

Sultan High School

2015

Score Board Replacement Project



Sultan High School
GO TURKS!



Sultan School District 311



TurkPride.tv, Sultan High Schools
award winning Broadcast Program



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In the summer of 2015 the Sultan School District Technology Department with the help from the Maintenance department did an in house replacement of the Sultan High School Gym's Scoreboard.

We removed the analog system that was installed when the school was built in the 80's and replaced it with projectors that are controlled by software.

Just some of the features of the system are:

- The new scoreboard accommodates any gym sport with a custom scoreboard designed for the specific sport.
- Each of the 3 scoreboards (1 on each side of the gym and 1 on the front of the scorer's table) can run independently from each other, so 3 events could be scored at the same time such as wrestling or half court volleyball.
- Easy and intuitive touch screen interface and a scoreboard control panel for score entry.
- Customizable with visiting team logos and names and a sponsor banner across the top.
- Non touch screen scoreboard and shot clock control buttons.
- Scoreboard integration into our Broadcast Club, TurkPride.tv online stream of Basketball.
- Digital Signage on the front of the scorer's table to generate ad revenue for the broadcast club.
- Easy sound control for the game announcer, scoreboard buzzer, and music.



I documented our project from conception to a few games into the second season of game play in the gym.

The Need

Simple, we need a new scoreboard at Sultan High School.

The current scoreboard is over 30 years old and is VERY temperamental.

The main controller seems to have intermittent connection issues and there is even a light on one of the boards that is lit all the time till the point it is supposed to light and then it goes dark, crazy.



The assistant principal and athletic director Mr. Sifferman and I (Dave Moon, Technology Director) started chatting one day about the broken scoreboard during a basketball game. In the end, I decided I would check around and see what it would take to repair the existing scoreboard, after all, a scoreboard is technology, isn't it?

After a few phone calls, and chatting with a couple of scoreboard repair places I located with the power of Google, the overall consensus was the control modules in each of the scoreboards needed to be replaced.

The cost ended up being the comparable regardless of the vendor and since new parts are long since gone the only option was re-certified. It would be a little over \$2,400 for two of them and the control modules did carry a DOA warranty, but no returns, and no promises this would fix the problem.

At this point Mr. Sifferman decided to inquire about the cost of a new scoreboard. Those numbers came back at 15k to 25k, depending on the features. We both decided that this would be a good solution, but doubt we could get funding support.

Coincidentally about a year prior I was looking for a way to get the score from the scoreboard onto our Broadcast Clubs live stream of basketball games. The end

result was a new scoreboard, but that path took me down looking at Software controlled scoreboards. I filed that information away for future reference.

The idea of using a PC and projectors has been rattling around in my head since we had our first conversation about the scoreboard but was hesitant to suggest it since that would mean one more thing on my department's plate to take care of.

After a long discussion with Mr. Sifferman we decided to pitch 3 solutions to the High School admins, coaches, and Superintendent.

1. Repair the existing scoreboards at \$2,400 in parts plus repair time, figured \$5,000 to be safe and no promise it would fix our problems.
2. Purchase new scoreboards at \$15,000 – \$25,000.
3. Rebuild from scratch with a PC and Projectors, estimated cost \$7,000. The benefits of this route were detailed.

I favored neither solution, most everyone was intrigued by the projector idea and wanted to know more about how it would work. Time to setup a demo!

Demo Time

We setup a demo in my lab showing the scoreboard on the projector and shot clocks on computer monitors. I invited everyone to stop in anytime the entire day. All the coaches made it by to take a look and try it out, I have several of the scoreboard operators come by and chime in too. All the admins came by as well.

I heard some great feedback and discovered some hurdles that we would need to get over to be successful. In the end the PC Scoreboard was worth further exploration. Some of the feedback I heard was...

- Will the projector be bright enough in the gym?
- The touch screen was not a good option for starting and stopping the clock, the coaches wanted the time keepers to have their eyes on the game not where their fingers were hovering.
- One coach said there was a NFHS rule that shot clocks must be separate from the scoreboard (I ended up looking this up in the rule book and it's not true).
- What if the computer crashes?
- What if one of the projectors fails mid game?

Had great feedback, most positive, all constructive, and a few negative. I heard nothing that would cause us to kill the project at this point.

I also run a Technology Club afterschool two days a week. They are great to lend a hand on projects from labor to design. The entire time I have been leaning on them for their thoughts and feedback.

