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The Best Web-Based Set Top Box (STB) Determination System Using the Analytical Hierarchy Process (AHP) Method

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Abstract

The transition from analog to digital television requires the public to use *set top box* (STB) devices in order to receive digital broadcasts. However, many users struggle to choose an *set top box* that suits their location and specific needs. This study aims to determine the best location-based *set top box* recommendations using the *Analytical Hierarchy Process* (AHP) method. AHP was chosen because it is capable of systematically processing comparisons of criteria such as chipset, brand, price, and features. Primary data was collected through surveys and interviews with technicians in Blitar City, while secondary data was obtained from journals and technical documentation. The results of the study indicate that the brand criterion holds the highest weight, followed by chipset, features, and price. *Set top box* with *Sunplus* chipsets demonstrated the best performance in areas with weak signals. The web-based system was developed using JavaScript, and the calculations were supported by Python to verify accuracy. Therefore, the AHP method is highly effective in providing optimal *set top box* recommendations based on location and user needs, while also serving as a digital education tool for the community. This *white box* testing successfully validated the implementation of the *Analytical Hierarchy Process* (AHP) for calculating the score of the set top box (STB). The test confirmed that the scoring function accurately produced the correct total score of 0.6673 for the GX6605 STB. This successful execution demonstrates the reliability and correctness of the system's decision-making process.

Keywords: *Javascript, Analytical Hierarchy Process, Set top box*

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1. INTRODUCTION

A set-top box is an electronic device that receives digital broadcasts, which are then connected to analog-based devices. Therefore, the adjustment between a location point (beam strength) must be adjusted to the chipset used (STB brands use different chipsets (Arifin & Adhiyoga, 2023). A common issue with set-top boxes is the selection of the set-

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top box brand (each brand uses different chipsets), as each brand has varying signal strengths, leading many users to experience difficulties or receive suboptimal digital signals. Inappropriate selection of a set-top box can impact installation costs. Previous research indicates that implementing a television broadcasting system is challenging due to several factors, including the emergence of new technology in the form of set-top box installation (Ariyani et al., 2023). Additionally, all analog TV systems have been shut down, and everyone must switch to digital TV systems (Rustamaji et al., 2024). Furthermore, some communities still enjoy analog TV, necessitating the sharing of knowledge, particularly regarding digital broadcasting technology (Nuryanto et al., 2024). The solution to address these issues is to develop a web-based system that can recommend the best set-top box based on the user's location by utilizing the Analytical Hierarchy Process (AHP) method, which involves inputting location data and feature preferences.

2. LITERATURE REVIEW

The migration from analog to digital broadcasting has significantly impacted television users worldwide. According to Ariyani et al. (2023), the shift from analog systems to digital platforms was driven by the government's policy to discontinue analog transmissions, which has created challenges for communities in rural areas with limited technical knowledge. Similarly, Rustamaji et al. (2024) emphasized that the analog switch-off requires users to install set-top boxes to receive digital signals, which often leads to installation difficulties and additional costs. Furthermore, Nuryanto et al. (2024) highlighted that despite the advantages of digital technology, lack of public awareness and low digital literacy remain major obstacles in achieving a smooth transition.

2.1.1 Application of the Analytical Hierarchy Process (AHP) in Decision Making

The Analytical Hierarchy Process (AHP) is widely recognized for its ability to handle multi-criteria decision-making problems. In the study by Saaty (1980), AHP was introduced as a systematic method for prioritizing alternatives based on pairwise comparisons. Building on this, research conducted by Akmal and Sari (2022) applied AHP to select optimal suppliers in e-commerce platforms, demonstrating its flexibility in ranking alternatives using multiple attributes. Additionally, Pratama et al. (2023) implemented AHP in determining the best e-learning platform, revealing that AHP effectively addresses subjective judgments by converting them into quantifiable weights. These studies affirm that AHP is suitable for evaluating STB selection criteria such as chipset performance, brand reliability, and feature availability.

