Android-Based Intangible Cultural Heritage Expert System
In Banten Province Using Backward Chaining Method

I Purwanto, H Y Fauziah*, M Subali, M Andriansyah, D Saptono, A I Sukowati and H Hanifah
Informatics engineering, Sekolah Tinggi Teknik Multimedia Cendekia Abditama (STTMCA), Tangerang - Indonesia
*Email : helmi@cendekia.ac.id

Abstract. Expert system is a system used to assist decision making that works by using the knowledge and analysis methods that have been defined by the expert. Intangible cultural heritage is a living cultural heritage that is recognized by some communities, groups or individuals. Banten Province has an intangible cultural heritage, but many people do not know there is many kinds of intangible cultural heritage that exist in Banten Province. The purpose of this paper is to make an Android-Based Intangible Cultural Heritage Expert System in Banten Province Using the Backward Chaining which is useful as a medium for the introduction of intangible cultural heritage that can be accessed easily. The software used is the Android Studio IDE which is installed with the Android SDK. The process of making an intangible cultural heritage expert system uses several stages, namely analysis, design, coding, implementation, and testing. The output of this research is that the application can be installed on an Android smartphone and data can be accessed offline.

1. Introduction
Intangible cultural heritage is scattered throughout Indonesia, which has become the identity of the area, one of which is in Banten Province. Banten is rich in intangible cultural heritage which contains ancestral values, for example, such as traditional musical instruments that have distinctive sound compositions and those instruments used for certain ritual activities. However, in the modern era, intangible cultural heritage has begun to be shifted.

The public interest in recognizing intangible cultural heritage (intangible) is also reduced due to social changes triggered by technological sophistication. Along with the times, various kinds of systems have emerged and were created to help identify a problem. The system not only provides information about an object, but can also handle object recognition problems based on characteristics and symptoms. This system is called the Expert System.

Expert system is a computer based system using knowledge, facts, and reasoning techniques in solving problems that usually can only be solved by an insider certain fields. Expert system add value to technology to assist in handle the increasingly information age sophisticated [1]. Expert System is a system that is intended to assist decision making that works using the knowledge and analysis methods that have been defined by the expert. This system has an absolute component that must exist, namely a knowledge base that comes from experts, a database that contains all the facts, an inference engine that contains a system of thinking and reasoning mechanisms used by experts, and a user interface that
connects the expert system with the user with questions. "Yes / no" or in the form of an option. In the inference engine, there are two patterns of reasoning, one of which is Backward Chaining.

Backward chaining is a reasoning backward, where work from the goal or goal which is in the section THEN, then match the facts in the section IF whether it is in accordance with the objectives or not to get a conclusion. If it matches it will be processed, otherwise it will be repeated [2]. The process ends when the destination is found. In backward chaining, reasoning starts from consequent to antecedent. Trace back to work backward to get facts that support the hypothesis [3]. In this research, the Depth First Search method is used which will carry out a deep search of the rules from the root node moving down to the inner level sequentially [4]. Backward Chaining is a search strategy in the opposite direction of forward chaining. The research process starts from the goal, namely the conclusion that becomes the solution to the problems at hand [5].

The research conducted by Cantika determined backward chaining as a method used to determine the nutritional composition system for cattle feed [6]. In a study conducted by Maradesa, it was explained that an expert system can help cataract patient to be diagnose the impact and to know the solutions and problems [7].

Based on this background, the author plans to make an Android-based Intangible Cultural Heritage Expert System in Banten Province Using the Backward Chaining Method which can be used as a medium for the introduction of intangible cultural heritage in Banten Province more easily. Expert system created using the android studio application as an IDE (Integrated Development Environment), and the Java Programming Language.

2. Methodology

2.1. Expert System

Some definitions of expert systems are:

- According to Durkin, the expert system is a computer program designed to model the problem-solving skills by an expert.
- According Ignizio, an expert system is a model and procedures relating, in a particular domain, where the level of expertise that can be compared with the expertise of a specialist.
- According Giarrantano and Riley, an expert system is a computer system that could match or mimic the ability of an expert.
- According to Turban, an expert system is a software package of decision making or problem solving that can achieve performance levels comparable or even better with a human expert in some specialized fields, and usually narrow problem area [8].