The kids were great in helping setup and man the demo. Their enthusiasm was contagious while showing others how it works. I am glad they were able to be a part of this.

Time to Plan

Now I need to take this project to the next step by listing expectations, planning on how to get to these expectations, and finally demoing a live proof of concept in the gym.

- Software – The leader seems to be pcscoreboards.com, they have great school pricing, a great product that is solid and stable, and meets our needs.
- Projectors – Need to be bright enough to be seen and clear and redundancy would be awesome.
- Shot Clocks – Need these... the software supports shot clocks, we need to hang 20" LCD computer monitors on the wall where the current shot clocks are located. We would also need a way to protect them.
- Starting and stopping the clock – This one was actually pretty easy; the software has hot keys for every function. A simple project box, 3 arcade buttons, and a USB keyboard emulator and boom, we would have buttons for the clocks.
- Computer – First thought was this computer would only be driving a scoreboard, then we added shot clocks, and we also have the control screen. One cool option pcscoreboard.com has is the ability to Chroma Key in a score bug onto our online broadcast stream of basketball games. That puts us at needing a quad video card.
- Score cart – Would our existing score cart accommodate a computer and the electronics needed to send multiple VGA signal's, one of them 190 feet.
- Wiring – BIGGIE! Many questions, can we use the existing 1/2" conduit that the current scoreboard and shot clocks use? If not, is there a clear path? Also electricity for the projector? Shot clocks had dedicated outlets already.
- Multiple Sports – Seems easy enough right? Different scoreboard program for each sport, but what about running scoreboards independently for wrestling tournaments? This turned my initial idea of simply splitting the same signal upside down since each scoreboard would need to display different information.
- Sound System Integration – The scoreboard software sounds a buzzer, and that needs to go over the PA system. Fortunately there is a jack to the sound system near the score table that they use for the announcer.

- Versatile – the ability to push out anything to the projectors, not just a scoreboard. Mr. Sifferman thought it would be nice to push out videos or PowerPoint's during assemblies. The current system consisted of setting up a portable projector screen and rolling out a cart that had a projector and speakers on it.

Setting the Project Parameters

Up to this point it's been chatting around and setting up a lab demo, but now it's time to set some clear parameters.

We must keep simplicity in mind as we plan. A new user should be able to setup and run the scoreboard from verbal or 1 page of instruction.

The computer will be dedicated to only a single purpose, the scoreboard for Basketball, Volleyball, and single wrestling matches. Any other use of the projectors will need to be from a laptop.

We need to have VGA and HDMI ports on the cart to drive the projectors directly. This is mostly for wrestling tournaments but will also work great for bringing in a laptop to show a presentation.

Need to run the VGA video over CAT6. We need to have an easy way to connect the multiple video signals from the score table to the box on the bleachers that ultimately leads to the pathway to the projectors

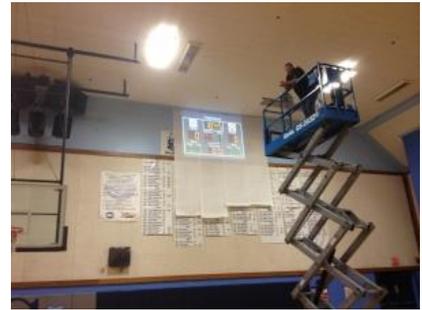
Sound needs to be controlled at the score table not just for the scoreboard PC but for any laptops, iPod's, and announcers that sit at the table. Inputs and volume control for each connection is imperative.

Proof of Concept

Time for a live demo in the gym! This was needed to prove to all that had a stake in this that it yes indeed it will actually work. It was nothing elaborate, just the projector I am eyeing for the job, a laptop, some white construction paper, and our man lift.

The mechanical score board in the gym measured 6'8" wide by 5'8" tall. We threw an image at the wall that ended up being 7' wide by 5'8" tall. The height measurement was our limiting factor because of a decretive board and sound dampening material below the projection area. If we used an electric projector screen then we could go bigger.

The image was bright and easily viewable from anywhere in the gym even with the white construction paper that was not a good reflective surface. It would be MUCH brighter with a true projection screen surface. The size of the information on the board itself was about the same if not a bit bigger from the existing scoreboard, so we didn't lose any size. Everyone was impressed with the outcome.



IT'S GO TIME

We got the green light to move forward with the replacement based on the estimate I gave of \$7,000 in equipment.

