XeroScout

(Universal Scouting System)

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# Introduction

XeroScout is an FRC scouting system designed to be reused year after year with no code changes. The idea is to focus on what needs to be scouted and the strategy derived from the scouting data, and not focus on the actual scouting process and software. This software should make the scouting process simple and seamless. The system includes the following features:

* Supports both match scouting and pit scouting
* Once the event has been created, no internet access is required. A local scouting data model is created, and all data is stored in this local data model. This local data model is stored in a single file that can be copied to a flash drive for safe backup during the event.
* Local scouting data model can be augmented with match scoring data and zebra robot position data from the blue alliance with internet access.
* Provides visual tracking of what scouting data has been imported and what is missing.
* Provides simple query capability to look at the data while local at the event
* Supports scouting forms that are defined via simple JSON data files
* Supports visualizations that are defined via simple JSON data files
* Uses a USB to USB transfer cable to transfer data between scouting tablets and a central scouting machine
* Frequent backups of the data model both on the scouting tablet and the central machine. Disasters can occur while scouting and there are always recent copies of the data available for recovery.

# Concepts

The Universal Scouting System relies on some basic concepts. These are explained here.

## Events

An event in the Universal Scouting System has the same meaning as it does for First Robotics. It is a two to five-day series of robot matches that result in an ultimate winning alliance. For instance, the PNW District Wilsonville Event is an event hosted by Error Code Xero.

## Blue Alliance

The blue alliance is a web site that serves information about FRC events via web-based API calls. This information is updated in near real time when FRC events are underway. This information is available in two different ways. First, the information is provided in a human readable form. You can navigate to the blue alliance web site and browse information. Second, the information is available through a set of web APIs to applications. This Universal Scouting System relies on information from Blue Alliance to both ease the process of initializing events and providing additional scoring and robot location data.

## Central Scouting Machine

This is a laptop, generally located in the stands that manages the scouting activities of the various tablets. This machine acts as a consolidation point for scouting data from the tablets. This machine runs the PCScouter application.

## Scouting Tablets

This is a tablet of some type[[1]](#footnote-1) that is used to do the actual scouting. Each scouting tablet has a name that is assigned when the tablet is initially synchronized with the Central Scouting Machine. This machine runs the PCScoutApp application that manages the scouting duties assigned to the specific tablet. Specific scouting assignments are transferred to the tablet when it is synchronized with the Central Scouting Machine.

## Synchronization

The synchronization process moves scouting schedule and assignment data from the central scouting machine to the scouting tablet. Synchronization also moves scouting data from the scouting tablet to the central scouting machine. Synchronization moves data through a network connection, Bluetooth classic, or through a special USB data transfer cable[[2]](#footnote-2).

## Event Data Model

The Universal Scouting System assumes that there is no access to the internet except for a few specific snapshots in time. Therefore, the system is designed around an event data model that is stored locally on a central scouting PC. The Event Data Model is the data model that contains all the scheduling information and scouting results. The Event Data Model is stored in full on the Central Scouting Machine as a JSON file and can be reloaded at any time. Each scouting tablet stores the scheduling information for the entire event as well as the scouting results for the local tablets. In addition, if data is imported from the Blue Alliance site, this data is stored in the data model locally as well.

## Tablet Identity

The central machine defines scouting tablet names. When a tablet synchronizes with the central machine for the firs time, a name is associated with the given tablet. In addition, a unique UUID is generated for each tablet. A UUID is a unique 128-bit number that will identify the tablet identity. Over the course of a scouting session as batteries run low, tablets crash, or other disasters occur, tablets can be reset and assume new tablet names. However, the tablet UUID will remain constant and associated any synchronized data with the given physical tablet.