3. METHODS

This study was conducted at Agus Electronics Store in Blitar City from January 15 to 17, 2025. The research subjects involved various brands of *set top boxes* (STB) used by residents in the Sukorejo District, with criteria focusing on chipset, brand, features, and price. Data were collected through field surveys, technician interviews, and literature reviews from relevant scientific journals. The tools used included a digital signal finder, *JAGI* antenna, and a *matrix*-branded STB installed at a fixed height of 5 meters above ground level. Data collection was quantitative, utilizing checklists for user location, chipset type, signal strength (beam), and Bit Error Rate (BER). The *Analytical Hierarchy Process* (AHP) was employed to analyze the data. AHP structured the decision-making hierarchy, conducted pairwise comparisons, calculated eigenvector weights, and determined the final

score of each alternative. The consistency of results was evaluated using the Consistency Ratio (CR), with a threshold of < 0.1 to ensure validity. *White-box* testing was used to verify the internal logic of the system's algorithm. The web-based system was developed using *javascript* for the user interface and *python* for AHP calculations. The website includes input forms for location and feature preferences, displaying STB recommendations based on user input. White-box testing yielded a total score of 0.6673 for the GX6605 STB, confirming the reliability and accuracy of the system in supporting effective decision-making.

4. FINDINGS AND DISCUSSION

4.1 AHP Weight Calculation Results

The following are the steps for calculating the AHP method:

Table 1. Comparison of Paired Criteria Matrices on a Point Scale AHP

Criteria	Brand	Price	Chipset	Features
Brand	1	3	5	3
Price	0.333	1	3	1
Chipset	0.200	0.333	1	0.333
Features	0.333	1	3	1

Sum the values of each column of the criteria matrix values above.
Chipset : 1 + 0.14 + 5 + 0.2 = 6.34
Features : 3 + 1 + 3 + 5 = 12.00
Brand : 3 + 5 + 0.71 + 3 = 11.71
Price : 7 + 7 + 1 + 1 = 16.0

Table 2. Calculate Element Value

Criteria	Brand	Price	Chipset	Features
Brand	0.4837	0.5294	0.4545	0.5000
Price	0.1612	0.1765	0.2727	0.1667
Chipset	0.0967	0.0588	0.0909	0.0556
Features	0.1612	0.1765	0.1818	0.1667

Sum the values of each column of the criteria matrix values above.
Chipset : 1 + 0.14 + 5 + 0.2 = 6.34
Features : 3 + 1 + 3 + 5 = 12.00
Brand : 3 + 5 + 0.71 + 3 = 11.71
Price : 7 + 7 + 1 + 1 = 16.0

Table 3. Criteria Weighting Values

Criteria	Weight
Brand	0.4649
Price	0.2121
Chipset	0.1074
Features	0.2156

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Based on the above data, the calculation is as follows:
Chipset : (0.1577+0.25+0.2562+0.4375)/4 = 0.2754
Features : (0.0221 + 0.0833 + 0.4268 + 0.4375) / 4 = 0.2424
Brand : (0.7885+0.25+0.0606+0.0625)/4 = 0.2904
Price : (0.0315+0.4167+0.2562+0.0625)/4 = 0.1917

Table 4. Maximum Eigen Value

Criteria	Number of Columns	Eigenvector weights
Chipset	6.34	0.4825
Brand	12.00	0.2424
Features	11.71	0.2904
Price	16.00	0.1917

$\lambda maks = (6.34 \times 0.2754) + (12.00 \times 0.2424) + (11.71 \times 0.2904) + (16 \times 0.1917)$
$= 1.7464 + 2.9088 + 3.4014 + 3.0672 = 11.1238$

$CI = (\lambda max - n) / (n - 1) = (11.1238 - 4) / 3 = 7.1238 / 3 = 2.3746$
RI (for $n = 4$) $= 0.90$
$CR = CI / RI = 2.3746 / 0.90 = 2.6384$

Based on the following criteria rankings:
1. Brand = 0.2904
2. Chipset = 0.2754
3. Features = 0.2424
4. Price = 0.1917

4.1.1 web programming design

In conducting research, researchers go through several stages. These stages are explained as follows:

1. Problem formulation

Researchers formulate problems based on the results of surveys conducted at the research site with technicians who are competent in their fields.

2. Literature study

Researchers review previous journals and articles related to the topic of the problem.

3. Site survey and interviews

Researchers conduct a survey at Agus Electronics Store, which serves as the research activity center, to collect field data.

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4. White Box Testing Planning

Testing was conducted using the white box approach, which involves examining the program logic and calculation flow comprehensively.

5. Data Processing

The researcher processed the data using the AHP method to calculate the final ranking based on categories that refer to the data

6. Conclusion

The conclusion discusses the results of the research design structure based on the data that will be inputted.

