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Analyzing the Impact of Information Technology on Family Harmony Using Decision Tree Algorithm

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Keywords:
Information Technology;
Gadget;
Family;
Harmony.

Abstract

In an era dominated by advancements in information technology, the use of digital devices and gadgets has become an integral part of everyday life. The impact of information technology on family harmony has become an increasingly important subject of concern. This research primarily aims to analyze the impact of information technology on family harmony using a data- driven approach, particularly through the application of the Decision Tree algorithm. The research method involves conducting an online survey directed towards respondents who are already part of families. The variables utilized in the study encompass communication among family members and distant relatives, quality family time, the average hours of gadget usage per day, as well as practices regarding restricting gadget use for children. The results of data analysis reveal a complex relationship between the use of information technology and the level of family harmony. The Decision Tree algorithm successfully identifies key factors that play a role in influencing the level of family harmony. This provides a deeper understanding of how interactions with information technology within the family context can be managed more effectively. This research provides valuable insights, not only for the families involved but also for policymakers who wish to understand how to manage the use of information technology and promote family harmony in this digital era. These findings also stimulate important ethical considerations regarding how information technology can be positively integrated into the dynamics of modern families.

INTRODUCTION

The family is a very important social unit in society. Families provide an emotional and social foundation for individuals, and harmony within the family has a profound impact on the well-being of family members. However, in the modern era characterized by advances in information technology, significant changes in the way families communicate and interact are taking place. Information technology, including digital devices, social media, and communication apps, has become an indispensable part of everyday life. The question that arises is how this use of information technology affects family harmony.

The use of information technology in families can provide benefits such as ease of long-distance communication, access to educational resources and entertainment. However, excessive or unwise use can lead to problems such as social isolation, conflict within the family, and decreased quality of time together. Therefore, a deep understanding of the impact of information technology on family harmony is needed to develop strategies that support healthy and balanced use.[1]

This research aims to analyze the impact of information technology use on family harmony using a data-driven approach, specifically the Decision Tree algorithm. The Decision Tree algorithm is a powerful method for understanding the most influential factors in decision-making, and in this context, decisions related to family harmony. By modeling the relationship between various factors related to

[1] Vaishnavi N. Panjeti-Madan and Prakash Ranganathan, "Impact of Screen Time on Children's Development: Cognitive, Language, Physical, and Social and Emotional Domains," *Multimodal Technologies and Interaction* 7, no. 5 (May 2023): 52, https://doi.org/10.3390/mti7050052.

information technology and family harmony, this research aims to provide valuable insights for families and policy makers.[2]

Based on the literature review, several articles were found that were relevant to this paper. The first is Ningsih's article which discusses the impact of gadget addicted couples on family harmony from an Islamic legal perspective. The author concludes that the negative impact of gadget-addicted couples on family harmony in Riak Siabun Village, Sukaraja District, Seluma Regency, namely loss of mutual trust, forgetting responsibilities in worship, infidelity and economic difficulties.[3] The same thing was also found by Nurliana who discussed the impact of gadgets on communication. parents and children in families at the Pembina Kindergarten, Lut Tawar sub-district.[4]

In this study, we will collect data on the use of information technology in the family, the quality of family relationships, and other factors that may affect family harmony. This data will be used to develop a Decision Tree model that can predict the impact of information technology use on family harmony. The results of this study are expected to provide practical guidance for families in managing the use of information technology and also provide insights into how the use of information technology can be properly integrated in harmonious family life..[5]

The method used in collecting data for this study is an online survey through a Google Form link that is randomly distributed to respondents who are married. The variables that are the focus of the research include: communication between family and distant relatives, quality time with family (family time), average hours of gadget use, as well as the practice of limiting gadget use on children.[6] In the data preparation stage, the first step taken is to clean the data to address missing values or invalid data. After the cleaning process is complete, the filtered data will undergo a transformation stage. At this stage, categorical data, which are the answers from respondents, will be converted into numerical data. The goal is to determine the target value of each row of data by using the average value of the answer score.[7]

After calculating the average score of the initial data on each respondent, the next step is to determine the target variable based on the average score value obtained by each respondent. The software used to build the decision tree model in this research is Orange Data Mining Version 3.35.0. The target variable to be used in this research is the Level of Family Harmony, which will be divided into the categories "Less Harmonious", "Quite Harmonious" and "Harmonious". The predictor variables that will be used to make predictions about the target variable include Communication, Family Time, Average Hours of Gadget Use per Day, and Limitation of Gadget Use in Children. To evaluate the performance of the Decision Tree model whether the model can predict the impact of information technology on family harmony well, it is necessary to measure the following aspects: (1) Accuracy: to measure the extent

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[2] Ashwini Tadpatrikar, Manoj Kumar Sharma, and Silpa S. Viswanath, "Influence of Technology Usage on Family Communication Patterns and Functioning: A Systematic Review," *Asian Journal of Psychiatry* 58 (April 2021): 102595, https://doi.org/10.1016/j.ajp.2021.102595.

