

FLL Scorekeeping

Efficiency, flexibility, support, and ease-of-use

1 INTRODUCTION

Scorekeeping in the *FIRST*® LEGO® League (FLL) is a key element of nearly all FLL events. While one of the core values of the FLL states that “what we learn is more important than what we win”, the excitement of the robot competition definitely adds to the appeal of the FLL and challenges teams to try their best. In essence proper scorekeeping ensures that the teams are awarded the correct amount of points they deserve, which in turn will be used in the robot game rankings, and the award distribution. Furthermore scorekeeping provides the teams with (direct or delayed) feedback on their achievements.

There is an increasing number of FLL events taking place around the globe. The program is expanding into new countries, and there is an number of regions in the countries where the program is already active is increasing. Organizations are moving from a single event to organizing multiple events in a season, for example multiple finales, qualifiers or local tournaments. Furthermore finales can differ: in size, in the availability of experienced volunteers and available resources. All these elements combined make that scorekeeping at the FLL needs to be flexible and efficient.

In recent years technology has made its way into FLL, various partners (for example the Dutch volunteers and Hands-on-Technology) have implemented the use of a scoring system that takes advantage of tablets, wireless communications and web-technologies. Other organizations have expressed their interest, as well as the issues faced in employing these new technologies themselves. However all organizations do see the potential benefits of these new technologies but do not have the capabilities, resources or knowledge to leverage the potential. Finally as a program that promotes the possibilities and importance of science and technology, embracing these tools could aid in presenting a FLL event in which science and technology are celebrated. These various reasons are depicted below.

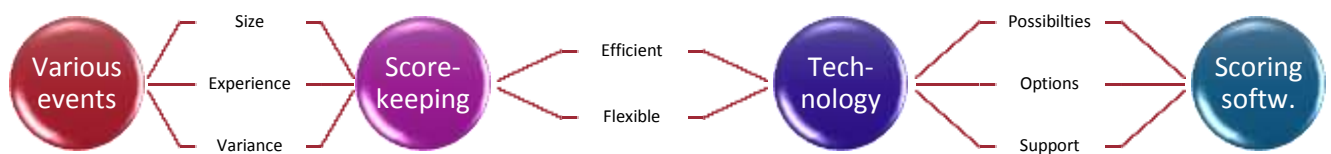


Figure 1 Project scope

Several FLL volunteers in the Netherlands, experienced IT professionals, already have experience with developing applications to support FLL events. One of these systems is the scorekeeping application, which has proven its value at various regionals and national finales. Using the IT-knowledge of these volunteers, combined with the experience of various types of finales we propose to develop a new scorekeeping application that aims to support the scorekeeping at FLL events. In combination with the requests from various partners and the recent developments in technology there is an opportunity to develop and effectively disseminate a scoring system, engineered on the needs of organizers.

2 OBJECTIVE

The objective is to provide an application and platform that support the various types of FLL events. This implies accounting for different scenarios, in which the available technology differs, the experience of the volunteers and the setup of the finales. Furthermore it requires providing the needed support with the system. In order to further refine the requirements we look at the different scenarios (types of events) in which the system could be used. We then prioritize the requirements by looking at the type of scenario that is the most common. These various scenarios are outlined below

2.1 SCENARIOS

Of course not all events can be easily classified in the various scenarios, however it helps developers to consider various options and uncover and prioritize requirements. Organizers can decide themselves how to apply the envisioned system, and which scenario best fits their needs and resources. The listed scenarios are in declining order of occurrence (i.e. small local finales are more common than large regional or national finales). The defined different scenarios are desired in the following dimensions.

- **Size:** In essence the number of teams participating in the events, although this could also depend on the 'prestige' of the final. We distinguish small and large local finales, qualifiers, regionals and (inter)national finales.
- **Connectivity:** The availability of systems to connect devices, such as Wi-Fi networks, or internet connections. This will determine how the information is exchanged between the various devices and possible external services
- **Support:** This includes for example the experience of an event organizer to independently setup, support and troubleshoot the scoring application. This can be done with external support, (experienced) local volunteers or on-site support from experienced scorekeepers.
- **Technology:** The technology available at the event for scorekeeping, for example the devices used to record the input or the laptop used to process the scores.