# Scouting Work Flow

The XeroScout system is flexible and can support various scouting workflow models. However, this application was built around the following workflow.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Step | Item | Description | Where | Internet Required |
| After Kickoff | | | | |
| 1 | Create Forms | This is the creation of the pit and match scouting forms based on studying the game and determining what needs to be scouted | Central | No |
| After qual match schedule published | | | | |
| 2 | Create Event | This step is executed after the qualification match schedule is published to the Blue Alliance and before qualification matches start. This step requires access to the internet to access the Blue Alliance web site. This step performs the following:   * Match schedule and participating teams are pulled from the Blue Alliance site * The pools of tablets available for scouting is defined * Match and Pit scouting schedules are generated assigning tablets to scouting tasks | Central | Yes |
| 3 | Store Event | This step is completed just after creating the event. The data model is stored on the local machine. | Central | No |
| 3 | Initialize Tablets | This step occurs when a tablet is synchronized with the central machine for the first time. The tablet is presented with a choice of tablet identities from the tablet pool and the given tablet is assigned the tasks associated with that tablet identity. | Both | No |
| After qual matches start | | | | |
| 4 | Scout | This step occurs throughout the event. Scouters use the PCScoutApp to scout pits or matches and this data is stored locally on the tablet. | Tablet | No |
| 5 | Synchronize | Any synchronization beyond the first one will result in data being transferred from the scouting tablet to the central machine. | Both | No |
| 6 | Import Match Data | At any point, the scoring data from the Blue Alliance for the event can be imported into the data model. This data then becomes available for query and visualization | Central | Yes |
|  | Import Zebra Data | As the zebra data becomes available, it can also be imported from the Blue Alliance and visualized on the central machine. | Central | Yes |
| 7 | Visualize | The data in the data model can be viewed and queried in several different ways including data tables and graphs. There is a specific visualization to aid in pre-match strategy. | Central | No |
| 8 | Repeat | Steps 4 through 7 are repeated throughout the event including visualizations specifically designed for Pre-Match strategy. |  |  |
| After qualification matches complete | | | | |
| 9 | Import Match Data | If all the match data has not been imported from the Blue Alliance during the qualification matches, import the remaining data. | Central | Yes |
| 10 | Import Zebra Data | If all the zebra data has not been imported from the Blue Alliance during the qualification matches, import the remaining data. | Central | Yes |
| 11 | Visualize | The data in the data model can be viewed and queried in several different ways to help generate the pick list for alliance selection. | Central | No |
| After elimination matches start | | | | |
| 12 | Scout | This step occurs throughout the event. Scouters use the PCScoutApp to scout matches and this data is stored locally on the tablet. |  |  |
| 13 | Synchronize | Any synchronization beyond the first one will result in data being transferred from the scouting tablet to the central machine. |  |  |
| 14 | Import Match Data | At any point, the scoring data from the Blue Alliance for the event can be imported into the data model. This data then becomes available for query and visualization |  |  |
| 15 | Import Zebra Data | As the zebra data becomes available, it can also be imported from the Blue Alliance and visualized on the central machine. |  |  |
| 16 | Visualize | The data in the data model can be viewed and queried in several different ways including data tables and graphs. There is a specific visualization to aid in pre-match strategy. |  |  |
| After elimination matches complete | | | | |
| 13 | Archive | Store the data for future use. |  |  |

# Scouting Forms

The following section defines the format of the scouting form files. An example can be found in Appendix A.

form string

The type of the scouting form, must be “pit” or “match”.

sections **SectionList**

name string

The name of the section

Items **ItemList**

type string

The type of item: boolean, text, numeric, choice, or updown

tag string

The name of the data field associated with this item

name string

The human readable name for this field displayed on the scouting form.

minimum double

For updown and numeric fields only, the minimum value for the field

maximum double

For updown and numeric fields only, the maximum value for the field

choices StringList

For the choice field only, the list of choices for the value.

maxlen double

For the text field only, the maximum string length of the input

# Software

## Prerequisites

The XeroScouting requires the following external prerequisites in order for the software to function.

* Open SSL for Windows (<https://slproweb.com/products/Win32OpenSSL.html>)

Provides SSL support for the applications when accessing sites like the Blue Alliance site.

* libUSBK (<https://sourceforge.net/projects/libusbk/>)

Provides low level USB access to support the USB to USB cable synchronization.

* zdiag (<https://zadig.akeo.ie/>)

Utility to assign the libUSBK driver to the USB to USB transfer cable.

## Software Installation

The prerequisites defined above should be installed prior to installing the XeroScout software. In addition, it is recommended that the USB driver be updated prior to installing the XeroScout software.

### USB Driver

If the USB cable is being used for synchronization, the driver for the cable should be update to be the libusbK driver. This is changed using the zdiag program above.