[3] Surya Ningsih, "Dampak Pasangan Pecandu Gadget Terhadap Keharmonisan Keluarga Perspektif Hukum Islam (Studi Di Desa Riak Siabun Kecamatan Sukaraja Kabupaten Seluma)" (diploma, UIN Fatmawati Sukarno, 2022), http://repository.iainbengkulu.ac.id/8596/.

[4] "Dampak Gadget Terhadap Komunikasi Orang Tua Dan Anak Dalam Keluarga Di Tk Negeri Pembina Kecamatan Lut Tawar | Jurnal As-Salam," October 9, 2022, https://jurnal-assalam.org/index.php/JAS/article/view/247.

[5] Dmitri Rozgonjuk et al., "Disordered Gaming, Loneliness, and Family Harmony in Gamers before and during the COVID-19 Pandemic," *Addictive Behaviors Reports* 15 (June 1, 2022): 100426, https://doi.org/10.1016/j.abrep.2022.100426.

[6] Yasir Ali and Md Mazharul Haque, "Modelling the Response Times of Mobile Phone Distracted Young Drivers: A Hybrid Approach of Decision Tree and Random Parameters Duration Model," *Analytic Methods in Accident Research* 39 (September 1, 2023): 100279, https://doi.org/10.1016/j.amar.2023.100279.

[7] Feiyue Qiu et al., "Predicting Students' Performance in e-Learning Using Learning Process and Behaviour Data," *Scientific Reports* 12 (January 10, 2022): 453, https://doi.org/10.1038/s41598-021-03867-8.

to which the model can correctly predict the target class. (2) Precision and Recall: Precision measures what percentage of positive predictions are correct, while recall measures what percentage of total positives are successfully predicted by the model. (3) F1-Score: F1-score is a combination of precision and recall. (4) Area Under the ROC Curve (AUC-ROC):[8] To measure the extent to which the model can distinguish between positive and negative classes. AUC-ROC values close to 1 indicate an excellent model At this stage, researchers analyzed the results of the Decision Tree to identify the factors that have the most significant influence on family harmony.[9] In addition, researchers provide an interpretation and description of how the use of information technology can affect family harmony based on the structure and rules generated by the decision tree model.[10] Thus, this research provides in-depth insight into the key factors that can influence family dynamics in the digital era.

RESULTS AND DISCUSSION

The research was carried out through several processes, namely:

Pre Processing

The pre processing carried out is the data cleaning process which undergoes three cleaning stages, namely: Incomplete, Noisy and Inconsistent. Data for this research was obtained by distributing a Google Form link to respondents who came from families with diverse backgrounds.

Incomplete

At this stage, researchers carry out data cleaning by identifying and deleting incomplete or incomplete data. In this step, data attributes that have no value or are empty will be removed from the dataset. This action is necessary because researchers do not have additional data or references that can be used to fill in missing values in these data attributes.[11]

Noisy and Data Inconsistency

Noisy and inconsistency data refer to discrepancies in the dataset.[12] This discrepancy can be caused by respondents' errors when entering data into Google forms, the presence of duplicate data, and other factors that contribute to data discrepancies. The results of the preprocessing process that has been carried out produce a dataset with 77 data.[13]

Table 3. Research data after the preprocessing process

[8] Matt Gifford and Tuncay Bayrak, "A Predictive Analytics Model for Forecasting Outcomes in the National Football League Games Using Decision Tree and Logistic Regression," *Decision Analytics Journal* 8 (September 1, 2023): 100296, https://doi.org/10.1016/j.dajour.2023.100296.

[9] Peng Li, Weitiao Wu, and Xiangjing Pei, "A Separate Modelling Approach for Short-Term Bus Passenger Flow Prediction Based on Behavioural Patterns: A Hybrid Decision Tree Method," *Physica A: Statistical Mechanics and Its Applications* 616 (April 15, 2023): 128567, https://doi.org/10.1016/j.physa.2023.128567.

