



MICHIGAN STATE UNIVERSITY

09/20: Prototyping

[The Capstone Experience](#)

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From Students...
...to Professionals

Prototypes

- Developed
 - Early
 - Rapidly
- Implement Subset of the Requirements
- Done for Variety of Reasons
- Are Not Finished Goods
- “Hacking” (Good Sense)

The Capstone Experience Prototyping 2

Why? Answer Questions

- Help Determine
- Specifications
 - Functional
 - Design
 - Technical
- Usability
- How Existing Code Works
- Programming Languages
- Development Environments
- Operating Environments
- Etc...

The Capstone Experience Prototyping 3

Why? Determine Schedule

Determine how long will it take to...

- ...learn the new programming language.
- ...learn the development environment.
- ...learn the existing code.
- ...convert the existing code.
- ...convert the existing database.
- ...get libraries working.
- ...deploy the application.
- Etc....

The Capstone Experience Prototyping 4

Why? Reduce Risk

- Operability
 - How do we make a game clock?
 - Where do we store the data?
- Interoperability
 - How does the game clock work with other tablets?
 - How do the tablets all write to the same database?
- Scalability
 - Will the game clock propagate in real time?
 - Will the database engine keep up?
- Reliability
 - What happens if the clock tablet dies?
 - What happens if the database tablet dies?
- Etc...

The Capstone Experience Prototyping 5

Speed (to Write)

- Critical
- 2-3 Day Tasks
- Use Whatever Works
 - RAD Languages
 - SDK's
 - IDE's
 - Design Tools
 - Wizards
 - Sample Code
 - Etc...
- Stop When Questions Answered

The Capstone Experience Prototyping 6



Tradeoffs: Speed (to Write) vs...

- Testing
- Documentation
- Security
- Software Engineering Best Practices
- Usability
- Performance
- Coding Standards
- User Interface Standards
- Using Real Data
- Etc...

Hence, Normally Not Appropriate in Final Deliverable

Challenge/Danger

- “Hack” Solution
 - It works.
 - It’s *a* way to do something.

vs

- “Correct” Solution
 - It works.
 - It’s the “right” way to do something.
(There may be more than one “right” way to do something.)

Often My Biggest Frustration

Prototypes: Case Studies

Basketball

- Play Effectiveness
- Player Timer
- Radio Stats
- Real Time Play Stats
- Plus/Minus

Basketball Play Effectiveness

- Coaches Desired
 - Determine Effectiveness of Plays
 - Record All Plays with Result
 - Produce Report of Effectiveness
 - Each Play
 - # of Success / # of Attempts
- I Learned (During First Meeting)
 - Done After Game from DVR
 - Lots of Plays (~ 200) in Play Book
 - ~60-80 Plays Run Per Game
 - Plays Categorized
 - Early Offense 1,2 (E.g., Fast Breaks)
 - Offense 1,2 (E.g., Half Court Plays)
 - Special Situations 1,2 (E.g., Out of Bounds)
- Overwhelming

Basketball App Architecture

Basketball Play Effectiveness

```

graph TD
    BPE[BPE Application] <--> VB[Visual Basic]
    VB <--> ACC[Access]
    ACC <--> WXP[Windows XP Desktop]
  
```

Basketball already had all three of these components.

Risks

- Learning Basketball Processes?
- Programming in Visual Basic?
- Access?
- Building a GUI with Access/VB?
- Interfacing VB with Access?
- Generating Reports in Access?
- Etc...



BB Stats AV1

Fields

- P# Play Number
- T Time
- C# Clip Number
- EO Early Offense
- O Offense
- SS Special Situations
- R Result

Nota Bene

- Just Screen Layout
- No Code (Underneath)
- Never Have All Entries Filled at Once

What I Learned From AV1 (1 of 2)

- Wanted to Identify Plays Within a Possession
- Plays Categorized Series / Set
 - Set is Variation on Series (“Parameterized Plays”)
 - E.g.
 - Series: Thumbs
 - Sets: Up, Down, Circle
 - Plays: Thumbs Up, Thumbs Down, Thumbs Circle
 - 1, 2 Notation
 - EO1 = Early Offense Series
 - EO2 = Early Offense Set
 - ST (Special Teams) Missing

Huge Impact On Design

What I Learned From AV1 (2 of 2)

- Results Coded
 - XN Missed N Pointer (X1, X2, X3)
 - ON Made N Pointer (O1, O2, O3)
 - FF Foul on the Floor
 - TO Time Out
 - Etc...
- Wanted to Record Notes on Defense
- Didn't Care About Player Times

BB Stats AV1

Fields

- P# Play Number
- T Time
- C# Clip Number
- EO Early Offense
- O Offense
- SS Special Situations
- R Result

