Flowcharts

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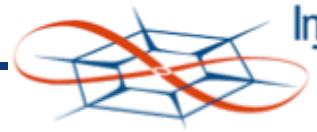
January 31, 2017



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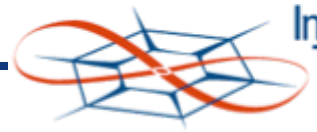
Program Design

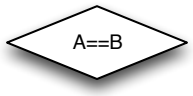
- Before writing code, we'll design an initialization subroutine and an execute subroutine
- We'll use a technique call Flow Charts that is a graphical representation of the program
- Flow Charts use a set of symbols to represent different actions of a program
- You can use Microsoft Visio on the EECS Windows computers to generate Flow Charts



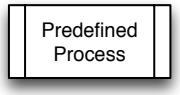
Flow Charts -- Basic Symbols

- The entry and exit for a process is denoted with a rounded rectangle

- Sequential code is indicated by a rectangle



- A conditional test is indicated by a diamond



- Invoking a subroutine is denoted by a rectangle with two vertical lines.

- An off-page connector is denoted by a circle.

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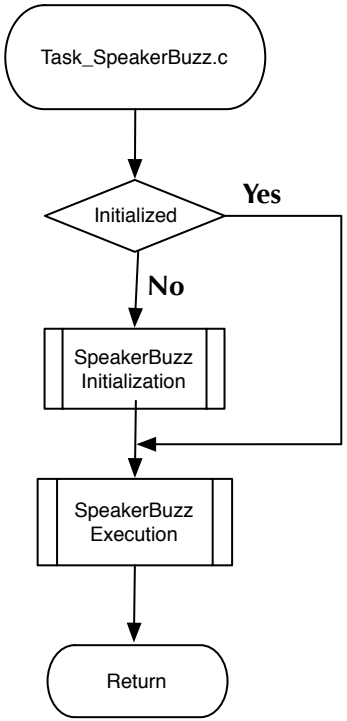
SpeakerBuzz Task



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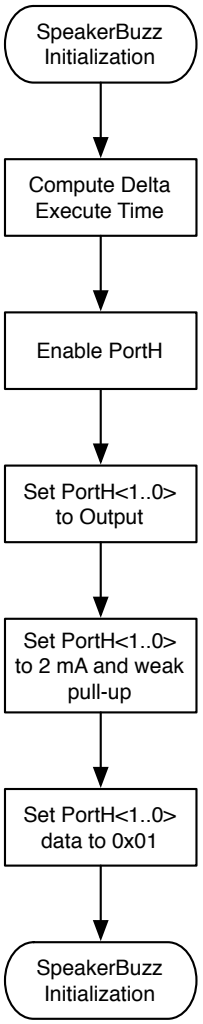
SpeakerBuzz Initialization



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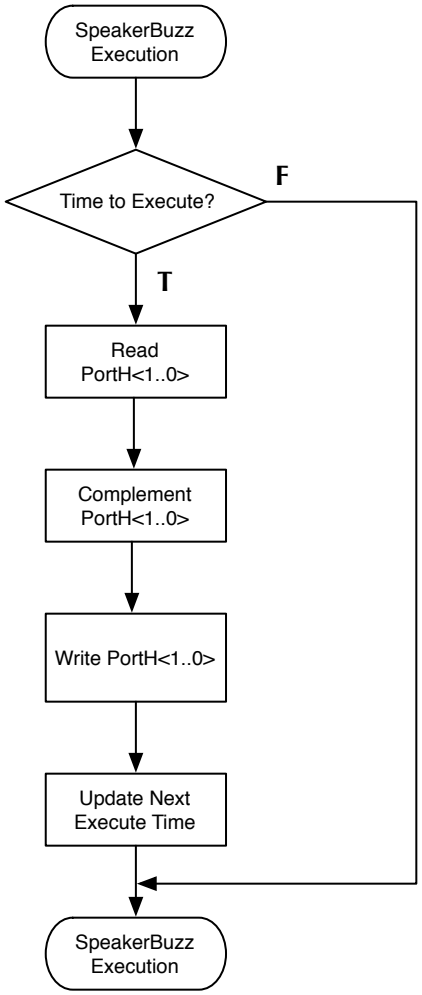
SpeakerBuzz Execute