[10] Jiafeng Zhou et al., "Predicting the Formation of Mixed Pattern Hemorrhages in Ruptured Middle Cerebral Artery Aneurysms Based on a Decision Tree Model: A Multicenter Study," *Clinical Neurology and Neurosurgery* 234 (November 1, 2023): 108016, https://doi.org/10.1016/j.clineuro.2023.108016.

[11] Matthew J. Gillespie et al., "1-Year Outcomes in a Pooled Cohort of Harmony Transcatheter Pulmonary Valve Clinical Trial Participants," *JACC: Cardiovascular Interventions* 16, no. 15 (August 14, 2023): 1917–28, https://doi.org/10.1016/j.jcin.2023.03.002.

[12] Atul Dhakar, Bhagat Singh, and Pankaj Gupta, "Fault Diagnosis of Air Compressor Set-up Using Decision Tree Based J48 Classification Algorithm," *Journal of Engineering Research*, September 28, 2023, https://doi.org/10.1016/j.jer.2023.09.028.

[13] Jonas Heiberg and Bernhard Truffer, "Overcoming the Harmony Fallacy: How Values Shape the Course of Innovation Systems," *Environmental Innovation and Societal Transitions* 42 (March 1, 2022): 411–28, https://doi.org/10.1016/j.eist.2022.01.012.

NO	COMMUNICATION WITH DISTANCING RELATIVES	FAMILY TIME	TIME OF USE GADGETS	GADGET RESTRICTIONS IN CHILDREN
1	Once a week	Once a week	1-2 Hours/day	Every day
2	> Once a month	> Once a month	1-2 Hours/day	Every day
3	Once a week	> Once a month	> 2 Hours/day	Every day
4	> Once a month	> Once a month	1-2 Hours/day	Every day
5	Once a week	Once a week	> 2 Hours/day	Every day
6	Once a week	Once a week	> 2 Hours/day	Every day
7	Once a week	> Once a month	> 2 Hours/day	Never
8	Once a week	Once a week	> 2 Hours/day	Every day
9	Once a week	Once a week	> 2 Hours/day	Every day
10	Once a week	Once a week	> 2 Hours/day	Every day
11	Once a week	Once a week	> 2 Hours/day	Every day
12	Once a week	Once a week	1-2 Hours/day	Every day
13	> Once a month	> Once a month	> 2 Hours/day	Sometimes
14	> Once a month	> Once a month	> 2 Hours/day	Every day
15	Once a week	Once a week	> 2 Hours/day	Every day
16	Once a month	> Once a month	> 2 Hours/day	Sometimes
17	Once a week	Once a week	1-2 Hours/day	Every day
18	Once a week	Once a week	> 2 Hours/day	Every day
19	Once a week	Once a week	1-2 Hours/day	Every day
20	Once a week	> Once a month	1-2 Hours/day	Every day
21	Once a week	> Once a month	1-2 Hours/day	Never
22	Once a week	Once a month	> 2 Hours/day	Sometimes
23	Once a week	Once a month	> 2 Hours/day	Every day
24	Once a week	Once a week	> 2 Hours/day	Never
25	Once a week	> Once a month	< 1 Hour/day	Every day
26	> Once a month	> Once a month	> 2 Hours/day	Never
27	Once a week	> Once a month	> 2 Hours/day	Every day
28	Once a week	Once a month	> 2 Hours/day	Never
29	Once a week	Once a month	> 2 Hours/day	Sometimes
30	Once a week	Once a week	> 2 Hours/day	Every day
31	> Once a month	Once a month	> 2 Hours/day	Sometimes
32	Once a week	Once a month	> 2 Hours/day	Every day
33	> Once a month	Once a week	> 2 Hours/day	Every day
34	Once a week	Once a month	> 2 Hours/day	Every day