Nota Bene

- Just Screen Layout
- No Code (Underneath)
- Never Have All Entries Filled at Once

BB Stats AV2

Fields

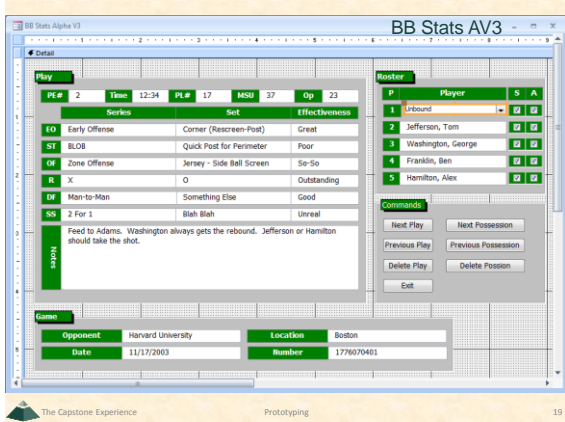
- PO# Possession Number
- PL# Play Number
- SS Special Situations
- DF Defense

Nota Bene

- Just Screen Layout
- No Code (Underneath)
- Would NOT Have Entries in All Fields

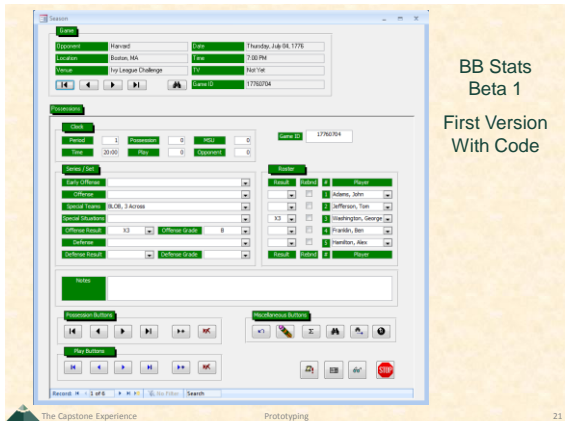
What I Learned From AV2

- Wanted to Grade Effectiveness of Plays
- Wanted to Record Player Steals and Assists (Remember this...)
- Needed to Navigate Plays and Possessions



What I Learned From AV3

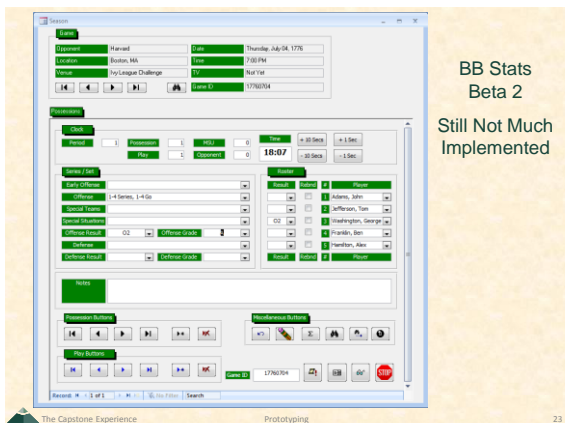
- Wanted Grades to Be A, B, C, D, F
- Wanted Results to Be X1, O1, X2, O2,...
- Wanted Results Associated With Players
- Wanted Series/Set Combined
- Wanted to Record Player Rebound
- Did NOT Want to Record Player Steals and Assists



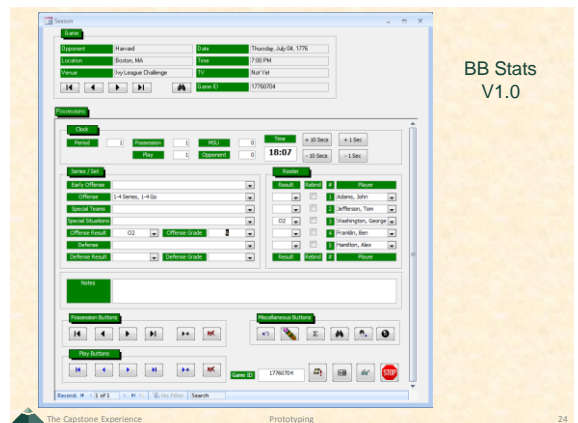
BB Stats Beta 1
First Version With Code

What I Learned From Beta 1

- Entering a Play
 - Some Things Calculated Automatically
 - Play/Possession Number
 - Score
 - Most Things Entered Via Pull-Down Menus
 - Series / Set
 - Result
 - But time Entered Manually (On Keyboard)
- Need Mouse-Only Input
- Need Easy Way to Adjust Clock