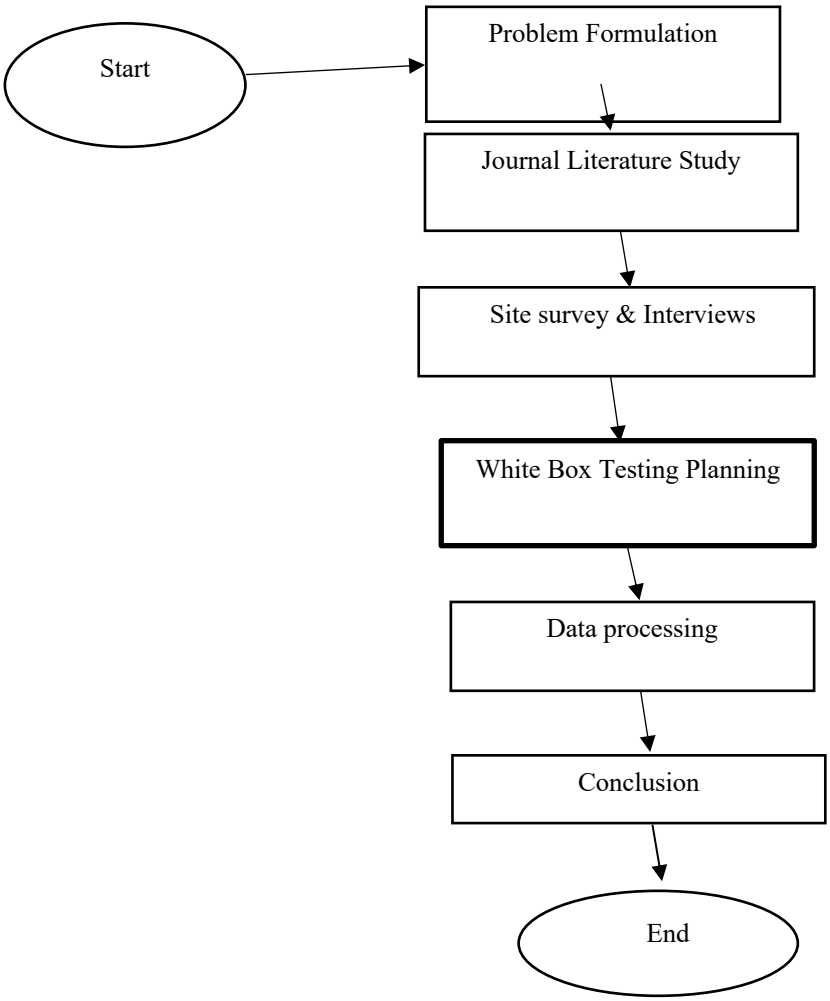


Figure 1. Research Stages Flowchart

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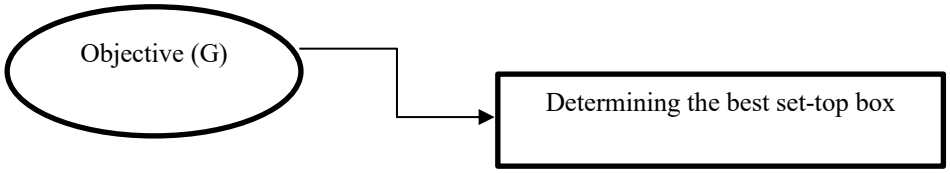


Figure 2 Decision Hierarchy Flowchart

he decision hierarchy structure is based on four main criteria, namely price, brand, chipset, and features. The main objective is to determine the best *set top box* (STB).