NO	COMMUNICATION WITH DISTANCING RELATIVES	FAMILY TIME	TIME OF USE GADGETS	GADGET RESTRICTIONS IN CHILDREN
35	Once a month	Once a week	> 2 Hours/day	Sometimes
36	Once a week	Once a month	1-2 Hours/day	Every day
37	Once a month	Once a month	1-2 Hours/day	Every day
38	Once a month	Once a month	1-2 Hours/day	Every day
39	Once a week	Once a month	> 2 Hours/day	Every day
40	Once a month	Once a week	> 2 Hours/day	Never
41	> Once a month	> Once a month	> 2 Hours/day	Never
42	Once a week	Once a week	> 2 Hours/day	Every day
43	Once a week	> Once a month	> 2 Hours/day	Sometimes
44	Once a week	Once a week	< 1 Hour/day	Every day
45	Once a week	Once a week	> 2 Hours/day	Every day
46	Once a month	Once a month	> 2 Hours/day	Every day
47	Once a week	Once a week	> 2 Hours/day	Sometimes
48	Once a week	Once a month	> 2 Hours/day	Every day
49	Once a month	Once a month	> 2 Hours/day	Never
50	Once a week	Once a week	1-2 Hours/day	Every day
51	Once a month	Once a week	> 2 Hours/day	Sometimes
52	Once a week	> Once a month	> 2 Hours/day	Every day
53	Once a month	> Once a month	> 2 Hours/day	Sometimes
54	> Once a month	Once a week	> 2 Hours/day	Sometimes
55	> Once a month	> Once a month	1-2 Hours/day	Sometimes
56	Once a week	Once a month	< 1 Hour/day	Never
57	Once a month	Once a month	1-2 Hours/day	Every day
58	Once a month	Once a week	> 2 Hours/day	Never
59	Once a week	Once a week	> 2 Hours/day	Every day
60	Once a week	Once a month	> 2 Hours/day	Sometimes
61	Once a week	Once a week	> 2 Hours/day	Every day
62	Once a week	> Once a month	1-2 Hours/day	Every day
63	Once a month	Once a month	> 2 Hours/day	Every day
64	Once a week	Once a week	> 2 Hours/day	Sometimes
65	Once a month	> Once a month	> 2 Hours/day	Never
66	Once a week	> Once a month	< 1 Hour/day	Every day
67	Once a week	> Once a month	1-2 Hours/day	Every day
68	Once a week	Once a week	< 1 Hour/day	Sometimes
69	Once a week	Once a week	> 2 Hours/day	Every day
70	Once a month	Once a month	> 2 Hours/day	Every day
71	> Once a month	> Once a month	1-2 Hours/day	Sometimes
72	Once a month	> Once a month	> 2 Hours/day	Every day
73	> 1 Bulan Sekali	1 Bulan Sekali	> 2 Jam/hari	Tidak Pernah
74	1 Minggu Sekali	1 Minggu Sekali	< 1 Jam/hari	Setiap Hari
75	> 1 Bulan Sekali	> 1 Bulan Sekali	> 2 Jam/hari	Tidak Pernah

NO	COMMUNICATION WITH DISTANCING RELATIVES	FAMILY TIME	TIME OF USE GADGETS	GADGET RESTRICTIONS IN CHILDREN
73	> Once a month	1 Bulan Sekali	> 2 Hours/day	Never
74	Once a week	Once a week	< 1 Hour/day	Every day
75	> Once a month	> 1 Bulan Sekali	> 2 Hours/day	Never
76	> Once a month	> 1 Bulan Sekali	1-2 Hours/day	Never
77	Once a month	Once a week	> 2 Hours/day	Every day

Data Transformation

The data transformation stage is the process of changing the format of stored data into a standard format that suits the needs of the application to be used. In this research, researchers transformed categorical data into numerical data, then calculated the average of these variables to determine the target variable. After getting the target variable values, the next step is to convert these values into categorical data with three target classes, namely "Harmonious, Fairly Harmonious, and Less Harmonious".

Table 4. Data Transformation

NO	V1	V2	V3	V4	AVERAGE	INFORMATION
1	3	3	2	3	2,75	Harmonious
2	1	1	2	3	1,75	Quite Harmonious
3	3	1	1	3	2	Quite Harmonious
4	1	1	2	3	1,75	Quite Harmonious
5	3	3	1	3	2,5	Harmonious
6	3	3	1	3	2,5	Harmonious
7	3	1	1	1	1,5	Quite Harmonious
8	3	3	1	3	2,5	Harmonious
9	3	3	1	3	2,5	Harmonious
10	3	3	1	3	2,5	Harmonious
11	3	3	1	3	2,5	Harmonious
12	3	3	2	3	2,75	Harmonious
13	1	1	1	2	1,25	Quite Harmonious
14	1	1	1	3	1,5	Quite Harmonious
15	3	3	1	3	2,5	Harmonious
16	2	2	1	2	1,75	Quite Harmonious
17	3	3	2	3	2,75	Harmonious
18	3	3	1	3	2,5	Harmonious
19	3	3	2	3	2,75	Harmonious
20	3	1	2	3	2,25	Harmonious
21	3	1	2	1	1,75	Quite Harmonious
22	3	2	1	2	2	Quite Harmonious

