PROJECT PROPOSAL

A STEP BY STEP GUIDE

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PUBLISHED BY:
POLITEKNIK KUCHING SARAWAK
MINISTRY OF HIGHER EDUCATION
KM22, JALAN MATANG,
93050 KUCHING, SARAWAK.

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e ISBN 978-629-7638-47-8

Cataloguing-in-Publication Data

Perpustakaan Negara Malaysia

A catalogue record for this book is available from the National Library of Malaysia

eISBN 978-629-7638-47-8

PREFACE

Project Proposal: A Step-by-Step Guide is a practical and accessible resource aimed at helping diploma and undergraduate students, particularly those in technical and vocational education and training (TVET) programmes.

This book offers a clear and structured pathway for developing effective project proposals, emphasizing real-world applications and practical problem-solving.

It takes readers through each stage of the proposal-writing process, from choosing research topics and defining project scopes to selecting appropriate methodologies and creating well-organized documents.

To guide readers effectively, the book includes helpful tools like flowcharts, templates, and examples, ensuring that even complex concepts are easy to grasp and apply.

The content is divided into chapters, starting with an introduction to project proposals and progressing to sections on problem identification, literature review, methodology, and expected outcomes.

Each chapter is designed to guide readers step-by-step, with clear objectives, focused subtopics, and practical tips like using Boolean search operators and citation tools to streamline their work.

Although this guide is tailored for students tackling academic projects, it is equally beneficial for professionals and researchers looking to improve their proposal writing skills. By combining practical advice with real-world relevance, this book ensures that readers are prepared to meet both academic and professional expectations with confidence.

We hope that Project Proposal: A Step-by-Step Guide becomes a trusted resource for its readers, inspiring confidence and capability in writing project proposals. We welcome any feedback or suggestions to improve future editions of this guide and ensure it continues to meet the needs of its audience.

Dr. Jam'aah Binti Suud
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Francisca Anak Kevin Akeu

ABSTRACT

This book provides a thorough guide to writing a project proposal, offering clear instructions on every step of the process, from selecting a suitable topic to managing the project's costs. It begins by introducing the concept of a project proposal, covering its key elements, purpose, and structure.

The book then explains the project development process, with detailed sections on flowcharts, project types, key characteristics, and the skills required to write an effective proposal. It also offers practical advice on choosing the right project topic, as well as the importance of conducting proper research, referencing relevant materials, and applying effective search techniques, including strategies for finding technical articles and conducting literature reviews.

The book further explores the core content of a project proposal, guiding the writing of essential sections such as the introduction, project background, problem statement, objectives, scope, and expected outcomes. A significant focus is placed on conducting a literature review, including tips on systematic searching, selecting sources based on inclusion and exclusion criteria, and effectively using databases like Google Scholar. Examples are included to illustrate how to present the findings of a literature review.

In the methodology section, the book delves into project design, featuring clear explanations of block diagrams, flowcharts, hardware components, and software systems. It also highlights the importance of sustainability in project design, ensuring that systems are both efficient and environmentally conscious.

The project management chapter introduces essential tools like Gantt charts, milestone tracking, and budgeting techniques, all aimed at supporting successful project execution.

Finally, the book covers citation styles, including IEEE and APA, offering guidance on correct in-text citations and formatting reference pages. With practical advice, helpful examples, and a clear structure, this book is an invaluable resource for students, researchers, and professionals who need to develop and manage successful project proposals.

Keywords: Project Proposal, Literature Review, Methodology, Project Management, Reference Materials, IEEE, APA, Gantt Chart.

