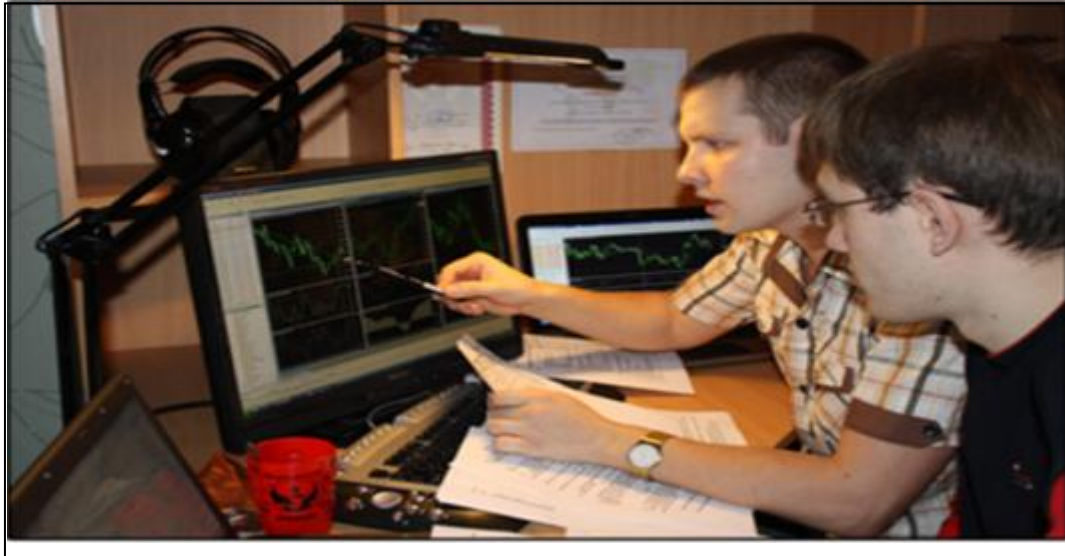# UNIVERSITY OF GOTHENBURG

Identifying Challenges Faced by Foreign Exchange Robots Designers

Bachelor of Science Thesis in the Software Engineering and Management Programme

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Anthony and Ronald are working on GPS Forex Robot,
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Identifying Challenges Faced by Foreign Exchange Robots Designers

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*Abstract-***The international currency market Forex, provides interesting opportunities in terms of wealth. Open twenty four hours a day and five days a week, the market provides a large number of currency pairs to trade. The capacity of manual Forex trader decreases in terms of decision making, depending on time spent in front of the computer, when monitoring the market for catching trading opportunities. It is also impossible to monitor more than two currency pairs. These are two of many other challenges faced by manual Forex traders. The automation solve these kind of problems and many more. However, to trade the market is complex and challenging to be automated. Therefore, this thesis aims to investigate ways of designing efficient Forex trading robots by identifying the challenges faced by designers and finding possible solutions to overcome the identified challenges. In addition to a related work literature, this qualitative study used interviews with professionals in the fields of economy, applied mathematics to economy, computer science and users. The results of this thesis identified Forex strategy related challenges and robot environment related challenges. In the first category, coming up with profitable trading system, forecasting the Forex market and switching between different strategies are the major identified challenges. In the second category, broker behavior control, the stability of the system and time constraints are the identified challenges. In robots using fundamental analysis, the suggested solution to forecast the Forex market is based on linear optimization and forecasting, combined with genetic algorithms while robots using technical analysis, the optimization of combined indicators is encouraged to be followed, for better design. Testing a trading system in available Forex platform simulators using historical data give reliability on the trading system's expected results. The identified challenges will help software engineers as guideline to design a more efficient Forex trading robot.**

Key Words - **Challenges, Automated, Foreign Exchange, Forex, Robot, Financial computing**

I. INTRODUCTION

It is stated in the theory of asset demand that the quantity demanded of an asset is positively related to its liquidity[1]. This justifies the choice of this constructive and interpretive-qualitative study that is oriented to Foreign Exchange (or Forex which is the simultaneous buying of one currency and selling of another in an over-the-counter market[2]) because it is the largest financial market in the world[3] and it is liquid. Considering the number of currencies in the world, everyday's trading opportunities per currency pair, are huge and a manual trader cannot monitor all of them. In order to maximize profit, one have to monitor and catch those trading opportunities, what is impossible to a human. It might be possible to assign as many human, however other human related weaknesses (e.g. tiredness, etc.) will follow and productivity will decrease. Nowadays, with the use of computer that is ubiquitous, Forex market is not left behind and the computer brings solutions to the mentioned problems. Moreover, a lot of studies attribute failure in Forex trading to emotional human pressure[4], giving more space to the computer use to trade the market.