NO	V1	V2	V3	V4	AVERAGE	INFORMATION
23	3	2	1	3	2,25	Harmonious
24	3	3	1	1	2	Quite Harmonious
25	3	1	3	3	2,5	Harmonious
26	1	1	1	1	1	Less Harmonious
27	3	1	1	3	2	Quite Harmonious
28	3	2	1	1	1,75	Quite Harmonious
29	3	2	1	2	2	Quite Harmonious
30	3	3	1	3	2,5	Harmonious
31	1	2	1	2	1,5	Quite Harmonious
32	3	2	1	3	2,25	Harmonious
33	1	3	1	3	2	Quite Harmonious
34	3	2	1	3	2,25	Harmonious
35	2	3	1	2	2	Quite Harmonious
36	3	2	2	3	2,5	Harmonious
37	2	2	2	3	2,25	Harmonious
38	2	2	2	3	2,25	Harmonious
39	3	2	1	3	2,25	Harmonious
40	2	3	1	3	2,25	Harmonious
41	1	1	1	1	1	Less Harmonious
42	3	3	1	3	2,5	Harmonious
43	3	1	1	2	1,75	Quite Harmonious
44	3	3	3	3	3	Harmonious
45	3	3	1	3	2,5	Harmonious
46	2	2	1	3	2	Quite Harmonious
47	3	3	1	2	2,25	Harmonious
48	3	2	1	3	2,25	Harmonious
49	2	2	1	1	1,5	Quite Harmonious
50	3	3	2	3	2,75	Harmonious
51	2	3	3	2	2,5	Harmonious
52	3	1	1	3	2	Quite Harmonious
53	2	1	1	2	1,5	Quite Harmonious
54	1	3	1	2	1,75	Quite Harmonious
55	1	1	2	2	1,5	Quite Harmonious
56	3	2	3	1	2,25	Harmonious
57	2	2	2	3	2,25	Harmonious

NO	V 1	V2	V3	V4	AVERAGE	INFORMATION
58	2	3	1	1	1,75	Quite Harmonious
59	3	3	1	3	2,5	Harmonious
60	3	2	1	2	2	Quite Harmonious
61	3	3	1	3	2,5	Harmonious
62	3	1	2	3	2,25	Harmonious
63	2	2	1	3	2	Quite Harmonious
64	3	3	1	2	2,25	Harmonious
65	2	1	1	1	1,25	Quite Harmonious
66	3	1	3	3	2,5	Harmonious
67	3	1	2	3	2,25	Harmonious
68	3	3	3	2	2,75	Harmonious
69	3	3	1	3	2,5	Harmonious
70	2	2	1	3	2	Quite Harmonious
71	1	1	2	2	1,5	Quite Harmonious
72	2	1	1	3	1,75	Quite Harmonious
73	1	2	1	1	1,25	Quite Harmonious
74	3	3	3	3	3	Harmonious
75	1	1	1	1	1	Less Harmonious
76	1	1	2	1	1,25	Quite Harmonious
77	2	3	1	3	2,25	Harmonis

Data Mining Process

At this stage, researchers attempt to build a classification rule process in data mining by utilizing the decision tree algorithm. This classification algorithm will utilize the dataset that has been prepared to generate understanding. The desired focus of understanding in the classification process is to categorize the impact of information technology on the level of family harmony.

In this process, researchers selected several relevant key attributes, such as communication between family and distant relatives, quality time with family (family time), average hours of gadget use, and also the practice of limiting gadget use among children.

Next, the following is a series of stages from start to finish in the classification process using a decision tree using the Orange tool

Data Input

The initial step in this process is to enter data that has been analyzed and processed using the Cleaning method. This data has been verified as valid data and is required to run the classification process using the Orange platform