1. Plug one end of the transfer cable into the tablet USB port.
2. Start the ZDiag program.
3. Under the Options menu, select List All Devices
4. Select the item ‘USB Transfer Cable’
5. In the central box to the right of the green arrow, select libusbK
6. Press the Replace Driver button. This can take up to five minutes

### Installing the software

The software is installed via a prebuilt installer. Run the installer and be sure the select ‘Create Desktop Icon’ option to make it easy to find the two applications

## XeroCentral

### Creating A New Event

Create a new event with the “File/New Event” menu. Follow the wizard prompts to create the event.

### Loading a Created Event

### Synchronizing With Tablets

### Reviewing Pit Scouting Data

### Reviewing Match Scouting Data

### Importing Blue Alliance Match Data

### Importing Blue Alliance Zebra Data

### Reviewing Pre-Match Scouting Graphs

### Reviewing Alliance Selection Graphs

## XeroScout

# Appendix A: Sample Pit Scouting Form

{

"form": "pit",

"sections": [

{

"name": "General",

"items": [

{

"type": "text",

"tag": "pit\_scouter",

"name": "Scouter",

"maxlen": 32

},

{

"type": "numeric",

"tag": "pit\_weight",

"name": "Weight (w/ bumpers)",

"minimum": 0,

"maximum": 200

},

{

"type": "choice",

"choices": [ "C++", "Java", "LV", "Python", "Other" ],

"tag": "pit\_language",

"name": "Programming Language"

}

]

},

{

"name": "ControlPanel",

"items": [

{

"type": "boolean",

"tag": "cpanel\_under",

"name": "Drives Under Control Panel"

},

{

"type": "boolean",

"tag": "cpanel\_rotate",

"name": "Rotate Control Panel"

},

{

"type": "boolean",

"tag": "cpanel\_position",

"name": "Position Control Panel"

}

]

},

{

"name": "DriveBase",

"items": [

{

"type": "choice",

"choices": [ "West Coast", "Mecanum", "Swerve", "Other" ],

"tag": "db\_type",

"name": "Drive Base"

},

{

"type": "updown",

"tag": "db\_wheels",

"name": "Wheels",

"minimum": 4,

"maximum": 12

},

{

"type": "updown",

"tag": "db\_cims",

"name": "CIMs",

"minimum": 0,

"maximum": 8

},

{

"type": "updown",

"tag": "db\_neos",

"name": "NEOs",

"minimum": 0,

"maximum": 8

},

{

"type": "updown",

"tag": "db\_falcons",

"name": "Falcons",

"minimum": 0,

"maximum": 8

},

{

"type": "updown",

"tag": "db\_others",

"name": "Other Motors",

"minimum": 0,

"maximum": 8

}

]

},

{

"name": "Collecting && Scoring",

"items": [

{

"type": "boolean",

"tag": "collect\_ground",

"name": "Ground Collect"

},

{

"type": "boolean",

"tag": "score\_lowgoal",

"name": "Score Low Goal"

},

{

"type": "boolean",

"tag": "score\_highgoal",

"name": "Score High Goal"

},

{

"type": "boolean",

"tag": "score\_trench",

"name": "Score From Trench"

}

]

},

{

"name": "Auto",

"items": [

{

"type": "choice",

"choices": [ "Far Left", "Left", "Right", "Center" ],

"tag": "auto\_perferred\_start\_pos",

"name": "Preferred Starting Position"

},

{

"type": "updown",

"tag": "auto\_max\_low",

"name": "Max Auto Balls Low",

"minimum": 0,

"maximum": 16

},

{

"type": "updown",

"tag": "auto\_max\_high",

"name": "Max Auto Balls High",

"minimum": 0,

"maximum": 16

}

]

},

{

"name": "Endgame",

"items": [

{

"type": "boolean",

"tag": "climb\_center",

"name": "Climb Center"

},

{

"type": "boolean",

"tag": "climb\_sides",

"name": "Climb Sides"

},

{

"type": "boolean",

"tag": "climb\_tilt",

"name": "Climb Tilted"

},

{

"type": "boolean",

"tag": "climb\_leveler",

"name": "Level Mechanism"

},

{

"type": "updown",

"tag": "climb\_assists",

"name": "Climb Assists",

"minimum": 0,

"maximum": 2

}

]

}

]

}

1. For now, only windows tablets are support. But there is nothing in the system that precludes any other type of tablet from being used. [↑](#footnote-ref-1)
2. <https://www.amazon.com/gp/product/B005OTPVMY/ref=ppx_yo_dt_b_asin_title_o01_s00?ie=UTF8&psc=1> [↑](#footnote-ref-2)