
#endif
```

```
64     istate_t s;
65     // protect the data structures
66     s=__get_interrupt_state();
```

intrinsics.h from IAR

```
/*
 * The return value of "__get_interrupt_state".
 */

typedef unsigned short istate_t;
```

Define istate_t for CCE

```
#if defined(__TI_COMPILER_VERSION__)
    typedef unsigned short istate_t;
#endif
```

Johnson

Different ISR Structure

```
#if defined(__GNUC__)
interrupt(TIMERA1_VECTOR) Timer_A(void)
#elif defined(__IAR_SYSTEMS_ICC__)
#pragma vector=TIMERA1_VECTOR
__interrupt void Timer_A(void) IAR
#elif defined(__TI_COMPILER_VERSION__)
__interrupt void Timer_A(void);
TIMERA1_ISR(Timer_A)
__interrupt void Timer_A(void) CCE
#endif
```

In msp430x14x.h

```
#define TIMER1_ISR(func) ISR_VECTOR(func, ".int05")
```

Registered Defined Differently

```
#if defined(__IAR_SYSTEMS_ICC__)
    volatile unsigned short *usCtlReg;
#elif defined(__TI_COMPILER_VERSION__)
    volatile unsigned int *usCtlReg;
#endif
```

```
usCtlReg=&TBCCTL1;
```

Definition In Loop - CCE

Errors:

```
void user_timer(short time)
{
    for(short b=0; b<time;b++) {
        for (long i=0;i<65300;i++) {
    }
}
}
```

Compiles:

```
void user_timer(short time)
{
    short b;
    long i;
    for(b=0; b<time;b++) {
        for (i=0;i<65300;i++) {
    }
}
}
```

CCE Rejects Some Declarations

Error: Cannot declare variable before non-blocking assignment.

```
#if defined(__TI_COMPILER_VERSION__)
    int i;
#endif

void InitCpu(void)
{
    // Turn off watchdog for now implement
    WDTCTL=WDTPW+WDTHOLD;

    // Init the LED port early
    P1DIR |= BIT7;
    #if defined(__IAR_SYSTEMS_ICC__)
        int i;
    #endif
```

CCE vs. IAR – The Compilers

- CCE allows you to view all functions and variables in each file.
- IAR sets all variables to 0 when they are initialized, CCE does not.
- IAR has option to generate HEX code, for CCE you must use a command to call an external program.

IAR

Output file

Override default

BRAIN.txt

Secondary output file:

(None for the selected format)

Format

Debug information for C-SPY

With runtime control modules

With I/O emulation modules

Buffered terminal output

Allow C-SPY-specific extra output file

Other

Output format: msp430-txt

Format variant: None

Module-local symbols: Include all

CCE

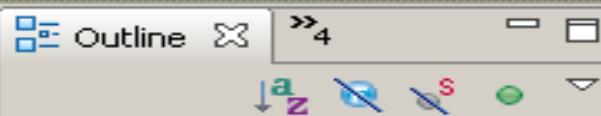
Post-build step:

Command:

```
$(CCE_INSTALL_ROOT)\tools\compiler\msp430\bin\hex430.exe --ti_.txt brain.out -o brain.txt
```

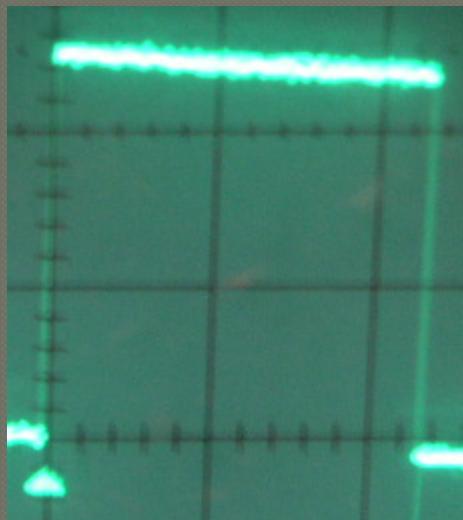
Description:

```
$(CCE_INSTALL_ROOT)\tools\compiler\msp430\bin\hex430.exe --ti_.txt brain.out -o brain.txt
```

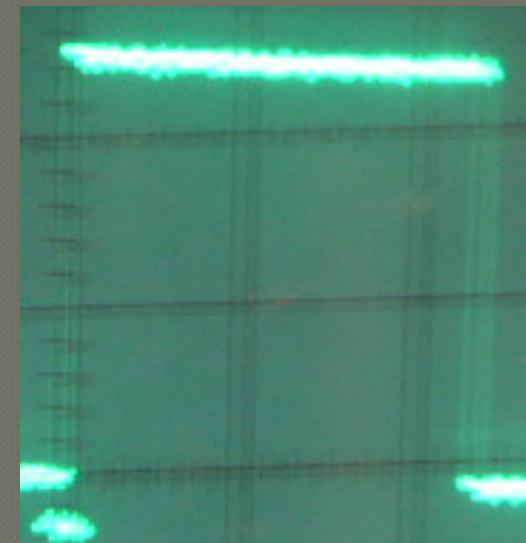


PWM Servo Test - Left

CCE



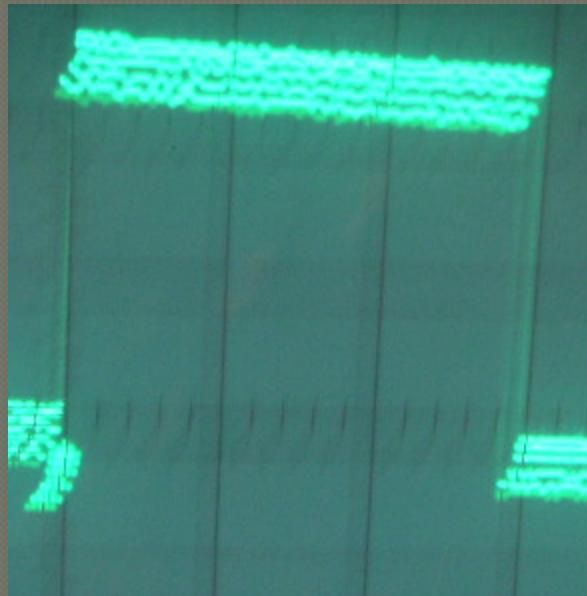
IAR



division - 500 μs

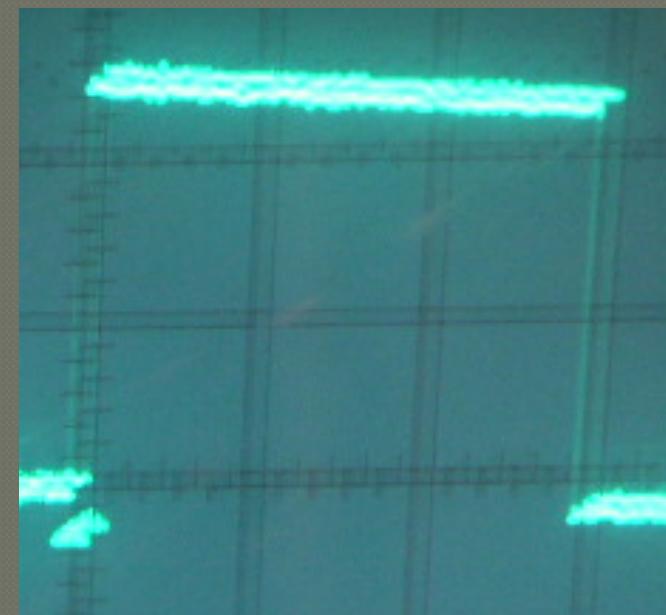
PWM Servo Test - Center

CCE



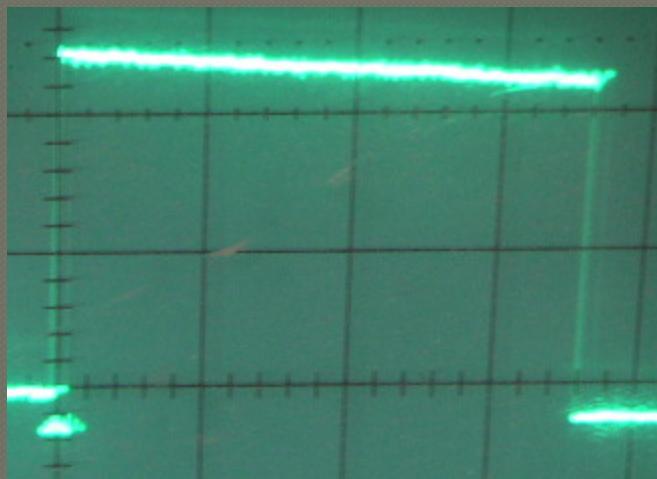
division - 500 μ s

IAR

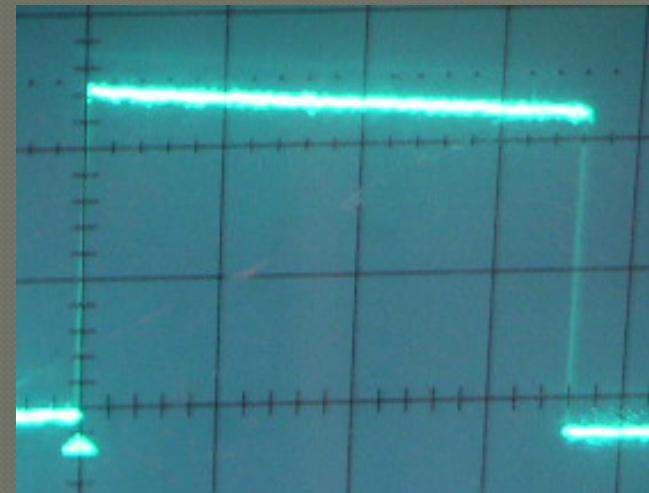


PWM Servo Test - Right

CCE



IAR



division - 500 μ s

CCE vs. IAR - Preference

- Prefer the CCE User Interface
- Easier in IAR to generate TI-TXT files for loading programs.
- IAR is less picky about syntax.
- Debug mode runs smoother in IAR
- CCE generates smaller code than IAR.

Section I Accomplishments

Kyle's Deliverables

- Tech-SAL IDE
- Installation Package
- Quickstart Guide

Jacob's Deliverables

- Visual Tech-SAL GUI Improvements
- Update Tool
- Documentation Updating

Brian's Deliverables

- CCE Compatibility.
- One set of code that works in both IAR and CCE.
- Document migration for future developers.
- Document CCE vs. IAR for future boards.

Section II Accomplishments

Colby's Deliverables

This Semester

- Wrote code for multiple device mapping
- Coded the Syntax Checker from BNF rules
- Board 10/12 support
- BEST Presentation
- To-do list for next semester's group

Greg's Deliverables

- BOARD 12 USER FUNCTIONS:

- Board 12 Motor, Servo functions
- Board 12 H-Bridge ISR

- Tech-SAL Package

- BEST

- BEST and Tech-SAL
- BEST Electronic Scoring

Tim's Deliverables

- Code integration, maintenance and troubleshooting
- Coding/commenting rules
- Baukus-Naur syntax rules
- Syntax checker coding/testing
- Regional Texas BEST presentation
- Project Package for spring 2008

Budget / Gantt Chart

Original Gantt Chart

	Task Name	Start	Finish	Resource Name		Task Name	Start	Finish	Resource Names
1	SOFTWARE DEVELOPMENT	Tue 8/28/07	Mon 12/3/07			26	WEEK 4	Tue 9/18/07	Mon 9/24/07
2	WEEK 1	Tue 8/28/07	Mon 9/3/07			27	Software Testing-Back End (CCE Code)	Tue 9/18/07	Mon 9/24/07
3	Review Previous Final Reports	Tue 8/28/07	Mon 9/3/07	Kyle		28	Software Testing-Front End (GUI)	Tue 9/18/07	Mon 9/24/07
4	Consult Previous Project Programmers	Tue 8/28/07	Mon 9/3/07	Colby		29	Software Documentation	Tue 9/18/07	Mon 9/24/07
5	Review Current SAL Translator	Tue 8/28/07	Mon 9/3/07	Colby		30	Revise GUI Code	Tue 9/18/07	Mon 9/24/07
