GameBot: A Visualization-augmented Chatbot for Sports Game

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Abstract
The major sports leagues, including The National Basketball Association (NBA) and the EPL (the English Premier League), are adopting conversational systems (chatbots) as an innovative outlet to deliver game information and engage fans. However, current sports chatbots only provide scores and game highlight videos, which are often inadequate for statistical data related requests. We present GameBot, an interactive chatbot for sports fans to explore game statistical data. GameBot features (1) the direct answers to user’s stats-related questions, and (2) the use of data visualizations as supporting context for sports fans’ stats-related questions.

Author Keywords
chatbot; sports visualization; visual chatbot; basketball; GameBot; sports chatbot;

CCS Concepts
• Human-centered computing → Information visualization; Systems and tools for interaction design;

Introduction
Conversational agents, or chatbots, have become extremely popular due to the recent rapid development of artificial intelligence, especially natural language understanding (NLU). The chatbot, identified as 2016’s breakthrough tech-
nologies by MIT Technology Review [16], allows humans to interact with machines as if communicating with a real person. Despite several high-profile failures [17], chatbots are increasingly being used in business as they boost operational efficiency and bring cost savings [12]. In the sports domain, chatbots are being used as a new outlet to connect and engage fans by offering quick and easy access to game stats and highlights [14]. In particular, the NBA, partnered with AI chatbot company, GameOn Technology, and deployed its chatbot service through Facebook Messenger to deliver in-game video highlights, news updates, and game previews 1.

Watching a sports game is a social experience. Previous research shows fans are engaging in chatting and becoming socially interactive when watching a game [4]. Fans also frequently share their views based on game stats data [21]. Sports chatbots enrich the game-watching experience by providing fans a customized experience to engage with their favorite teams and players [10]. However, current chatbots are inadequate when it comes to communicating game statistical information.

To address this gap, we proceeded to first understand what kind of stats sports fans care about when they are watching the game. Based on sports fans’ comments in Reddit, we characterized three major stats-related categories that fans care about: (1) individual player stats; (2) team stats; and (3) team performance record. In addition, given visualization has been widely used in sports media, we argue that visualizations are able to provide additional context beyond the direct answers in the sports domain. In light of these findings, we present GameBot: a visual-augmented sports chatbot focused on game stats information.

GameBot can directly answer questions related to game stats, such as those about a player’s points or rebounds or a team’s season record thus far. GameBot also provides visualizations such as a game flow chart and a shot chart in case users need more context for their questions. For questions regarding game highlights, GameBot can automatically generate a game summary sentence to cover the main highlights. We present the detailed design and implementation of GameBot and discuss several potential avenues for future work.

Related Work
Our work is inspired by the use of visualization in the sports domain, where researchers have studied visualizations in many sports including basketball [20] and baseball [2] among others presented in an extensive survey on sports data visualization by Perin et. al.[15]. Metoyer et. al. also explored how to automatically integrate sports recap stories and visual elements [9]. Zhi et. al. explored how visualizations enabled sportswriters and sports fans to construct data-driven stories and social commentary [21]. Based on these prior works, we incorporated visualizations into the GameBot responses with the aim to provide more context and help users make sense of answers to game stats-related questions.

Our GameBot also draws insights on the conversational interface research and the current chatbot practices. Chatbots, as conversational agents that interact with humans by natural language, are becoming a popular form of human-machine conversation. Previous work has design conversational agents for data science tasks [3] and computational limits problems [5]. Chatbot itself has also achieved success in several industries such as finance [11], insurance [7], travel [8], and healthcare [19]. In sports domain, chatbots have been widely used by big leagues and sports events including NBA [10], EPL [13], and Football World Cup [1]. In this paper, we advance the current sports chat-
bot by including comprehensive stats-related information, providing direct answers to game stats questions, and using visualizations to provide the context of the answers.

**Sports Fans’ Comment Characterization**

Inspired by previous research where social media comments were used to explore sports fans’ behavior [18], we began by analyzing sports fans’ comments aiming to understand what statistical information fans care about. Previously, based on the 1,500 “live game” comments corpus collected from Reddit, we characterized fans’ comments into six themes: **Player/team Appraisal**, **Game Observation**, **Personal Passion**, **Statistical Information**, **Game Decision-maker**, and **Peripheral Subjects**. To characterize the stats-related comments, we conducted a qualitative analysis on **Statistical Information** and **Game Observation** comments from the aforementioned corpus. Two coders individually coded a set of comments into different categories, refined the result over several iterations, and then merged the result. We summarized three major stats-related types that fans cared about:

- **Individual Player Stats** highlight a player’s stats data. Examples such as “LeBron shooting 90% on 24 points & the game is tied, let that sink in.”
- **Team Stats** highlight teams’ stats data. Examples such as “Cavs wins the first quarter by 1 with only 30% shooting.”
- **Team Season Record** comments focus on a team’s historical performance for the season. Examples such as “This will be the 10th win in a row.”

**Figure 2:** Overview of GameBot system. GameBot takes user questions as input and output the stats-related answers. GameBot

**Figure 3:** Game flow chart. It shows two teams’ scores over time.

**System Description**

GameBot is a visualization-augmented sports chatbot that focuses on fans’ stats-related questions. In this section, we describe how we built GameBot, with emphasis on its system architecture and user interface.

