**ARTIFICIAL INTELIGENCE BASED BUSINESS STRATEGY FOR OPTIMIZED ADVERTISING**

Project Id: 2021-152

**A picture containing text, clipart, vector graphics

Description automatically generated**

Final Report Thesis

B.Sc. (Hons) Degree in Information Technology

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Sri Lanka Institute of Information Technology

Sri Lanka

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I certify that I have read this thesis and that it is entirely acceptable, in content and quality, as a Bachelor of Science thesis.

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Approved for Research Project:

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# DECLARATION OF ORIGINALITY

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# ABSTRACT

The impact of unrelated advertisement have been a great socialized problem nowadays. Platforms like social media , video streaming platforms and e-commerce platforms have overcome this situation with the use of user based advertisement delivery. Those platforms have taken the use of factors like demographics , user profile , history and comment reactions to predict the advertisement to the user. Similar these platforms , television advertising also caters for a huge audience. When comes to the Sri Lankan context , although people are aware of the technology majority of them get to know about products and services over the television. But televisions commercials are always content based and does not consider the users aspect when delivering the advertisement. Previous studies also shows that a majority of the Sri Lankan population which represent all ages from 5 to 95 watches television. Through out this study an analysis was conducted to evaluate how effective user preferred and related television advertising will be . To take advantage the disadvantages of the current advertising mechanism of television , a concept prototype for user preferred television advertising was implemented .The system comprises of machine learning and deep learning models built to make the predictions out of the data gathered. It also facilitates an Ethereum based blockchain encryption which makes the users privacy more secured.

**Keywords**: Smart Advertising, , User preferred, recommendation , Blockchain

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I'd like to express my gratitude to our course coordinator, Mr. Jagath Wickramarathne, for his invaluable assistance in providing course materials and for sharing his vast knowledge of the module. Finally, I'd want to express my gratitude to my parents and group members for guiding me and supporting me in solving problems I faced when developing the system, as well as my SLIIT colleagues who supported me often when working on the assignments and other aspects of the project. Of course, my deepest appreciation goes out to everyone who helped in any way to the success of this study, even if their names aren't included above.

# DEDICATION

I would want to dedicate this research to my University, Parents, and friends, who have been an everlasting source of inspiration to me. They have given us courage, spirit, and direction.

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# INTRODUCTION

## **Background**

An advertisement or advertising is the promotional act of selling a product, service, or brand. It builds an attraction in the target audience [1]. Nowadays advertisements are socialized in a variety of ways, such as Display Advertising, Video Advertising, Mobile Advertising, and Native advertising. In any form, the main goal of advertising is to reach the audience most likely to be willing to pay for the products or services and convince them to buy. Advertising is the most effective means of reaching out to the audience. Audiences are more informed about the brands available in the market and the range of items available to them through advertising. Compared to society even kids, teenagers, and adults are exposed to advertisements [1].

Currently, advertising is used far and wide such as in newspapers, television, social media, and other ecommerce platforms. Although rapid development has happened in digital media like YouTube and other social media, television advertising still follows a traditional method which is based on the location and schedule of the tv programs, but most of the other digital media used a user centered targeted mechanism. In this research, the intention is that Television advertising should also shift from traditional to user-centric contextual advertising. In this research, the main goal is to propose a system that recommends TV advertising by evaluating demographics, facial features, and emotions. The survey we collected clearly states that most of the users even prefer watching advertisements if the advertisement really maches their likes and dislikes. Not only likes and dislikes are important for the prediction , emotions and facial feature are also important to choose the most relevent advertisment for the user.

This research project is mainly focused on three major factors demographics , facial features and emotions to deliver the final product which is the advertisement recommendation system. The main requirement is that anyone who uses our system must have a Smart TV and a camera .With the help of the camera and the AFFEDEC software consisting the training model which is used in gathering emotions, facial features, and demographics (age and gender) are processed in the front end. As user privacy is a major concern nowadays, those snaps will never be saved or stored in this system. The main purpose of using the AFFEDEX software is that to gather relevant data (emotions, facial features, and demographics) in real-time in a way that does not harm the users privacy. Much research has validated AFFEDEC and its ability to classify facial features and emotions.[2][3] At that point, no need to save captured snapshots in the encrypted database and just save & store the features as JSON files in the blockchain encrypted database.

* + 1. Literature survey

Several research articles and implementations have been done in the world today to identify demographics , emotional and facial features of users for recommendation. Despite the fact that there have been several studies in this area, no such study or analysis has been performed to determine how influential demographics, facial features, and emotions are in classifying user favorite advertising. This report includes some of the studies done in this particular domain. Xiaohua Huang have proposed a method to recognize arbitrary-view facial expressions by using discriminative neighborhood preserving embedding and multi-view concepts. Initially, it captures the discriminative property and afterward, it investigates the proximity of intra-class samples in a low-dimensional subspace from any viewpoint. this method produces promising results for recognizing face emotions with arbitrary perspectives, according to experimental findings on the BU-3DFE and Multi-PIE databases [4].

This conducted research describes a computerized technique for presenting interactive advertisements based on one embodiment of the invention [5]. The research has shown how to enable interactive ads to be loaded on mobile devices and how to interact with such interactive adverts on their mobile devices while offline [6]. An interactive advertising board is another invention based on environmental factors [7].