6	Review Current SAL Syntax Detector	Tue 8/28/07	Mon 9/3/07	Tim		31	Revise SAL Translation Code	Tue 9/18/07	Mon 9/24/07
7	Review CCE Compatibility	Tue 8/28/07	Mon 9/3/07	Brian		32	Revise CCE Code	Tue 9/18/07	Mon 9/24/07
8	Review Current Documentation	Tue 8/28/07	Mon 9/3/07	Greg		33	Compile and Upload Competition Version	Tue 9/18/07	Mon 9/24/07
9	Review Current GUI	Tue 8/28/07	Mon 9/3/07	Jacob		34	WEEK 5	Tue 9/25/07	Mon 10/1/07
10	WEEK 2	Tue 9/4/07	Mon 9/10/07			35	Project Lab 2 Robot Testing	Tue 9/25/07	Mon 10/1/07
11	Download and review Electronic Scoring Software	Tue 9/4/07	Mon 9/10/07	Tim		36	Test Software	Tue 9/25/07	Mon 10/1/07
12	Brain Board RC Testing	Tue 9/4/07	Mon 9/10/07	Tim		37	Revise GUI Code	Tue 9/25/07	Mon 10/1/07
13	Initial Testing-Back End (CCE Code)	Tue 9/4/07	Mon 9/10/07	Kyle		38	Revise SAL Translation Code	Tue 9/25/07	Mon 10/1/07
14	Initial Testing-Front End (GUI)	Tue 9/4/07	Mon 9/10/07	Greg		39	Revise CCE Code	Tue 9/25/07	Mon 10/1/07
15	Revise CCE and RC Code	Tue 9/4/07	Mon 9/10/07	Brian		40	Test Run of Electronic Scoring Software	Tue 9/25/07	Mon 10/1/07
16	Revise SAL Translation Code	Tue 9/4/07	Mon 9/10/07	Colby		41	SAL Software Support	Tue 9/25/07	Mon 10/1/07
17	Revise GUI Code	Tue 9/4/07	Mon 9/10/07	Jacob		42	WEEK 6	Tue 10/2/07	Mon 10/8/07
18	WEEK 3	Tue 9/11/07	Mon 9/17/07			43	Test Software with Lab 2 Robots	Tue 10/2/07	Mon 10/8/07
19	Brain Board RC Testing	Tue 9/11/07	Mon 9/17/07	Tim		44	Prepare Competition Scoring Software	Tue 10/2/07	Mon 10/8/07
20	Software Testing-Back End (CCE Code)	Tue 9/11/07	Mon 9/17/07	Kyle		45	Revise/Test GUI Code	Tue 10/2/07	Mon 10/8/07
21	Software Testing-Front End (GUI)	Tue 9/11/07	Mon 9/17/07	Greg		46	Acquire Scoring Setup (Projector, Laptop, etc)	Wed 10/3/07	Fri 10/5/07
22	Revise GUI Code	Tue 9/11/07	Mon 9/17/07	Jacob		47	Revise/Test SAL Translation Code	Tue 10/2/07	Mon 10/8/07
23	Revise SAL Translation Code	Tue 9/11/07	Mon 9/17/07	Colby		48	Revise/Test CCE Code	Tue 10/2/07	Mon 10/8/07
24	Revise CCE and RC Code	Tue 9/11/07	Mon 9/17/07	Brian		49	Compile and Upload New Version	Tue 10/2/07	Mon 10/8/07
25	Compile First Revision	Tue 9/11/07	Mon 9/17/07	Tim					

Gantt Chart

	Task Name	Start	Finish	Resource Name
50	▪ WEEK 7	Tue 10/9/07	Mon 10/15/07	
51	Test Software with Lab 2 Robots	Tue 10/9/07	Mon 10/15/07	Kyle
52	Upload Software Revisions	Tue 10/9/07	Mon 10/15/07	Greg