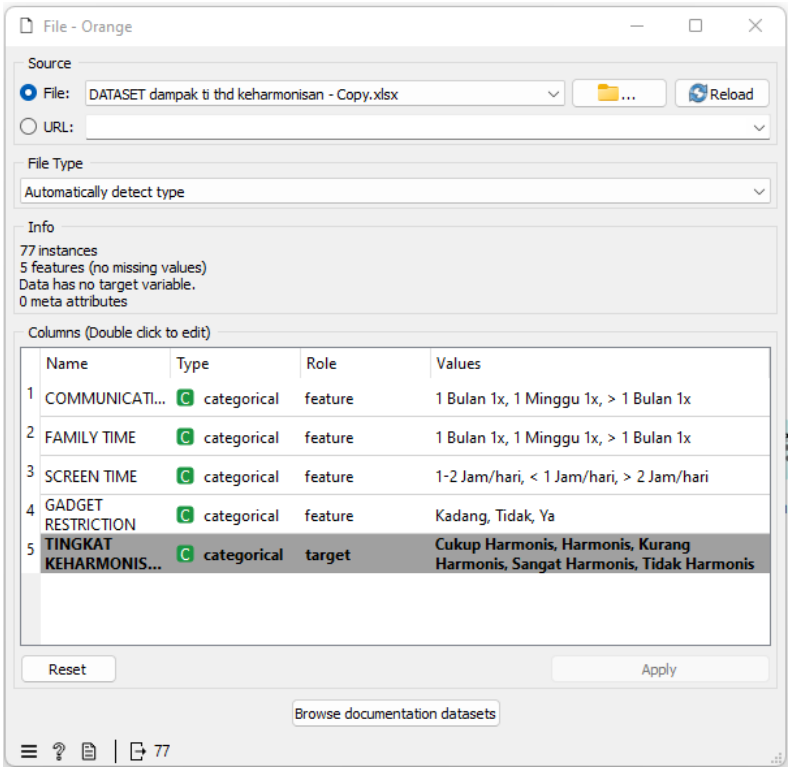

Figure 1. Input Dataset in Orange

View Data

To display the data selected in the first step, you can do this by placing the Data Table widget

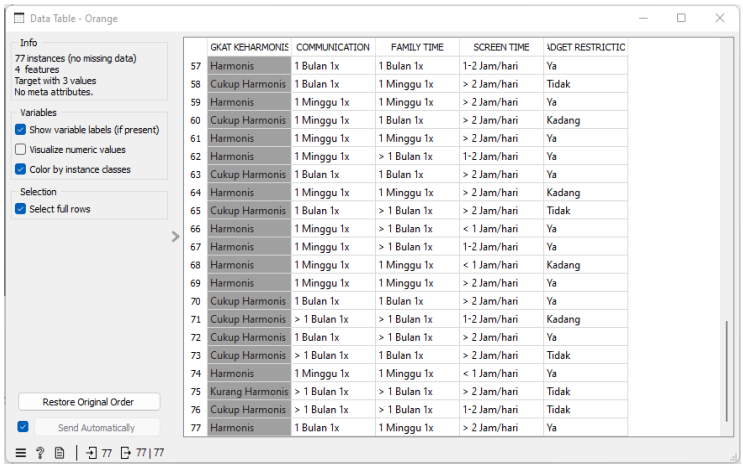

Figure 2. Viewing the Data Table in Orange

Classification Process

To run the classification process on existing data, the next step is to select the Tree widget and place it on the Orange canvas, as seen in the image below. After that, connect the Tree widget with the File Widget.

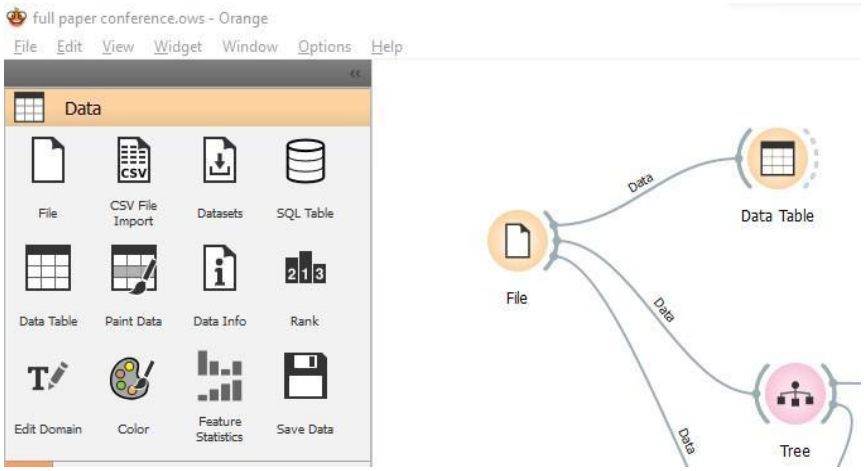

Figure 3. Classification process using Tree in Orange

View Classification Results

To display the results obtained in the classification process, you can use the Tree Viewer widget. Place this widget on the Orange canvas and connect it to the Tree widget. In this way, classification results can be easily visualized.