Expert systems or knowledge-based systems are part of artificial intelligence that allows computers to process and derive conclusions from a set of rules [9]. This system works by using knowledge and analysis methods that have been defined in advance by experts in accordance with their field of expertise. This system is called an expert system because it has the same function and role as an expert who must have knowledge and experience in solving a problem. The system usually functions as an important key that will help a decision support system or executive support system [10].

2.2. Intangible Cultural Heritage

Intangible cultural heritage is a practice, representation, expression, and knowledge and skills (including instruments, objects, artifacts, cultural space), that communities, groups and in some cases individuals recognize as part of their cultural heritage. Individuals who claim to be a cultural heritage are called living cultural heritage. UNESCO classifies intangible cultural heritage into several categories as follows; oral traditions and expressions, performing arts, practices (social, rituals and festivals), knowledge and practice about nature and the universe, traditional skills [11].
2.3. Backward Chaining

Backward Chaining is an inference technique. Goal-driven technique starts from the goal to reach the data and proves if it supports the hypothesis [12]. In this approach, tracking starts from the goal, then searches for rules that have that goal for the conclusion. Next process tracking using the premise for the rule as a new goal and looking for another rule with a new goal as the conclusion. The process continues until all possibilities are found. Backward Chaining is inference that works backward towards the initial conditions. The process begins with Goal (which is in the THEN section of the IF-THEN rule), then a search is started to match whether the facts match the premises in the IF section. If it fits, the rule is executed, then the hypothesis in the THEN section is placed in the database as a new fact. If they don't match, save the premise in the IF section to the stack as a sub Goal. Process ends if Goal is found or there are no rules that can prove the truth of the subGoal or Goal [13].

2.4. Android Studio

Android Studio is Environment The official Integrated Development Environment (IDE) for Android application development, which is based on IntelliJ IDEA. Apart from being a powerful code editor and IntelliJ developer tools, Android Studio offers many features that increase your productivity in building Android applications [14].

2.5. System Development Life Cycle (SDLC)

SDLC is a work stage that aims to produce a high quality system in accordance with the wishes of the customer or the purpose of the system. SDLC is a framework that contains the steps that must be taken to process the development of a software. This method contain complete plan to develop, maintain, and replace specific software [15].

3. Research Methodology

3.1. Research Object

Legacy culture not object (intangible) is a living cultural heritage that is recognized by some communities, groups and individuals. UNESCO classifies intangible cultural heritage into several categories, namely traditions and oral expressions, performing arts, practices (social, rituals and festivals), knowledge and practice about nature and the universe, traditional skills.

3.2. Research Methods

The method that researchers used in this research is the System Development Life Cycle (SDLC) with the Waterfall model. The method used consists of 6 parts, namely:

- Needs Analysis
- Design
- Encoding
- Implementation
- Testing
3.3. Stage of Making the Applications

The following are the stages of making an application which can be seen in the Figure 1.

- **Data and Information Collection**
  The stage begins with collecting data and information related to making Android applications.

- **Android Design**
  At this stage the authors designed the workflow and work system to be used in the APK.

- **Interface Design**
  The Android Interface design stage is to make the application comfortable to use by the user.

- **Creating an Android Interface**
  After designing, then the writer made the display design and logo.

- **Preparing Data**
  The amount of data prepared was 30 intangible cultural heritages in Banten Province.

- **Analyze Data**
  The next step is to classify intangible cultural heritage by creating a database and a decision tree.

- **Data Results**
  At this stage, the data obtained from the analysis will be imported into the Android Studio application.

- **Import Android UI design and Data to Android Studio**
  After the data, logos and images are obtained, they are imported into Android Studio.

- **Android-Based Application Development**
  The next step is to create an Android-based application by entering program listings and setting the UI appearance in Android Studio.

- **Implementation of Coding**
  After the design and program listing is complete, the next stage is coding with Java and XML to arrange the application according to the wishes both in terms of appearance and program listing.

- **Build into APK**
  The build stage is the application project stage that Android Studio builds can run on an Android device.

- **Trial APK on Android**
  The last stage is the implementation and testing of finished applications on Android smartphones.

4. Results and Discussions

4.1. Need Analysis

The data needed in designing the Expert System application is intangible cultural heritage in Banten Province. The hardware and software requirements include a laptop with a minimum of 4GB RAM, the Android Studio application.

4.2. Design

4.2.1. Flowchart

The flowchart is the flow of the Android application that will be created as shown in Figure 2. The Flowchart model is an illustration of the APK file workflow that is installed on an Android device. There is a main page with 5 buttons that represent their respective functions, there is a start button to start an expert system, a guide button, information and about which has a flow for reading how to use,
reading information and about the application being made. And finally the exit button is to end the use of the application (See Figure 1).

