

An Intelligent Marketing Expert System for Identifying Prospective Customers in Targeted Advertising so as to Enhance Profitability

Fale Mantim Innocent, Jakawa Jimmy Nerat, Pwul Klingshak, Dagwam Basil Naanman, Sa'ad Sakinat Maigoro

Abstract— Marketing is an integral part of any thriving business. It is no doubt that only successful marketing campaigns yield profit. The major problem faced by these marketing campaigns is the identification of prospective customers. Random advertisement can be very expensive hence, targeted advertising should be adopted in order to reduce advertisement cost which in turn maximizes profit. This research proposes and implements a rule-based inference engine which was built using Python to identify prospective customers for targeted advertising. To achieve this feat, the inference engine analyzes customers' demographics, buying history, and commentaries. The commentary analysis mechanism of the inference engine was built using Python's Natural Language Toolkit. The other programmable components of this system were built in C#.NET using Microsoft Visual Studio 2017. The knowledge base of the system was developed using Microsoft SQL Server 2012.

Index Terms— Expert Systems, Natural Language Processing, Targeted Advertising, Stimulus-Response Consumer Behavior Model

1 INTRODUCTION

THE essence of marketing is to match the right offer with the right prospect [1]. The success of any marketing campaign is largely affected by consumer behavior. Consumer behavior deals with people's decision-making process regarding what they want, need, buy, or even with how they act regarding a product, service, or company [2]. A consumer's buying decision can be highly unpredictable because it is influenced by a mix of psychological, personal, and/or social factors. These factors are mostly internal, that is personal-variable (consumer behavior model), making it difficult to analyze [3]. This research is based on the stimulus-response consumer behavior model. Its concentration is on external factors (stimulus) that are likely to influence a customer's buying decision (response). The major external factor in this case is an ad rightly targeted at a prospective customer. Ads are relatively expensive especially when an organization targets its entire customer-base. Most ads return void because the customers being advertised to are not interested in such products and/or services. Targeted advertising is most appropriate for any online advertisement platform. With targeted advertising, ads are placed based on customers' demographic analysis, buying history analysis, and/or other behavioral analysis [4]. This means that not all customers are targeted and the overall cost

of advertising is thus reduced [5] [6] [7].

This research proposes a rule-based inference engine [8] that is capable of identifying prospective customers [9] through the analysis of their demographics, buying history, and commentaries. The commentary analysis mechanism of the inference engine, as proposed, will be modelled using Python's Natural Language Processing (NLP) Toolkit.

Section 2 of this paper discusses 'LITERATURE REVIEW' while section 3 presents 'SYSTEM ARCHITECTURE'. Section 4 is 'CASE STUDY'. Section 5 explains 'IMPLEMENTATION' while section 6 presents 'DISCUSSION OF RESULTS'. Section 7 presents 'CONCLUSION' while Section 8 outlines 'REFERENCES'.

2 LITERATURE REVIEW

The key to customer prospecting is to create a marketing strategy [10]. The prospects to which marketing campaigns are to be targeted at can be grouped into: existing customers; and potential customers [9]. For potential customers, the social media and other online platforms will serve as good source for mining information such as customer demographics. One common method of customer prospecting is customer profiling. This requires that the customer population is grouped based on certain demographic characteristics such as gender and age bracket [11]. These groups, called clusters, are further analyzed using either of partitioning or hierarchical clustering techniques to get prospective customers for targeted advertising. One other method of customer prospecting is through the analysis of customer buying history [12]. This statistical method is for determining consumer buying behavior. Such statistical analysis is based on the assumption that if a customer has a satisfactory behavior towards a product/service or perhaps

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patronized a product/service once, then such a customer is likely to buy again.

'An Intelligent Marketing Expert System for Identifying Prospective Customers for Targeted Advertising so as to Enhance Profitability' varies from a lot of expert systems in its genre including the ones that are based on techniques mentioned in this literature because it doesn't only analyze customers' demographics and buying history. It adopts AI's Natural Language Processing [13] [14] technique for the analysis of customer commentaries in order to identify prospective customers to whom ads are to be targeted. The commentary analysis mechanism is based on a proposed novel method which shall be discussed in section 5.

external entities interacting with codes.

3 SYSTEM ARCHITECTURE

A hybrid architecture (Layered and N-Tier architectures) is ideal for the development of the system. The layered architecture was used in the developmental stage to separate concerns [15]. These concerns are codes organized in separate files. The layered architecture (see Fig. 1) enhances clarity and organization of codes – no spaghetti codes. The layered architecture organizes dependencies in a top-down approach. The cross-cutting layer handles security, operational management, and communication within the system. Users and Data Sources are