Using a robot (software) to trade the Forex market, means that the robot will be used to predict the trend of the market in order to generate profit. However this market is unpredictable. Its behavior is dynamic, constantly moving in an infinite variation of three movements: up, down, or sideways[5]. The hypothesis that computer cannot process feelings, natural speech or images[6], characteristics that plays significant role in the Forex market movement[1, 7], makes challenging the work of robots designers, by using computers to predict emotional related market to gain money.

Only 5% of manual Forex traders are reported to be successful[8]. The Elliot wave theory[9] has shown that the market depends on human psychological decision. It makes the market complex and uncontrollable. This explains the failure of the remaining 95% of traders. Automating such complex market, reduces risk related to human weaknesses. However, even though the Forex trading is attractive and presents the most wealth gaining opportunities in the world, the automation has its own challenges.

Studies have reported robots based on technical analysis approach (using historical data to forecast the future)[10]. Few research efforts approaches which look into possibilities of automation of fundamental analysis (using economics law of foreign exchange) have been conducted[11] and some studies are conducted toward artificial neural network (ANN), as a way of using Forex network data to better build an efficient robot[12]. These various studies have mostly reported how to solve

profitability challenges but the inventory of challenges to be aware of in robot design still remains.

Donald Rumsfeld, the former United States Secretary of Defense, in 2002 stated" ...*There are known unknowns; that is to say, there are things that we now know we don't know... But there are also unknown unknowns – there are things we do not know we don't know*"[13]. We know that the challenges faced by the Forex trading robot designers are not documented, therefore this thesis aims to investigate ways of designing efficient Forex robots and addresses the following research questions:

- What are the challenges faced by Forex trading robots designers (RQ1)?
- What are the possible solutions to overcome the identified challenges(RQ2)?

The answers to these research questions will be useful to software engineers interested in Forex trading robots design as well as a guideline to other researchers in financial computing especially in Forex market.

Due to limited resources, the study does not focus on stock exchange market. Action design research (ADR) [14] would be the second choice methodology approach, to involve a company and to test findings.

This qualitative study uses grounded theory strategy of inquiry and employs open-ended questions to collect participants meaning. Interview is the used method to answer the RQ.

This work identified Forex trading strategy related challenges as well as environment related challenges. The solutions found, recommend more research for each category and the solutions are open for future research.

In the following section, a brief introduction to the Forex market and the robot are developed followed by the methodology description. After, the results are presented and discussed and the conclusion are made.

II. RELEVANT THEORY

Since the introduction of electronic brokering (brokering is a financial Electronic System that provides facilities to the Forex trading process) in 1996, Forex trading is open to the public using internet[3]. Since then, robots design and implementation have grown with the aim to extract benefits from the Forex market.

Studies related to automated Forex trading classify robots in many design types depending on the algorithm used, however every robot can fall in one of two categories: fundamental analysis or technical analysis based robots. Based on technical analysis approach, Zhihong [10] stressed

that algorithm based on combination of market indicators (indicators are part of online trading platform; they are built-in function that allows trader to display a certain dependence on the screen) in technical analysis give better results because each indicator has its advantages and disadvantages. Single indicator often produces false signal which may cause loss. There are few research efforts and approaches which look into possibilities of automation of fundamental analysis (using economics law of foreign exchange)[11]. Some studies are conducted toward artificial neural network (ANN), as a way of using Forex network data to better build efficient robots.

A. Forex Market

This section presents theories that provides the reader with tools for interpreting and understanding the results.

To take advantage from the market, a Forex trader (persons that trade on Forex markets for purposes of profit[2]), has to predict the move of the market, and place an order in the same direction as the market. If the market moves in the predicted direction, then the gap of the currency rate between the two period of time is a profit, otherwise the gap generates the loss.

A successful Forex trader is a Forex trader who often gets profit. Supply and demand for any given currency, thus its value, are not influenced by one single element, but rather by several. These elements generally fall into three categories: economic factors, political conditions and market psychology.

- **Economic factors**

Miskin[1] states that in short run, interest rate follows the theory of asset demand. This theory say that holding all of the other factors constant, the quantity demanded of an asset is positively related to wealth, to its expected return relative to alternative assets, to its liquidity relative to alternative assets and negative related to the risk of its returns relative to alternative assets.

In long run, it follows two rules: the law of one price and the theory of purchasing power parity

> The law of one price: if two countries produce an identical good, and transportation costs and trade barriers are very low, the price of the good should be the same throughout the world no matter which country produces it.

> Theory of purchasing power parity: Exchange rates between any two currencies will adjust to reflect changes in the price levels of the two countries.

The data can be retrieved in (a) economic policy, disseminated by government agencies and central banks, (b) economic conditions, generally revealed through economic reports, and other economic indicators.