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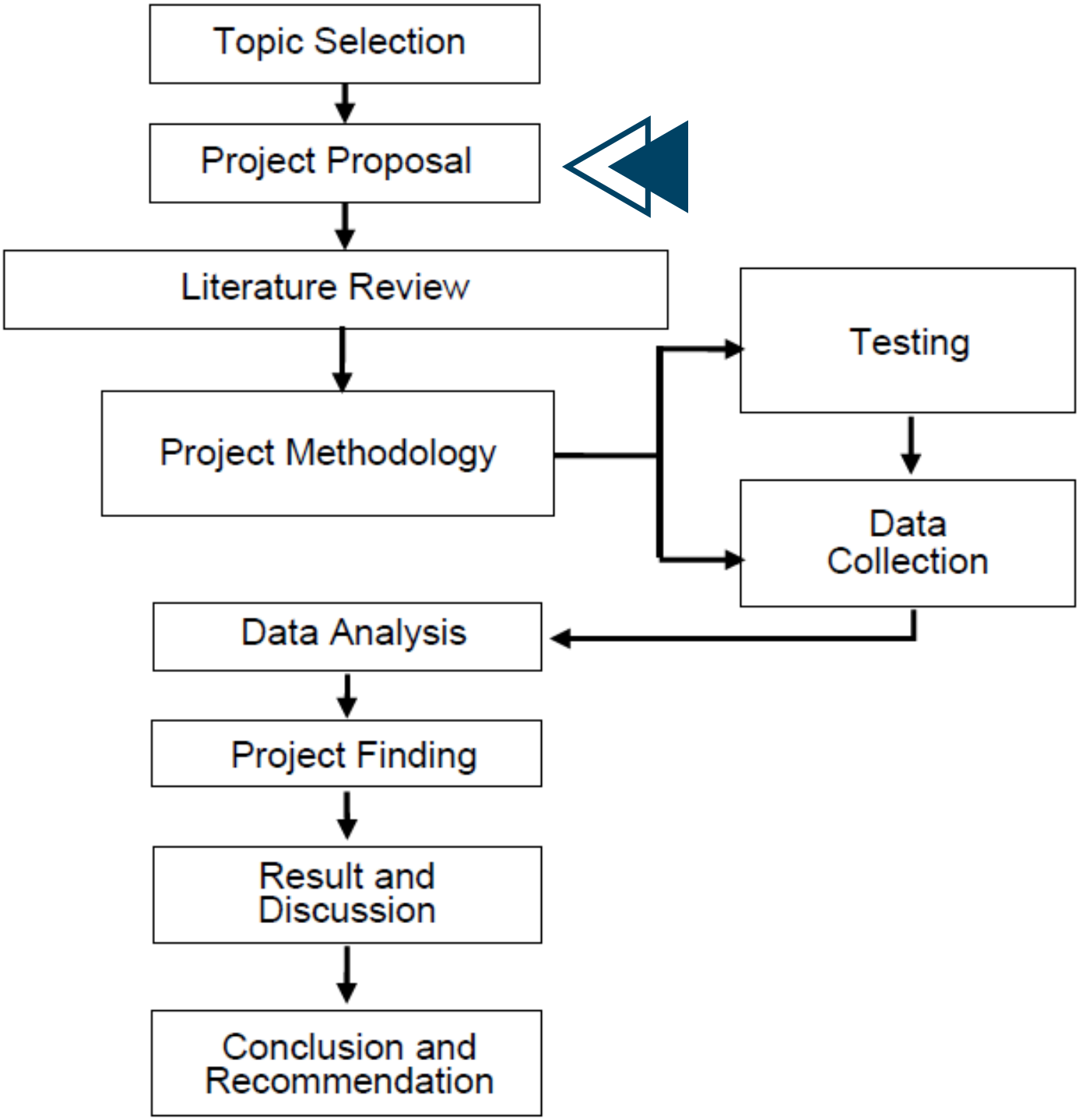
INTRODUCTION TO PROJECT PROPOSAL

PROJECT DEVELOPMENT FLOWCHART



PROJECT PURPOSES

1. **To identify existing problems**

The first step in any project is recognizing the challenges or issues in the current system, community, or field. This stage involves analyzing circumstances, conducting surveys or research, and understanding the root causes. For example, identifying inefficiencies in a process or gaps in knowledge forms the foundation for further action.

2. **Search for a solution**

After identifying the problem, the next step is to explore potential remedies or strategies to address it. This could involve brainstorming, reviewing existing methods, or innovating new solutions. The aim is to find feasible, practical, and effective ways to mitigate the identified issues.

3. Test the proposed solution

Once a solution is identified, verifying its efficacy and applicability is essential. This stage involves conducting experiments, pilot projects, or simulations to ensure the solution works under real-world conditions. Testing helps refine the solution and provides evidence of its practicality.