An improved content activator incorporated in interactive advertising has been described by Huber, Lemmons, Zenoni, and Hensgen [8]. In [9], the influence of mobile advertising content on purchase intention was shown using a framework developed from previous models and theories of technology adoption. Park and Choi [10] developed a method for broadcasting interactive advertising with extensive information that uses secondary information tags. In the meanwhile, style is available in an off-line mode.

The study "Effect of Age and Gender on Consumer Response to Advertising Appeals"[11] was performed by Pragya Keshari and Sangeeth Jain. Although several studies have been done to assess the efficacy of advertising based on a variety of variables such as presenting style, endorser attractiveness, creative appeal, and so on, The influence of demographic variables on customer reaction to advertising appeals was investigated by these two researchers. Their goal was to look at how customers responded to rational and emotional advertising appeals based on age and gender. A total of 348 customers from the cities of Indore and Ujjain were studied.

A study titled "Ads-In Site: Location-based Advertising Framework with Social Network Analyzer"[12] was done by Sri Lanka Institute of Information Technology researchers. This study proposes an application that allows users to choose their favorite advertising based on their social profiles. They created a system that takes into account the user's demographics while presenting appropriate advertising for the user by tracking the position of stores within a 5-kilometer radius of the user's house. The social profiles are used to categorize advertisements based on the user's preferences and dislikes. They've come to the conclusion that their technology is capable of delivering the most amount.

Yanghui Raoa, Qing Li, Liu Wenyin, Qingyuan Wu, and Xiaojun Quan have conducted a research “Affective topic model for social emotion detection”[13]. The purpose of this research is to examine how social media can be used to detect emotions in readers. When applied to social media, analysis from the reader's perspective can be more useful than traditional sentiment analysis conducted from the writer's perspective. They propose an emotional topic model that introduces an intermediate layer to bridge the gap between social media materials and a reader's emotions. The suggested methodology may be used to categorize unlabeled documents' social emotions and create a social emotion lexicon. Extensive tests utilizing real-world data have proven that the proposed approach is effective in each of these applications.

Nomura, Tomomi, and Yasue Mitsukura have conducted a research “Detection of Latent Emotion Using TV Commercial Evaluation”[14].In this study, By analyzing Japanese TV advertising, they were able to discover hidden emotions. They detect emotions on both, Tv advertisements and people who watched that advertisement but not in real-time. As a result, they use an electroencephalogram (EEG) and a questionnaire to examine consumers' underlying emotions while watching TV commercials that they later remembered favorably. In Japan, they work on both award-winning and non-award-winning television ads. They also looked at the effects of positive TV advertising on consumers' recollections across time: immediately after seeing and a month later and get the result of the questionnaires, In the long term, both award-winning and non-award-winning TV ads had nearly identical memory retention rates.

The research provides fundamental knowledge and descriptions of machine learning and recommendation systems. The subject of machine learning algorithms, which are used in such programs, was more widely discussed. The paper focused mainly focuses on filtering algorithms based on users' or objects' demographics, and based on content. The overview of these algorithms includes similarities, drawbacks, and advantages, algorithm evaluation steps, and the sample value estimation of the prediction of the evaluation. The architecture part of the work starts with the definition from the MovieLens portal of the databases used. The technologies and realistic application of the above-described algorithms are then discussed afterward. The next section includes an overview of the findings and assumptions based on the computer-based simulations to determine how the algorithms operate. After the work, there is a review, an assessment of the success of the suggestion systems and lessons learned from the research, as well as a plan for more work on the problem of those systems.

"Anders Martoja" published a paper titled "Blockchain in Distributed Systems as a Privacy Enabler," with the goal of preventing audit data. The technology he utilized to create this system was blockchain. The simplest word for the blockchain, according to the author, is a list of records that expands as new information is added. New data is entered in the form of records or blocks. A pointer to the preceding block is included in each block. A record also includes a date for when the action block was inserted, as well as the actual data that should be retained in the block.To keep the blocks safe, they are encrypted. In a blockchain, changing a record necessitates changing every block that follows it. A majority of the systems having the same blockchain must be tampered with for the network to accept the changed blockchain. As a result, blockchain technology is impervious to change[15].

## **Research Gap**

With the technological enhancement advertising which plays a major role has been developed within the major platforms where advertisement are been displayed . Although social media, video streaming platforms and other web platforms uses this modern mechanisms , television advertising is still out of date. This novel system “Intelligent Advertiser” is prototype concept which gaps in between the modern technologies developed in other platforms to the television advertising domain. Stated bellow are the novel functions which are implement in this system;

* User detection
* Predict advertisements based on demography
* Evaluating how effective demographics are for television advertising
* Predict advertisements based on emotions
* Evaluating how effective emotional features are for television advertising
* Blockchain encryption with Ethereum.
* Predict advertisements based on all four features