It is obvious that designing a robot based on the economic factors is challenging because part of data are in economic newspapers (e.g. Wall Street Journal, Forex section)[1]

- **Political conditions**

Internal, regional, and international political conditions and events can have a profound effect on currency markets[1]. A real example is the 9/11 terrorist attack in the US which had

strong impacts on the Forex market. This kind of event is not easy to model making robots design difficult because of its forecasting.

- **Market psychology**

Market psychology and trader perceptions influence the foreign exchange market in a variety of ways[15, 16]. Roomers around the economy of a given country for example can affect the Trader's decision making, so the Forex market. The literature did not revealed a robot design of this kind. The Figure1 give an overview on how Forex Market looks like. It displays the currency interest rate price move between two countries within a period of time.

Figure 1: Screen Caption of Montly EURUSD Forex Market, from 1991-2013

B. Market trends

Some researchers like Brown[17] claim that Forex market has only two trends: the uptrend (bullish) and downtrend (bearish). However most of traders find in addition another, that is the ranging trend, a side way trend[18, 19]. The Figure 2 shows the three trends and give the idea on the design considerations. The uptrend robot design is the reverse of the downtrend design while the ranging trend needs appropriate design.

Professional traders spend many hours sitting in front of computers, waiting for the right moment to perform a deal. They cannot be in good shape all the time. That is why, soon or later, traders start considering automation of trading process. They formalize trading rules and express them in the form of algorithms, this is called a trading system (TS). To make a trading robot, it is need a profitable TS.

Figure2: Market trends[19]

Trading System

A TS is a set of instructions which advise opening or closing trading positions based on the results of technical analysis. It allows to exclude randomness in the trading process. Strict adherence to the system permits to rule out the emotional factor in the trade. For this reason, one must strictly follow all recommendations of the system even if for all that a potentially profitable position will not be opened. Six steps[20] might be important in order to create a TS:

- **Step 1**. Time Frame: the market might be going down in one minute chart and going up in five minute chart. It is recommended to choose one time frame that the system will use.
- **Step 2**: Find indicators that help identifying a trend.
- **Step 3**: Find indicators that confirm the trend. The robot will monitor the variables of the indicators and place conditionally order accordingly.
- **Step 4**: Define the risk: how much the system is willing to lose in case the market moves against prediction.
- **Step 5**: Define entries and exits.
- **Step 6**: System rules must be written down and implemented.

A good TS predicts the trend, entry point (for buying or selling signal), exit point (take profit or stop loss). It provides the level of risk and the money management as well.

After developing a profitable TS, the software designer can then design a robot, based on the TS.

C. Robots design

A Forex robots (software that automatically trades without human intervention) or expert advisor (EA) is a program capable of performing in the client terminal any action following the instructions of a trader, without his direct involvement. Simply, this is a program sending applications to a broker without any intervention on the part of the trader. From a psychological point of view, the Forex robot is irreplaceable. A Forex trader using robots, does not need to have an in-depth knowledge of technical and fundamental analysis, since all the calculations are already included in the program. Besides, the robot is able to handle the trading signals even when the trader is absent from the workplace.

As stated in previous section, the first step of making a robot is to develop a TS. The TS behind robots, are designed following the ground principles as described below:

Fundamental analysis: are based on economic factors. The few implemented robots of this kind uses the artificial neural networks (ANN) to predict the market, using the different statistical algorithms. The ANN collects a big number of economic indicators as input in a so called "black-box" software to be used to forecast the market[11, 21].

Technical analysis

Robots designed in this category base their actions on three axioms[22]:

- The market movement considers everything: the gist of it is that any factor that influences the price, whether

economic, political, or psychological, has already been taken into account and reflected in the price chart

- The prices move with the trend: The current trend will go on until the opposite trend sets in. Technical indicators are used to detect the reversal.
- The history repeats itself: technical analysis and studies of the Forex market dynamics are closely related to the studies of human psychology. Elliot wave principle is one of the studies conducted in this area.

Elliott wave principle[9, 17] is a form of technical analysis that some traders use to analyze financial market. It can be profitable and computable because it results in fractals. Elliot wave Theory was proposed by an accountant and business expert Ralph Nelson Elliott. He observed the stock markets (that are almost similar to the Forex market) in the hope of understanding the market behavior. After, he had performed a large work, he concluded that the financial market is based on a certain cyclic laws in human behavior psychology. According to Elliott, the financial market price behavior can be clearly interpreted and shown in the chart as waves (the wave is here an explicit price move). The Elliott wave theory says that the market can be in two large phases: bullish market and bearish market. He shows all prices that move on the market are divided into:

- five waves in the direction of the main trend (waves 1 to 5 in Figure 3);
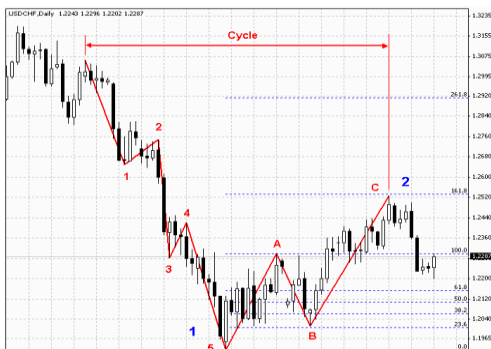- three corrective waves (waves A, B, C in Figure 3).