Figure 2 Scorekeeping scenarios

3 SYSTEM ELEMENTS

From the scenarios we can conclude that the intended system will exist of several elements. For each of these the following (high-level) requirements and functions are defined. The requirements start from the very basic level (scenario 1), all other elements are optional (modular and extensible). In other words we envision a system that at its core supports the basic finale where no connectivity and a single device is used (tablet, phone, laptop) as this is the most common scenario. This includes the options to use various devices or paper forms to collect the input, use a central application to process the scores and track the teams, and disseminate the results to the teams.

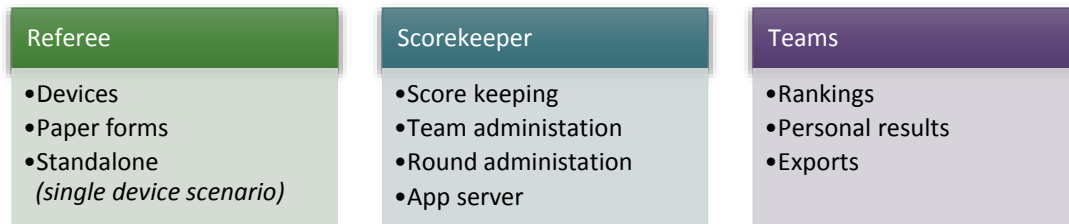


Figure 3 Basic Scorekeeping System Elements

This basic system can be extended to include multiple different devices, additional services and extra options for setting up the events, and the team administration. In any case all systems should:

- Be easy to use by inexperienced scorekeepers and referees.
- Template for previous and new challenges without the need to redevelop the apps.
- Adhere to the international FLL rules and regulations, but provide flexibility where possible.
- The system should be modular, i.e. support different configurations such as localization.
- Maintained and supported by an international base of volunteers (i.e. no single person).

This addition of these requirements to the basic elements results in the high-level system design:

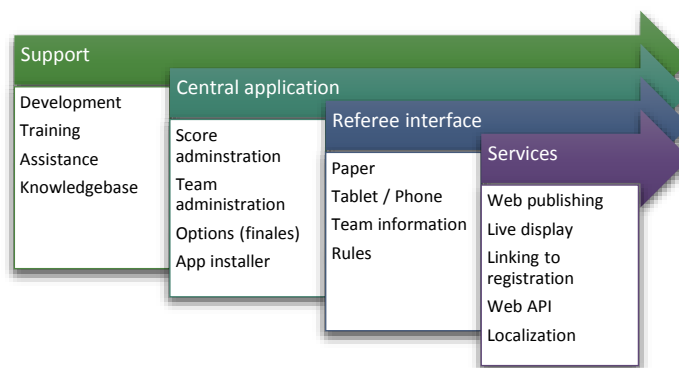


Figure 4 Expansion of system elements

The following section describes each element in more detail, distinguishing between the basic (directly needed) requirements and the future extensions. Please note that this is a preliminary list and can be amended based on the received input and feedback from partners, volunteers, and developers.

3.1 CENTRAL APPLICATION

The central application is used to calculate the scores, create a ranking and administrate the teams. This application will run on a laptop or desktop and should be able to function without an internet connection. Furthermore the central application will be used to install apps on devices in case no internet connection is available.

3.1.1 Basic requirements

- Team administration (import, manual)
- Event administration (rounds, finales)
- Manual score input
- Read challenge template
- Ranking, export for award distribution
- App server for devices
- Score administration

3.1.2 Extended requirements

- Sync to internet
- Schedule options
- Web-based administration / sync for multiple laptops
- Add information to teams (photo, background, etc)
- Create / load challenge template
- Localization support

3.2 REFEREE INTERFACE

At the basic level the referees use paper forms to record the results from the robot game. These results are transferred to the scorekeepers who enter them in the central application. The application should also be able to run standalone, for finales where a single device is used, as in that case there is no need for a centralized application, requiring the ability to locally administrate teams. As teams and referees interact with the system through this interface, localization is an important addition.

3.2.1 Basic requirements

- Should be printable
- Can run on different operating systems (Windows, Android, iOS)
- Can run on different size devices (Phone, Tablet, Laptop)
- Ability to sync, in case of connection loss
- Should be able to run an event 'standalone' (i.e. add teams, provide ranking) or online (i.e. connect to central application)

3.2.2 Extended requirements

- Provide team information to the referees
- Provide information on the rules
- Call for assistance from head referee
- Retrieve configuration, data and challenge from server (either online or prior to the event from a central application)
- Localization support

3.3 SERVICES AND FEATURES

In addition to the elements above described, which should be able to work independently, new technologies allows us to extent the application with additional services and features. Some of which are commonly requested by partners, others increase the efficiency or flexibility of the score keeping platform. Finally these feature also increase the 'high-tech' image of the FLL events.

