Crowd Sourcing and Prediction Markets

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ABSTRACT
We introduce our work on the use of prediction markets as a tool for mining knowledge from within an enterprise (i.e., Nokia Corporation). Various companies – including Google, HP, and Yahoo – have experimented with internal prediction market services, testing its utility for tapping knowledge distributed and nascent within their organization. We are also exploring the use of this tool for capturing knowledge within the corporation, such as estimating the market-readiness of a product (e.g., mobile phone) in the run up to its release. For this exploration, we created a custom prediction market service, called FishMarket, and experimented with several iterations of the game design. Our variant of the game is designed specifically for mobile devices. Our objective is to provide quick, low overhead usage that enables a large population to participate during brief moments of opportunity, that we call *mobile moments*. We briefly describe the three design iterations of FishMarket, the small-scale pilots to assess the designs, the resulting lessons learned, and summarize some open issues.

Author Keywords
Game design, mobile moments, mobile widget, organizational knowledge, social elements.

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Design, Economics, Experimentation, Human Factors.

INTRODUCTION

Knowledge can be widely distributed across groups and individuals in an enterprise. It can also be difficult to induce relevant parties to reveal information for effective decision-making. Crowdsourcing is one technique a corporation can use to surface knowledge nascent in an organization [21]. We experimented with a mobile game based on a variant of futures market, known as prediction market, to tap into this knowledge.

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A futures market trades contracts to buy and sell an asset at a particular time in the future. A prediction market is an online futures market whose payout is tied to the outcome of some unknown future event [3, 5, 24]. At any time, the price reflects the traders' consensus on the outcome's likelihood. Thus, through the price formation process, the market harnesses the esoteric or specialized knowledge of the traders in a manner that efficiently and effectively aggregates and forecasts outcomes. Price can be interpreted as the probability of an event. One of the best known of these prediction markets is the Iowa Electronic Market that has been running since 1988 [2, 13]. In recent years, various companies including Google, HP, and Yahoo have experimented with prediction markets [5, 6, 9, 17].

In contrast to other techniques, such as opinion polls, prediction markets perform better [3, 4, 10]. The power of a prediction market derives from the fact that they provide incentives for truthful revelation and information discovery. Specifically, such speculative markets induce people (i.e., traders) to reveal what they know by "putting money where their mouth is" since getting the answer right or wrong has financial consequences. This belief is backed by the price that the individuals are willing to buy or sell assets associated with their position.

Decision markets are a particular kind of prediction market that estimates the consequences of a decision [11]. The contracts in these betting markets seek opinions to controversial topics or actions by treating current market odds as best, expert consensus prices [1, 11, 19]. Such markets are directly useful for predicting success or failure of a product or for making decisions, such as whether the current software and hardware of a smartphone is good enough to release to the public [1, 11].

Our variant, called FishMarket, is a custom implementation of prediction market targeted for mobile devices. We designed it to enable workers to play the game anytime and anywhere, and to put their insights to work in a manner that is quick and easy and requires low overhead. The latter is based on observations that during mobility, users have short periods of time (i.e., 4 seconds), called *mobile moments*, for engaging in activities [18].

In the remainder of this position paper, we will describe the mobile prediction market that we built called FishMarket. Then, we describe the three iterations in the evolution of FishMarket based on small internal pilots of each iteration. We summarize the lessons learned in these pilots, and conclude with issues and relevance of prediction markets for focus of the workshop.

FISHMARKET

FishMarket is a prediction market service created for use on mobile devices. It maintains a number of parallel prediction markets at any given time. Each market is a question with two or more mutually exclusive outcomes. Each outcome is represented by a contract; an outcome must be clear, easily understood, and easily verified via a third-party source. For example, instead of stating that Nokia stock will be impacted by iPhone introduction, we specify contracts that expire on a certain date, with outcomes tied to the Nokia stock price on that date.

Players are seeded with an initial amount of fake money ($1000). To participate in a market, they purchase bundles from the market. Each bundle, costing $1, contains a share of each contract. At the expiration of the market, a participant is paid $1 for each winning contract they hold, while each losing contract is worth $0.