Figure 3:Elliot Wave Principle in A part of bearish trend[9]

The related work literature has unfolded some major challenges and possible solutions in the robots design process. Following are major discovered challenges but they are not exhaustive.

D. Challenges and possible solutions

- The Trading System (TS) is the core of a robot. It is a challenge to develop one which is profitable. People protect their TS and available TS are scams [23].
  Develop a TS that fits the robot to be designed. Options are diverse. Buy a system or develop one. It is advised to make one from simple idea or ameliorate a simple existing robot.[23]
- Design the forecasting is among the big challenges faced by robots designers. As a solution to this challenge, if fundamental analysis is used, one of the computable and efficient solution found is based on linear optimization and forecasting, combined with a genetic algorithm[21, 24] , and if technical analysis is used, an experiment is advised to be conducted, in the combination of more than one indicator[25]. These provided solutions do not guarantee total control in predicting the market movement however they give better results.
- Some brokers intentionally disable clients robots when running. They also change the level of their commission without informing the clients, which has impact on robot profitability[26]. The most appropriate solution is to change the broker, and find who is registered in a national or international financial authority[26].
- Errors[27]: Errors can occur, but when the consequence weight on money balance, this become a challenge and a priority. Two sort of errors can occur: Trading related and runtime related errors. Ex: connectivity error, server busy error etc.

III. METHODOLOGY

Social constructivism worldview is held in this study to choose the interpretive-qualitative methodology[28] over quantitative or mixed methodology. As Crotty[29], and Locke et.al [30] described, findings are constructed from interviews. The contexts where participants live and work have been considered. Participants' backgrounds are recognized to shape their interpretations. Open-ended questions has been used to interview them so that they can share their views.

The researcher conducting the interviews is familiar and interested in the Forex trading and Software engineering in order to understand and discuss different issues related to the Forex environment.

A. Procedure

The study was conducted from April to May, 2013.
Activities carried out in this research are interviews and data analysis

Interview Study

We carried out semi-structured interview as discussed by Myers and Newman[31]. They stressed that the researcher has to prepare some questions beforehand. During the interview it is allowed to improvise by using probe questions to clarify a question or to gather further information. The interviewer must be the researcher or someone who belongs to the team. This approach has been chosen because it fits the qualitative nature of this research environment. The Forex environment is understood by the author according to the Figure 4. The figure is explained as an environment that happening within the brokering system where the Forex trader is the user and applies the theories related to economy/finance, computer science and mathematics.

The combined face-to-face and telephone interviews (the interviewee had a telephone and the researcher had Skype) were used. The interview conducted face-to-face were recorded using iPhone while telephone interviews with Skype were recorded using MP3 Skype recorder software.
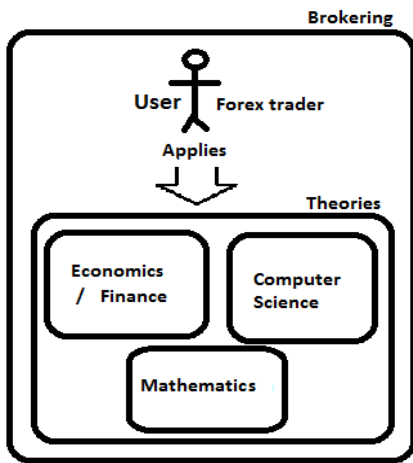

Figure 4: Automated Forex trading environment/Author's interpretation

The recorded materials were later transcribed for easy data analysis. Interview questions were grouped into four categories: Forex traders, economist, mathematician and computer scientist. (see Appendices 1- 4)

Participants

Interviews with the following professionals helped to understand data from different perspectives according to interview process Figure 5. This means the interview began with the Forex traders, followed by the economist, then the mathematician and finally the computer scientist. By this thinking, the author used information from Forex traders to better interview the economist and both information helped him to interview the mathematician, etc.
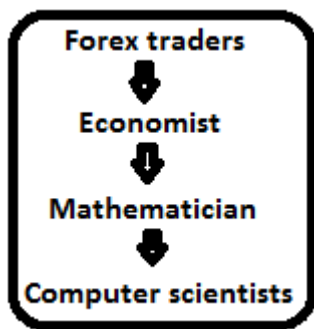

Figure 5: Interview process(By the Author)

A total of five participants were interviewed and the average time of interview was 45 minutes. The participants have been asked the right to be recorded before the interview.