**Architecture**

The system architecture of GameBot is shown in Figure 2. Given a user request question, GameBot first classifies user’s intention into one of the stats-related categories. The four possible categories are (1) Individual Player Stats; (2) Team Stats; (3) Team Season Record; (4) Game Overview. For each class, GameBot extracts and returns the corresponding values from game stats data. In addition, GameBot provides several visualization options for users to explore. We explain each step in detail below.

**Data collection** GameBot automatically scrapes the current day’s game schedule and stats data from the ESPN website. These data include game scores, team and player stats.

**User intent classification** The focus of GameBot is not on the specifics of intent classification algorithms but rather
on using visualizations to augment stats-related answers. Thus we used a set of simple key phrases to search user request question sentences to match Individual player stats, Team stats, and Team Season Record categories. For example, we used a set of key phrases such as “season records” or “season performance” to match Team Season Record category. For Game Overview questions, we first constructed a corpus of questions that are potentially related to game overview, such as “what happened in this game?”, “describe the game highlight”, etc. We then compared the word-based cosine similarity between user questions and every sentence in the question corpus. We set the similarity threshold of the classifier as 0.5. GameBot will return a clarification sentence “I don’t understand, could you ask another question?” if the user request question wasn’t classified as any stats-related category.

Stats value extraction We currently used an exact match procedure that aligns user question sentence word-by-word to find the desired stats type and players or team value. For example, we used “pts” and “points” to check if users want a player or team’s point value. We also used exact word match to find the desired team name or player name in Team Stats, Individual Player Stats, and Team Season Record categories.

Output result generation For Individual Players Stats and Team Stats categories, GameBot directly returns stats values for players or teams. For example, “Chris Paul got 12 assists” was returned for “how many assists did Paul get?” For Team Season Record category, GameBot generates a sentence to summarize the team’s season record so far: “The Houston Rockets improved to 12-6 on the road and 18-8 overall.” For the Game Overview category, we integrated a highlight event, such as a triple-double player or a player who had the leading score, and the current game result into the returned game summary sentence: “Chris Paul’s triple-double helps the Thunder to an 83-80 lead with 5:00 left in the fourth quarter.”

Visualization customization Previous studies showed visual charts have the potential to provide additional supporting context beyond the direct answer in the computer-mediated chat-style conversation [6]. In GameBot, we adopted and designed five visualizations and tables for each stats-related category aiming to provide more data context for user’s questions. Table 1 shows the visualizations and the corresponding customization arguments for each category. For Game Overview, we use the flow chart (Figure 3) to show the changes of the two teams’ points with time and shot chart (Figure 5) to show all the shots in a spatial layout with an overview of the shot distribution. For Individual Player Stats and Team Stats, we use the corresponding stats tables to show the comprehensive stats data for players (Figure 7) or teams (Figure 6).
Record, we designed a bar chart to show a team's previous game results in this season (Figure 4). For both home and away games, we used color encoding to indicate the result and the a-axis stands for time. This chart aimed to give an overview of the team's performance, for both the overall games and home / away games.

To further support users in exploring visualizations, we also incorporated an interactive customization function in GameBot. For the flow chart, users can select to show or not show the run annotation (a time interval over which one team heavily outscores the other). The arguments for the shot chart include time (game quarters), shot result (made or miss), and shot position (three points, two points, or shots in the paints). For other stats tables and the team record bar chart, the user needs to specify the team name.

User interface
GameBot communicates with users through a typical chatbot interface (as shown in Figure 8). At the beginning, GameBot shows the current day's games in boxes. Once a user has clicked a game box, GameBot will load the corresponding data and start the conversation by summarizing game highlights into a sentence. Users enter request questions into the input box and receive real-time answers. After each request, GameBot will ask users if they want to check the corresponding visualizations for more context. GameBot facilitates the visualization customization process with clickable hints buttons (as shown in Figure 9).

The GameBot back-end is built in JavaScript with D3.js for creating visualizations and communicates with a Python back-end that runs the data collection. We will open-source all back-end and front-end components after the paper is published.

Future work
Our future work includes evaluating the current system, extending the intent classification approach, and exploring the use of narrative visualization in the chatbot.

Evaluation study
We plan to study if GameBot can help sports fans answer their stats-related questions. Other potential research questions include (1) What are the pros and cons of using context visualization in the sports chatbot domain? (2) How would fans respond to the visualizations in chatbot?

Intent classification approach
The current intent classification approach is based on rule-based word matching. We plan to deploy the system online to collect more real users’ questions, which can be further used to develop machine learning-based intent classification models.

Narrative visualization in chatbot
Narrative text and visualizations are increasingly being used together for communicating data stories. The interplay of text and visualization has also been extensively studied [22]. Would narrative visualization also help data communication in the computer-mediated chat-style conversation scenarios? Would users prefer it over pure visualizations in the chatbot?

Conclusion
In this paper, we contribute (1) a characterization of sports fans’ stats-related comments; (2) GameBot, a visual-augmented sports chatbot focused on game stats information; (3) a discussion for future research directions. We hope our work can spur more discussion on conversational design and sports communities in HCI research.
REFERENCES