Players trade contracts using a continuous double auction (CDA) [11, 17]. Specifically, traders submit limit orders in the form of bids (buy orders) and asks (sell orders). A trade is executed if the highest bid exceeds or is equal to the highest ask price. If the number of shares in the bid and ask orders are not the same, then the number of shares traded is the lower of the two. Orders are maintained in an order book in their respective bid and ask priority queues. The bid queue is ordered from the highest to the lowest, with equal priced bids ordered by time they were submitted. The ask queue is ordered from lowest to the highest.

We use fake currency rather than real money, and only small amounts are at stake. Accrued wealth (in fake currency) accumulated through a history of accurate predictions is the extrinsic motivation to trade. It complements the game's intrinsic motivation of pitting one's judgment against others in competition.

The following example illustrates game play:

> **Market:** Nokia stock price as of close of the New York Stock Exchange (NYSE) on January 31, 2009.
>
> *Contract_1:* Nokia Stock price is >= $20; pays $1 if true, $0 if false
>
> *Contract_2:* Nokia Stock price is < $20; pays $1 if true, $0 if false

This market offers two different contracts covering all possible outcomes: Contract_1 and Contract_2. On the close of the NYSE on the given date, one of the given contracts will be true, while the other will be false. The true contract will payout $1 for each one held, while the other contract will payout $0.

Suppose Jim plays the market and buys 30 bundles for $30. Based on specialized knowledge he believes will affect the Nokia stock price, he proceeds to sell all 30 shares of Contract_2 for $.50/share and recoups $15. Let's further suppose that Contract_1 is found to be true at the close of the market. Jim's 30 shares of Contract_1 will be worth $30. Along with the $15 he received from selling Contract_2 earlier, he has made a profit of $15. This illustrates an important feature of prediction markets; the reward from taking a correct position (Contract_2) provides the incentive for Jim to share his specialized knowledge.

FISHMARKET – EVOLUTION

First Iteration: Key Game Elements

In the first design iteration, the goal was simply to imitate the Iowa Electronic Market (IEM). It has a simple interface with relatively easy to understand play mechanics. The web site is open to experimental play. We used it to experiment with corner cases of the auction system. We felt that, considering the length of time the service has been operating, they have addressed the most important design issues. At a minimum, the IEM provides a reference baseline for making design choices.

In the initial prototype, a mobile Web application was created to play the game. The Web application was implemented using HTML and Javascript. The backend server software used the Python scripting language for game play and Berkeley Database for persistence. These technologies enabled very rapid prototyping and easy deployment to actual users in our pilots.

Using the mobile phone's Web browser, the user had access to a number of different web pages for trading bundles, submitting bid or ask trades, accessing the current price quotes, and viewing the history of trades. Only the current high bids and low asks were revealed as the price quote. Importantly, our UI reduced the number of user options made available relative to the IEM. Because mobile screens tend to be smaller than desktop monitors, and network latencies much greater from a mobile device, a simpler UI facilitated quick, mobile game play.

Second Iteration: UI Dynamics

The goal of the second iteration was to deploy the system for user testing within our lab (about 50 people at the time). The main changes were to create the mobile *widget*, to simplify the UI, and to harden the backend infrastructure.

A mobile widget is a standalone application built with standards-based Web technologies (such as CSS, HTML, and Javascript) and runs within Nokia's Web Run-Time engine (WRT) [8]. The widget is downloaded and installed on the user's mobile device, and then configured with the user's credentials. In contrast to using the Web browser interface, the widget automatically connects to the Web application URL and automatically authenticates using the configured user credentials. This greatly simplifies and expedites access for the user, which is important for game play during those short mobile moments.

In a pilot of the first version of FishMarket, there was confusion with terminology; for example, using bid/ask on

the quotes page and buy/sell on the trading page. Furthermore, when placing a trade, the user invariably consulted a separate page to determine the current pricing. In this iteration, we consistently used the terms buy/sell. We also merged the quotes and transaction pages into one page (see Figure 1 (B)) that displayed the current respective quotes for the buy/sell transaction. Also, we revealed only the current price quote and did not provide visibility into the prices in the queue shown in the figure until the third iteration.