3.3.1 Basic requirements

- Publishing/Export to website
- Export/Display intermediate results

3.3.2 Extended requirements

- Live displays, team information on screen, live results from round, camera feed.
- Web API interfaces
- Linking to registration (national) systems
- CSS/Logo for webpages
- Central site for FLL to publish scores, and administrate events
- Localization

3.4 SUPPORT & DEVELOPMENT

In order to ensure a smooth adaption of the scoring platform by the partners, the continued support and the further development of the platform, a community of FLL volunteers should support and develop the system. Ideally this team would consist of FLL volunteers from around the globe.

3.4.1 Basic requirements

- Developers (incl. documentation)
- Training for and dissemination to partners
- Knowledgebase / FAQ / Helpdesk

3.4.2 Extended requirements

- Community based development (open-source)
- Pool of experienced volunteer to provide on-site support and provide translations
- International community of IT volunteers
- Hack-a-thon (see below), annual meet-ups, and other community building efforts

4 PROPOSED PROJECT PLAN

4.1 DEVELOPMENT APPROACH

We aim to setup the development in such a way that other (international) volunteers can join in. This requires a central place to share the code, a set of standard that will be adhered to by the developers, and an initial design of the basic elements of the application. By using a common frame of reference for the high level design and a specific design for the basic elements we can achieve useable results, which can be expanded upon later.

As an open-sourced community driven platform, the scoring application will be under constant development. However it is important for the partners to have a set of tested applications that are well documented. This quality assurance will be achieved by listing and tracking specific objectives (tasks) that need to be built. Once the base-system has been established, there is more room to develop additional features and modules.

Therefore we propose to start with a small group of volunteers that are already familiar with each other and the FLL. Furthermore these volunteers have experience with IT development and/or the scoring application used by Hands-on-Technology and the Netherlands. To reduce the ‘management’ overhead, this initial group will consist of volunteers from the Europe and Middle East region. Once established the group can be expanded with other interested volunteers.

4.2 TIMELINE

We initially focus on providing the event organizers with a platform that fulfills the basic requirements outlined above. The objective is to provide this platform in the upcoming season. The proposed timeline for this period is outline below. Interested partners could get involved in the earlier stages and pilot the system. However they should be aware that there are significant efforts involved in testing and evaluating the application, although this could also be done by (key-) volunteers.

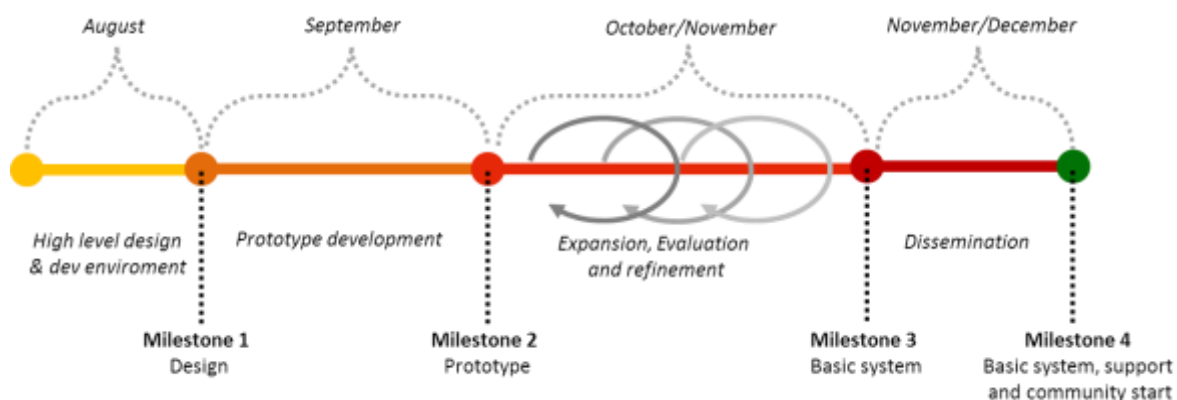


Figure 5 Development timeline for basic platform

4.2.1 High level design en development environment

The initial stage is focused on establishing a common frame of reference. This includes a more detailed design of the application, the standards to be used, and a more detailed list of tasks. In addition the development and test environments need to be created and the project team has to be assembled. At the end of this stage a detailed design should be available.