Although it was a challenging task this Intelligent Advertiser is build including all the features mentioned above and also it caters for Sri Lankan context. Comparison between the novelty of the research and existing projects are shown below in the table 1.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Research** | **Gender and Age Related Effects While Watching YouTube Advertisements** | **Ads-In Site: Location based Advertising Framework with Social Network Analyzer** | **Affective Topic Model for Social Emotion Detection** | **Emotion Classification of Social Media Posts for Estimating People’s Reactions to Communicated Alert Messages during Crises** | **Concept-Based Approach for Research Paper Recommendation** | **Blockchain Voting System** | **AI based business strategy for optimized advertising** |
| **Age and gender prediction** | Yes | No | No | yes | No | No | Yes |
| **Evaluating effectiveness of demography** | No | No | No | No | No | No | Yes |
| **Emotion prediction** | No | No | Yes | Yes | No | No | Yes |
| **Evaluating effectiveness of emotional features** | No | No | No | No | No | No | Yes |
| **Ad recommendation using demographics , emotions and facial features** | No | No | No | No | No | No | Yes |
| **Recommendation using tags** | No | Yes | No | No | yes | No | Yes |
| **Ethereum based blockchain encryption** | No | No | No | No | No | No | Yes |

Table 1. 1. Comparison between this part of the research and existing projects

## **Research Problem**

Marketability and product advertising have developed throughout time as a result of development of technology, but substantial modifications in advertising have been applied in specialized sectors such as social media, e-commerce, and video streaming platforms. Traditional advertising tactics are still in use on television, and they are carried out in a form that does not take into account the user engagement, which has a direct impact on sales conversions. Users' satisfaction with targeted advertising that are broadcast at different times tends to be low due to a lack of understanding between the users' intentions and the characteristics of each advertisement.

Chart, pie chart

Description automatically generated

Fig . 1 Survey results 01

Chart, pie chart

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Fig . 2 Survey results 02

Targeted advertising has become a challenging process to handle due to the lack of technology to examine the target audience's emotions [16] and to protect the privacy of users' data [17]. According to the results of the surveys performed using a Google form, the majority of respondents acknowledged that the commercials currently shown on television are unrelated to them, which is the research problem to be addressed in this study. To solve the difficulties of advertising marketability and user satisfaction ratio, a way of overcoming traditional advertising by applying a user-centric mechanism must be developed.

## **OBJECTIVES**

* + 1. Main objectives

The most common technique of communicating the message of purchasing items to the client is through television advertising. The major goal of this study is to employ Artificial Intelligence aspects to take advantage in developing this system. This novel system allows advertisements to be delivered  to the user on their preferences, considering aspects such as user demographics ,emotions, and facial features. When it comes to advertising, the function of the advertising agency is crucial. The advertisements (ads) with tags and titles allow the system to propose the most appropriate ads for the user by categorizing the ads based on the user's preferences. This provides the company with a lot of opportunities.

* + 1. Specific objectives

In order to reach the main objectives, the specific objectives that need to be attained are as follows;

* **Evaluating demographic features for advertisement recommendation**

Initial objective of the study is to gather data related to demographics which a very important factor for advertisement classification. The data should be preprocessed and trained against the sample advertisements to examine the effectiveness of each factor.

* **Emotional analysis for advertisement recommendation**

Emotions of the user plays a prominent role to predict if the user prefers the advertisement or not. Emotional data is preprocessed and trained against advertisements to evaluate how each emotions and facial features effect users preference.

* **Advertisement Recommendation with tags**

Combining all factors collected from the previous components and by considering the tags used to categorize advertisement , user preferred advertisements are predicted.

* **Blockchain for security**

When working with data and information, security is always a top priority in any system. As this system continuously monitors the user to collect various data the  privacy of the user should be an important concern.    Smart contracts based on the blockchain are used to store processed user data as well as ads provided by the companies. Ethereum  Blockchain is also used to transmit data around the system, ensuring that privacy is maintained.

# METHODOLOGY

## **Methodology**

During the initial step the user will be captured using the camera and the extracted features will be sent to database as a JSON format. The captured data is trained against age , gender ,emotional and facial features in order to predict the most relevant advertisement for the user. A blockchain db is used in between to verify the security of the system and the users privacy. Fig.3 depicts the overall systems diagram which elaborates how all the components are connected to each other and how the advertiser works.