4. Make improvements in a particular field of knowledge and social life in the community

Finally, the project contributes to advancing knowledge and making a positive impact on the community. This purpose highlights the importance of enhancing societal welfare, improving quality of life, or addressing specific challenges in a specialized field. The findings or outcomes should offer tangible benefits to individuals or groups.

WHAT IS "PROJECT PROPOSAL"

What is a "Project Proposal"?
A **project proposal** serves as the initial and essential document that provides a detailed overview of the project. It acts as a blueprint that sets the foundation for the project's execution and evaluation. Below are its main aspects:

1. **An Initial Document with Project Details**
   The project proposal is the starting point in the project development process. It outlines the basic idea, purpose, and scope, giving stakeholders a clear understanding of what the project aims to achieve.

   2. A Comprehensive Plan
   The proposal goes beyond mere project initiation. It includes a structured and detailed plan, covering several critical components such as:

   i. **Project Background:**
   This section provides context for the project by explaining the history or circumstances that necessitate its implementation. It identifies existing challenges or gaps that the project seeks to address.

   ii. **Strategies to Find Answers:**
   This portion elaborates on the methods and approaches that will be employed to tackle the project objectives, including:

   a. **Project Problems:** Highlighting the specific issues that require solutions.
   b. **Project Questions:** Identifying the queries the project seeks to answer to ensure clarity and focus.
   c. **Significance of the Project:** Explaining the value and importance of the project to stakeholders and the community, emphasizing its contribution to knowledge or societal welfare.

   3. Document Length
   As per the "Buku Panduan Pelaksanaan Projek Pelajar (Program Diploma) Politeknik Malaysia Edisi 2021", the project proposal should be concise and limited to a maximum of 30 pages. This ensures that the document is detailed yet straightforward, providing all necessary information without being excessively lengthy.

BEFORE WRITING PROJECT PROPOSAL

BEFORE WRITING PROJECT PROPOSAL

Before embarking on the process of writing a project proposal, it is essential to conduct thorough groundwork. Proper preparation ensures that the proposal is well-structured, relevant, and addresses critical gaps in knowledge. Below is a detailed explanation of the key steps involved in the preparatory stage:

1. Identifying the Project Topic

The first and most crucial step is selecting a project topic that aligns with your interests, expertise, and the needs of the field. The topic should be:

i. Relevant to current issues or trends in your area of study.
ii. Unique enough to contribute to existing knowledge while being feasible for investigation.

2. Defining the Project Problem or Questions

The project problem highlights the gap in knowledge or the issue that needs addressing. It forms the basis of the entire proposal. To define this:

a. Clearly outline the challenge or question you aim to resolve.
b. Ensure it is specific, measurable, and directly related to your topic.

3. Setting Project Objectives

Project objectives are the goals you intend to achieve through your study. These should be:

a. Clear and concise.
b. Directly linked to solving the project problem or answering the project questions.
c. Realistic and achievable within the scope and time frame of the project.

4. Defining the Scope of Literature Review

The literature review provides context and justification for your project. To define its scope:

a. Focus on studies, theories, and data directly relevant to your project objectives.
b. Highlight gaps in existing project that your project aims to address.

5. Creating Search Keywords Based on Project Objectives

Effective search keywords are critical for finding relevant literature. To develop these:

a. Extract key terms and phrases from your project objectives.
b. Use tools like ChatGPT to refine and expand your keywords for better results.

6. Searching for Literature Sources

Once the keywords are ready, begin searching for academic resources. Use:

a. Online databases like Google Scholar, Scopus, or IEEE Xplore.
b. Institutional library resources for books, journals, and conference proceedings.

7. Building a Project Database in Mendeley

Organizing references is vital for managing your literature effectively. Use Mendeley or similar reference managers to:

a. Organize the Literature Review: Create folders for different subtopics or themes.
b. Create Citations: Automatically generate in-text citations and bibliographies.
c. Group Resources: Arrange materials based on relevance to your objectives.

8. Developing the Main Project Topic

Once you have a comprehensive understanding of the project area, develop a focused main topic. Ensure that it:

a. Reflects the central theme of your study.
b. Encapsulates the purpose and significance of your project.