Mr. Sifferman started reaching out to organizations that help out the district. He was able to quickly raise about a third of the funds from the Booster Club, Youth Basketball, and others. Worst case my department could chip in some funds, I usually have a few thousand left over by the end of the year.

At some point between the proof of concept and drawing the project out I had the idea of replacing the artwork at the front of the cart with a couple of TV's, especially if we could find ones that fit and look nice. I thought one could be used to show the scoreboard and the other could be used for advertisements to help generate revenue for the broadcast club, let's just say that added \$800 to the project.

Design Time

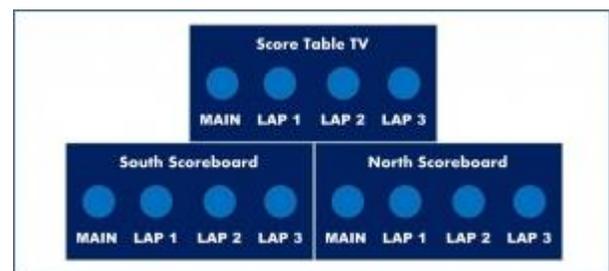
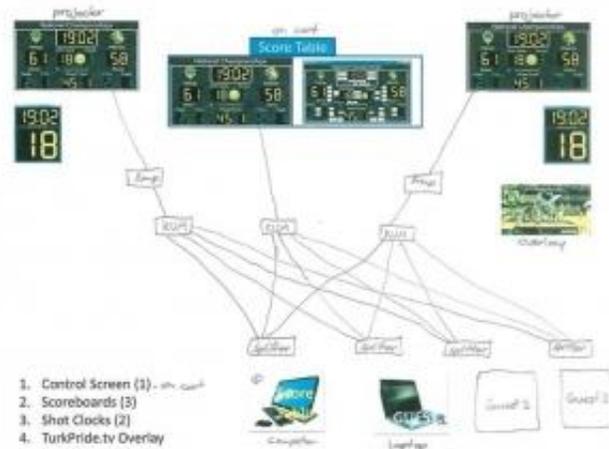
Time to take all the great input we have received to this point and the lessons learned from our two live demo's and put pencil to paper and come up with a design.

Ease of use needs to be top priority. I do not need to get the Friday night call at 8pm asking for emergency help with the scoreboard at a home playoff game.

We scoped out being able to use 3 laptops in order to display 3 different images (scoreboard, scoreboard and TV) for wrestling mostly.

I beat my head up against my desk for an hour on how to make this happen, in the end one of my guys drew it out in about 5 minutes (thanks Benny). Not gonna lie, made me feel a bit slow on this one.

The concept is simple, each of the 4 possible sources feeds into a 4 way VGA splitter/amp. Then each source from the splitters feed into a VGA selector switch (mistakenly labeled KVM on the drawing). Each projector and the TV has its own 4 port selector... North Scoreboard, South Scoreboard, Score Table TV. Each selector would have each source clearly labeled (see pic). Just select what source you want displayed on each specific projector or tv.



Since the shot clocks will only be shot clocks, and the overlay will only be the overlay image, they did not need to be part of the equation.

For the video signal my original thought would be to have the VGA over CAT6 amplifiers not in the cart but attached to wall under the bleachers. This would have required double the amount of amplifiers since there was too much signal loss between the cart and the wall in test setups. At \$150 per amp, it was decided to put the amps in the cart and eventually put a set behind the bleachers.

Sound was simple, we had an old school dial mixer we were hanging onto with 5 inputs and it fit perfectly in a cubby hole on the cart. Each source and the announcer would have their own volume control.