![Flowchart Model](image-url)

**Figure 1. Application Making Stages**

![Flowchart Model](image-url)

**Figure 2. Flowchart Model**
4.2.2. Data Table

The data in the table is a representation of knowledge that comes from facts obtained from an expert in row and columns. From Table 1, we can see that the musical instruments and their characteristics are related, for example CAM1 (bamboo) is one of the characteristics of AM1 (Angkulung Buhun) and AM5 (Pantun Bamboo).

**Table 1. Musical Instrument Data Table**

| Musical Instrument Characteristics | AM1 | AM2 | AM3 | AM4 | AM5 |
|-----------------------------------|-----|-----|-----|-----|-----|
| CAM1                              | x   |     | x   |     |     |
| CAM2                              |     | x   |     | x   |     |
| CAM3                              |     | x   |     |     |     |
| CAM4                              | x   |     |     |     |     |
| CAM5                              | x   | x   |     |     |     |
| CAM6                              |     |     |     | x   |     |
| CAM7                              |     |     |     | x   |     |
| CAM8                              | x   |     |     |     |     |
| CAM9                              |     |     |     |     | x   |
| CAM10                             | x   |     |     |     |     |
| CAM11                             |     |     |     |     | x   |
| CAM12                             | x   |     |     |     |     |
| CAM13                             |     |     |     |     | x   |
| CAM14                             | x   |     |     |     |     |
| CAM15                             |     |     |     | x   |     |
| CAM16                             |     |     |     |     | x   |

**Table 1. Description:**

**Musical Instrument**
- AM1 = Angklung Buhun
- AM2 = Bedug
- AM3 = Bendrong Lesung
- AM4 = Dogdog Lojor
- AM5 = Pantun Bamboo

**Musical Instrument Characteristics**
- CAM1 = Bamboo
- CAM2 = Wood and Skins
- CAM3 = Wood
- CAM4 = Shaken
- CAM5 = Beaten
- CAM6 = Pounded with Pestle
- CAM7 = Beaten with a Stick
- CAM8 = Once a Year
- CAM9 = Month of Ramadhan
CAM10 = Rice Processing
CAM11 = After Working in Rice Fields
CAM12 = Ornamental Rice Trunks
CAM13 = Professional Person
CAM14 = Like a Boat
CAM15 = Sounds “dog.. dog..”
CAM16 = Sounds Similar to Patingtung Accompaniment

4.2.3. Rule Table

Rule table is information of new facts built from existing facts. Rule uses an IF-THEN rule base to present expert knowledge on a particular problem [16]. For detail can be seen in Table 2.

Table 2. Table of Musical Instrument Rules

| No. | Rule |
|-----|------|
| 1. | **IF** Bamboo and Shaken and Once a Year and Ornamental Rice Trunks **THEN** Angklung Buhun |
| 2. | **IF** Wood&Skins and Beaten and Month of Ramadhan and Professional Person **THEN** Bedug |
| 3. | **IF** Wood and Pounded with Pestle and Rice Processing and Like a Boat **THEN** Bendrong Lesung |
| 4. | **IF** Wood&Skins and Beaten and Sounds “dog..dog..” **THEN** Dogdog Lojor |
| 5. | **IF** Bamboo and Beaten with a Stick and Sounds Similar to a Patingtung Accompaniment and After Working in Rice Fields **THEN** Pantun Bamboo |

4.2.4. Decision Tree

Decision Tree is similar to the human decision-making process and so that it is easy to understand. It can solve in both situations whether one has discrete or continuous data as input [17]. A tree is a hierarchical structure consisting of nodes that store information and branches that connect the nodes. The decision tree makes it easy to make decisions. For detail be seen in Figure 3.

Figure 3. Musical Instrument Decision Tree [18]
4.3. Encoding

Coding, namely entering programming language script coding into the application project that is being created, the author uses the Java programming language and Extensible Markup Language (XML) as a programming language to create Android applications through Android Studio.