9. Determining Subtopics

Subtopics break the main project topic into manageable sections, making the proposal more structured. To determine subtopics:

a. Identify key areas or aspects of the project problem.
b. Ensure each subtopic contributes to achieving the project objectives.

GUIDE TO CHOOSE PROJECT TOPIC

GUIDE TO CHOOSE PROJECT TOPIC

Selecting the right project topic is a crucial step in ensuring the success of your academic or professional endeavor. A well-chosen topic aligns with your interests, goals, and available resources while contributing meaningful insights to your field. Below are detailed steps to guide you:

1. Identify Your Interests

Start by considering areas that genuinely intrigue or inspire you. Choosing a topic that aligns with your personal or professional passions will keep you motivated throughout the project.

2. Review Existing Literature

Conduct a thorough review of relevant books, journals, and research articles to identify gaps or opportunities in existing knowledge. This step helps refine your understanding and provides context for your topic.

3. Consult with Your Academic Supervisor

Discuss your ideas with your supervisor or mentor. Their expertise and feedback can help you refine your topic and ensure it is academically or professionally relevant.

4. Consider Relevance

Evaluate the significance of the topic to your field of study, industry, or community. A relevant topic is more likely to make a meaningful impact and attract interest from stakeholders.

5. Narrow Down Your Scope

Avoid overly broad topics that may be difficult to address within the constraints of time and resources. Focus on specific aspects of a subject to ensure depth and clarity in your project.

6. Check Feasibility

Assess the practicality of conducting research on your chosen topic by considering:

a. Access to necessary resources (equipment, tools, etc.)
b. Availability of data and project materials
c. The time required to complete the project within the deadlines

7. Seek Inspiration from Current Issues

Explore recent trends or challenges in your field or community. Selecting a topic tied to current issues can enhance the relevance and timeliness of your project.

8. Address Industry and Community Problems

Consider targeting a project topic that solves real-world problems in industries or communities. This approach increases the likelihood of securing funding or support from organizations.

9. Align with Your Career Goals

Choose a topic that complements your career aspirations. For example, focus on a specific company or field you aim to work in. This approach not only builds expertise but also enhances your professional profile.

10. Leverage Personal Experience

Draw from your experiences in daily work, school, or institutional activities. Practical insights can provide unique perspectives and help you address familiar challenges effectively.

TYPE OF PROJECT

Understanding the types of projects available helps ensure your efforts are focused and aligned with your objectives. Below are two primary types of projects commonly undertaken in academic, institutional, industrial, or community settings:

1. Product-Oriented Projects

Definition: These projects focus on developing a tangible product, often in the form of a prototype. The objective is to create a functional item or system that addresses a specific need.

Examples:

i. Designing a prototype for an energy-efficient lighting system.
ii. Developing a mobile application for community services.
iii. Constructing a tool or machine to improve industrial processes.

Key Features:

iv. Utilization of appropriate and innovative technology.
v. Focus on functionality, efficiency, and usability.
vi. Often includes iterative testing and refinement to ensure the product meets the intended purpose.

2. Method-Oriented Projects

Definition: These projects involve creating or improving methods, processes, or approaches to solve specific problems. They may focus on new strategies or adaptations of existing methods.

Examples:

i. Developing a new teaching method for institutions.
ii. Improving workflow processes in industries.
iii. Implementing a community-based waste management system.

Key Features:

iv. Centered around problem-solving and innovation.
v. Can be applied to institutions, industries, or communities.
vi. Emphasis on efficiency, sustainability, and adaptability.

Application Contexts

Both product- and method-oriented projects can be applied across various contexts:

a. **Institutions**: Address challenges such as improving educational outcomes, administrative efficiency, or student engagement.
b. **Industries**: Solve operational problems, enhance productivity, or integrate new technologies into existing workflows.
c. **Communities**: Focus on social challenges like healthcare access, environmental sustainability, or economic development.

Summary

Whether you choose a product-oriented or method-oriented project, the aim is to address real-world problems with practical and innovative solutions. The type of project should be chosen based on the resources available, the target audience, and the impact you wish to achieve.