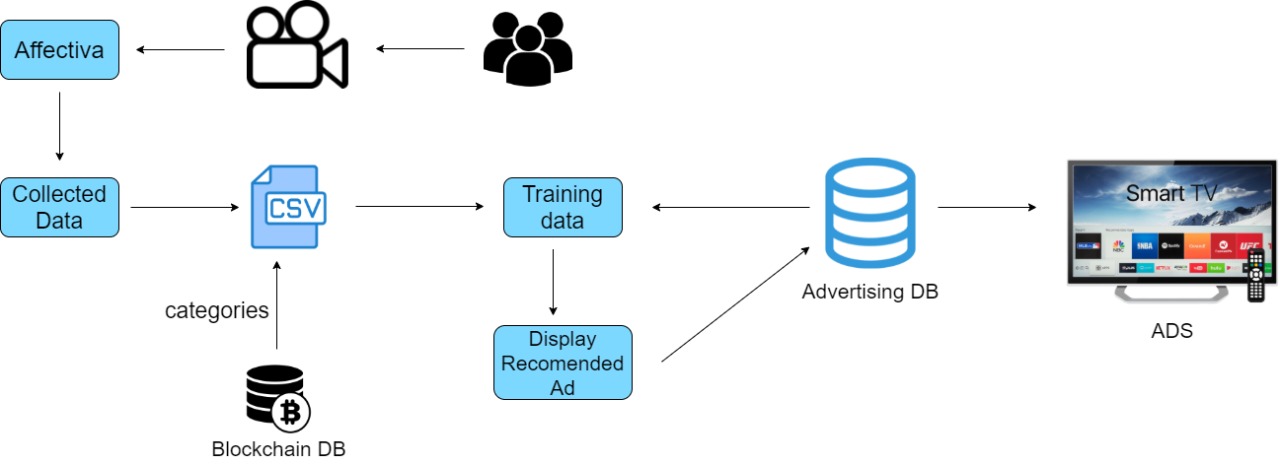


Fig . System Overview Diagram

### 2.1.1 Approach of the study

As the initial step facial images was to be collected since one of the main concerns of this study is target the Sri Lankan context. To fulfill the above requirement , a web application was implemented. It consist of Human detection model which uses the open cv library to capture faces. The link address was shared among colleagues of SLIIT and some relatives in order to collect a balanced data set of all age groups and gender. The age groups were defined as 5 – 19 ,19 – 35 , 35 – 55 and 55 – 75.

The users which clicks on the web URL are provided with instructions step by step which makes them easier to walk through the data collection process. After the user visits the web page the user is notified to give access to the camera of the device they accessing the URL. When the permissions are given the user can see them selves from the screen which will open a window to capture the user. At the text box below the capturing frame the user is directed to enter an id which is preferred in a format which includes the name , gender and the age. Then the user should click on the start button for the model to start capturing facial images. While the capturing process is happening , the user is instructed to pose in different sides facing the face which helps future detection of the system. After the capturing is over the user should click on End & Submit button which will send the captured image to the cloud in the format of an array.

The data collected is filtered and preprocessed to make sure all the data are usable .The next step id the gathering of emotional and facial features. One of the main concerns of this study was that the study was based on recommending advertisements for Sri Lankan context .Since the pandemic was all over the country it was a difficult task to gather data individually so another application for emotion detection was built. As there are so many models to detect emotional and facial features which is validated by many researches in obtaining higher accuracies we used the software name AFFDEX which has a validation accuracy of 97% for emotional and facial feature detection. Another importance of the data set is that it was collected while the users are let to watch a video clip consisting 4 advertisements which is also the sample advertisement used in the analysis. The diagrams below Fig .4 and Fig .5 demonstrates the interfaces of the data collection models.

Graphical user interface, text, application

Description automatically generated

Fig . 4 Age and Gender data collection

Graphical user interface

Description automatically generated

Fig . 5 Emotional & Facial features

The collected data is cleaned a extracted as csv files for the analysis .Initializing the analysis the demographic factors age ,gender 7 emotional factors and 9 facial features are trained against the 4 advertisements. Through out the study two machine learning models Random Forest , Support Vector Machine and a deep learning sequential model is used. As mentioned above, separate machine learning models were implemented with emotional, facial features, and demographic data to recommend advertisements. For each approach, Random Forest and Support vector machine was used as our baseline models. Further, the Deep learning model was implemented for each feature set, afterward compared the accuracies with the baseline models and ensure to keep the architecture of the deep learning model the same to avoid any conflicts and get the maximum accuracy [18][19]. In view of fact that the results obtained by the SVM and RF models are not accurate enough, and implemented a deep learning Sequential model . The deep learning model consists of three fully connected hidden dense layers .The first layer is always dense, but the input size of the first layer is different from each model according to the size of the feature set. And the last layer is always a dense layer with SoftMax activation function, which classifies into four classes. The model was trained in batches of 32 using categorical cross-entropy as the loss function. The Adam optimizer was used with the learning rate η = 0. 0001 and decay rates β1 = 0.9, β2 = 0.999.The maximum epochs were set to 500, but also set early stopping criteria of 50 epochs. So, the training will be stopped if the validation loss did not improve after 50 consecutive epochs, and the best model weights will be retained. The diagram Fig .6 demonstrates the architecture of the deep learning model.