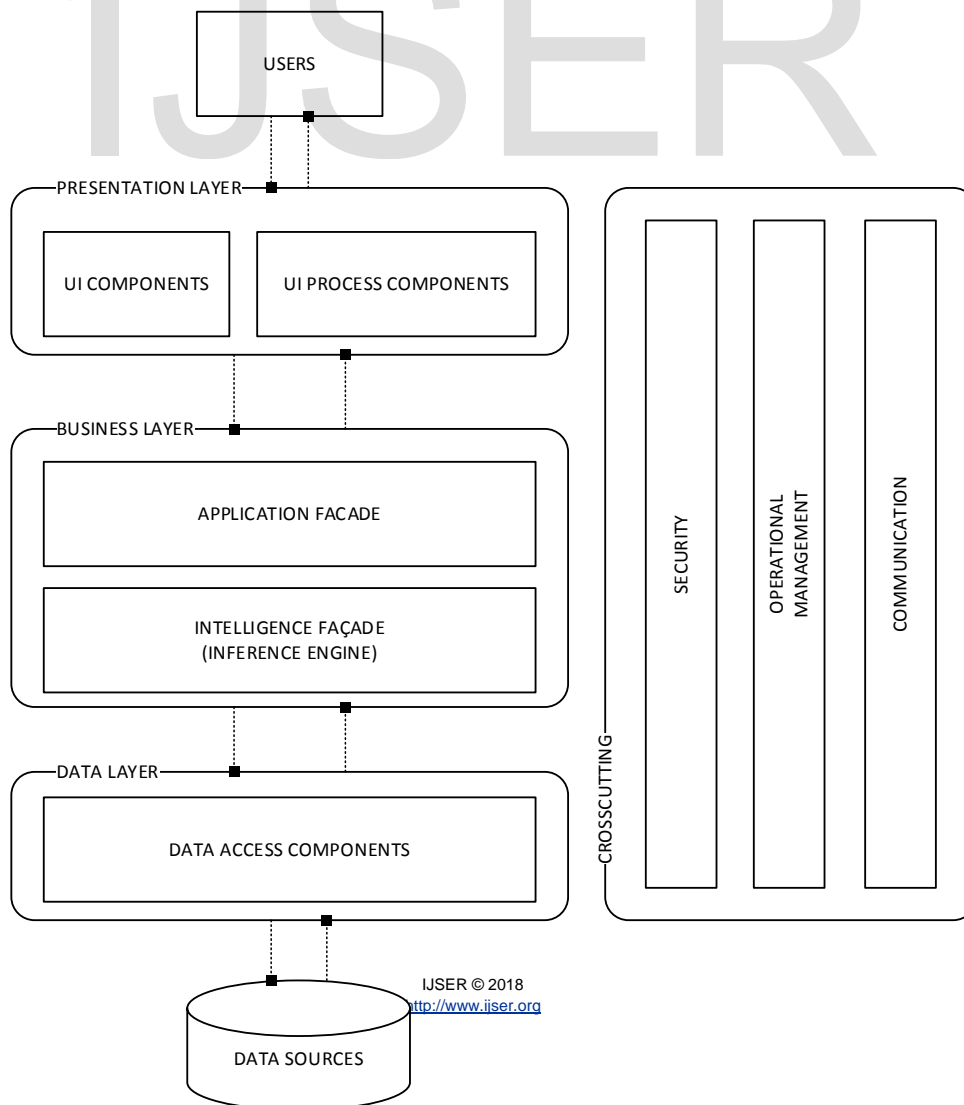


Fig. 1: Layered Architecture

The functional process logic, data access, data storage, and user interface are developed and maintained on 3 different physical servers as independent modules. These 3 different servers/tiers are both platform and performance isolated (see Fig. 2). This is so that the client, application, and data tiers will provide optimum performance. Each tier is supposed to portray a physical server but the client tier is a virtual one. It is there to show how handhelds, PCs, desktops, and so on make use of web browsers to access the system (application tier and data tier). The application tier consists of ActiveX Data Object (ADO).NET and the inference engine. ADO.NET is responsible for sending and retrieving information to and from the data tier as a client request necessitates. The inference engine consists of three mechanisms to handle Customer Profiling, Customer

Buy- ing His- tory Analysis, and Commentary Analysis. The Data Tier houses the knowledge-base and database of the system. The knowledge base consists of the rule-base which stores the rules guiding the operations of the inference engine. These rules are looked-up and executed by the inference engine via a technique called forward chaining. The database serves as a repository of products, records of stock, demographics of customers, financial transactions, and commentaries posted by customers especially with regards to products. The database also maintains a list of registered users, their roles, and permissions as regarding modules of the application to which access rights are granted to such users.