PROJECT CHARACTERISTICS

In planning and executing a successful project, it is essential to ensure the following characteristics are clearly defined and adhered to:

1. Clear Duration and Objectives

Every project must have a well-defined timeline, specifying the starting and ending points. Objectives should be SMART (Specific, Measurable, Achievable, Relevant, and Time-bound), ensuring clarity and focus on the desired outcomes.

2. Problem-Solving Focus

Projects should aim at identifying and resolving specific issues, whether they are societal, industrial, or environmental. This ensures relevance and applicability in the real-world context.

3. Industry and Community-Centric Approach

The project should align with the needs of industries or communities. Solutions should cater to improving productivity, and quality of life, or addressing pressing challenges within these settings.

4. Improvement and Enhancement

Projects should focus on enhancing or improving existing technologies, processes, or methods. Emphasis should be placed on modernization and upgrading rather than duplicating existing solutions.

5. Incorporation of Commercial Value

Leveraging cutting-edge technologies such as the Fourth Industrial Revolution, green and sustainable innovations, energy conservation, recycling, and ergonomics ensures commercial viability. Projects should also encourage entrepreneurship by introducing market-ready solutions.

6. Multidisciplinary Integration

Wherever applicable, projects should incorporate expertise from two or more disciplines. Multidisciplinary approaches foster innovation by combining diverse skills and perspectives.

Example of Multidisciplinary Integration:

Consider a project focused on developing a medical device. Instead of relying solely on individuals with biomedical engineering backgrounds, the project could take a multidisciplinary approach. Professionals from electrical engineering, materials science, computer science, and medicine could collaborate.

Each discipline brings unique expertise: Electrical engineers contribute to circuit designs. Material scientists improve device durability and biocompatibility. Computer scientists design software for device functionality. Medical professionals ensure the device meets patient and clinical needs. Such integration results in holistic and innovative solutions, enhancing the medical device's functionality and market readiness.

REQUIRED SKILLS FOR WRITING A PROJECT PROPOSAL

REQUIRED SKILLS FOR WRITING A PROJECT PROPOSAL

Writing a project proposal requires a diverse set of skills that encompass reading, writing, reviewing, and technical expertise. Developing these skills not only ensures the quality of the proposal but also enhances the writer's ability to express ideas effectively and convincingly. The key skills required are as follows:

1. Reading Skills

Effective reading is the foundation for crafting a compelling project proposal. Key aspects include:

i. **Techniques:** Mastering skills like scanning (quickly identifying specific information) and skimming (understanding the main ideas) are crucial for efficiently processing large volumes of text.
ii. **Interest in Reading:** A genuine curiosity to read diverse materials broadens one's knowledge and helps develop fresh ideas.
iii. **Critical Thinking:** Reflecting on what to express based on the information gathered enhances clarity and focus.
iv. **Speed Reading:** Attending speed reading classes can improve both the quality and quantity of reading, enabling the writer to process complex materials quickly.

2. Writing Skills

Writing forms the backbone of any project proposal. To develop and refine this skill:

i. **Talent and Practice:** Writing talent can be nurtured through consistent practice. Start by writing small pieces, such as blogs or social media posts, to build confidence and familiarity.
ii. **Critical Writing:** Enhance critical writing skills by engaging in activities like discussing, comparing, and critiquing. Sharing perspectives and ideas with peers fosters a deeper understanding of complex issues.
iii. **Continuous Improvement:** Writing skills are not developed overnight. It's an ongoing process of learning and improvement, where one must gradually strive for better structure, coherence, and impact in their writing.

3. Reviewing Skills

Reviewing involves analyzing and synthesizing information to strengthen the content and arguments in the proposal. It requires:

i. **Analytical Thinking:** Assessing the publication of articles, identifying key issues, and understanding complex theories contribute to high-quality proposals.
ii. **Higher-Level Thinking:** Developing a clear perspective and interpreting information critically ensures the proposal is well-grounded and meaningful.
iii. **Contextual Awareness:** Being aware of the broader implications and viewpoints on a subject provides a holistic approach to problem-solving.