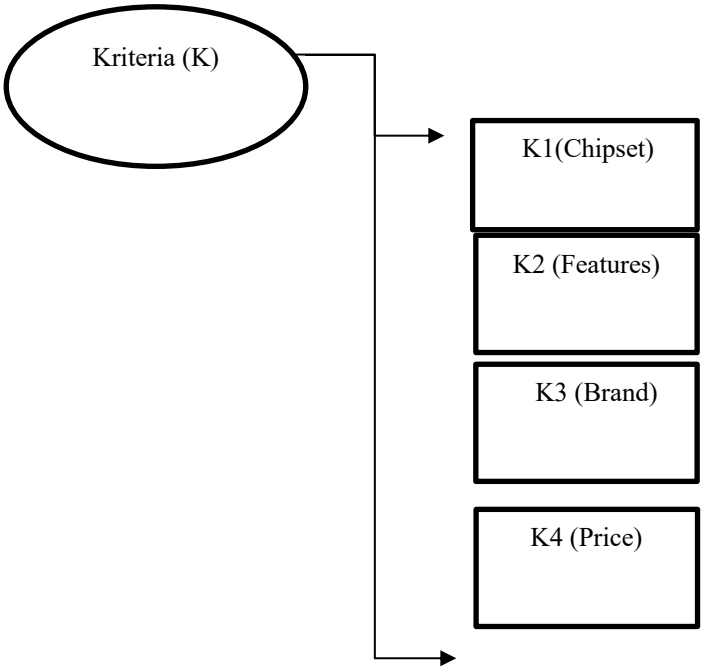


Figure 3. Criteria Flowchart

The criteria are divided into four categories: chipset, features, brand, and price.

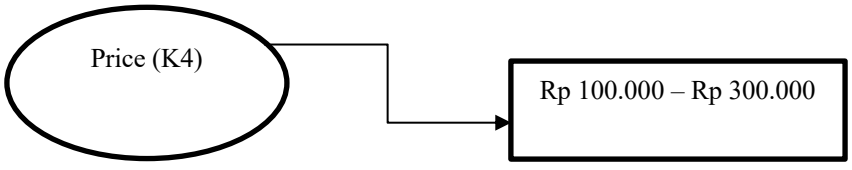


Figure 4. Price Flowchart

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Price (K4) with price options ranging from Rp100.00 – Rp 300.000

5. DISCUSSION

1. Application of the AHP Method

In this study, the *Analytical Hierarchy Process* (AHP) method was applied to determine the best choice from various brands and types of set-top boxes based on several criteria, namely chipset, features, brand, and price. The AHP method was chosen because it can provide decision solutions through weighting and pairwise comparisons. The process began by establishing a decision-making structure consisting of selecting the best STB, evaluation criteria (chipset, features, brand, and price), and decisions in the form of several types of STBs commonly used by the public. Each criterion is then compared one by one in pairs to evaluate various criteria against each other. Weight calculations are performed on each criterion to determine the priority of each evaluation aspect. The calculation results show that the brand criterion has the highest weight, followed by chipset, features, and price.

2. White Box Testing

The white box testing shown in the code above is an implementation of the *Analytical Hierarchy Process* (AHP) method to calculate the total score of a GX6605 model *set-top box* (STB) device. This test focuses on the internal logic and calculations in the JavaScript and Python code.

D: > skripsi ivan > whitebox.html > ...

```html
<!DOCTYPE html>
<html>
<head>
  <title>White Box AHP Test</title>
</head>
<body>
  <h2>Hasil Pengujian White Box AHP</h2>
  <div id="hasil"></div>

  <script>
    // Bobot dari hasil AHP pada Tabel 3.6 dan 3.7
    const bobot = {
      chipset: 0.2754,
      fitur: 0.2424,
      merek: 0.2904,
      harga: 0.1917
    };

    // Nilai dari STB (misal STB GX6605) -> dari Tabel Bab 4.1.2
    const STB = {
      chipset: 0.92,          // skor langsung
      fitur: 1,               // Internet = 1, Tidak = 0
      merek: 1 / 16,          // satu dari 16 merek
      harga: (300000 - 140000) / (300000 - 100000) // semakin murah semakin bagus
    };

    // Fungsi penghitungan skor total
    function hitungSkor(data, weight) {
      const skor =
        (data.chipset * weight.chipset) +
        (data.fitur * weight.fitur) +
        (data.merek * weight.merek) +
        (data.harga * weight.harga);

      return skor.toFixed(4); // dibulatkan 4 desimal
    }
```

Figure 5. White Box Testing Coding

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The calculation function then takes these values and calculates the total score by multiplying each STB criterion value by its respective criterion weight, then adding the results together. After that, the score is rounded to four decimal places. The output result of this white box test is "STB GX6605 Total Score: 0.6673".