- Forex traders (referred as P1: participant one): Two Forex traders have been interviewed: both are experienced Forex traders living in Nigeria and using robot to trade. The Forex traders are key participants

because they act in the Forex market as users. Their information provides the general and detailed insight of theories application to the Forex market

- Economists (Referred as P2): A professor at National University of Rwanda (NUR) in Money and Banking, provided useful information guiding the Forex market in practice. He stressed for example the instability between economic theories and the reality due macro-economic variables that are difficult to control
- Mathematicians (Referred as P3): helped to understand how to model prediction of the Forex market.
- Computer Scientists (Referred as P4): A creator of robot algorithms and robots developer, argued on design and implementation.

Data analysis

An inductive thematic data analysis built on patterns has been conducted following Braun and Clarke[32] steps:

- Self-familiarizing with data: The interview collected data were read and lighted by the related work literature
- Generating initial codes: The results were coded according to Table 3 in the result section
- Searching and reviewing themes: Among the challenges patterns, set of themes have been identified and reviewed
- Defining and naming themes
- Producing the report: We described the themes.

Data collection and analysis was conducted simultaneously in this qualitative research as supported by Merriam[33]

IV. RESULTS

The content of this section answer in details the research questions RQ1 and RQ2 addressed in the introduction section, from participant perspective.

Two themes have been discovered in the data analysis: Strategy related challenges and environment related challenges

A. Theme 1. Strategy related Challenges

Table 2 describes challenges that are related to strategy design, to implement the robots. Come up with a profitable trading system, forecasting the Forex market and come up with a strategy switch algorithm are the three major challenges found in this theme.

Commentary

Trading System: It is challenging to come up with a trading system because of the complexity of the Forex market and its changing characteristics. There are a lot of variables to control, within different time series. There are sub components to be designed in order to have a complete TS. Some of them are: money management plan and risk management. Every sub component has itself specific parameters to take in consideration in order to be profitable. For example, setting the time frame to T1 (e.g. 1 hour), the stop loss to SL1 (e.g. 100 dollars) and the take profit to TP1

(e.g. 50 dollars) generates a loss while setting them to different values without changing the robot design generates profit. That is why a TS is challenging and worth special experiment in order to come up with profitable TS.
Forecasting: No one in world has control over the future. Regardless the TS used, or available resources, loss is inevitable in the Forex trading. The solution provided in the Table 1 help to higher winning probabilities. The first given solution is based on applying statistic hypothesis of forecasting time series in combination with the autoregressive integrated moving average (ARIMA). The second is using human to read the economic data and use his decision as input for the robot. When ANN is used, Trying to input a lot of variables in the TS to better control the environment as it is the case for the ANN, data processing become a real challenge, and the result of processed data become obsolete when needed.
Strategy Switch: Most of the time, the change of the Forex market behavior is detected by indicators however indicators are not "confirmer". Sometimes they indicate a situation and after few minutes they indicate the opposite, making the switching strategy design very challenging.

Challenges	Description	Possible Solution
Trading System	P1 raised the challenge of developing a TS	P4 suggested to find a simple TS that is available and ameliorate it by adding self ideas. After, a complete testing is required, first in simulator, second with demo account testing (using virtual money to real Forex market) and finally in the real account(account with real money)
Forecasting	No one can claim to control the future. That is why it is reported to be a challenge when we design software to predict the future. All participants confirmed that it is challenging to design a robot that makes all the time right Forex market prediction. P4 reported challenges related to power processing data when number of variables in input is significant in using Artificial Neural Network	• Referred to P3, forecasting issue can be solved by linear optimization and forecasting, combined with genetic algorithms. • Involvement of the Forex trader (user) prediction feature in design is advised according to P1.
Strategy switch	A robot can have more than one strategy to act in different market conditions. It is challenging for the robot to detect when to switch on and off this or that strategy. The ranging period is the most difficult. P1 stressed this to be a serious challenge.	P4 advise to develop an appropriate switch algorithm using appropriate indicators to detect different market behaviors. He usually use the Average Directional Movement Index (ADX)[34] indicator to detect the ranging phase of the trend

Table 1: Strategy Related Challenges

B. Theme 2. Environment related challenges
The Table 2 describes challenges that are related to the robot working environment. The challenges that compose this theme can be controlled but can lead to disaster if they are not properly managed. Broker behavior, stability of the system and time constraints are the major challenges identified in this theme.

Commentary

Broker behavior: Among the brokers, there are scammers. If not managed, the consequences weight on the account. The most reported scam in the interview is disabling the robot which controls the client's account. In this situation, the Forex trader can lose money for two reasons: either the stop loss did not stop the order resulting in losing money, or the take profit did not react and a trade-off can lead on losing money as well.
Stability of the system: the environment in which the robot runs is a challenge especially when it is not taken in consideration from the beginning. The robot "must" be always in running status in order to be profitable. If for one or another reason it changes the status, this become a threat, and the robot designer must thing about this challenge as well.
Time constraints: This challenge is related to the geographic time differences between robots hosting country and the broker hosting country. The computation can be problematic when data are different, that is why the robots designer has to take in consideration this issue.