Time to build the parts list

- Two Projectors \$3,400 – We all know as the lumens go up the cost climbs even faster, and throw redundancy into the equation we could easily hit \$10,000 in projectors along. I found the Epson PowerLite W16SK 6000 Lumens Dual Projector for \$1,700 on our state contract. Perfect fit, provides the lumens needed by throwing the same image at the board from 2 projectors and provides the redundancy needed. Even with 1 projector down it is still bright enough to see in the gym. Bonus, the bulbs are under \$100!
- Two 42" LED TV's \$796 – I was lucky to find a TV that had nearly the exact dimensions needed! The LG Electronics 42LF5800 42-Inch 1080p Smart LED TV (2015 Model) fit all my requirements with the exception of a VGA input. No worries, I bought a HDMI to VGA adapter.
- Video Card \$154 – Sapphire AMD FirePro W4100 2GB GDDR5 Quad Mini DP PCI-Express Graphics Card 100-505817
- One HP Proliant Tower Computer \$0 – We had several i3's in surplus that we ended up using.
- Three 4 port VGA Selector Boxes \$30
- Five VGA over CAT Amps \$625
- Four 4 port video splitters \$200
- One gallon of Projector Screen Paint \$180
- One 24 outlet powerstrip for inside the score table \$40
- One touch screen monitor for the score table \$250
- Multiple cables, adapters, extenders in the cart \$200
- Two TV Mounts \$60
- Two boxes of CAT6 \$200
- Software licensing from pcscoreboards.com \$1,250 – Basketball, Volleyball, and a site license for Wrestling, this way we could run 3 mats at one time.
- Pixi Pro Projector Control Units \$700 – The remotes seem to work just fine from anywhere in the gym, but I know they would get lost eventually or always be prone to the dead battery virus. Plus this just polishes up the install a little bit more.
- Components for the Score Keeper and shot clock operators buttons - \$200 (trip to Fry's and bought everything off the self)
- Plexiglass for the front of the Score Cart and the Shot Clocks \$120

Step 1 of the build

The scorer's table

This step of the build will be completely on scorer's table. The table will now essentially be the brains of the entire system.

Preparing the table was 75% of the project. Summarizing it into a dozen pictures and a few paragraphs really doesn't put the amount of work that went into it into perspective.

Let's tear apart the score table and figure out what we are working with, here are some before pictures. In case you are wondering, that's Benny's finger. The Score Table was hand built by one of the old coaches; construction is outstanding, if anything 'over built'.



Inside after we pulled off the front artwork. Benny sizing up the TV, it fit PERFECT. The board in the center is what we are attaching the TV mounts too. That is 2 pieces of 3/4" plywood screwed together and then attached to the frame of the cart.



Here is a picture with the TV's installed, this actually turned out to be extremely easy. There will be a piece of 1/4" Plexiglas over the front that will come off with a couple of screws for easy access. The TV's swing out to give us super easy access to the inside of the cart.



Getting the TV's in was just one small part of the battle, there is still a lot of work to be done in the score table itself.

Sound

We had a simple old school dial mixer sitting on a shelf with 5 inputs and it fit perfect in the cubbyhole on the table. It has an XLR output, so no need to convert the signal. We did have to use a DI Box for each input and that was another \$50. The inputs were:



- Laptop source 1
- Laptop source 2
- Laptop source 3
- Announcers Microphone
- PC in the Table running the scoreboard software

Laptop connections

We made 2 of them VGA with Mini Sound jacks and 1 HDMI. Each of these laptop connections ran into a splitter, then into each of the 3 video selectors, and



finally to either the table side of the Cat6 to Video adapters or the TV in Front.

A better way to keep score

Coaches and scorekeepers all thought the touch screen concept of the software would take their focus off the game and put it more on the location of their finger on the screen. I took that feedback and had Benny assemble a scoreboard control panel using off the shelf buttons and a box from Fry's, I also bought a keyboard encoder from ebay. We also added a hand held push button that connects to the back of the control panel with a 10' cable for the shot clock reset. This allows a score keeper and an operator for the shot clock. I had the button otherwise it would have been \$50



TV's, one for advertisements and one for a Scoreboard

The TVs have 2 USB connections for playing video files or a slideshow with pictures on the drive. We put an extension cable on 1 and hid it just inside the underneath of the score table for easy but hidden access. The 2nd USB we put on the front of the table using a panel mount adapter for USB. I figured this would be easy access if they 'needed' something to be displayed or wanted to play a video or something.



This is where my Tech Club excels. They took on the responsibility to create all the content on the screens. We are starting with just a static slide show of pictures, but they are working hard to improve the content. I am sure by next year we will have completely animated advertisements and game time filler.

The Computer

Did a quick upgrade to the HP, replaced the Hard Drive with a SSD drive, bumped up the RAM, probably not necessary, but didn't want to risk any slowdowns. The video card has 4 mini display port connections. 1 for the control screen, 1 for the Shot clocks, 1 for the Scoreboard, and the last 1 for the green screen overlay for our video stream. We have a surplus of these machines, once we are up and running I will create a complete spare computer to keep in a closet someplace. This way in an absolute worst case scenario we can swap out the entire computer in less than 10 minutes.