53	Revise/Test GUI Code	Tue 10/9/07	Mon 10/15/07	Jacob
54	Revise/Test SAL Translation Code	Tue 10/9/07	Mon 10/15/07	Colby
55	Revise/Test CCE Code	Tue 10/9/07	Mon 10/15/07	Brian
56	SAL Software Support	Tue 10/9/07	Mon 10/15/07	Tim
57	Prepare Interim Presentation	Tue 10/9/07	Mon 10/15/07	Team
58	Prepare Interim Reports	Tue 10/9/07	Mon 10/15/07	Individual
59	▪ WEEK 8	Tue 10/16/07	Mon 10/22/07	
60	Test Revisions with Lab 2 Robots	Tue 10/16/07	Mon 10/22/07	Kyle
61	SAL Software Support	Tue 10/16/07	Mon 10/22/07	Greg
62	Revise/Test GUI Code	Tue 10/16/07	Mon 10/22/07	Jacob
63	Acquire Scoring Setup (Project, Laptop, etc)	Thu 10/18/07	Fri 10/19/07	Colby
64	Revise/Test SAL Translation Code	Tue 10/16/07	Mon 10/22/07	Colby
65	Revise/Test CCE Code	Tue 10/16/07	Mon 10/22/07	Brian
66	Compile and Upload New Version	Tue 10/16/07	Mon 10/22/07	Tim
67	▪ WEEK 9	Tue 10/23/07	Mon 10/29/07	
68	Revise Documentation	Tue 10/23/07	Mon 10/29/07	Kyle
69	Test Software	Tue 10/23/07	Mon 10/29/07	Greg
70	Revise GUI Code	Tue 10/23/07	Mon 10/29/07	Jacob
71	Revise SAL Translation Code	Tue 10/23/07	Mon 10/29/07	Colby
72	Revise CCE Code	Tue 10/23/07	Mon 10/29/07	Brian
73	SAL Software Support	Tue 10/23/07	Mon 10/29/07	Tim

Gantt Chart

	Task Name	Start	Finish	Resource Names
74	▪ WEEK 10	Tue 10/30/07	Mon 11/5/07	
75	SAL Software Support	Tue 10/30/07	Mon 11/5/07	Kyle
76	Revise Documentation	Tue 10/30/07	Mon 11/5/07	Greg
77	Test GUI Code	Tue 10/30/07	Mon 11/5/07	Jacob
78	Test SAL Translation Code	Tue 10/30/07	Mon 11/5/07	Colby
79	Test CCE Code	Tue 10/30/07	Mon 11/5/07	Brian
80	Compile and Upload New Version	Tue 10/30/07	Mon 11/5/07	Tim
81	▪ WEEK 11	Tue 11/6/07	Mon 11/12/07	
82	Revise Documentation	Tue 11/6/07	Mon 11/12/07	Kyle
83	Test Software	Tue 11/6/07	Mon 11/12/07	Greg
84	Reviset GUI Code	Tue 11/6/07	Mon 11/12/07	Jacob
85	Revise SAL Translation Code	Tue 11/6/07	Mon 11/12/07	Colby
86	Revise CCE Code	Tue 11/6/07	Mon 11/12/07	Brian
87	SAL Software Support	Tue 11/6/07	Mon 11/12/07	Tim
88	▪ WEEK 12	Tue 11/13/07	Mon 11/19/07	
89	SAL Software Support	Tue 11/13/07	Mon 11/19/07	Kyle
90	Revise Documentation	Tue 11/13/07	Mon 11/19/07	Greg
91	Test GUI Code	Tue 11/13/07	Mon 11/19/07	Jacob
92	Test SAL Translation Code	Tue 11/13/07	Mon 11/19/07	Colby
93	Test CCE Code	Tue 11/13/07	Mon 11/19/07	Brian
94	Compile and Upload New Version	Tue 11/13/07	Mon 11/19/07	Tim

Gantt Chart