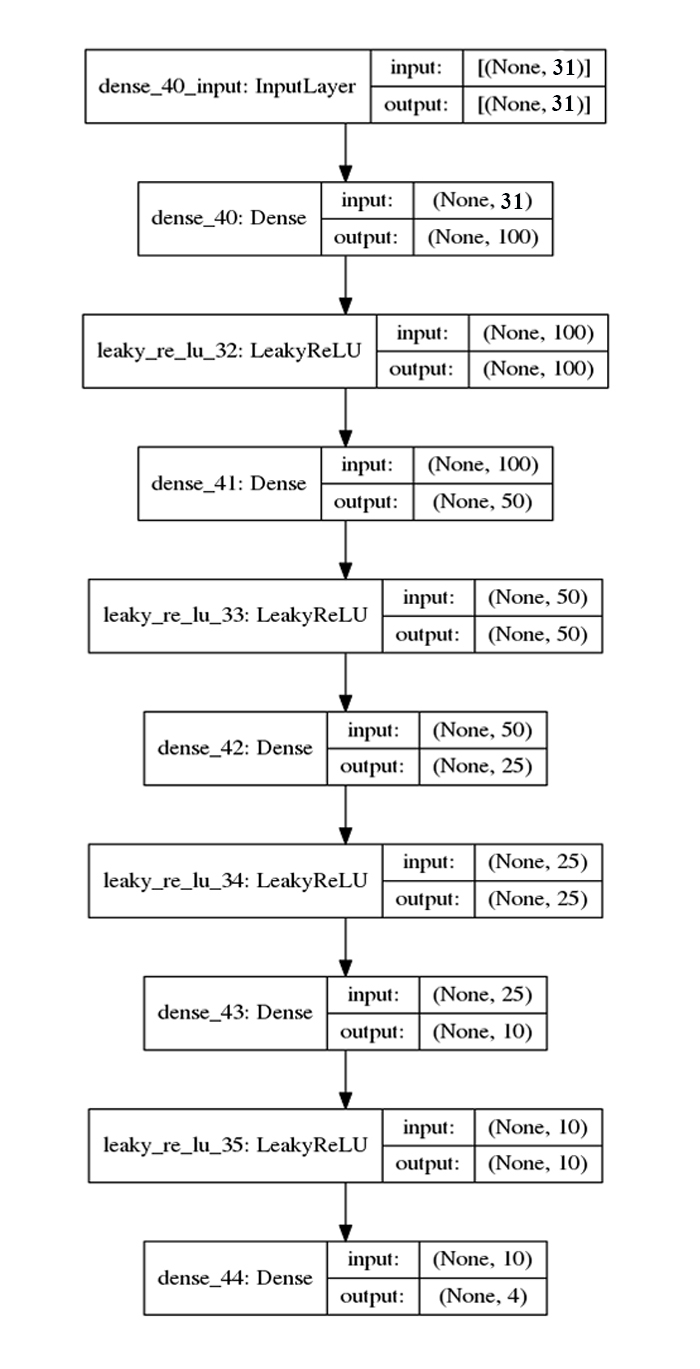


Fig . 6 Deep learning model architecture

After the analysis is conducted separately and accuracy was not satisfactory to predict advertisements , all the 31 factors containing demography , facial and emotional features were experimented. Throughout the process an Ethereum blockchain encrypted mongo db is used communicate and pass the data needed for each component. As this system is distributed to 4 components and is iterative , we have used agile best practices. Agile software development is a set of techniques for creating software that are based on the concept of iterative development. The agile technique is simple to understand. Identifying requirements and producing solutions through the collaborative efforts of self-organizing and cross-functional teams, as well as their end users, are all part of agile methodologies. Small cross-functional self-organizing teams develop smaller chunks of functionality on a regular basis using agile methodologies, allowing for frequent customer input and course correction as needed. This is seen in Fig .7 Within the agile technique, the SCRUM method is utilized to oversee the software development process.

Diagram

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Fig . 7 Agile methedology

### 2.2 Commercialization aspects of the product

The majority of the users in Sri Lanka still uses traditional media so it is considered that television is the best way to commercialize a product. In the television advertising domain , it still consider the traditional ways of advertising which is based on the location and the time of the day. This affects both the consumer and the company. The  current method does not cater the users real need which sometimes allows the user spending time with unwanted and unrelated advertisements.

The end goal of any advertising campaign is to drive sales towards the company or product. The number of impressions , click through rate , likes and dislike are used to evaluate the success of such advertisements on other digital platforms. Although we can evaluate the success rate in other platforms , television has no mechanism for evaluation. Therefore the proposed concept prototype is implemented to make television advertisements more relative and effective for the user and the advertiser.

As the first stage of introducing this concept, we created a fakebook page including all the details of the concept. And also a diagram representing the complete overview of the system is posted. As Facebook is one of the top 10 online market places we could receive some good feedback from people who appreciate the concept. In this stage the system is utilized with real users to for a period of 10 days to validate the prediction. The figures Fig .8 and Fig .9 clearly demonstrates the snaps of the Facebook page.