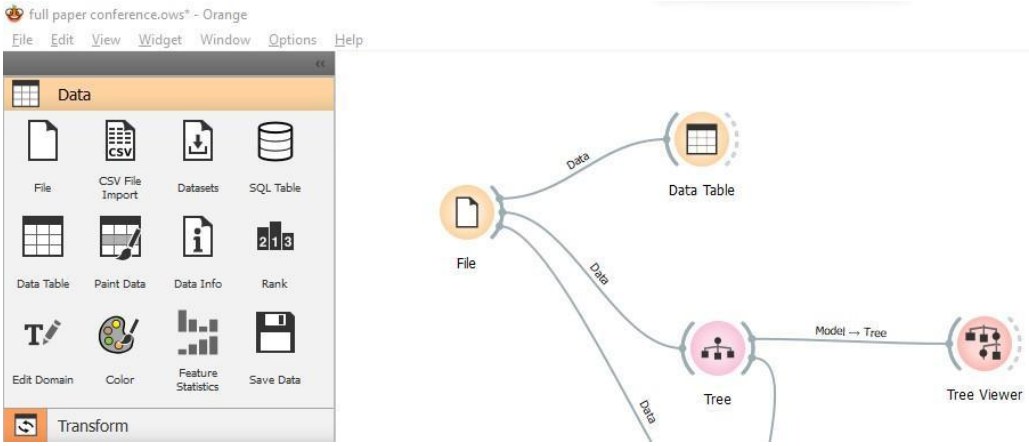

Figure 4. Viewing classification results with Tree Viewer in Orange

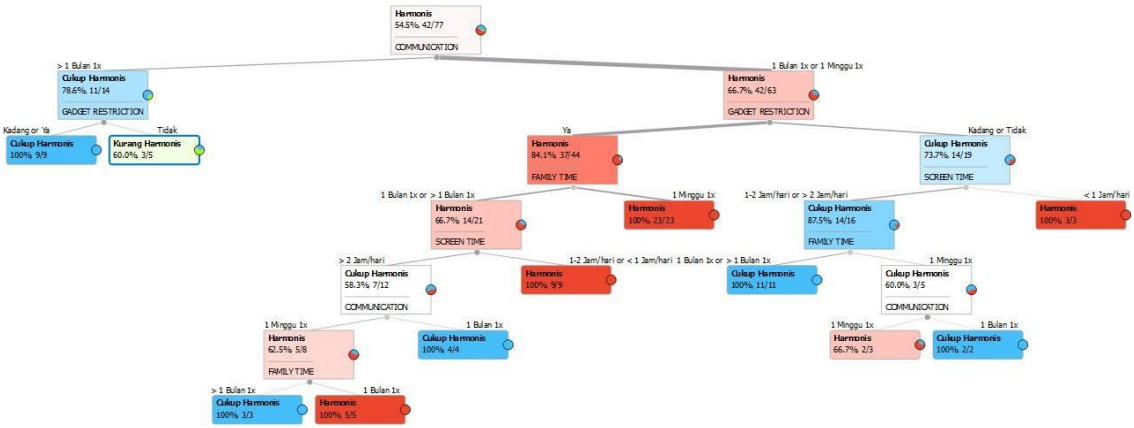

Figure 5. Decision Tree results using Orange

Model Evaluation

To properly evaluate the performance of the Decision Tree model in predicting the impact of information technology on family harmony, measurements are needed in the following 6 aspects:

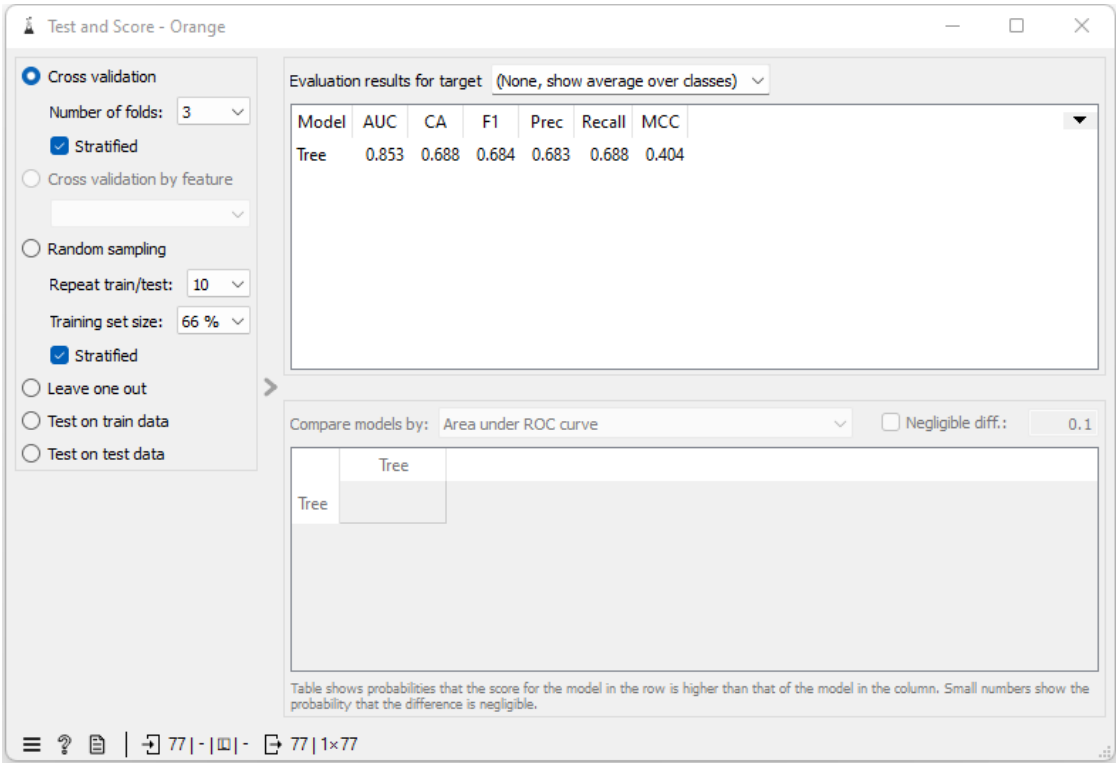

Figure 6. Test and Score on Orange

1. Accuracy: 0.688 or 68.8% decision tree can correctly predict the target class.
2. Precision: 0.683 or 68.3% correct positive predictions
3. Recall: 0.688 or 68.8% of the total positives successfully predicted by the model.
4. F1-Score (a combination of precision and recall): 0.684 or 68.4%.
5. Area Under the ROC Curve (AUC-ROC): 0.853 or 85.3% of the Decision Tree model can differentiate between positive and negative classes. AUC-ROC values close to 1 indicate a very good model.

Interpretation of Classification Results

Table 5. Target Class and Rule generated by the decision tree

Target Class		Rule
Harmonious	✓ Communication	: Once a month or Once a week
	✓ Gadget Restriction	: Yes
	✓ Family Time	: Once a week
	✓ Screen Time	: 1-2 Hours/day or < 1 hour/day
Quiet Harmonious	✓ Communication	: Once a month or Once a week
	✓ Gadget Restriction	: Sometimes or No
	✓ Screen Time	: 1-2 hours/day or > 2 hours/day
	✓ Family Time	: Once a month or > Once a month
Less Harmonious	✓ Communication	: > Once a month
	✓ Gadget Restriction	: No

Interpretation results using the decision tree algorithm in Orange software indicate that families that can be considered harmonious are families that communicate with relatives or distant relatives using video calls at least once a week or at most once a month. Apart from that, the family also routinely limits children's use of gadgets every day, spends quality time with the family on vacation or just going for a walk at least once a week, and limits gadget use for adults to less than one hour per day or maximum two hours per day. On the other hand, families that are considered less harmonious are families that rarely communicate with relatives or distant relatives and do not impose restrictions on their children's use of gadgets.

CONCLUSION

Information technology can positively impact family harmony by facilitating more accessible long-distance communication between family members who are geographically separated. Using video calling or text messaging applications can help families stay connected even though they are in different locations, thus increasing the feeling of closeness and connection between family members. However, on the other hand, information technology can also cause disharmony in the family if it is not used wisely. For example, excessive use of gadgets by family members, especially children, can interfere with direct interactions between family members. When family members are more involved in online activities than interacting in the real world, this can result in a breakdown in communication, conflict, or even social isolation within the family. The impact of information technology on family harmony depends on how this technology is managed and used by each family member. Wise and balanced use can increase harmony, while uncontrolled use can damage family relationships.

It is essential to increase digital awareness and literacy in families so that they can understand the positive and negative impacts of information technology and adopt wise ways of using it. Implementing a gadget use policy in the family is recommended to protect children from excessive gadget use, which can disrupt interactions between family members. Families should allocate quality time together without interference from digital devices; this can strengthen relationships between family members and increase harmony. Education and training related to the wise use of information technology must be introduced to family members and involve schools and society at large. Further in-depth research is needed to investigate the impact of information technology on family harmony, emphasizing specific aspects such as the use of social media, online games or certain types of devices.

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