Challenges	Description	Possible Solution
Broker behavior	P1 stressed that intentionally some brokers disable the robot, a challenge that can lead to money lost	According to P4, designing the Stop Loss and Take Profit invisible to broker is a way to prevent the broker to act on client robot settings. Stop Loss is a stop order; it is a price set by trader, at which a market order will be closed if the symbol price moves in a direction that produces losses for the order[22]. Take Profit is a stop order; it is a price set by trader, at which a market order will be closed if the price moves in a direction that produces profits for the order. [22]
Stability of the system	Stability issue is related to every situation that can cause the interruption of the robot to run. Below are some causes: Power: In order to be profitable, a robot must always be in status "running". A child can disconnect the computer, the electricity can be a problem in certain part of the world, etc. P1 raised this issues and find it as a threat for profitability.	P1 noted that the most popular solution is the use of a Virtual Private Service (VPS), which it is a service provided to a client to host a robot for better service, in exchange of a payment. P4 give the solution to design the robot by preventing errors stressed in the related work literature, as much as possible and design the robot to be able to inform the user about the action that has not been performed. He further suggested to test the robot efficiently
Time constraints	According to P1, Broker's place time and Trader's robots place time have to be synchronized. If the two places have different time, calculations challenges occur.	This time related challenge is solved in the robot design. Robot that not take consideration of this issue, present disturbances when running. (Referenced by P1).

Table 2: Environment related challenges

V. DISCUSSION

This discussion section has drawn a connection between the RQ, the findings, the existing literature and the author interpretations. It discusses major findings of the study, and give the author a space of arguing on the facts and his overview on the research topic, connecting the interview results and the literature.

A. Similarities and Differences

Findings are consistent with existing literature on the fact that it is challenging to design and develop robot that control the market, especially in unexpected cases like in ranging trend. Participants insist on overcoming the challenges by researching and self-training.

The major difference to be noted is the conciliation between economic prediction theories and the reality. Theories give precise factors that influence the economy[1], however economists in interview compare economy prediction to random game[35], making robot design based on fundamental analysis challenging. Another reported difference is the vision of the market in term of the trend. A robot designer can fall in understanding the Forex market as two or three trends as reported in the literature[17-19]

Complementarities between related work literature and interview can be seen in different parts, where a challenge is discovered in one and the answer is found in the other part,

or additional answer can be found in one another part. Detailed case will be given in the findings reflection section.

B. Findings Reflection

Considering the theme1, the following reflections can be extracted, to light the answer to the RQ1 and RQ2:

Trading system: If to develop a profitable TS is stressed as a challenge, it is because it folders a lot of concepts to be taken in consideration. The challenge come from making decision for each issue of the TS from a lot of available information. That is why experiment research is appropriate before making sure the TS is profitable. The interview suggests to test the TS with different variables in a simulator, a demo and finally with real account. The use of ANN stressed in the literature spawned a challenge related to power processing in the interview, giving a picture of complementarities of the used methodology approach.

Forecasting: This challenge is given a specific interest because of his necessity. The forecasting issue has to be well designed for a robot to be profitable. From economic point of view, the prediction of the Forex market is still a challenge. No one can claim to control the market, regardless his experience and degree of education. When designing a robot, the designer need to have in mind that the Forex market is very risky. P2 and other economists have confirmed this issue. "*That paper found that 70 per cent of*

the RBA's forecasts for underlying inflation for the year ahead were close to the mark, but its predictions of economic growth were less accurate, and its unemployment rate estimates no better than a random walk"[35]. If the majority of economists do not rely on the results of their efforts, how aware will be the designer when implementing the economists idea?

From mathematician perspective, the non-linearity of the market can be solved by linear optimization and forecasting. This might be efficient with less variables as input. However in Forex market, more variables are in consideration. The impact can be seen from computer scientists' (P4) point of view, that indicated a challenge related to power processing[12]. This can lead to obsolete information if one chose a low time frame to trade.

From Forex trader perspective, the ranging phase of the Forex market is difficult to control and is among the most challenging issues faced by robots.

The interview complement the solution found by designing a robots feature that involves user in forecasting the market. The author find as well the Elliot wave approach to be an option in forecasting the Forex market, but it is not simple to implement. Aronson[36] criticized the Elliot wave principle that it is too vague to be useful, since it cannot consistently identify when a wave begins or ends.

Strategy Switch: The interview could find this challenge that was not find in literature. The Forex market have multiple behaviors, so more than one strategy can be designed and implemented in form of algorithm. Switching between them to fit the market is difficult because the Forex market does not provide precise entry or exit point. The strategy switch might be difficult in the ranging phase because P1 confirmed this phase to present multiple behavior and so making difficult to detect.