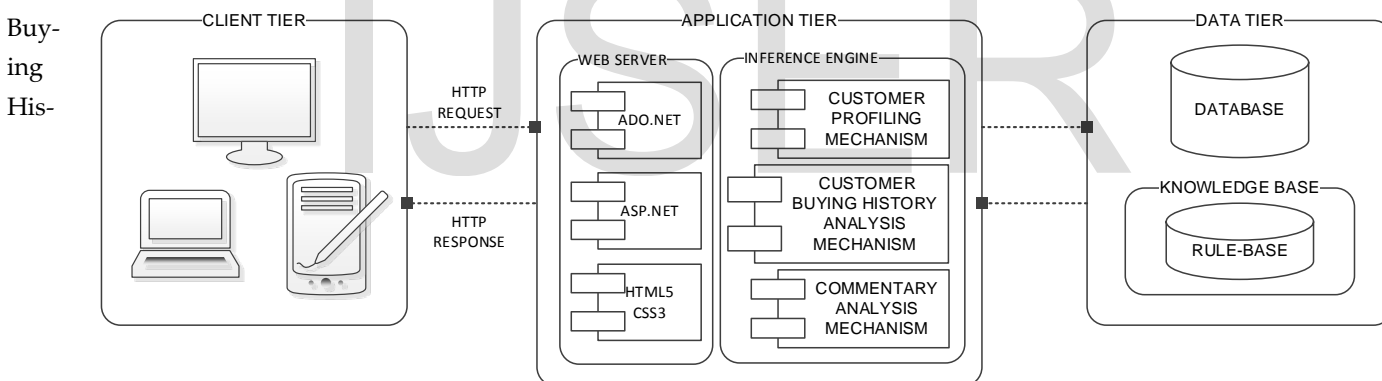


Fig. 2: 3-Tier Architecture

4 CASE STUDY

For better experimentation and interaction with the system, a case study was carefully chosen. M. A. Onigbinde Stores are located in all major cities in Nigeria. They deal in varieties of consumables including food items, toiletries, household essentials, personal care products, fruits & vegetables, bed & bath, luggage, clothing, beverages, liquor & cigarettes, and lots more. Their services include retail and wholesale. Their Plateau State branch is located on #26, Ahmadu Bello Way, Jos

East, Jos, Plateau State, Nigeria. It is the biggest single supermarket in Plateau State, Nigeria. And it is located on the busiest street in Plateau State, Nigeria. They attract an estimated unregistered 2,000 customers weekly. They do not have a website where they advertise their products nor perform online transactions. They incur a lot of cost in advertisement campaigns, usually on local television and radio. They strategically place billboards in order to create awareness to prospective customers. They periodically organize trade fairs causing them to subsidize prices of commodities in order to attract more customers. Some of these campaigns are successful while

most of them are not. They run on an estimated advertisement budget of ₦5,000,000.00 a year (for Plateau State alone). These scenarios and several other ones make M. A. Onigbinde a suitable case study for this research.

5 IMPLEMENTATION

The inference engine identifies prospective customers using three disjointed mechanisms: Customer Profiling; Buying History Analysis; and Commentary Analysis mechanisms. They all address different prospecting needs and their implementation details are shown in the following subsections.

5.1 Customer Profiling Mechanism

For every new ad, the customer profiling mechanism categorizes customers into clusters based on some shared customer demographic characteristics. Such characteristics include gender and age range. Targeted ads are then placed on customers' wall and also sent to their email accounts based on the cluster in which they belong. These feature also help marketers make decisions on the products that should be made available and by how much. For example, when there are more males that patronize a business than females, it will only be wise to deal more in products that appeal to the male gender. The same thing applies to the age cluster and perhaps, other clusters. Fig. 3 is a flowchart showing the workability of the customer profiling mechanism.

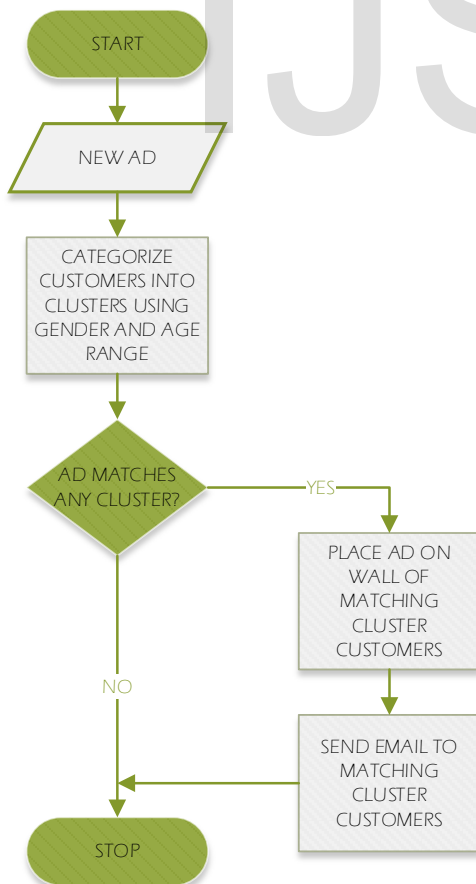


Fig. 3: Customer Profiling Mechanism

5.2 Buying Behaviour Analysis Mechanism

This mechanism uses a threshold value (between 0 and 1) which is given by the following equations:

$$T(c) = \sum_{n=1}^{\infty} b(c); \quad \cdot \quad \cdot \quad (1)$$

$$T(c, p) = \sum_{n=1}^{\infty} b(c, p); \quad \cdot \quad \cdot \quad (2)$$

$$T_v = \frac{T(c, p)}{T(c)}; \quad \cdot \quad \cdot \quad \cdot \quad (3)$$

Equation 1 represents the total purchases ever made by a customer. It is a summation of all $b(c)$ where $b(c)$ is the buying history of such a customer. Equation 2 represents the total purchases of the product (whose ad is to be placed) made by a customer. It is a summation of all $b(c, p)$ where $b(c, p)$ is the buying history of such a customer in relation to that product. T_v is calculated using Equation 3. A benchmark value of 0.05 is therefore taken because percentage error of less than or equal to 0.05 is ignorable unless when otherwise stated. If the threshold value is less than or equal to the benchmark value, then the customer is most likely to be uninterested in the product otherwise, an ad is placed on the customer's wall and also sent to the customer's email account (see Table 1).

