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Computer Networks

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Project Report: Wireless Networks

The topic we chose to do for our project was wireless networks. We chose this topic as wireless networks seem to be a more versatile network design and are able to incorporate every user within a radius without connecting them through a physical medium. Throughout our semester we went through several phases for our project that led us to the final result. The initial phase of our project that we conducted was researching wireless networks. This phase consisted of a lot of individual research, however my group member, William Wolf, and I also worked together doing the majority of our researching papers, articles, and tutorials on the internet to gain insight and a better understanding of wireless networks all the while collaborating. Through our research we were also searching for a possible algorithm or protocol to implement that corresponded to wireless networks. Through our research we uncovered a bunch of possibilities as to what we would potentially implement, but none of them seemed particularly exclusive to wireless networks nor peaked our interest. This led us to implement a game over a wireless network as both of us have some interest in game design and having a server play against a client appeared to demonstrate wireless capabilities well. However, due to the nature of this project and the overall class we decided to implement a simpler game of Tic-Tac-Toe in which a client plays against a server.

After we completed the majority of our research we decided to move onto the next phase, our presentation. For our presentation we chose to focus more on wireless networks as a general concept in networking and explained the aspects of it such as history, issues, standardized protocols, etc. This ended up being fairly trivial after the hours we spent researching because we had already learned the majority of the information we needed to present on. Additionally, we added a lot of slides explaining different concepts and components of wireless networks in order to give our audience a better understanding of them just as we had gained a better understanding from our research. Although we did end up having a lot of information already known from our research we also were continually researching when writing our slides in order to discern, for the audience, pertinent versus irrelevant information. This allowed us to present in a fashion that informed the audience in a straightforward manner and emphasize the point while avoiding presenting on information with little substance to reinforce it. Another issue that we came across while creating our presentation was to make our focus on wireless networks while at the same time avoiding overlapping or presenting on what another group may have presented on because our topic of wireless network is a superset of some of the other topics including, mobile networks, sensor networks, and networking trends. This is the primary driving factor for why we presented on the overall concepts involved in wireless networks. It was hard to find specialized parts of wireless networks that were not going to be covered by another group in some form or fashion.

We organized our presentation along the lines to first set-up and inform the audience of what a wireless network is and how it works. Next we explained the different types of wireless networks that are still currently used as standards defined by the IEEE. These being WWAN, WMAN, WLAN, and WPAN. The first ype, WWAN (Wireless Wide Area Network), is the largest wireless network it consists of networks of cell-towers and gives internet access to regions as large as countries. The next type is the WMAN (Wireless Metropolitan Area Network) which is a subset of WWAN as it gives large areas like cities and campuses wireless internet access but is not quite as large scale when compared to WWAN. The next type is used commonly for household wireless, WLAN (Wireless Local Area Network), which provides homes, local shops, offices, etc. a significant radius to connect to the internet but generally persists in local areas. And the last type of wireless network, WPAN (Wireless Personal Area Network), is used for facilitating a direct wireless connection between other WPAN enabled devices. After we reviewed the types of wireless networks we shifted our focus to comparing wireless networks to wired by detailing and illustrating the performance and external issues that wireless networks face, such as infrastructure, bandwidth inadequacy, electromagnetic interference, etc. Wireless networks have numerous performance issues when compared to wired at least in residential networks, but the ease of access to the network that wireless provides is not easily overlooked. Another concern of wireless networks is data privacy, there are several ways to intercept a wireless packet as whatever is broadcasting the packet is broadcasting throughout its entire range and therefore unintended users can receive packets. There are also ways to mitigate this but nevertheless if the data is travelling wirelessly it is more vulnerable to attacks over wired transmissions. Then we finally were able to close out our overview of wireless networks by moving on to our implementation demonstration.

To begin our implementation phase we again had accrued quite a lot of information of our initial research phase but there was plenty of lacking information. This led us to several online tutorials on client and server programs which we followed a few of them to gain a better feel for writing such programs and eventually we were ready to start creating our idea for a client server Tic-Tac-Toe game. The first obstacle we faced was simply setting up a connection to the server which through our prior knowledge and tutorials was easy enough to manage our way to solving connecting them. Next we moved onto sending the data of the Tic-Tac-Toe board across the connection which ended up being far more difficult than we anticipated. All of the tutorials we followed prior, sent simple data, like a ping, through the connection and altering the two-way connection to serve our array of chars (the Tic-Tac-Toe board) was a large hurdle in our way. The next task we set out to complete was setting up the game design for Tic-Tac-Toe. We thought it would be interesting if the server automatically played against the client rather than one player on the client-side and one player on the server-side. Our initial idea was to code a deterministic bot to play against the client but, given the limitation of Tic-Tac-Toe, the client would only ever lose or tie the game. In order to remedy that and give some variation in the way the server played we gave the server a random spot on the board where to place its next character. However, we quickly realized that the server could overwrite the character the client had played. Therefore, we had to add check conditions everytime the board was sent from either client or server in order to ensure that the new space was not already filled with a character. Finally, we added win, lose, and draw checks, made a board print method, and tidied up some remaining bugs. With all those components finished we had a mostly complete implementation.

Both Billy and I worked the same hours on this project so the overall result is pretty much split in half between our efforts, however William did more of the coding and I was researching things to assist his coding but we were working together the entire time we were working on this project.

The project we did on wireless networks all and all proved to be a very insightful and illuminating project for me as to what wireless networks are, how they work, and how they are incorporated into our society and everyday life. Wireless networks have a brief but interesting history and are still in their infancy in terms of their development with large scale programs like <https://www.starlink.com/> perhaps there will soon be a ‘WGAN’ (Wireless Global Area Network). The Tic-Tac-Toe algorithm we implemented is a simple program but I think that it illustrates the utility of wireless networks nicely as servers and clients can co-exist in completely separate mediums while still sharing data and information which is the purpose of computer networks in general with more versatility to them.