The Touchscreen

I decided to go with a rugged POS touch screen. Again reliability needed to be considered, I didn't feel comfortable using a \$99 multi touch consumer grade monitor. The POS Screen cost \$250 for a 17" with a USB interface.



Protecting the TV's

I ordered our Plexiglas, it was only \$80 for 1/4 stuff. They cut to size and it slid right in. We used only 6 screws to hold it in and put a brace down the center between the TVs for added support.

The TV install was far easier than any of us predicted. I had 2 full days planned for the TV install, in the end, it was 4 hours. We really lucked out.



Video Signals

We need to duplicate all of the VGA signals leaving the computer and the 3 laptop inputs and send them to a video selection switch.

From the selector switch we need to convert the VGA signals to CAT6 and that takes powered equipment in the cart.

It's getting crowded in there, but Benny is a master at keeping wires clean.

We also need to send 1 HDMI signal to the TV in front and a VGA signal to TurkPride.tv for the scoreboard overlay on the broadcast.

Benny mounted a power strip with 24 plugs spread far apart to accommodate all of the 'wall warts' that just about every piece of equipment had.



The Snake

With 5 output video signals leaving the cart, Internet back into the table, 1 XLR cable from the mixer on the cart and Power all needing to be plugged in correctly each time the cart is used Benny decided to make a snake.

He color coded all of the CAT6 ends and ultimately put matching colored jacks in at the bleachers to match so it is painfully obvious how to hook it up (I hope).

Benny bought wire braid and assembled a pretty impressive single wire snake coming from the cart.



I had some concerns with running the power parallel with the data and sound, but it is only a 6 foot snake. In the end, it all sounded fine and had no issues with video signal.



The cart is finished. It should just be plug and play, and most importantly SIMPLE.

Step 2 of the build

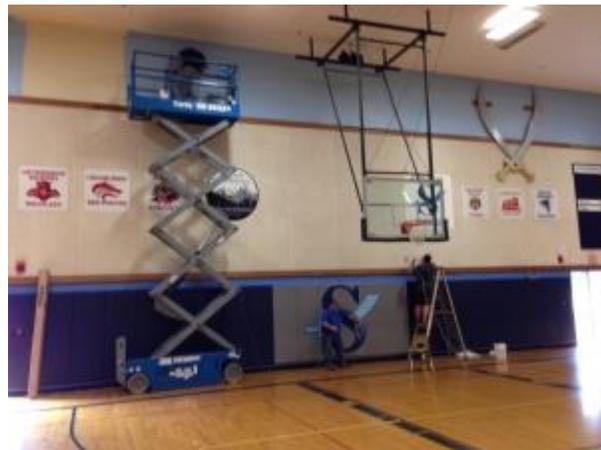
Pulling wire

We went into this project knowing we would have to pull fresh CAT6 from the gym wall where the score table plugs in at to the projectors.

What was unknown was if we could use the existing conduit that the existing scoreboards used for their wire.

If we could not utilize those pipes we are looking at a good week of pulling fresh CAT into the penthouse of the gym and back down to the projectors.

We need 3 CAT6's on each side of the gym, one to run the VGA over CAT6 to the scoreboard, one to run VGA over CAT6 to the shot clock, and finally one for controlling the projectors with the PIXI PRO.



We lucked out! After a bit of scratching our heads trying to figure out how the heck they ran the wire, we decided to just start pulling on them and look for movement. In the end, we figured out that 3 wires start at the wall (where the score table plugs in), and run to the shot clock, 1 wire drives the shot clock, and from there 1 wire goes up to the scoreboard and another wire goes 'who knows where', it goes into another conduit and takes off down the inside of the wall. We actually never figured it out so just left it alone.

We used the existing wire to pull a string through the conduit. Once we had the string we pulled our CAT6. Total pull to the shot clock box was 90', and then another 70' to the score board with enough to make it 13 more feet to the projector on the ceiling.

Again we lucked out. I had planned a couple of days on pulling wires, in the end it was about half a day, most of it spent trying to the current run.

Step 3 of the build

Installing the projectors

We are pretty lucky to have a great and supportive maintenance department here at the Sultan School District. They love to get behind us and support us any way they can when we cook up crazy ideas like this one.