Table 1: Buying History Analysis Algorithm

Algorithm: BuyingHistoryAnalysis(CustomerID)

INPUT: vector X of overall purchases made by customer; and product p to be advertised

OUTPUT: An ad placed on customer's wall and also sent to customer's email account

<*Computer $T(c), T(c, p)$ *>

$T(c) := 0$

$T(c, p) := 0$

Benchmark = 0.05

for each x in X

$T(c) := T(c) + 1$

if x = p then

$T(c, p) := T(c, p) + 1$

fi;

rof;

$T_v = T(c, p) / T(c)$

if $T_v > \text{Benchmark}$ then

return p;

fi;

```
return null;
end;
```

5.3 Commentary Analysis Mechanism

The goal is to identify nouns from commentaries such that they are marked as candidate products to be advertised. This mechanism uses Natural Language Processing (NLP) techniques to analyze commentaries posted by customers. The basic assumption here is that all customers are knowledgeable in English. For every potential advertisement, the CA mechanism looks up commentaries posted by a customer. It does a lexical analysis and divides these commentaries into paragraphs, sentences, and words. The next step is syntactic analysis. It parses sentences using context free grammar (CFG) in accordance to the English grammar. If the text being examined was deemed correct by the syntactic analyzer, it passes it to the semantic analyzer. In the semantic analysis stage, it analyzes the meaning of texts and discards the ones that make no sense. The implementation and usage of Disclosure Integration and Pragmatic Analysis steps of NLP are deemed as unnecessary since the goal is just to identify nouns within a given text. The nouns identified are matched against the product name to be advertised. If a match is found, an ad is placed on such a customer's wall and also sent to the customer's email account. Fig. 4 is a flowchart showing the workability of the CA mechanism.

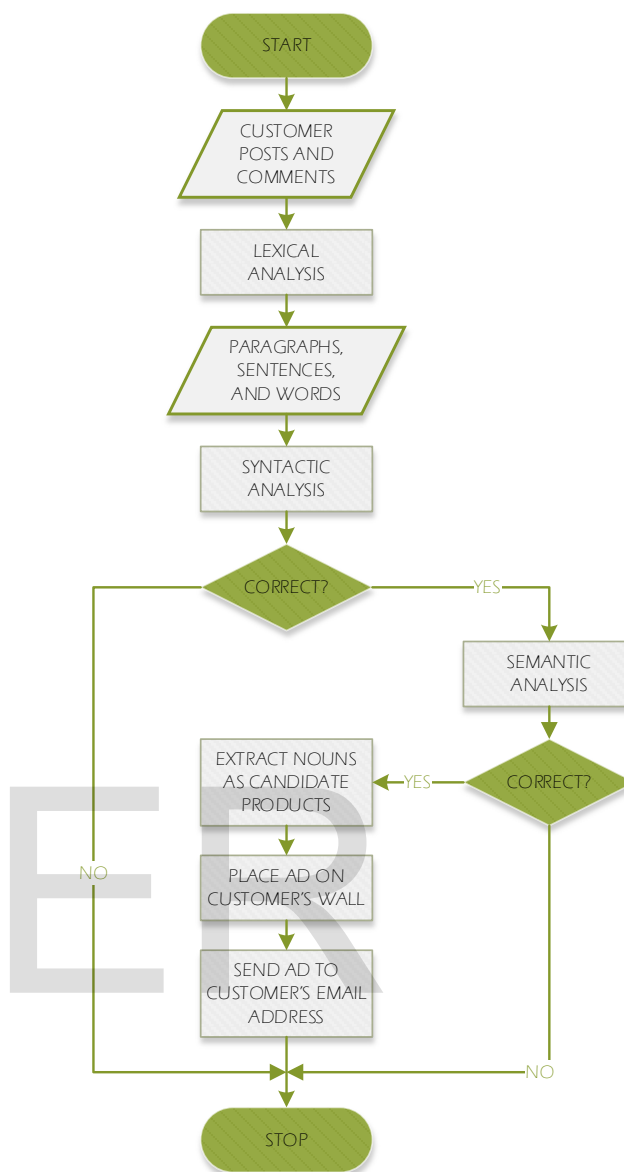


Fig. 4: Commentary Analysis Mechanism

The application has modules for products setup and stock management. Modules also exist for customer/user account creation and ad display. Fig. 5, Fig. 6, Fig. 7, Fig. 8, Fig. 9, and Fig. 10 in Appendix I are screenshots showing the product setup, stock management, user account, post, comment, and ad display modules respectively.