4.4. Implementation

Implementation is carried out after the design is complete done and next will implemented in the programming language that will be used. The aim of implementation is to confirm the design module is running as it should. Can be seen in Figure 4 until Figure 12.

| Splash Screen Interface | Main Page Interface | Category Page Interface |
|-------------------------|---------------------|------------------------|
| ![Splash Screen Interface](image1) | ![Main Page Interface](image2) | ![Category Page Interface](image3) |

**Figure 4. Splash Screen Page**  **Figure 5. Main Page**  **Figure 6. Category Page**

| Object Page Interface | Expert System Page Interface | Object Description Page Interface |
|-----------------------|-----------------------------|----------------------------------|
| ![Object Page Interface](image4) | ![Expert System Page Interface](image5) | ![Object Description Page Interface](image6) |

**Figure 7. Object Page**  **Figure 8. Expert System Page**  **Figure 9. Object Description Page**
4.5. Application Testing

At this stage the writer will test the application that has been completed. Application testing is a critical element of application quality assurance and provides key reviews of specification, design and coding. Testing will be done by testing the application in alpha and beta.

4.5.1. Alpha Testing Results

Based on the test plan that has been prepared, the following test results can be seen in Table 3.

| No.  | Test Item          | Test Details                                  | Test Results |
|------|--------------------|-----------------------------------------------|--------------|
| 1.   | Splash Screen      | Displays the title of the application         | Successful   |
| 2.   | Main Menu          | Displays the main page of the application     | Successful   |
| 3.   | Category           | Displays the category menu                    | Successful   |
| 4.   | Object             | Displays the object menu                      | Successful   |
| 5.   | Expert System      | Displays questions with “yes/no” Process inquiries | Successful |
| 6.   | Object Description | Displays the object description                | Successful   |
| 7.   | Guide              | Displays a guide on how to use the application | Successful   |
| 8.   | Information        | Display intangible information                 | Successful   |
| 9.   | About              | Displays information about the application    | Successful   |
| 10.  | Exit               | Exit the application                          | Successful   |
Based on the results testing with blackbox that has been done, the authors conclude that the application can work and produce the expected output, no errors or errors are seen.

4.5.2. Beta Testing Results

Based on a questionnaire that has been made with fast variables, namely an assessment of the display, user convenience, system performance, and content, the results can be seen in Table 4.

| Table 4. The Results of The Questionnaire [19] |
|------------------------------------------------|
| **No.** | **Display** | **Answer Frequency** | **Index %** |
| 1. | Color composition | SS 8 S 11 N 1 TS STS | 84 |
| 2. | Clarity of existing text | SS 6 S 14 N 4 TS | 86 |
| 3. | Display / image variations | SS 5 S 11 N 4 TS STS | 81 |
| 4. | Display quality | SS 5 S 11 N 3 1 TS STS | 80 |
| 5. | Clarity of the questions given | SS 6 S 12 N 2 TS STS | 84 |

**Index Average Display**

| **No.** | **User Convenience** | **Answer Frequency** | **Index %** |
| 1. | Easy of installing applications | SS 7 S 9 N 3 1 TS STS | 80 |
| 2. | Easy of operating the applications | SS 6 S 13 N 1 TS | 85 |
| 3. | Easy of understanding the results | SS 4 S 15 N 1 TS | 83 |

**Index Average User Convenience**

| **No.** | **System Performance** | **Answer Frequency** | **Index %** |
| 1. | Feedback given after giving an answer | SS 6 S 13 N 1 TS STS | 82 |
| 2. | Speed to display the information | SS 8 S 10 N 2 TS STS | 86 |

**Index Average System Performance**

| **No.** | **Content** | **Answer Frequency** | **Index %** |
| 1. | System Objectives | SS 3 S 15 N 1 1 TS STS | 80 |
| 2. | The information provided is in accordance with the needs and objectives | SS 6 S 12 N 2 TS STS | 84 |

**Index Average Content**

From Table 4, it can be concluded that the average index value of display variables is 83%, user convenience variables are 82.67%, system performance variables are 84%, and content variables are 82%. The four variables fall into the "Strongly Agree" category so that the application is feasible to use. Beta testing is done using a Likert scale. The original Likert scale is a set of statements (items) offered for a real or hypothetical situation under study. Participants are asked to show their level of
agreement (from strongly disagree to strongly agree) with the given statement (items) on a metric scale. Here all the statements in combination reveal the specific dimension of the attitude towards the issue, hence, necessarily inter-linked with each other [20]. The percentage field of the four variables is shown in Figure 13.