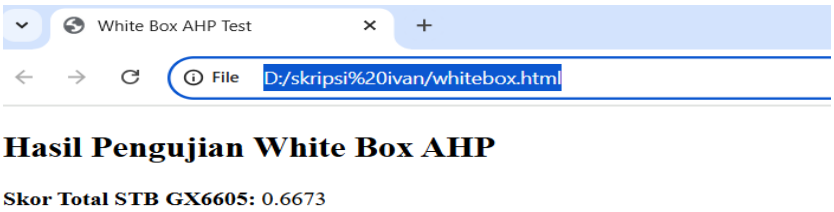


Figure 6. Output Score

2. Programming Design

```
skripsi ivan > hitungan.py > stb
# Bobot dari hasil AHP (Tabel 3.6 - 3.7)
bobot = {
    "chipset": 0.2754,
    "fitur": 0.2424,
    "merek": 0.2904,
    "harga": 0.1917,
    "sinyal": 0.15
}

# Contoh satu data STB
stb = {
    "chipset": "GX6605",
    "chipset_skor": 0.92,
    "fitur": "Internet",
    "jumlah_merek": 1,
    "max_merek": 16,
    "harga": 140000,
    "max_harga": 300000,
    "min_harga": 100000,
    "sinyal": 4   # misalnya daerahnya sinyal 4 dari 5
}

# Hitung skor normalisasi
skor_chipset = stb["chipset_skor"]
skor_fitur = 1 if stb["fitur"] == "Internet" else 0.5
skor_merek = stb["jumlah_merek"] / stb["max_merek"]
skor_harga = (stb["max_harga"] - stb["harga"]) / (stb["max_harga"] - stb["min_harga"])
skor_sinyal = stb["sinyal"] / 5

# Hitung skor total
skor_total = (
    bobot["chipset"] * skor_chipset +
    bobot["fitur"] * skor_fitur +
    bobot["merek"] * skor_merek +
    bobot["harga"] * skor_harga +
    bobot["sinyal"] * skor_sinyal
```

Figure 7. Web Programming Coding

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The above program is a web application that aims to provide recommendations for the best *set-top boxes* based on the user's location using JavaScript programming language. This web program consists of a user interface for entering location data (subdistrict and hamlet) and internet feature requirements, then processing the data using a weighted calculation method, namely the *Analytic Hierarchy Process* (AHP). The *set-top box* data set includes 11 types of chipsets such as Mstar 7700, Mstar 01, GX6701, Surplus, GX3235S, 2519, Gemini, GX6605, Montage, Gauvin, and G703x5.

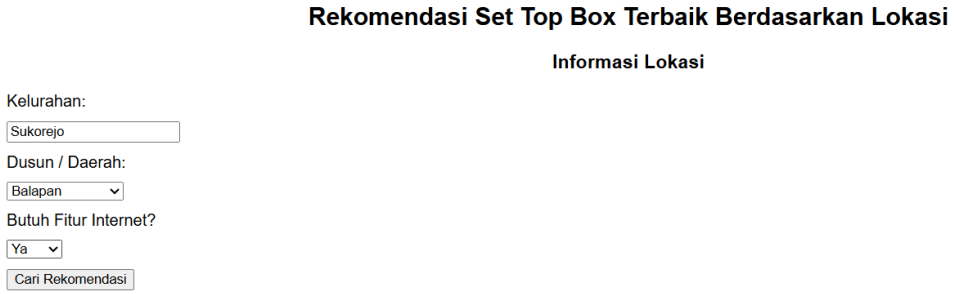


Figure 8. Main Home Page

The main home page displays a form that includes the sub-district, hamlet, internet features or not, and search recommendations for the type of *set-top box* brand.

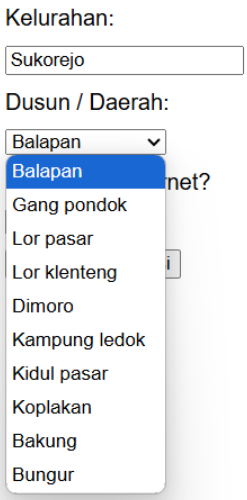


Figure 9. Subdistrict and hamlet features

In the subdistrict and hamlet features, users can fill in the form according to their respective places of residence by clicking “Hamlet/Area,” which will bring up a list of area names from which they can select a location.

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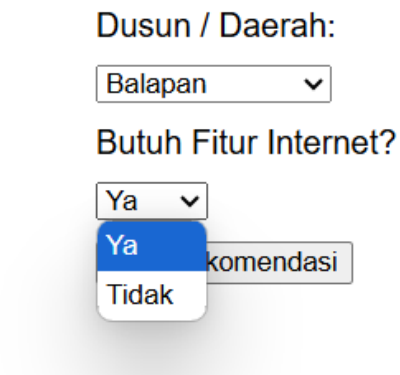


Figure 10. Internet Enabled features

With Internet enabled features, users can select the quality of the set-top box by clicking "Yes/No" to display the corresponding set-top box brand data.