6 DISCUSSION OF RESULTS

6.1 Experimental Setup

For proper evaluation of the system, a beta-test was performed by both management and regular cadre employees of M. A. Onigbinde Stores, Jos, Plateau State. Questionnaires were administered to both management and regular cadre to evaluate their experience of the system. Each question in the questionnaire has options based on Rensis Likert's scale (Strongly Disagree=1; Disagree=2; Neutral=3; Agree=4;

Strongly Agree=5).

6.2 Experimental Results

The findings of this system's evaluation (as described in *Table 2*) is a comparison of means – with its dependent and independent variables coded (CP=Customer Profiling; CBH=Customer Buying History; CA=Commentary Analysis; MC=Management Cadre; RC=Regular Cadre).

TABLE 2: RESULTS OF THE SYSTEM EVALUATION

GROUP	CP	CBH	CA
MC	5.00	4.00	4.50
RC	5.00	4.20	4.00
AVERAGE OF MEANS	5.00	4.10	4.25

The result of this analysis shows how the management and regular cadre rate the system. The average rating shows that the customer profiling mechanism's accuracy of the system is rated 100.0% while the customers buying history mechanism is rated at 80.20% accuracy. The commentary analysis mechanism scored 80.50% rating.

7 CONCLUSION

The Customer Profiling, Buying History, and Commentary Analysis mechanisms were successfully implemented and experimental results of their ratings were favorable. However, further research is recommended. A modification of the inference engine will be necessary for three reasons. Firstly, the inference engine, as implemented, is rule-based. A hybrid, that is, a combination of rule-base and case-base will ensure robustness of the system. Secondly, the inference engine, as implemented is based on the stimulus-response consumer behavior model. Customer demographics, buying history, and commentaries were key for customer prospecting. A key assumption in this research is that the external environment (such as ads) influences a customer's buying decision but in reality, internal factors or personal-variables have greater influence on a customer's buying decision, hence an inference engine that successfully implements the complex model of consumer behavior will outperform this system. Lastly, the commentary analysis mechanism was built on the assumption that all customers have vivid understanding of the English Language. A multi-lingual commentary analysis mechanism will ensure that non-English speaking customers' needs are equally attended to.

REFERENCES

[1] Farm Market ID, "Agricultural Intelligence Solutions You Can Trust,"

[Online]. Available: <https://www.farmmarketid.com>. [Accessed 11 December 2017].

[2] Study.com, "What Is Consumer Behavior in Marketing? - Factors, Model & Definition," [Online]. Available: <https://study.com/academy/lesson/what-is-consumer-behavior-in-marketing-factors-model-definition.html>. [Accessed 11 December 2017].

[3] T. K. Jisana, "Consumer Behaviour Models: An Overview," *Sai Om Journal of Commerce & Management*, vol. 1, no. 5, pp. 34-43, May 2014.

[4] M. Lisa, "Examples of Targeted Advertising," *Chron*, [Online]. Available: <http://smallbusiness.chron.com/examples-targeted-advertising-10869.html>. [Accessed 18 December 2017].

[5] D. Sara and L. Friedrich, "Selective marketing for environmentally sustainable," 2008. [Online]. Available: <http://ro.uow.edu.au/cgi/viewcontent.cgi?article=1477&context=commpapers>. [Accessed 17 December 2017].

[6] Arab British Academy for Higher Education, "Target Market Strategies," [Online]. Available: <http://www.abahe.co.uk/b/International-Trade/International-Segmentation/Target-Market-Strategies.pdf>. [Accessed 17 December 2017].

[7] A. Khaled, "The Four Factors for Targeting an Attractive Market," *International Journal of Humanities and Social Science*, vol. 4, no. 9, pp. 71-76, July 2014.

[8] N. L. Griffin and F. D. Lewis, "A Rule-Based Inference Engine which is Optimal and VLSI Implementable," in *IEEE International Workshop on Tools for Artificial Intelligence*, Fairfax, VA, USA, 1989.

[9] B. C. Paul, G. Edna, G. Dimitrios and K. Pasumarti, "Identifying Prospective Customers," [Online]. Available: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.200.6408&rep=rep1&type=pdf>. [Accessed 17 December 2017].

[1] Info Entrepreneurs, "Create Your Marketing Strategy," Chamber of Commerce of Metropolitan Montreal, [Online]. Available: <http://www.infoentrepreneurs.org/en/guides/create-your-marketing-strategy/>. [Accessed 18 December 2017].

[1] EXPERIENCEUX, "What is Customer Profiling?," EXPERIENCEUX, [Online]. Available: <http://www.experienceux.co.uk/faqs/what-is-customer-profiling/>. [Accessed 18 December 2017].

