

FiberKraft: An Interface for Designing Optical Fiber Networks

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ABSTRACT

The deployment of optical fiber networks is increasing in the world. However, designing these networks can be challenging, especially because there are currently few specialized tools for designing such networks. We present a tool, FiberKraft, that specifically focuses on helping people design optical fiber networks. FiberKraft is equipped with interaction mechanisms through which people can automate many of the tasks related to designing networks. We also give people different data visualizations that enable them to have a better overview and understanding of the physical space where their network design will be placed. We also leverage the knowledge of a specialized crowd to help designers build off the work of others, while still leaving room for their own unique creations. This work contributes to the design of tools for sketching and modeling telecommunication networks.

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INTRODUCTION

In the last decade we have witnessed a growth in the number of optical fiber networks that exist in people's homes and organizations [2]. This increase has mainly been because people want faster Internet communication to access: video-based multimedia, rapid peer-to-peer file transfer, high definition multimedia online gaming, among other services. Similarly, the increment in personalized services that know the end-user's every need through constant monitoring, has also increased network traffic.

Optical fiber networks are now found in a variety of places, such as homes, government organizations, private companies, among other edifications [3]. Despite its increase, little attention has been paid to creating specialized tools that facilitate the design of fiber optical networks. Most research and industry tools, including those tailored for traditional copper wires, have focused on the management and documentation of networks, or helping people visualize network vulnerabilities [1,4,5,6]. Yet, specialized network design tools could streamline design work, reduce network costs, and facilitate troubleshooting in the design stage and not at the stage of installation and implementation of the network.

In this paper we present: FiberKraft, a computer aided design (CAD) tool with a graphic environment that is tailored to assist people in the design of optical fiber

networks for homes and businesses.

Our tool helps designers to: 1) spatially organize the physical space their network will cover; 2) save time designing the telecommunication and urban infrastructure of their network; 3) quantify the amount of material their network requires; d) and obtain ideas from a specialized



crowd on how to design the network of a certain home or organization.

Figure 1: Screenshot of the insertion of elements FTTH and creation a summary table.

SYSTEM DESIGN

FiberKraft was developed in C#, in conjunction with AutoCAD 2013 which works as an external program execution. We choose this configuration, so that anyone acquainted with AutoCAD could potentially start using FiberKraft and avoid having to learn a new system. The interface of our tool is composed of 2 main parts: Workplace Definition and Sketching Area.

Workplace Definition: This component lets designers work on a new project that contains all the elements needed for designing a network. The end project is loaded in AutoCAD. The designer can set values such as the address of the physical space where the network will be placed, or date. We use the geographical location to help designers potentially find other network designs in the area. We believe designers can benefit by exploring the networks designs of others, especially if the designs are from homes near the one the designer is currently working on, as they might have similar structures and geographical problems.

Sketching Area: This component lets designers draw the physical space surrounding the network they are designing, and explore different network designs. We let people share the physical spaces and networks they have sketched, as well as use the sketches of others. FiberKraft tries to make people leverage the work of the crowd to help in the design of their own the fiber networks.

To start their sketches, designers are given the option of either entering a drawing in the sketching area by inserting

a DWG file from any computer path, or directly drawing blocks that represent different neighborhoods. Four vertices define the geometry of one block and when the person finishes drawing the block, the information is saved in the internal data base of our application. The block basically helps to define a neighborhood with its houses and roads. The person can also add metadata to the neighborhood she drew. The metadata usually holds details about the neighborhood, such as date it was founded etc. People can use the metadata and stored information to search for neighborhoods that are similar to the ones they are working on. This enables people to see how others have structured the network under similar conditions, and get ideas of how they will start their own design.