The theme 2 differs from the theme 1 in the sense that once the solution is found, it is stable and can be applied to other robots, what is different in the theme 1. We can fully solve the challenges in the theme 2 but no one can claim to fully stabilize the challenges in the theme 1.

Broker behavior: This challenge is in the category of solving a problem related to scams and contract negotiations. A lot of solutions have been suggested, among them is to change the broker however in software design perspective, by interviewing P4, he suggested a better solution which is to design a set invisible the "take profit" and "stop loss" to the broker.

Stability of the system and Time constraints: As another example where the methodology approach gave efficient result as complement, the literature discovered the software errors related challenges while interview found time and power related challenge. From these challenges, only the errors related to the software are very tricky to control because it is not easy to know what we do not know. If a bug is in the program, even though tested, there is no way to know if a software is fully free of bugs. To ensure the

stability of the system because of the electricity or other causes, the author suggests that another solution could be, to prepare an appropriate environment so that the robot can run without interruption. (voltage converter, use batteries as power emergency, solar energy, etc). He further suggest a logical solution to time constraint, by choosing a VPS in the same regional time as the broker.

Even though the chosen themes are separated, they are complementary in the sense that they all contribute to the sole objective of profitability. All the challenges might be controlled for the product safety and reliability.

Briefly, we suggest a designer to take the whole system in hand, not only implementation but understand the whole Forex system to get efficient robot.

C. Adds to the Research

The identified challenges are probably known by practitioners, but in the best on our knowledge, literature did not found a research that condense these challenges together to be like a guideline to new curious in the field of robot design.

D. Research Methodology Comment

The used methodology was appropriate, however anyone with a different approach especially involving a company can perform the same study and provide better results. Action design research (ADR)[14] would be better as well as a use case study. Bigger study might be conducted to answer all the unfolded issues to have a complete result. Limitation was that some interviewees did not turn up and this affected the results and the initial plan.

Considering the importance of the Forex market, the author found very few, the literature available. In over 700 databases visited, only 6 relevant articles were found. This proves a need of more research in the field of automated Forex trading.

E. Future Research Areas or Possibilities for Improvement

This study raised many future research area especially in finding proof of the concept for possible solutions. The list of identified challenges and possible solutions are non exhaustive and it is opened to be added other challenges to the present work. Finally, design and implement an efficient robot can be a future work.

F. Validity dissussion

Triangulation has been used in order to check the validity of found information. The related work literature and participants do not contradict. If we use forum as source of information, it is found that validity threat is very low.

VI. CONCLUSION

Through this paper, the challenges faced by Forex robots have been identified and grouped in two categories: strategy and environment related challenges. In the first category, it has been identified trading system, forecasting and strategy switch related challenges. Broker behavior, stability of the system and time constraints related challenges are the three

major challenges found in the second category. For each challenge in the identified categories, solutions have been proposed, research and self training were the best solution advised by the literature review as well as the interview participants. Research was proposed because it gives proof of concept and brings an added value to the industry. *"Absorb as much as you can and learn from your fellow traders. Remember, it's better to check and educate yourself before you wreck yourself!"[37].* Qualitative methodology has been followed, where literature review and interviews are the two methods used for data collection. The participants were chosen from four point of view, according to the areas that intervene in the Forex market. The results of this work, can be useful to robot designer. The Forex market presents opportunities but can lead to disaster as well. Robots make a lot of money in Forex market and give time to further research.

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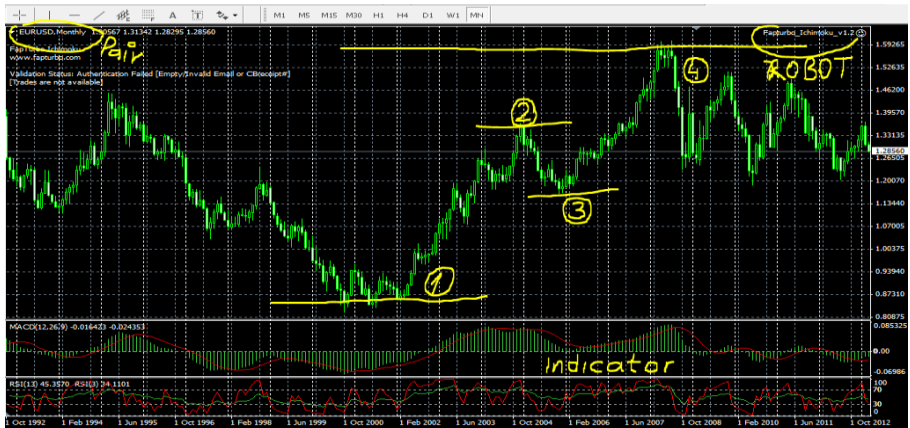**Appendix 1: Computer scientists questionnaire**

Figure 6. Forex Market

Forex market is based on the movement of a pair currency rate (ex. EurUsd). To trade the market is to predict the trend where the curve of the market goes, and gain the gap between the two points. Example. 2-1(buy) or 3-2(sell). The market follows human psychological decision making (Between sellers and buyers). It moves freely and no one even a country can control it. We can say it is non-linear.