Cari Rekomendasi

Rekomendasi Set Top Box

No	Chipset	Merek	Fitur	Harga	Skor Rekomendasi
1	GX6701	Noise, Aldo, Elynx, Force, T2, Intra, Luby 01, Lumax, Matrix burger, Rime, Hinomaru, VDR, Acces, Kubik, Super HD, Wellhome	Internet	Rp 120.000	0.927
2	Gemini	Luby 03, Myvo, Openta, Tafware	Internet	Rp 130.000	0.596
3	Surplus	SOGO biru, DVB T2, Finito, Goldstat revo, Goto, Mitsonic, Venus brio	Digital	Rp 130.000	0.557
4	Mstar 7700	D colour, Evercross Max, HD TV, Sogo merah, TNT	Digital	Rp 100.000	0.527
5	2519	Advance 02	Internet	Rp	0.516

Figure 11. Recommendation Search Feature

The recommendation search feature displays a list of *set top box* brands ranging from low to high prices, adjusted according to their quality score.

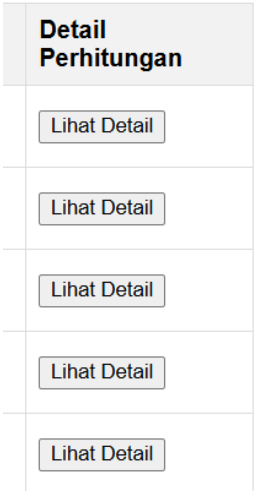


Figure 12. Calculation Details Feature

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In the calculation feature, users can view detailed calculation data for each type of set top box by clicking on one and then pressing "view details," which will display the complete formula for the final score.

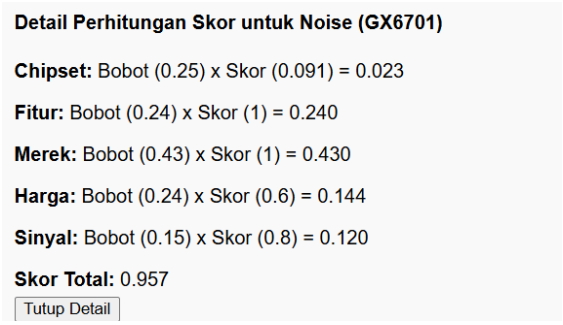


Figure 13. Detailed Calculation Results

After the user presses the "view calculation" button, the results will appear, starting from the chipset, features, brand, price, and signal for each selected set-top box.

This research began with data collection through field surveys and direct interviews with technicians from AEB Electronics Store in Blitar City. The researcher identified areas with varying digital signal strengths and recorded the characteristics of each location based on beam strength. This process included collecting signal strength data, identifying the types of chipsets in several brands of set-top boxes (STBs), and documenting signal reception results at several user locations. Additionally, the researcher developed a hierarchical structure for the application of the Analytical Hierarchy Process (AHP) method. During the study, there were several challenges, particularly when collecting data in the Sukorejo sub-district with weak signals, which caused measurement processes to become unstable. To address this, the researcher selected measurement times during periods of low signal interference by conducting repeated measurements at the same location. The findings of this study are a web-based system design that not only presents set-top box recommendation results but also displays additional features such as a user location form, internet feature requirements options, and detailed final score calculation results. Based on the results processed using the AHP method, the GX6605 set-top box achieved the highest total score of 0.6673, making it the best recommendation for areas with low signal strength. This demonstrates that the AHP method is effective in generating optimal choices tailored to user needs and geographical conditions.

6. CONCLUSION

The application of the *Analytical Hierarchy Process* (AHP) method in this study is able to provide valid decision-making solutions that can produce weight values in determining the most suitable *set-top box* based on signal conditions (BEAM) at each user location. Testing the AHP method using a white box provides more efficient calculation results for calculating the criteria weights and total scores of each set-top box alternative. In creating the website, there are still restrictions on certain sub-district locations in determining the best set-top box, which will require data development that can be

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expanded to other areas. The web display needs changes in terms of design and other features that can attract users when they want to access the system.

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