4. Technical Skills

In the digital age, technical proficiency is indispensable for efficiently managing and presenting proposals. Necessary tools include:

i. **Microsoft Word:** For formatting and writing.
ii. **Reference Managers:** Tools like Mendeley help in organizing and citing references, ensuring the proposal meets academic and professional standards.
iii. **Qualitative Analysis Software:** Tools like ATLAS.TI assist in analyzing qualitative data and structuring findings logically.
iv. **AI Tools:** Leveraging AI tools such as ChatGPT for brainstorming ideas, refining language, or summarizing complex concepts can significantly enhance productivity.

REFERENCE MATERIALS

REFERENCE MATERIALS

Reference materials play a pivotal role in the development of a well-informed and credible project proposal. They provide the foundational knowledge and insights needed to address the project problem, support arguments, and propose innovative solutions. Below is a detailed explanation of the types of reference materials that are commonly used in project proposals:

1. Main Source Materials

The core of any research lies in its main sources, which provide primary data, original research, and critical findings. These include:

i. **Technical Article:** These are detailed documents focusing on specific research outcomes, methodologies, or case studies in specialized fields. They are highly valued for their accuracy and relevance.
ii. **Review Article:** These summarize and evaluate existing research in a specific area, offering a broad perspective and highlighting gaps that the proposed project can address.

2. Other Reference Materials

In addition to the main sources, other materials complement the research by providing context, supporting evidence, and a broader understanding. These include:

i. **Scientific Articles:** These articles, published in peer-reviewed journals, present new findings or theories and are a reliable source of evidence for the proposal.
ii. **Research Reports:** These include detailed research documentation conducted by organizations, providing practical data and insights that align with real-world scenarios.

REFERENCE MATERIALS

i. **Guidelines:** Standards or protocols issued by authoritative bodies serve as a benchmark for ensuring the project aligns with best practices and regulatory requirements.
ii. **Textbooks:** Textbooks provide a comprehensive overview of theoretical concepts and foundational knowledge relevant to the project.
iii. **Law and Regulations:** Referring to legal documents ensures the project complies with national or international regulations, particularly when it involves safety, ethics, or environmental concerns.
iv. **Best Practices:** Documents outlining proven methods or strategies in specific industries provide a roadmap for achieving project goals effectively.
v. **Newspapers and Articles:** These offer insights into current events, societal needs, or emerging trends, which can be used to establish the relevance of the project to real-world issues.

APPROACHES TO USED REFERENCE MATERIALS

To maximize the value of reference materials, consider the following approaches:

i. **Identify Reliable Sources**: Use peer-reviewed journals, recognized publishers, or official organizations to ensure accuracy and credibility.
ii. **Organize References:** Maintain a well-structured system using tools like Mendeley or Zotero to manage citations and bibliographies efficiently.
iii. **Critically Analyze:** Evaluate the reliability, applicability, and limitations of each source to ensure they contribute meaningfully to the project.
iv. **Cite Appropriately:** Follow a standard referencing style, such as APA or MLA, to give credit to original authors and avoid plagiarism.

TECHNICAL ARTICLE

A technical article is a scholarly or professional document focused on a specific technical topic or field. It aims to communicate complex information, ideas, or research findings clearly and effectively to a targeted audience. This audience may include engineers, scientists, academicians, or professionals within the relevant domain.

Key Characteristics of Technical Article

1. Objective and Factual A technical article presents data, methodologies, and results in a neutral and evidence-based manner. This ensures the credibility and reliability of the information provided.

2. Focused Topic The content is concentrated on a specific technical issue, process, system, or innovation, allowing the article to delve deeply into the subject matter.

3. Structured Format

Technical articles typically adhere to a well-defined structure, which includes:

- **Abstract**: Provides a concise summary of the article's content.
- **Introduction**: Explains the context and outlines the objectives of the article.
- **Methodology**: Describes the approach, processes, or tools used in the study.
- **Results**: Presents the findings or outcomes derived from the study or experiment.
- **Discussion**: Interprets the results of the research objectives and context.
- **Conclusion**: Summarizes the key points and highlights implications or recommendations.
- **References**: Cites all sources used, ensuring proper attribution and further reading opportunities.

4. Technical Language

Precise terminology and jargon relevant to the subject area are used. This often requires the audience to have prior knowledge or expertise to fully comprehend the content.

5. Visual Aids

Graphs, tables, charts, and diagrams are often included to illustrate complex data, clarify concepts, or support the arguments presented.