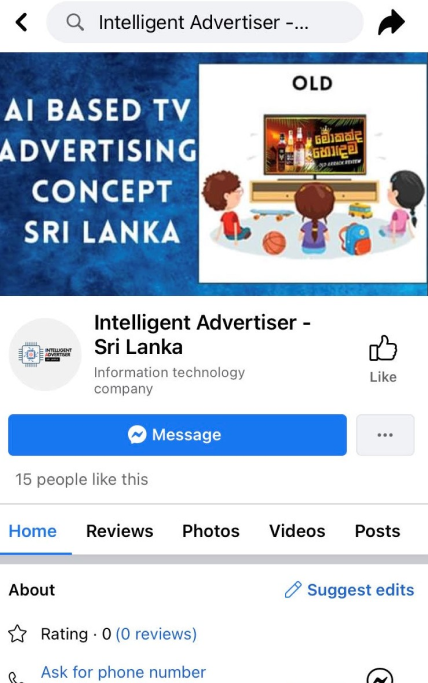


Fig . Facebook Page

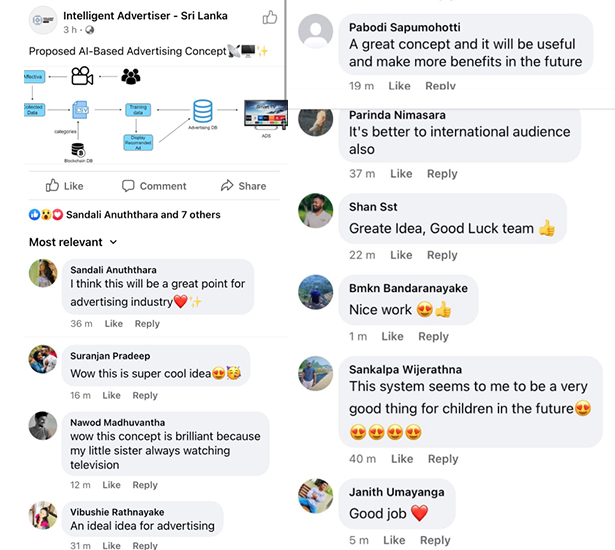


Fig . Comment section

## **Testing the product**

For testing purposes of the product’s ability to recommend the best advertisement , the users were let to watch the same video which was used in the requirement gathering. Importance is that unlike the requirement stage , this video does not consist of the 4 advertisements embedded to the video. After the user is detected and by considering the results obtained from the analysis done through out the research , the most suitable advertisement will be placed as an overlay of the screen the video is streamed. The table 1 shows some of the test cases used to test the results of this concept prototype.

|  |  |  |
| --- | --- | --- |
| **Test Case Number** | **Test Case** | **Expected Result** |
| Age prediction | Locate the user in front of the screen in order to predict the age | Predict the correct age group |
| Gender prediction | Locate the user in front of the screen in order to predict the gender | Predict the correct gender |
| Emotion prediction | Locate the user in front of the screen in order to predict the his/her emotions | Predict accurate emotions |
| Generate feedback | Considering the emotions and facial features a feedback should be generated | Accurate results of the feedback generated |
| Facial expression detection | Analyze the facial feature and do the prediction | Predict the most prominent features |
| Advertisement prediction | Predict the mot suitable advertisement by considering the results obtained from the analysis | Predict accurate results |
| Secure the privacy of the user | Encrypt the data using blockchain | Test the postman endpoints to validate |
| Validate the prediction | Use users response to validate the preferred advertisement prediction | Response matching the prediction |

Table 1 :Test cases

# RESULTS & DISCUSSION

## **Results**

The advertiser has designed the advertisements to target the age groups: children, young, young adults, and elders. Therefore, A correlation analysis of age groups was done against the most memorable advertisement.

**Chart

Description automatically generated**

Fig . Corealtion status with most frequently viewed

### 3.1.1 Accuracy of age and gender model

Based on the two features, age and gender, the accuracy of the RF and SVM algorithms is the same as 54%. Fig.11 shows a detailed report.

Table

Description automatically generated

Fig . Age and Gender results of SVM & RF models

The deep learning model also failed to increase the accuracy in classifying the dataset. Moreover, as this model only has two input features and the input features are categorical values, the performance worsened. Fig.12 shows a detailed report regarding age and gender categorization.

Table

Description automatically generated

Fig . Results of the Deep Learning model

The following graphs Fig.13 and Fig.14 illustrates the accuracy and loss curves of the deep learning model.

Chart

Description automatically generated

Fig . Accuracy curve of demographics

Chart, line chart

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Fig . Loss curve of demographics

### 3.1.2 Accuracy of emotional model

As the idea was to evaluate how good is emotional features alone in recommending advertisements to the users. As mentioned earlier, it has eight emotional features. RF and SVM classified data based on emotional features, and both algorithms acquired the same accuracy of 55%, as shown in Fig.15

**Table

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Fig . Accuracy of emotional data with SVM & RF models

The accuracy of the trained model is 65%, AUC is 80% for the deep learning emotional classifier. Fig.16 shows the confusion matrix of the classifier.

**Chart

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Fig . Confusion matrix of deep learning model

The techniques that used in this research have recovered the best model before overfitting with the help of early stopping middleware. Fig.17 & Fig .18 shows the accuracy and loss curves for the training and validation dataset