	Task Name	Start	Finish	
95	▪ WEEK 13	Tue 11/20/07	Mon 11/26/07	
96	SAL Software Support	Tue 11/20/07	Mon 11/26/07	Kyle
97	Finalize Documentation	Tue 11/20/07	Mon 11/26/07	Greg
98	Finalize GUI Code	Tue 11/20/07	Mon 11/26/07	Jacob
99	Finalize SAL Translation Code	Tue 11/20/07	Mon 11/26/07	Colby
100	Finalize CCE Code	Tue 11/20/07	Mon 11/26/07	Brian
101	Compile and Upload Final Version	Tue 11/20/07	Mon 11/26/07	Tim
102	▪ WEEK 14	Tue 11/27/07	Mon 12/3/07	
103	Final Report	Tue 11/27/07	Mon 12/3/07	Team
104	Final Presentation	Tue 11/27/07	Mon 12/3/07	Team
105	Project Notebook	Tue 11/27/07	Mon 12/3/07	Individual

Final Gantt Chart

Name : SOFTWARE DEVELOPMENT		8/28/07	9/4/07	WEEK 3		9/11/07	9/18/07
	Review Previous Final Reports	8/28/07	9/4/07		Tested RC Code from SAL and BEST	9/11/07	9/18/07
	Consult Previous Project Programmers	8/28/07	9/4/07		Create GUI User Documentation	9/11/07	9/18/07
	Review Current SAL Translator	8/28/07	9/4/07		Review Schematics for Board 12 Moto...	9/11/07	9/18/07
	Review Current SAL Syntax Detector	8/28/07	9/4/07		Create BEST GUI Version	9/11/07	9/18/07
	Review CCE Compatibility	8/28/07	9/4/07		Begin modifying SAL to translate RC C...	9/11/07	9/18/07
	Review Current Documentation	8/28/07	9/4/07		Revise CCE and RC Code	9/11/07	9/18/07
	Review Current GUI	8/28/07	9/4/07	WEEK 4		9/18/07	9/25/07
WEEK 2		9/4/07	9/11/07		Create SAL Package	9/18/07	9/25/07
	Electronic Scoring Setup (Hardware)	9/4/07	9/11/07		Create Board 12 Motor and Servo Code	9/18/07	9/25/07
	Electronic Scoring Setup (Software)	9/4/07	9/11/07		Revise SAL Translation for BRAIN board	9/18/07	9/25/07
	Fix BEST Demo Robot for Kick-Off	9/4/07	9/11/07		Create GUI Versions (BEST, SAL)	9/18/07	9/25/07
	Revise CCE and RC Code	9/4/07	9/11/07		Test Motor/Servo Outputs for Brain B...	9/18/07	9/25/07
	Revise SAL Translation Code	9/4/07	9/11/07		Revise CCE Code	9/18/07	9/25/07
	Revise GUI Code	9/4/07	9/11/07				

WEEK 5		9/25/07	10/2/07	WEEK 8	10/16/07	10/23/07
...Add Control Set to GUI (Brain, Board 12)		9/25/07	10/2/07	...Revise SAL Package	10/16/07	10/23/07
...ReWrite Motor (B12), header files		9/25/07	10/2/07	...SAL Software Support	10/16/07	10/23/07
...Change 'period' to 'semi-colon' for SAL...		9/25/07	10/2/07	...Revise/Test GUI Code	10/16/07	10/23/07
...Differential Steering Mapping w/ Brain ...		9/25/07	10/2/07	...Acquire Scoring Setup (Project, Lapt...	10/18/07	10/20/07