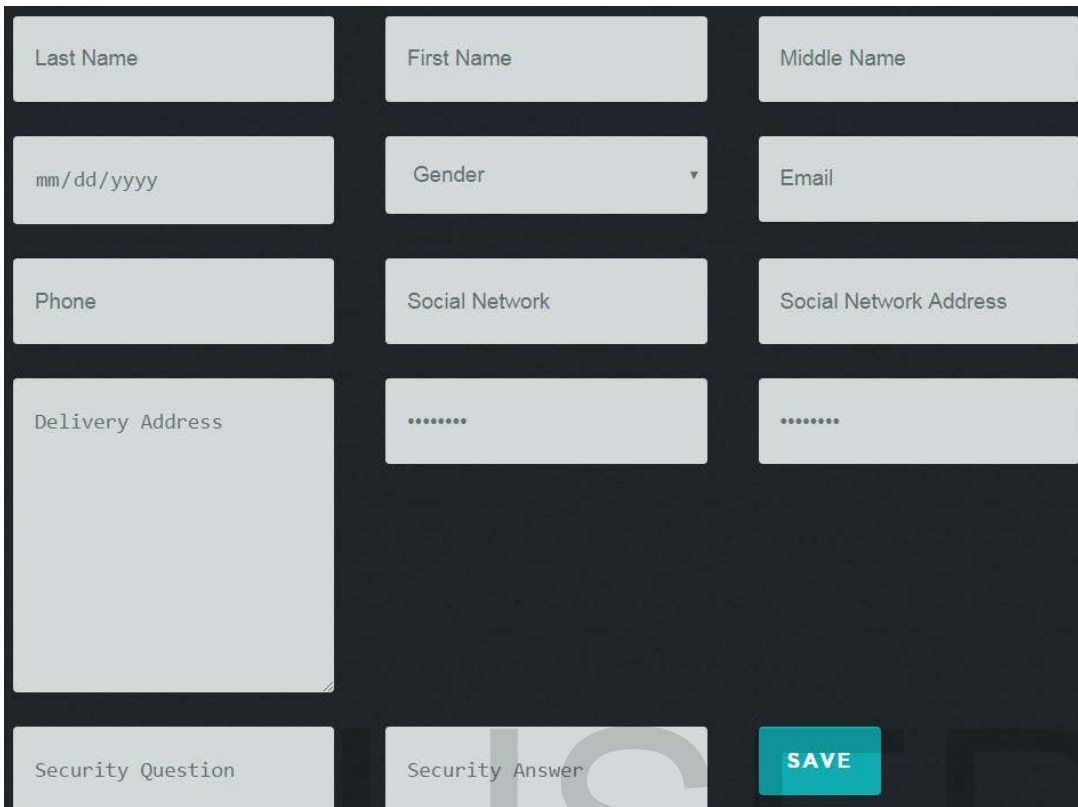
[1] L. L. Gerald, B. Steven and J. J. Eric, "Consumer buying behavior on the Internet: Findings from panel data," *Journal of Interactive Marketing*, vol. 14, no. 1, pp. 15-29, 2000.

[1] B. Steven, K. Ewam and L. Edward, *Natural Language Processing with Python*, J. Steele, Ed., Oreilly, 2009.

[1] C. Abhimanyu, P. Abhinav and S. Chandrev, "Natural Language Processing," *International Journal of Technology Enhancements and Emerging Engineering Research*, vol. 1, no. 4, pp. 131-134, 2013.

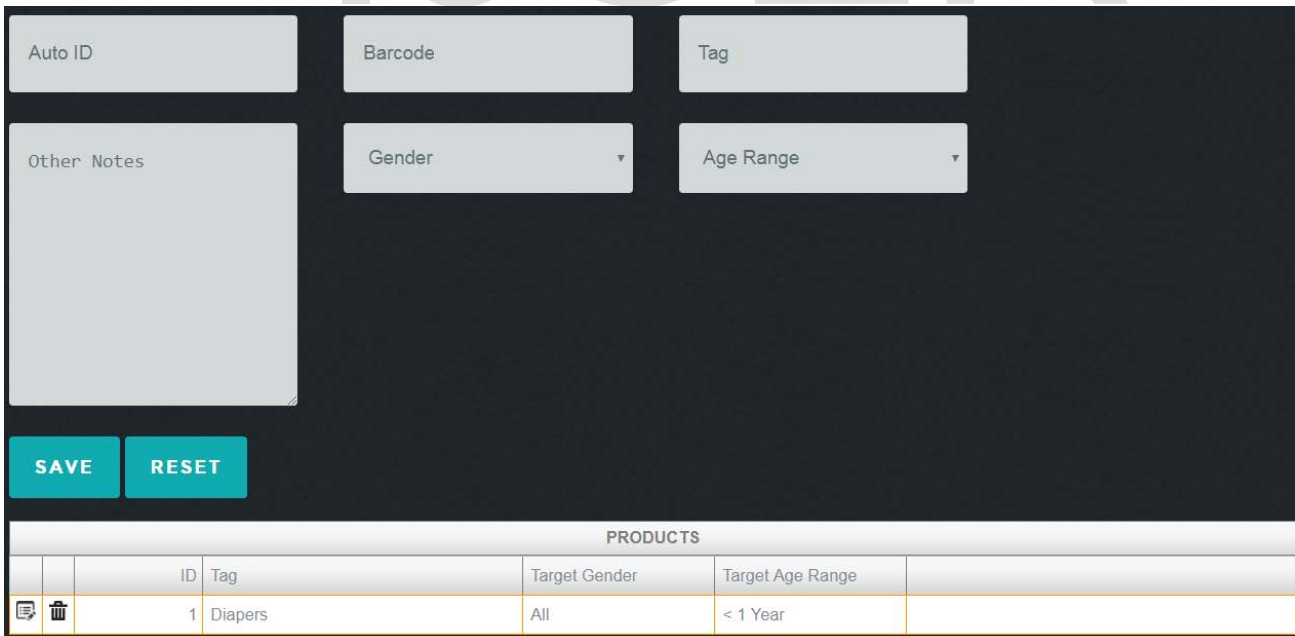
[1] D. Alan, H. W. Barbara and M. R. Roberta, *System Analysis & Design*, 5th ed., John Wiley & Sons, Inc., 2012.