BB Stats Beta 2
Still Not Much Implemented



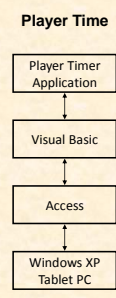
BB Stats V1.0



Player Timer

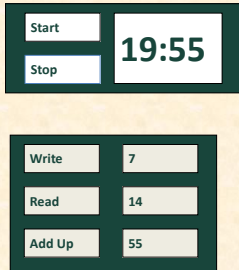
- For Each Player, Track
 - Minutes Played
 - Game Clock Time
 - Consecutive & Total
 - Minutes Rested
 - Wall Clock Time
 - Consecutive
- Must
 - Be Usable
 - On the Bench
 - In Real Time
 - Portable and Not Require Electrical Outlet
 - Feel Like a Pen and a Clipboard

Basketball App Architecture



Player Timer Prototypes

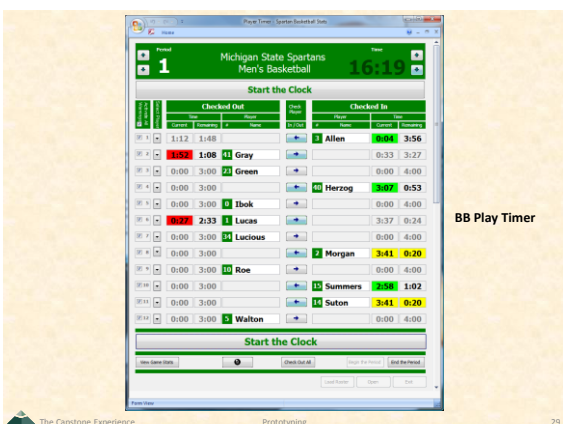
- Game Clock
 - Start / Stop
 - Counts Down
 - By Minutes/Seconds
- Access Interface
 - Write Number
 - Read Number
 - Add Up Numbers



Player Timer Development

- Knew Exactly What They Wanted, So...
- Designed "Final" Version
 - User Interface
 - Data Base Schema
 - Etc...
- Coded "Final" Version
- Lab Tested "Final" Version
- Field Tested "Final" Version
 - At a Scrimmage
 - Totally Unusable
- Scrapped "Final" Version UI

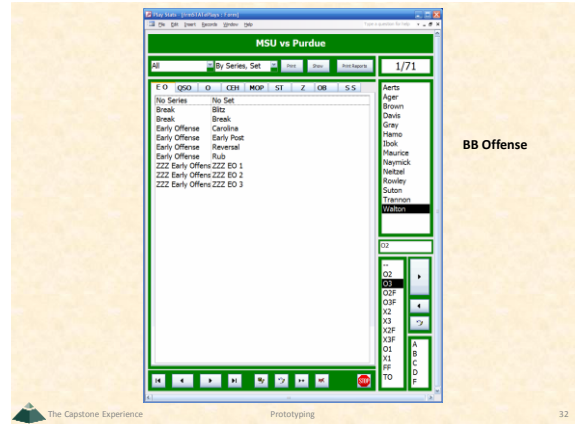
Huge Mistake!



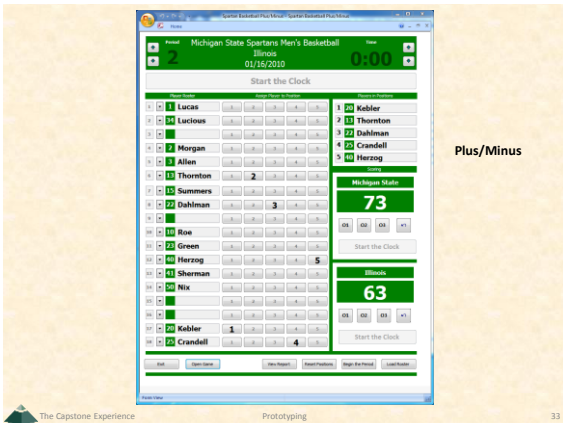
BB Play Timer

Software Updates

- Enable Clock Adjustments (While Clock Stopped)
- Enable Check In/Out By Touching
 - Check In/Out Button
 - Player Name
 - Player Slot
- Allow > 5 Players Checked In (While Clock Stopped)
- Enable Pending Check In (While Clock Running)
- Eliminate Almost All Modal Dialog Boxes



BB Offense



Plus/Minus

Your Prototypes

- What?
- Why?
- How?
- When?
- Where?

What's next?

- Team Status Report
 - [PowerPoint Template](#)
 - Due Noon, Monday, September 27
 - All Teams, Document and PowerPoint
 - Email to Dr. D.
 - Read Submission Instructions in Template
- Each Team Presents
 - Using a Team Laptop
 - At Most 15 Minutes (Rehearse Timing)
 - Single or Multiple Presenters (Your Choice)
- Dress is business casual.
- "Formal" Team Pictures Right After Meeting