...Finish CCE Code		9/25/07	10/2/07	...Revise/Test SAL Translation Code	10/16/07	10/23/07
...Modify 'For' loop statement code		9/25/07	10/2/07	...Revise/Test CCE Code	10/16/07	10/23/07
WEEK 6		10/2/07	10/9/07	...Compile and Upload New Version	10/16/07	10/23/07
...Finalize SAL Package		10/2/07	10/9/07	WEEK 9	10/23/07	10/30/07
...Finish Board Header Files		10/2/07	10/9/07	...Revise Documentation	10/23/07	10/30/07
...Add Save/Open Function to GUI		10/2/07	10/9/07	...Test Software	10/23/07	10/30/07
...Acquire Scoring Setup (Projector, Lapt...		10/3/07	10/6/07	...Revise GUI Code	10/23/07	10/30/07
...Continue Differential Steering Mappin...		10/2/07	10/9/07	...Revise SAL Translation Code	10/23/07	10/30/07
...Board Testing		10/2/07	10/9/07	...Revise CCE Code	10/23/07	10/30/07
...Draft SAL commenting and code conv...		10/2/07	10/9/07	...SAL Software Support	10/23/07	10/30/07
WEEK 7		10/9/07	10/16/07	WEEK 10	10/30/07	11/6/07
...Complete SAL IDE		10/9/07	10/16/07	...Tech-SAL Installation Package	10/30/07	11/6/07
...Board 12 H-Bridge Interrupt		10/9/07	10/16/07	...Create BEST Header File	10/30/07	11/6/07
...Revise/Test GUI Code		10/9/07	10/16/07	...Work on Update Manager	10/30/07	11/6/07
...Finish BRAIN RC Differential Mapping		10/9/07	10/16/07	...SAL Syntax Checker	10/30/07	11/6/07
...Revise/Test CCE Code		10/9/07	10/16/07	...Test CCE Code	10/30/07	11/6/07
...Continue SAL commenting and code re...		10/9/07	10/16/07	...SAL Syntax Rules	10/30/07	11/6/07
...Prepare Interim Presentation		10/9/07	10/16/07			
...Prepare Interim Reports		10/9/07	10/16/07			

WEEK 12		11/13/07	11/20/07
Compile Tech-SAL Package for Regionals		11/13/07	11/20/07
Test Autonomous and RC Brain Functionality		11/13/07	11/20/07
Finalize Update Manager		11/13/07	11/20/07
SAL Syntax Checker		11/13/07	11/20/07
Finalize CCE/IAR Compatibility Issues		11/13/07	11/20/07
Finish SAL Syntax Checker Helper Functions		11/13/07	11/20/07
WEEK 13		11/20/07	11/27/07
Compile Tech-SAL Package for Regionals		11/20/07	11/27/07
Finalize Translation Code		11/20/07	11/27/07
Finalize GUI		11/20/07	11/27/07
SAL Syntax Checker		11/20/07	11/27/07
Add CCE/IAR Compatibility		11/20/07	11/27/07
Finalize Tech-SAL Package		11/20/07	11/27/07
WEEK 14		11/27/07	12/4/07
Final Report		11/27/07	12/4/07
Final Presentation		11/27/07	12/4/07
Project Notebook		11/27/07	12/4/07

Questions?