Questions

1. With consideration to non-linear function, what are possible predictions algorithms within the field of computer science that can help determine points 1,2, 3 and 4.

2. What challenges do you think can occur when trying to compute such functions?

3. How possible is it to overcome those challenges?

4. Once computed, what challenges do you think can occur when running, with consideration of client-server data communication?

5. What are possible solutions to overcome them?

6. Can you direct me to someone and/or literature that can be helpful?

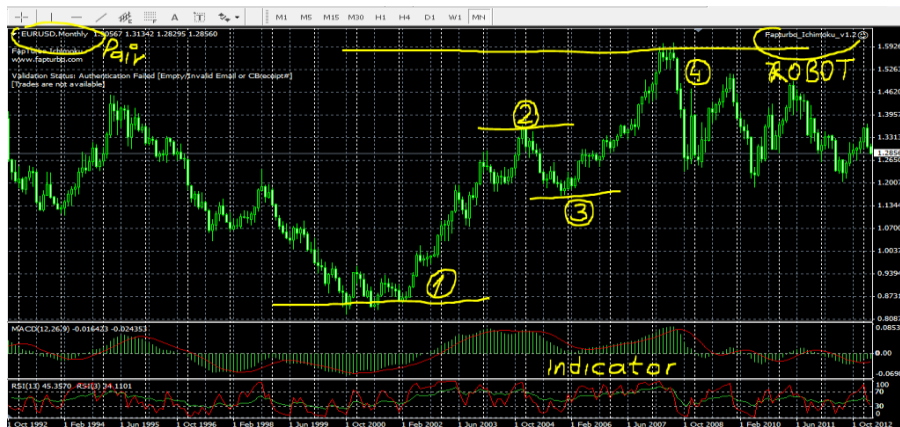**Appendix 2: Economists Questionnaire** (Field of Economics of Money, Banking, and Financial Market)

Figure 6: Forex Market

Questions

1. With consideration to Forex market, how can we forecast the move of the market, to be able to determine reversals and retracements? (points 1 and 3)

2. Is there economic models that follows the Forex market to be possible to compute the forecasting?

3. If computed, what kind of challenges do you think can happen?

4. What are possible solutions to overcome those challenges?

5. Can you direct me to someone and/or literature that can be helpful?

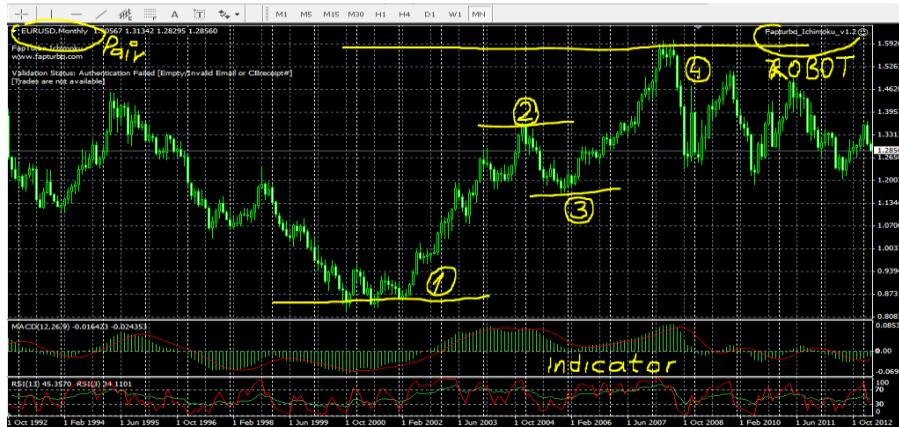**Appendix 3: Applied Mathematics to economy Questionnaire**

Figure 6. Forex Market

Questions

1. With consideration to a non-linear function (Example of Forex market: Figure 6), how can we determine the global and local maximum and minimum? (Points 1, 2, 3, 4).

2. Is there some mathematical models we can follow in order to capture them?

3. If computed, what kind of challenges do you think can occur?

4. How possible is it to overcome those challenges?

5. Can you direct me to someone and/or literature that can be helpful?

Appendix 4 : Forex traders Questionnaire

Questions

1. Presentation: what do you do, your experience in Forex trading

2. How do you trade in order to be profitable?

3. What kind of strategy do you use?

4. What challenges do you face?

5. How do you overcome those challenges?

6. In your strategy, do you use automated robots?

7. What algorithm does it use?

8. What challenges does it face?

9. How do you overcome them?

10. Can you direct/recommend me to someone and/or literature that can be helpful?