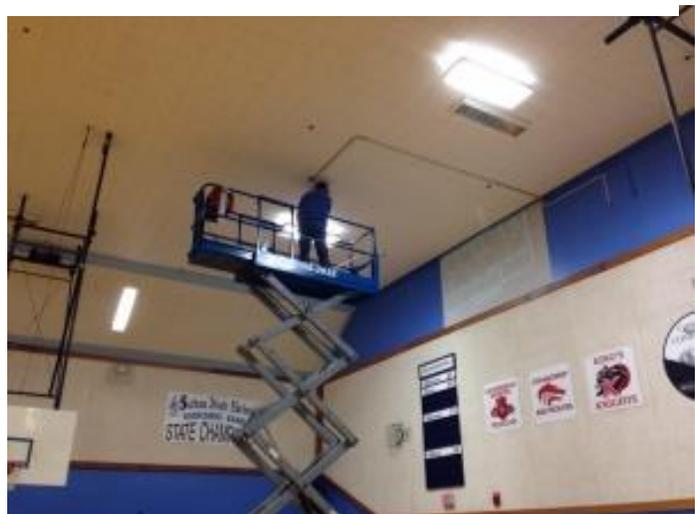
Glenn (one of our maintenance guys) took down the old score boards and shot clocks, unfortunately I didn't get any pictures of that happening, bummer.

He also took this opportunity to paint the top portion of the entire gym to match the schools primary color of blue. He also painted on the projection screen using screen paint, it looked much darker and grayer then I thought it was going to, it actually really bothered me after I saw it, and I was really worried it was not reflective enough.

The old scoreboard had a dedicated AC outlet right next to it, Glenn extended that out 13' from the wall on the ceiling to our projector mount point. He also ran our CAT6 in plastic panduit up to the ceiling and out to the projectors. The installation looked great!

Time for a test, I just had to see how that screen paint was going to look, as I said before it was really bothering me. I grabbed my boys, a laptop, the CAT6 to VGA extenders and we headed to the gym. After a couple of minutes of getting the projectors aligned and aimed we plugged everything in...

Here is a picture of David (one of my techs) aiming the projector, Hey David, you have it upside down.

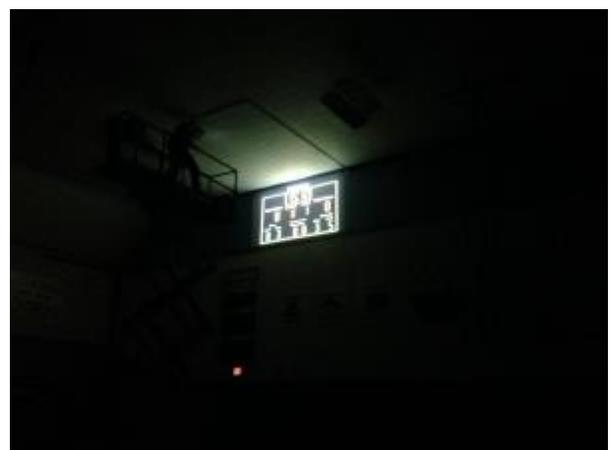


This picture is the scoreboard on, with a blue background (its default). The picture doesn't do it any justice at all, in person it looked BRIGHT and CLEAR.



We changed the background of the scoreboard to black, this really tricks the eye into not knowing the image doesn't fill the entire area of the painted screen

This picture was one we just couldn't resist trying, it is with all the lights off. It looked so sweet! I just wish the pictures looked better. There was actually enough light to be able to see to walk around.



And finally this picture is from the man lift behind the projector, this really gives a better idea on how bright it is from sitting in the bleachers.



This also confirmed that the VGA to cat6 converters and our newly ran cables are all working.

Since the projector is a DUAL projector designed to provide extra lumens and redundancy, we turned one of them off and the picture was very acceptable and usable, noticeably dim from the other, but still very much usable.

Our maintenance department decided to make protective screens for the projectors rather than us buying something that doesn't fit the dual projector setup (Did I mention yet how awesome these guys are?). Pretty impressed with what they came up with. They even made them so they would hinge open for access.



Step 4 of the build

Putting it all together

It's now time to take the score table to the gym and also finish up some wiring under the bleachers.