APPENDIX



A registration form with the following fields: Last Name, First Name, Middle Name, mm/dd/yyyy (date), Gender (dropdown), Email, Phone, Social Network, Social Network Address, Delivery Address (text area), Security Question, Security Answer, and a SAVE button.

Fig. 5: User Account



Product Setup form with fields: Auto ID, Barcode, Tag, Other Notes (text area), Gender (dropdown), Age Range (dropdown), SAVE, and RESET buttons.



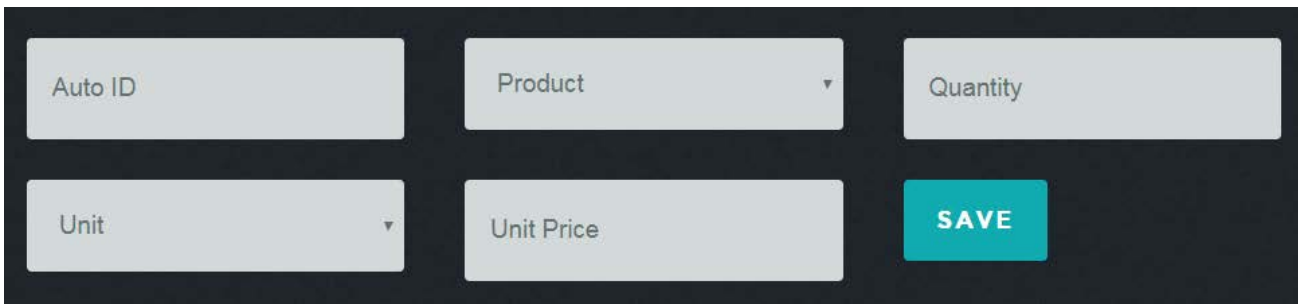
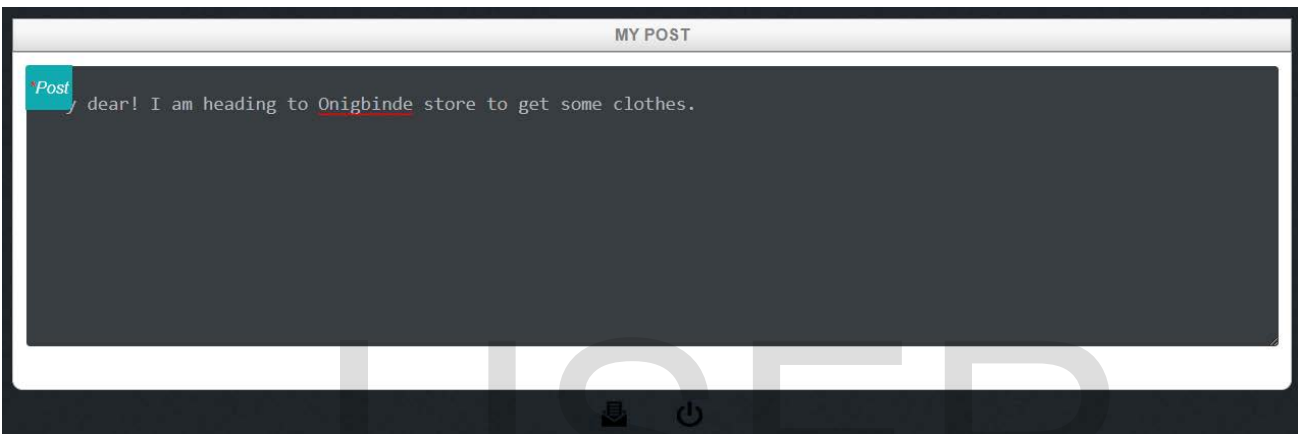
PRODUCTS					
	ID	Tag	Target Gender	Target Age Range	
 	1	Diapers	All	< 1 Year	

Fig. 6: Product Setup



A screenshot of a stock management form. It features a dark background with light gray input fields. The fields are arranged in two rows. The top row contains 'Auto ID', 'Product' (with a dropdown arrow), and 'Quantity'. The bottom row contains 'Unit' (with a dropdown arrow), 'Unit Price', and a teal 'SAVE' button.

Fig. 7: Stock Management



A screenshot of a post creation form. The title bar reads 'MY POST'. The main text area contains the text: 'y dear! I am heading to Onigbinde store to get some clothes.' A teal 'Post' button is visible on the left side of the text area. At the bottom, there are icons for a download and a refresh.