![Graph of Questionnaire Results](image-url)

**Figure 13. Percentage of Four Variable Questionnaire Results**

5. **Conclusion**

From this research, several conclusions can be drawn, namely:

- Expert System for Intangible Cultural Heritage in Banten Province Based on Android Using the Backward Chaining Method, successfully created with Android developer tools Studio, and with the Java and XML programming languages.
- Based on alpha testing using the blackbox method, this application has been able to work and produce the expected output. Based on the beta test using the Likert scale, this application falls into the very agreeable category in terms of display 83%, convenience 82.67% users, 84% system performance, and 82% content so that the application is suitable for use as a medium for the introduction of intangible cultural heritage in Banten Province.

**References**

[1] Tarigan A F 2014 Sistem Pakar untuk Mendiagnosa Penyakit Ginjal dengan Metode Backward Chaining TIMES Journal 3 (2) 25-29

[2] Bahl N and Kapoor N 2016 Comparative Study of Forward and Backward Chaining in Artificial Intelligence. International Journal Of Engineering And Computer Science International Journal of Engineering and Computer Science 5 (4) 16239-16242

[3] Mukhtar N and Samsudin 2015 Sistem Pakar Diagnosa Dampak Penggunaan Softlens Menggunakan Metode Backward Chaining Buana Informatics Journal 6 (2) 21-30
[4] Iriani S 2015 Penerapan Metode Backward Chaining pada Sistem Pakar Diagnosa Penyakit Tulang Manusia *IJNS – Indonesian Journal on Networking and Security* **4** (1) 51-55

[5] Al-Ajlan A 2015 The Comparison between Forward and Backward Chaining *International Journal of Machine Learning and Computing* **5** (2) 106-113

[6] Cantika Y E, Witanti W and Renaldi F 2016. *Proceedings of the 7th SNST 2016*.

[7] Maradesa E 2012 *Application of Backward Chaining Method for Disease Diagnosis Cataract* Gorontalo: Universitas Negeri Gorontalo

[8] Sasmito G W 2011 Application Expert System of Forward Chaining and The Rule Based Reasoning For Simulation Diagnose Pest and Disease Red Onion and Chili Plant. *Proceedings of The 1st International Conference on Information Systems For Business Competitiveness* 392-398

[9] Prasetyadi G C 2017 Web-Based Expert System Application To Recommend Computer Specifications For Gaming Using Backward Chaining Inference Method *Journal of Information Systems* **13** (2) 110-117

[10] Salman F M and Abu-Naser S S 2019 Expert System for Castor Diseases and Diagnosis. *International Journal of Engineering and Information Systems* *International Journal of Engineering and Information Systems* **3** (3) 1-10

[11] del Barrio M J, Devesa M and Herrero L C 2012 Evaluating intangible cultural heritage: the case of cultural festivals *City, Culture and Society* **3** (4) 235-244

[12] Alhammadi D A A 2010 *Developing Expert System for Diabetes Mellitus Patients* Riyadh: King Saud University

[13] Matyendra N A 2018 Perancangan Sistem Pakar Mendiagnosis Penyakit Kulit Pada Anak Dengan Menggunakan Metode Backward Chaining *Jursima* **6** (2) 6–17

[14] Gestwicki P and Ahmad K 2011 App inventor for Android with studio-based learning *Journal of Computing Sciences in Colleges* **27** (1) 55-63

[15] Guntamukkala V, Wen H J and Tarn J M 2006 An Empirical study of selecting software development life cycle models. *Human Systems Management* **25** (4) 265-278

[16] Wahyudi R and Prasetyo W D 2018 Implementing Forward, Backward Chaining and Certainty Factor in Responsive Web-Based Expert System of Cow Disease *International Journal of Informatics and Computer Science* **2** (1) 7-19

[17] Patel H H and Prajapati P 2018 Study and Analysis of Decision Tree Based Classification Algorithms *International Journal Of Computer Sciences And Engineering* **6** (10) 74-78

[18] Erdani Y 2012 Improving the Knowledge Performance using Ternary Grid Knowledge Acquisition and Model, WSEAS Transactions (Journals) on Information Science and Application *International Journal of Advanced Computer Science and Applications* **3** (2) 1-12

[19] Mohd C K and Shahbodin F 2015. Personalized Learning Environment: Alpha Testing, Beta Testing & User Acceptance Test. *Procedia-Social and Behavioral Sciences* **195** 837-843

[20] Joshi A, Kale S, Chandel S and Pal D K 2015 *Likert Scale: Explored and Explained* *Current Journal of Applied Science and Technology* **7** (4) 396-403