Third Iteration: Social Dynamics

The goal of the third iteration was to fill out the components of the system that grease the game play. Specifically, we added social and competitive elements to engender awareness and social interaction. These components addressed concerns with market liquidity, with fostering knowledge elicitation and information exchange, and with sustaining interest and activity during the course of the running of the prediction market.

Market liquidity relates to a vibrant market where there are buyers and sellers who are willing to make trades without causing significant price movement. This is more than just enabling traders to buy and sell contracts through their mobile devices. During thin market periods, market makers (cooperation) are required to hold positions temporarily to facilitate trades. Such positions are risky. While different mechanisms can be used to induce trading (e.g., call market, market maker) [4], we opted to bring social elements in to see if that will help. The rationale is that a prediction market is inherently collaborative requiring participation, cooperation, competition, and collective action.

Kollock [14, 15, 16] has written extensively about the importance of social dynamics and, in particular, of identity and network of social relationships for the healthy functioning of a market. Identity is important for accountability of individuals. Interconnected network of relationships are important in terms of the role played by intermediaries; the most important being trust and flow of favors as informal means of managing risks. Trust and favors are the social capital on which risk is informally managed whereas a market's contract is formally dealing with the risks in transactions. However, contracts are not sufficient for covering all contingencies and any formal mechanism for dealing with risks in transactions can be expensive. Thus, interactions, be it trades or chitchat, and accountability in the form of visibility of trades can help nurture and preserve both identities and network relationships. Finally, leader boards provide ongoing updates of participation and status of market participants (see Figure 1).

Our Experiences

First Pilot

The initial prototype was functionally equivalent to the IEM. However, we found this experience to be confusing for the novice user; the interface used foreign concepts (trading in a continuous double auction) and foreign terms. Evidence during early game play showed that users were confused and were not willing to spend the effort learning to play the game.

Second Pilot

In this second pilot launched after the second design iteration of FishMarket, one individual did much better than the others. He credited his success to being familiar with basic trading through buy-sell auctions.

One important design decision was which games to play. The market supported multiple simultaneous games that we felt was an important option to incentivize more users to play. To test understanding, we designed one game that had a high probability of a particular outcome. We felt this would give an indication of whether players understood the game mechanics. For the high-likelihood event, the expected outcome was the market would quickly stabilize on a price, and that price would reflect one very high probability outcome. The other markets had choices that we felt were more uniformly distributed. One market was chosen whose outcome was not easily guessed, but where players could easily obtain the information from other sources.

The outcome of the pilot of the second iteration was largely inconclusive, but we did observe that trading quickly subsided after the first day, and that users were still confused by the game mechanics.

Third Pilot

In the third pilot with users in our lab using the third iteration with social dynamics, we conducted only one prediction market exploring smartphone sales related to Apple iPhone, Nokia N97, and Palm Pre. While we did get quite a few users trying out this version, there were still issues related to game play, questions about new functionality like scoring, and thin market. Trading was not sustained over the period. The social functions had a curiosity component for some people.

Discussion

One key challenge in creating FishMarket is to make the game play accessible to novices. It is an issue that we tackled through the three iterations of the system. At the conclusion of the third pilot, we recognized that a larger pilot to the whole company was needed to tap the diverse and independent knowledge within the company [21]. However, thin markets due to a complex auction-style interface are a concern, and we debated on changing from a continuous double auction mechanism to a simpler alternative such as market scoring rules [12, 17]. We felt

that continuous double auction mechanism would provide direct interaction amongst a pool of users; participants bet against one another rather than an intermediary. This seemed to fit with the social environment we tried to foster.

CONCLUSION

Our interest in the workshop is to participate and contribute in two lines of discussions. The first is around the user interface design, game design, and social design of crowdsourcing tools. The second is around attributes of crowdsourcing tools that effectively channel, share, and sort out the best of the participant's abilities. Prediction markets have several properties that make them interesting as a crowdsourcing tool in general and more specifically for HCI as it relates to deciding whether a product is good enough to be released.