Purpose of Technical Article

The primary purposes of the technical article are:

- To inform or educate the audience about specific technical advancements or research outcomes.
- To document processes, designs, or experiments for future reference.
- To contribute to the growing body of knowledge within a technical field.

Examples of Technical Article

- Articles published in engineering or scientific journals.
- White papers introducing new technology, methodologies, or frameworks.
- Technical documentation for software or hardware systems.

Intended Audience

The target audience for technical articles typically consists of individuals with expertise or a strong interest in the topic, such as:

- Academicians and researchers looking to deepen their understanding of a specific area.
- Engineers and scientists applying or developing the discussed technologies.
- Professionals in related industries seeking practical applications or innovative solutions.

EXAMPLE OF TECHNICAL ARTICLE

gion 10 Symposium (TENSYMP), 5-7 June 2020, Dhaka, Bangladesh

Cost, Portable ECG Monitoring and Alar System Based on Deep Learning

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Electrocardiogram (ECG) has be he detection of cardiovascular dis ctrical impulse disruption that ca t may lead to arrhythmia. Arrhyt tions of having an arrhythmia, bu ythmias in a routine test. Therefo nal monitoring system plays a bi ar day by day. This researc developing a method for predicti ion) along with monitoring the EC ythmia prediction model and an A G surveillance system, Long ural network, Recurrent Neu nd Keras library are applied her ls and algorithms help to achieve o arrhythmia prediction. The sys Raspberry pi 3, Arduino UNO, or, HC-05 Bluetooth, biomedical s ystem will make easier for docto ir patients outside the hospital an monitoring. The total componen is around USD 58.

- arrhythmia, ECG, LSTM, RNN, n

ON INSTRUMENTATION AND MEASUREMENT

able Wearable Tele-ECG Monitoring

an, Orhan Ozhan, Yasemin Karadana, Muhammed Gulcu, Samet Macit, and Fas

paper introduces a wearable Tele-ECG and onitoring system which has a novel architecture nable singlet redesigned with textile electrodes eads, snap fasteners, Velcro, sponges, and an addition, a Bluetooth low energy (BLE), a ver, and a web page have been added to the monitoring. The TE can be attached to and singlet by a Velcro, which allows the user to easily for long-term use. A new holter-based been designed to evaluate the TE-based ECG erage correlation between the recorded ECG as 99.23%. A filtered digital signal, with a high io of 45.62 dB, is transmitted to the smartphone G signal is plotted, the HR is calculated with lute percentage error, and displayed. The data ver, allowing the patient's physician to analyze time through the web page or the smartphone. eyond the normal range or user presses the on the smartphone screen, the physician is ically by an short message service (SMS) with the map. The battery lasts approximately it needs replacement, the system automatically y an SMS and a flashing LED. This fast and monitoring system has the potential to improve uality by providing a psychological reassurance.

Bluetooth low energy (BLE), ECG telemon- e, Internet of Things (IoT), telehealth care, ing system, wearable sensors.

gel at the electrode–skin interface, for sig derive certain ECG leads. The conductive and cause skin irritation [3], [4] and the A may cause allergic reactions of the skin high conductance initially, after prolonge lose their adherence resulting in signal l replacement. Therefore, the use of Ag/Ag extended periods of patient monitoring is As alternatives, dry metal electrodes have and some studies have explored textile el has a minimal effect on patient's normal The TE also has high contact conductivit for a reliable ECG acquisition [13], [14]. to pick up ECG, EEG, and electromyogra and they have been proven to be as reli electrodes [15]. In normal conditions, the c based ECG monitor is regarded as equiva Humid conditions are advantageous rather to TE-based monitor due to the electrol sweat. The electrolyte includes molecules ar it increases electrical conductivity [16], [17

Contactless ECG sensors provide the cor itoring in nonhospital environments [18]. D surement systems have been reported inclu can be fixed to chair [19], bed [8] or c clothes [20]–[22]. Nemati *et al.* [3] demon

REVIEW ARTICLE

A review article is a type of scholarly article that provides a comprehensive summary and critical analysis of existing research on a specific topic or field. Unlike primary research articles that present new data or experiments, review articles synthesize and evaluate findings from multiple studies to offer an overview of current knowledge, trends, gaps, and future directions.