4.2.2 Prototype development

Next a prototype is built according to the design of the first stage. This prototype will contain all the basic functionality listed in the design and should be able to be used at FLL events. However the focus is on building functionality, and less on the performance, robustness or user-interface. The prototype will be tested in simulations of the described scenarios.

4.2.3 Expansion, evaluation, and refinement

The prototype is then provided to interested partners, who will provide feedback. At this stage the system will be refined, robustness will be added and the interface will be improved. Furthermore –if time allows- additional options and features can be added. This stage is a cycle in which the system is continuously modified and tested. In addition to the developers, the partners need to make an effort to test the system and provide feedback. This also requires administration and prioritization of the feedback.

4.2.4 Dissemination

After the -intense- development cycle, the refined system will be made available to all partners. At this stage the documentation, and support options need to be prepared. The system will be made available through a separate site where also documentation can be found, a knowledgebase as well as helpdesk function. Additional volunteers (experienced score-keepers) and partners (involved in testing) can be enlisted to help out.

4.2.5 Long term (Next season and beyond)

After the base-system has been established other volunteers can be invited to join in. This can either be developers working on the core system, or developing new modules. Other volunteers can offer to help support FLL event organizers, and provide feedback from their own experiences. This will mostly be done in the off-season period of the *FIRST*® LEGO® League (April and beyond)

4.3 RESOURCES

In order to develop the application we need the following items:

- Endorsement / Approval (FIRST / LEGO)
- Github (code repository and project tool) (provided by volunteers)
- Website to disseminate and provide end-user support (provided by volunteers)
- Test devices (provided by volunteers)
- Test-users (partners already volunteered)

Ideally we would need:

- Enterprise licenses for Android and iOS (approx. €350 a year)
- Production environment (cloud) (t.b.d.)
- Hack-a-thon (see below) (LEGO)

4.4 PROJECT ASSESSMENT

Given the objective to develop a system/platform that could be employed in the upcoming season several considerations have to be made. Furthermore there are several other aspects of the project that are worth considering. This section briefly touches upon important aspects of the project not described earlier in the document.

4.4.1 Hack-a-thon / Community building

In order ensure a timely delivery, it is important to find a way for effective collaboration. Especially in the period where the prototype will be developed it is important for the developers to be able to interact quickly. As a pivotal point in the project we propose to host a hack-a-thon during this stage. In this hack-a-thon the developers meet up for a weekend of collaborative programming. In the past these events have proven very successful to develop workable prototypes that have been expanded in the time following the hack-a-thon.

After the initial design has been established such a hack-a-thon would provide a great 'boost' to the project. In order to motivate volunteers to participate in this project we could consider hosting this hack-a-thon at a location provided by LEGO, for example in Billund. Volunteers could travel there by their own means, and work together in an inspiring environment on an application that will benefit all FLL events. Furthermore such an event will help to create a sense of community and build a strong relationship and commitment between the volunteers.

4.4.2 Risks

The financial risks of this project are limited as there are limited investments required. The development of the basic system can be done with no out-of-pocket costs. However there are two other risks. First the project relies on a community of committed developers and -in time- volunteers to support event organizers. It is important to keep volunteers motivated and committed, especially during the first year of the project. We also aim to build a system of loosely coupled components that can be built and rebuilt in any language/framework to the developers' liking. This reduces lock-in of individuals and specific components. Building the community is imperative to the success.

Somewhat related is the time-issue; the period to develop the initial system is relatively short. This requires the volunteers to put in extra effort to create a useable system for this season. However by distinguishing between the various scenarios and prioritizing the requirements we can scale the system depending on the progress and the available resources. Furthermore, once the basic outline (design) of the system is done we can enlist other volunteers to help in the development and support.

Note that both the community and time issue can be (somewhat) mitigated by the proposed hack-a-thon.

Finally there is a risk of limited adaption by the partners, which would negatively affect the volunteers. In other words, we need to prevent putting time and effort into developing a system that will be used in a limited way. To prevent this, we need to align the system with the needs of the users. By involving partners in the development project in an early stage we can ensure that it suits their needs and adopt the system. The approval of partners, or even LEGO/FIRST will motivate other partners to use it as well.