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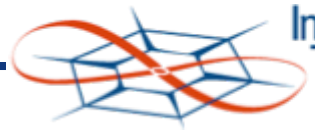
SpeakerBuzz -- Next Steps

- Flow Charts help us visualize the organization of our programs
- The first set of Flow Charts describe what we want the program to do, not how to do it
  - The "What" becomes our program comments
- We refine our Flow Charts to specify how to accomplish our program goals
  - We use the subroutines in TI DriverLib to implement our program



Pseudocode

- A second approach is to write the outline of a program in a "Pseudo-language"
- The focus is on what to do, not the how or syntax
- Basic constructs:

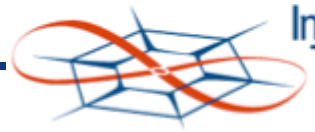
FUNCTION is description of a single task in design

SEQUENCE is a linear progression where one task is performed sequentially after another.
WHILE is a loop (repetition) with a simple conditional test at its beginning.
IF-THEN-ELSE is a decision (selection) in which a choice is made between two alternative courses of action.

REPEAT-UNTIL is a loop with a simple conditional test at the bottom.
CASE is a multiway branch (decision) based on the value of an expression.
CASE is a generalization of IF-THEN-ELSE.
FOR is a "counting" loop.

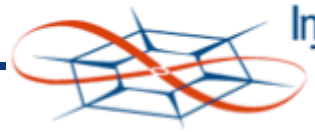
SpeakerBuzz -- Task

```
FUNCTION Task_SpeakerBuzz {

      IF ( <Task_SpeakerBuzz not initialized> ) {
         <SpeakerBuzz_Init>
      }

      <SpeakerBuzz_Execute>
}
```



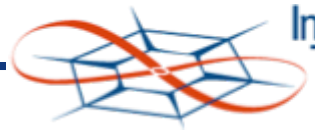
SpeakerBuzz -- Initialization

```
FUNCTION SpeakerBuzz_Init {
      <Compute delta execution interval>
      <Enable PortH>
      <Set PortH(1..0) to output>
      <Set PortH(1..0) to 2 mA output drive>
      <Write PortH[1..0] <= "01">
}
```



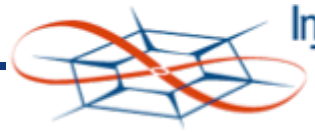
SpeakerBuzz -- Execution

```
FUNCTION SpeakerBuzz_Execute {
      IF (<Time to execute>) {
          <Read PortH[1..0] to Temp>
          <Complement Temp[1..0]>
          <Write PortH[1..0]>
          <Update next execution time using delta interval>
      }
}
```



Development of Pseudocode

- Initial Pseudocode can be vague
  - What does <Time to execute> mean?
  - What should the "delta interval" be?
  - What does it mean to <Enable PortH>
- Refine Pseudocode
  - Recognize <Time to execute> requires a CurrentTime and and ExecuteTime
    - These become state variables in your program
  - Recognize the "delta interval" is related to the sound frequency you want to generate
    - This is determined by the physical system
  - Recognize that <Enable PortH> is a hardware related function
- Refine your Pseudocode **before** writing your program



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Additional Resources

- Creately flowchart tutorial: http://creately.com/blog/diagrams/flowchart-guide-flowchart-tutorial/
- Pseudocode: http://www.ittc.ku.edu/~gminden/Embedded_Systems/PDFs/Pseudocode_Standard.html
- Microsoft Visio: http://technology.ku.edu/office
- A Flow Chart "Cheat Sheet" is at: http://www.ittc.ku.edu/~gminden/Embedded_Systems/PDFs/flow-chart-symbols.png
- IBM's Flow Chart Techniques is at: http://www.ittc.ku.edu/~gminden/Embedded_Systems/PDFs/IBM-FlowchartingTechniques-GC20-8152-1.pdf

Actions

- Read the Creately tutorial at: http://creately.com/blog/diagrams/flowchart-guide-flowchart-tutorial/
- Read the Pseudocode_Standard: http://www.ittc.ku.edu/~gminden/Embedded_Systems/PDFs/Pseudocode_Standard.html
- Be prepared to apply these techniques in class