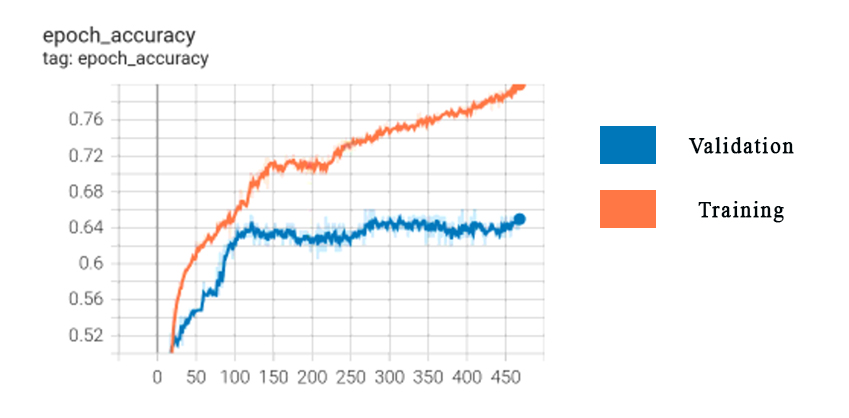


Fig . Accuracy curve of emotions

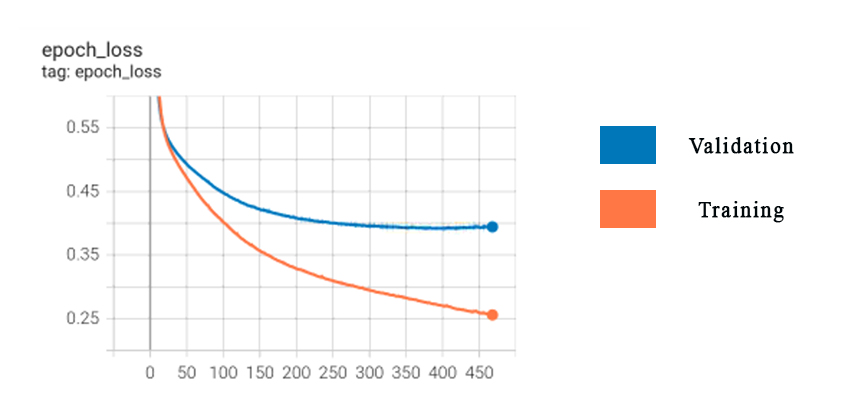


Fig . Loss curve of emotions

### 3.1.3 Accuracy of facial features model

The maximum accuracy of SVM and RF algorithms for facial features is 57%. Fig .19 shows the classification report.

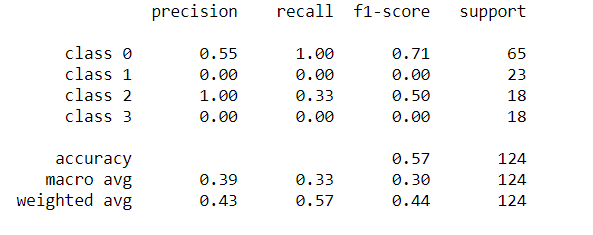


Fig . Accuracy of facial feature data with SVM & RF models

However, the accuracy of the deep learning model increased significantly for the facial features dataset. Fig.20 & Fig.21 shows the classification report and the confusion matrix obtained using the deep learning model. And the accuracy is 86%, with AUC 94.99%

**Table, calendar

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Fig . Accuracy of facial feature data with deep learning model

**Chart

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Fig . : Confusion matric of facial feature results

### 3.1.4 Accuracy of Ensemble model

All the above models were somewhat good at recommending user-preferred advertisement. All the deep learning models performed better than standard machine learning models. Enough studies have been performed on recommending ads based on emotions, demographics, and facial features individually. To the best of our knowledge, The first were to analyses facial features, emotions, age, and gender to recommend user-preferred advertisements on television.

The accuracy of the SVM and RF were the same as facial features for the ensemble model. However, the accuracy of the deep learning model increased significantly. According to the classification report in **Fig.22**, the accuracy is 90%, and the AUC is 97.38%.

**Table

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Fig . Accuracy obtained for ensemble method

**Fig.23** , **Fig.24 & Fig .25**  respectively shows the confusion matrix and the loss and accuracy curves for the ensemble model. The ensemble model shows that using demographics, emotions and facial features all together improves the quality of recommended systems.

**Chart

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Fig . Confusion matrix of the ensemble model