We also provide the option of splitting neighborhoods into lots. Lots are basically residential buildings that can have (or not) already an optical fiber network. Examples of lots are business buildings, malls, apartment houses, among others. Designers can also draw lots with four vertices. Designers can set values for each lot such as: address, number of telephone lines and lot type (e.g., mall). FiberKraft automatically calculates the area that defines the lot, thus helping the designer to better calculate the costs of putting a fiber optical network in a particular building. Internally our tool differentiates between the geometry of blocks (neighborhoods) and lots (buildings.) We allow people to zoom in and out to easily view the total number of neighborhoods and buildings they have drawn. This can help people get a better overview of the physical space where they will design the network. The designer is also empowered to insert urban infrastructure into the sketching area such as: pipelines, trees, poles, terminals, among other elements.

We provide a default set of urban structures that people can use in their sketches. These elements facilitate network designers' tasks, as in most cases the person had to invest time in manually drawing the elements herself. Our tool also empowers designers to insert telecommunication infrastructure, specifically those related to the infrastructure of a Fiber to the X (e.g., home) network with PON (passive optic network) architecture such as: optical splitters, optical line terminals (OLT's), optical network terminations (ONT's) etc. Designers can also select the types of wires that will be drawn from the fiber network such as the feeder cabling, distribution cabling and the user's line. People can make this selection by simply setting the insertion point and scale for each item. Additionally, we provide mechanisms to help automate this selection process: the person has to simply draw a polyline of n vertices that represents the path of the cable and the type of cable. Overall, our interface provides mechanisms to save designers time in repetitive tasks. Figure 1 shows a palette that contains telecommunication elements that can be inserted onto the sketching area. The counting for each telecommunication element inserted and the total length of each kind of cable is presented in the summary table shown in the right. The table helps designers have an overview of the costs of their current network design. Aside from the default urban and telecommunication infrastructure provided, designers can

also define their own infrastructures and share it with the crowd. People can easily build off the infrastructures others have defined. This type of sharing lets our tool be always up to date with the different infrastructures as it is driven by the people. FiberKraft also provides designers with different visualizations and cues to obtain better perspectives of the physical space and infrastructure where their network will be placed. As mentioned previously we provide people with a table that lets them have an overview of the number of urban and telecommunication infrastructures. Additionally, we give designers tree views where they can visualize the buildings they have defined in different neighborhoods. We show the data related to the buildings in a hierarchical form to facilitate the visualization of the urban infrastructures and telecommunication elements in the building, and within the neighborhood. Similarly, people can view the network designs of others, letting them better inspect the physical spaces others have worked on, and network designs proposed for those spaces. We believe this can help people obtain ideas of how they will design their own network, and avoid some of the problems others have gone through.

CONCLUSION

The installation of Fiber optical networks is increasing in the world. It is therefore necessary to have tools that facilitate the design of these networks for a variety of different physical locations. In this paper we presented a specialized tool, FiberKraft, for designing fiber optical networks. Our tool strives to help network designers in three main ways: 1) save designers time in trivial tasks, such as drawing network infrastructure or doing summary tables; 2) provide ways to visualize their network design from different perspectives; 3) facilitate integrating the crowd to provide ideas and keep the tool updated. Our research contributes to the design of novel interfaces for designing networks. It also lets us explore how tools for conducting specialized tasks can be enhanced by providing specialized interaction mechanisms and leveraging the crowd's work.

REFERENCES

1. Miguel Alberto Planas, Doug Edward Talbott, Network management graphical user interface, US Patent, 2000
2. Koonen, Ton. "Fiber to the home/fiber to the premises: what, where, and when?" *Proceedings of the IEEE* 94.5 (2006): 911-934.
3. Lin, Chinlon, ed. *Broadband optical access networks and fiber-to-the-home: systems technologies and deployment strategies*. John Wiley & Sons, 2006.
4. Kevin L. Fox, Ronda R. Henning, John T. Farrell, Clifford C. Miller, System and method for assessing the security posture of a network and having a graphical user interface, US Patent, 2003
5. Carl T. Madison, Jr., Richard C. Flathers, Configurable graphical user interface useful in managing devices connected to a network, US Patent, 1999
6. Marshall Strickland, Rob Strickland, Graphical user interface for customer service representatives for subscriber management systems, US Patent, 1999.