Fig. 8: Post

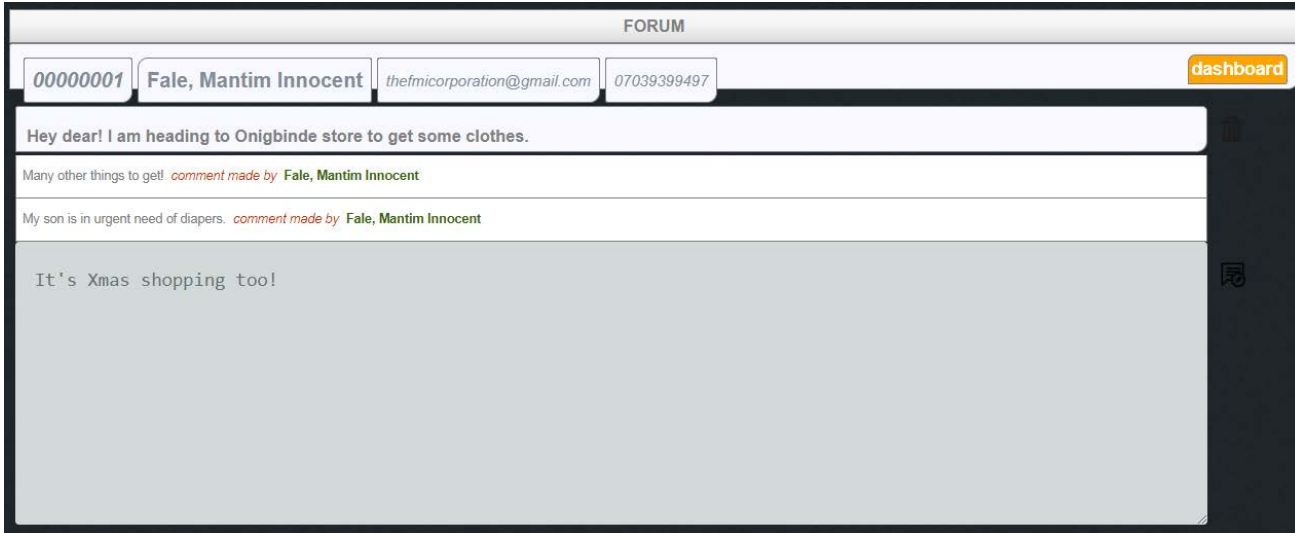


Fig. 9: Comment

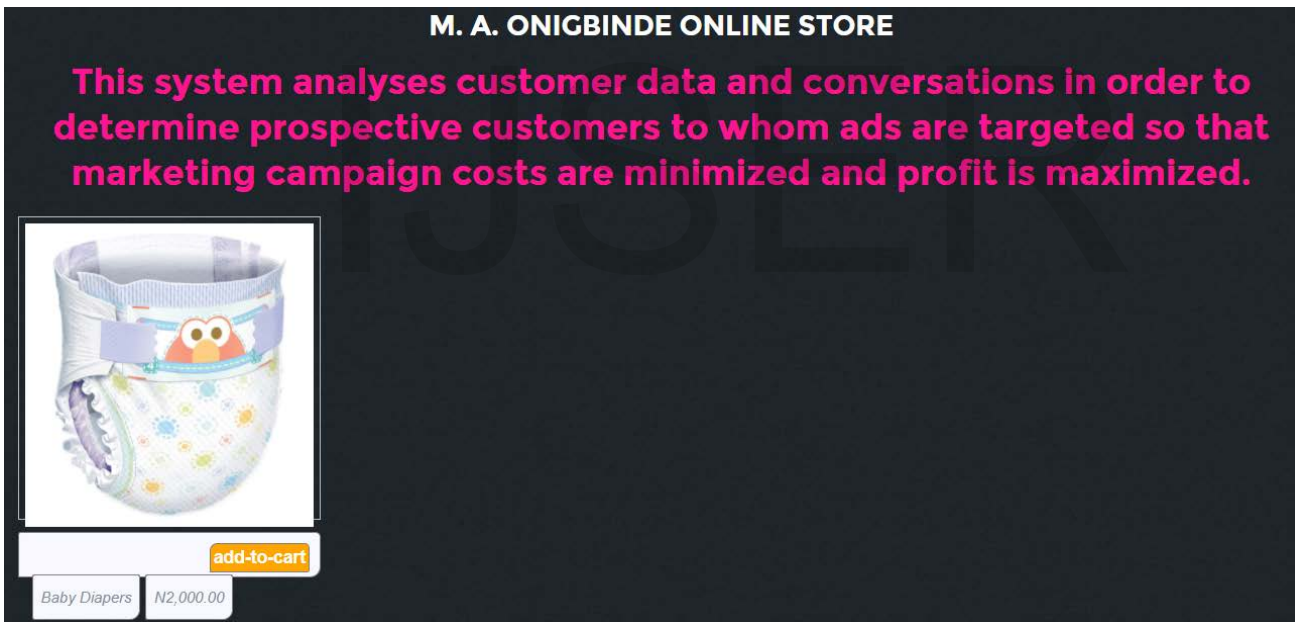


Fig. 10: Ad Display