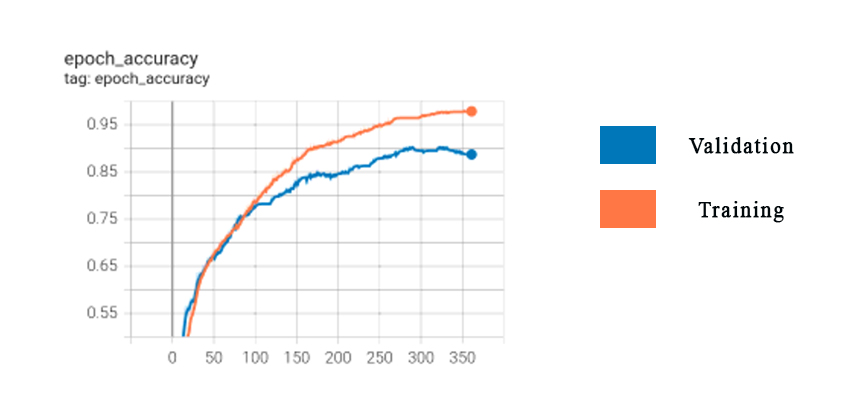


Fig . Ensemble model accuracy curve

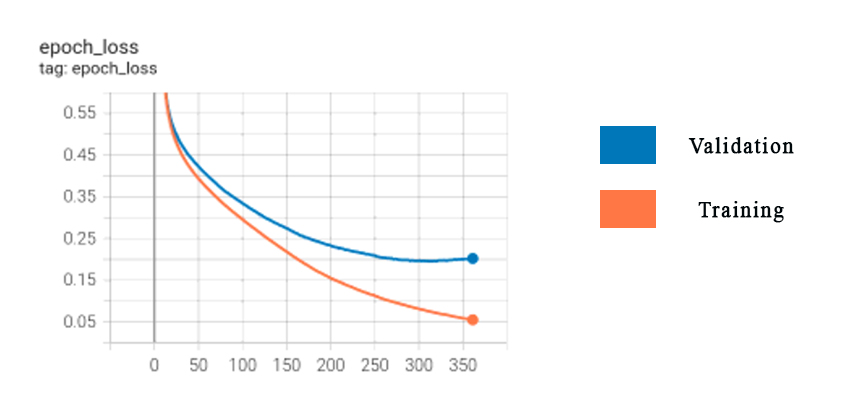


Fig . Ensemble model loss curve

## **Research findings**

In this study three factors have been used to train the data set against advertisements in order to select the most preferred advertisement .Table.1 bellow depicts the comparison of the results obtained. As the first model , Age and Gender data which are the demographic data was trained using three algorithms and among those three the deep learning model has obtained the highest test accuracy which is 70% .The same method have been followed regarding the facial and emotional data using the deep learning model and has obtained a test accuracy of 80% and 95% respectively. Then finally all the factors together was trained in the ensemble model and was able to obtain the highest accuracy of all models which is 97%.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Model** | **Test Accuracy %** | **AUC %** | **Precision** | **Recall** | **F1** |
| Age & Gender | 52 | 70 | 0.27 | 0.52 | 0.36 |
| Emotion | 65.05 | 80.15 | 0.66 | 0.65 | 0.64 |
| Facial | 86.55 | 94.99 | 0.86 | 0.86 | 0.86 |
| Ensemble | 90.32 | 97.38 | 0.90 | 0.90 | 0.90 |

Table 2 Comparison of models

As for the results obtained by each individual component there are some novel finding which are unique for this research. Stated below are the research findings of the study.

* In order to predict the best advertisement , all the factors should be considered
* The younger age group shows more attention towards the sample video
* Every age group and gender dislike advertisement at the beginning of the tv program
* Identify the best and worse locations for displaying the ads during a movie.
* Recommend ads based on all 31 factors with higher accuracy
* Encrypt the data with Ethereum for recommendation system

## **Discussion**

A sample of 100 users were studied for their emotional, facial and demographic feature changes by monitoring and logging the changes closely. 77 data points were retained after preprocessing and filtering. Joy, sad, … were belong to emotional features while eye lifting, laughing, .. were belong to facial features. Age and gender features were belonged to demographic data. Even though the previous studies have suggested that the recommending ads based on demographic data are a great success, analysis of this study shows otherwise. Nevertheless, this study proposes a new and affectional method for recommending ads while preserving the privacy of the users. Recent studies suggest that a considerable percentage of the Sri Lankans watch live tv across all age groups [19].The same study points out that the advertisers cost the advertisements according to the time of broadcasting. But this study suggested a more robust and affective way for the advertisers to broadcast ads and more importantly they can evaluate the performance of the suggested advertisements in real time.

Also the user studies were performed during the pandemic and tried best to minimize the environmental variables for each user because environmental factors matter the most for the emotional features. But it was a challenging task for us to interview each user in a specific place at a specific time due to the covid outbreak In the future, the performance of the recommender system is being planned to evaluate. Furthermore, the team is interested in building an unsupervised recommender system that recommends new advertisements to the users based on their emotional, facial, and demographic features. Nevertheless, the advertisement database is being planned to expand as well.

# SUMMARY OF EACH STUDENTS CONTRIBUTION

**Evaluating demographic features for advertisement recommendation**

* Train the model with human images consisting of age, gender labels.
* Disregard non-human objects when detection.
* Classification of images according to age and gender.
* Further classification into peer groups considering the age and gender of detected images.

**Advertisement Recommendation with tags**

* Considering the TV viewers interests
* Build new tags and review the advertising information
* Finding special key points and choosing similar ads
* Stop the tendency to repeat the same ads play

**Emotional analysis for advertisement recommendation**

* Initially Extracting facial features depending on the emotions.
* From the features captured classification the emotion through an algorithm.
* Depending on the current advertisement the feedback emotion will be recorded.
* The stored feedback from the audience will be sent to the advertising firm as a report which will aid in creating a quality advertisement.

**Blockchain for security**

* Admin panel UI
* Create a dynamic system to interact with multiple Ethereum networks.
* Add advertising system data to the smart contract.
* Manage Smart contracts for each advertisement.
* Retrieve data from Smart Contracts.
* Manage smart contract data access.
* Develop blockchain manager
* Design and create a blockchain network.
* Create miners and nodes accordingly.

# Gant chart

Chart, waterfall chart

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Fig . 26 Garnt Chart

# CONCLUSION

This novel study was done to find out how affectively tv advertisements can be recommended by considering the demographic features (age, gender and peer groups), facial features and emotional features. Therefore a sample of 100 users was let to watch a short movie clip with four advertisement and was able to gather their emotional, facial and demographic features. Then at the end of the movie, the user was asked a questioner “what was the most memorable advertisement played?” as if to verify the collected data when training. All the three factors was trained against the advertisement data using a deep learning model and the results obtained were that there is no strong correlation between the three factors against the user-preferred advertisement. In the end ensemble model outperformed all with 97% accuracy. Therefore it is concluded that an ensemble model with demographic, emotional and facial features is best at recommending preferred advertisements.

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# Appendix

**Survey results were as follows**

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**Teams

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