We cut out a spot for a remodelers 2 gang box on the bottom of the front of the bleachers next to the existing connections, hind sight, we should have just used the scoreboard jacks that were / are in... whoops. This is where the 6 Ethernet cables will plug in, they are color coded to match the cables coming from the cart. The guys also put a 6 port box on the wall behind the bleachers that go to the projectors, shot clocks, and broadcast table for the overlay. One more connection to get Internet at the table but not on the scoreboard computer, last thing I need is for someone to be surfing during a game, or worse get a bug or a pop up storm.



The software 'remembers' what picture goes on what screen. I thought it best to create a user for each of the 3 sports and put PCScoreboard exe in the startup folder. It did take a few minutes to set up each sport with the screens all outputting to the correct locations, but once done, worked perfectly.

Dry run done, now for the real thing... GAME TIME!

No training for the score keeper, just tossed him in, I did sit with him for the first 3 sets of the volleyball game, the software is amazing and easy to use, and I probably overstayed my usefulness.



Conclusion

Huge success! A few hiccups getting there, but nothing that made anyone ask us why we would consider doing such a thing. That's a win. The first few games I was close by just in case. Now I am not even worried about it.

Fell within the original budget of \$7,000 plus the \$800 for the 2 TV's. Final on paper was \$7615. This of course does not include myself or my crews labor costs. Also we easily spent \$500 in small incidentals needed for the installation, my department picked up those costs. I would feel comfortable in saying the actual was closer to \$9,000.

I have documented a few issues and some of my thoughts that have popped up now that we are two seasons into using the scoreboard.

Sound

It hasn't worked as well as I thought. The mixer we salvaged blew up during the 2nd basketball game of the season. The ref's were irritated, but understanding that we were still working out some bugs. I did a quick google search on the mixer and found out it was from 1977... oh boy... my bad. I bought a \$99 mixer with enough inputs and swapped it out. It has way more knobs and buttons than I wanted, but oh well, it now works way better.



I also added a little alarm clock that has Bluetooth and an MP3 player with a line out. This made it easy for coaches and students to bring in music on a flash drive or connect via Bluetooth. This connects to the new mixer

Projectors

Found out the order of turning on the equipment matters a lot. The VGA to Cat6 powered connectors feed the projectors a fake signal to keep them from going to sleep (guess this is more for a monitor), but that fake signal is at a different resolution than what I have set for the scoreboards. In short if the projectors are turned on AFTER the computer they do not fill the whole screen. That creates panic and a call to me.

The fix is to use the SOURCE SELECTOR on the cart to switch to another source and back to the score table pc and it syncs back up correctly.



Software

Had to upgrade some of the PCSCOREBOARD Software, the wrestling scoreboard we purchased does not do blood time, no biggie, just a \$20 upgrade.

I put MS Office on the ScoreTable PC, this was so they can show PowerPoints on the scoreboards and I made a PowerPoint Scoreboard for the 'Turkolympics'. Both have worked out great. Originally I was only going to allow the scoreboard software, but that was silly, they can run PowerPoints. But still no Internet!

Shot Clocks

I used some 24" VGA monitors I had. The viewing angle isn't as good as today's modern monitors. On the court you can see them bright and clear from any spot, but from the stands you can only see the one on your side. If I had used TV's instead they could have been bigger and clearer from anywhere in the gym.

Ad Revenue

Having the TV playing ad's on the score table has been a real boost our Broadcast club TurkPride.tv. It really puts it in the fans face of who supports Sultan High School.

TurkPride.tv

The Broadcast Club came out ahead on this install as well. The software creates a scoreboard overlay that can be Chroma keyed into the live stream. Currently the scoreboard software only has Basketball, but after reaching out to the developer I found out Volleyball is on the list to do.

If I was to do it again

The only major thing I would do different is to use TV's instead of projectors. TV's would have opened up more possibilities for ad revenue and player information.

Four screens would have made the scoreboard itself and then one more on each side vertical displaying other information. They would need to be protected with a screen. The ones on the side could actually be spares for the main 4, since the side ones wouldn't have to match.

Since the conception of this project the costs of TV's has come down by nearly 50%.



Connecting to the projectors without the Score Cart

My number one question from staff is 'How do I connect my iPad to the projectors in the gym?'

Ugh... Going into the project that was never talked about nor did we even think about it. I am exploring options, the projectors have 3 inputs so it wouldn't be hard to hook up a next gen apple tv or something. I also have plenty of power at the projector, maintenance put in a quad electrical box. I do have to admit it would be cool to use an iPad to score a little league basketball or volleyball game.