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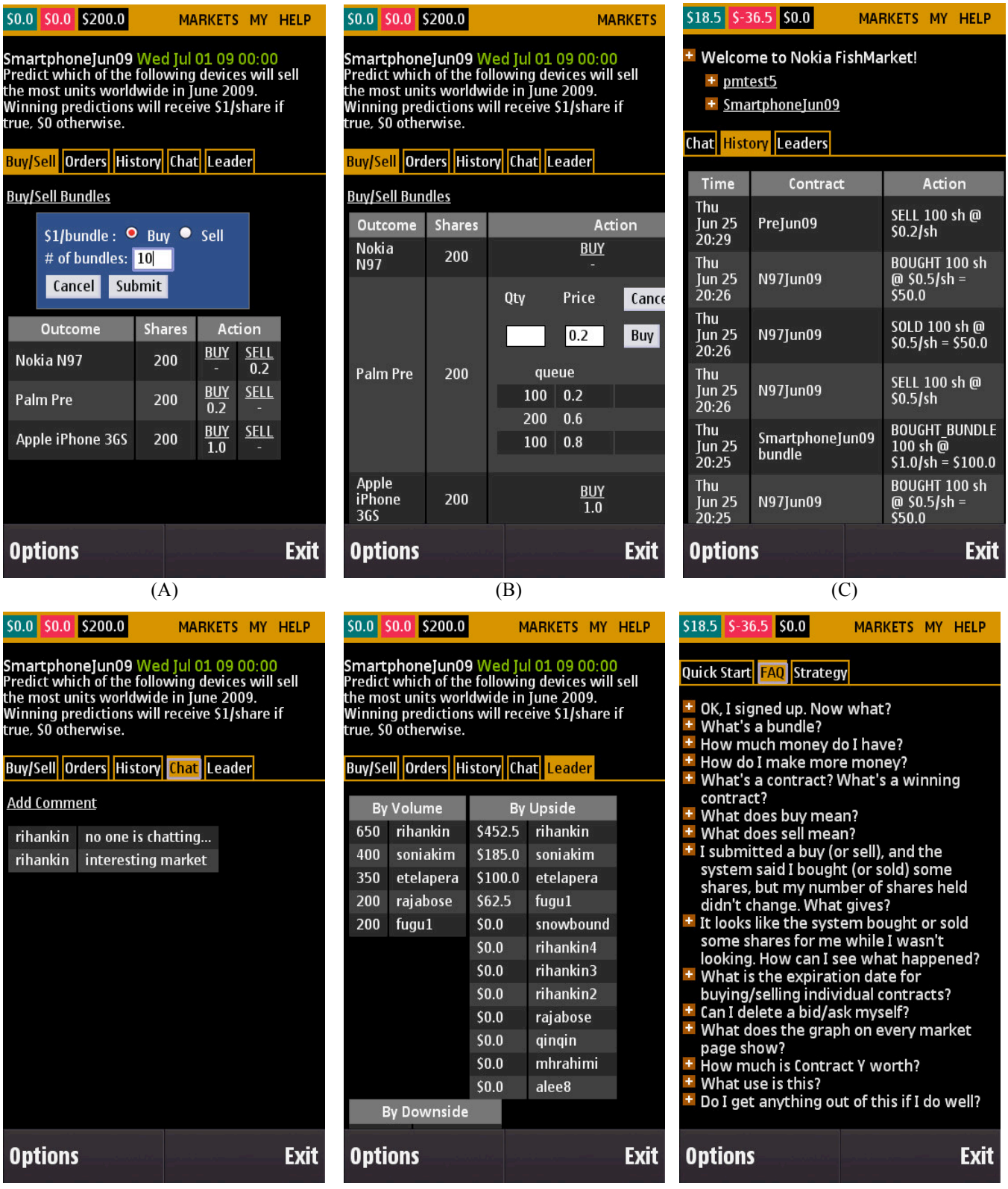

Figure 1: FishMarket screenshots – (A) Buying 10 bundles. (B) Placing an order to buy Palm Pre contracts. (C) History of user's trades. (D) Chat. (E) Leaders in the market. (F) FAQ.