4.4.3 Other scoring applications

Other scoring applications already exist that need to be considered as well. Although these systems provide to a more or lesser extent the required functions, they differ from the proposed system in one or more of the following points:

- **Targeted technology:** existing systems focus on a specific technology (for example iOS) and are not cross platform compatible. The proposed system works on multiple platforms and with different form-factors (desktops, laptops, phones, tablets).
- **Functionality/Flexibility:** The existing applications have a set of defined functions that are tailored to the specific needs of that organization. They do not account for differences in FLL events. The proposed system will be flexible and account for different setups
- **Integration/Expendability:** Existing systems are stand-alone, for example calculate score or have no option to be extended with additional features or modules from other developers.
- **Localization:** A specific example of the additional flexibility, localization is a feature most applications are 'lacking'. However considering the international aspect of the FLL localization support is an important element. It allows teams and referees to use the system in regions where the command of the English language is limited.
- **Community supported:** Perhaps most importantly, the proposed system will not be the result of one volunteer but rather a pool of volunteers, increasing the life-time of the app, the reliability of the development team and the available resources to provide support.

Note that the proposed system does not aim to replace existing systems, every event organizer is free to decide upon to the tools they use. However we want to provide a way for developers that do similar things to share, to learn and to work with each other. Rather than multiple similar applications we aim to combine development efforts opening up the platform for new ideas and extensions. By no means do we wish to discourage other volunteers from undertaking their development efforts, but we encourage the sharing of ideas and exchange of feedback.

4.4.4 Impact

Finally we need to consider the (potential) impact of the system. As mentioned in the introduction to goal of the system is threefold: (1) efficient score administration supporting the most common finales (2) allowing flexibility and optional features and extensions, (3) create a global FLL community of scorekeepers and developers. Through these elements the proposed system can benefit the entire FLL community, improving the experience for teams, volunteers and event organizers alike.

5 DEVELOPERS

5.1 RUUD PUTS

TBA

5.2 ROB VAN WIJK

5.2.1 Professional

Computer Science student, currently working on his MSc thesis. Worked on several small, real-world projects during the course of his studies. A big proponent of well-documented software which stays maintainable for a long time.

5.2.2 FLL

Involved with the FLL since 2004. Made the switch to the scoring department after a few years of other functions and has been there ever since. Experience with almost all sizes of FLL events: from regional finals with six teams to Dutch national finals as well as international finals (OEC 2006 Eindhoven, OEC 2009 Copenhagen, OEC 2011 Delft) numbering in the many dozens of teams.

Has worked, together with another volunteer, on expanding the capabilities and robustness of Skip Gridley's FLL Scoring System in Excel. Feels that Skip has done some great work, but the system is reaching the limits of what Excel can reasonably support.

5.3 RIKKERT KOPPES

5.3.1 Professional

Developer and application integrator with a professional experience of nearly 15 years. Fluent in client side web technologies. He has recently worked as a freelancer for the Dutch project iSPEX, which aims to bring science to the public by providing iPhone add-ons capable of measuring aerosol distributions. The result of 6000 collaborative measurements by the general public were combined in a live map of the Netherlands (<http://ispex.nl>). Lastly, a strong believer in service oriented architecture and modularization of services to enhance portability and updatability.

5.3.2 FLL

Involved with the FLL since 2004. Mostly IT support, but also graphics design (posters, boklets, flyers, flags, shirts) as well as judging (core values (head judge), programming). Lead system integrator at the Dutch Finals in 2013, which basically proved the feasibility of the aforementioned approach.

5.4 KENNY MEESTERS

5.4.1 Professional

Information Manager with an extensive IT project management background in international settings. Through research and projects, specialized in managing IT projects and programs in the NGO and Public service domain. Currently researcher in the impact of information and information systems in humanitarian (crisis) responses. Topics include, decision making processes, user focused design, management information needs and system integration.

5.4.2 FLL

Involved with the FLL since 2005. I've hosted (MC-ed) various finales, (regionals, world festival (2007), OEC (2006), national finales (2006-2009).) Besides MC'ing the events active as a Judge. Head project judge at OECs, and during the World Festival in St Louis. Judge Advisor at the OEC and a referee at times. Worked on various events for (FIRST Netherlands) creating schedules, logistics, ICT (e.g. webstreams/sites, construction etc).