Key Characteristics of a Review Article

1. Synthesizes Existing Research

- Combines findings from various studies into a coherent narrative or framework.
- Aims to identify patterns, relationships, or inconsistencies within the body of knowledge.

2. Comprehensive Coverage

- Includes a broad range of studies to ensure a balanced and holistic perspective.
- Focuses on significant and influential works within the field for relevance and accuracy.

3. Critical Analysis

- Evaluate the strengths, weaknesses, and reliability of the research being reviewed.
- Highlights controversies, limitations, or gaps in current understanding.

4. Organized Structure Review articles typically follow a structured format that includes:

- **Abstract**: Summarizes the article's purpose, scope, and key conclusions.
- **Introduction**: Introduces the topic and outlines the objectives of the review.
- **Body**: Discusses themes, trends, or classifications in the research, often using thematic or methodological organization.
- **Conclusion**: Summarizes findings and proposes future research directions.
- **References**: Lists all sources used, ensuring proper citation and facilitating further reading.

5. Thematic or Methodological Organization

- Can be organized by themes, methodologies, or chronological developments, depending on the focus of the review.

6. Does Not Present New Experimental Data

- Focuses on analyzing and interpreting existing research rather than presenting original experiments or findings.

Purpose of a Review Article

The primary purposes of a review article are:

- To provide an accessible summary for readers who are new to the topic.
- To synthesize fragmented knowledge and offer a cohesive understanding of the subject.
- To identify research gaps and propose directions for future investigation.
- To serve as a reliable reference point for ongoing studies and discussions.

Types of Review Articles

1. Narrative Review

- Offers a general overview and discussion of a topic without strict systematic methods.

2. Systematic Review

- Follows a rigorous methodology to collect, evaluate, and summarize all relevant research on a specific topic.

3. Meta-Analysis

- Combines statistical data from multiple studies to derive quantitative conclusions.

4. Scoping Review

- Maps the breadth of research on a topic, often identifying gaps or emerging areas.

Intended Audience

The audience for review article typically includes:

- **Academicians and Researchers**: Seeking an overview or critical analysis of the field.
- **Policymakers or Practitioners**: Looking for evidence-based recommendations to inform decisions.
- **Students**: Aiming to understand the current state of knowledge and emerging trends.

  By offering insights into current research and identifying areas for further study, a review article serves as a critical tool for advancing understanding and fostering innovation in any discipline.

EXAMPLE OF REVIEW ARTICLE

sensors

MDPI

Review

ECG Monitoring Systems Review, Architecture, Processes, and Key Challenges

Mohamed Adel Serhani [1,*], Hadeel T. El Kassabi [2], Heba Ismail [2] and Alramzana Nujum Navaz [1]

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Received: 29 F

DOI 10.1007/s11517-012-1021-6

Abstract: H
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Keywords: E

REVIEW ARTICLE

A comprehensive survey of wearable and wireless ECG monitoring systems for older adults

Mirza Mansoor Baig · Hamid Gholamhosseini · Martin J. Connolly

Received: 31 October 2012 / Accepted: 17 December 2012 / Published online: 19 January 2013

Abstract Wearable health monitoring is an emerging technology for continuous monitoring of vital signs including the electrocardiogram (ECG). This signal is widely adopted to diagnose and assess major health risks and chronic cardiac diseases. This paper focuses on reviewing wearable ECG monitoring systems in the form of wireless, mobile and remote technologies related to older adults. Furthermore, the efficiency, user acceptability, strategies and recommendations on improving current ECG monitoring systems with an overview of the design and modelling are presented. In this paper, over 120 ECG monitoring systems were reviewed and classified into smart wearable, wireless, mobile ECG monitoring systems with related signal processing algorithms. The results of the review suggest that most research in wearable ECG monitoring systems focus on the older adults and this technology has been adopted in aged care facilitates. Moreover, it is shown that how mobile telemedicine systems have evolved and how advances in wearable wireless textile-based systems could ensure better quality of healthcare delivery. The main drawbacks of deployed ECG monitoring systems including imposed limitations on patients short battery life, lack of user acceptability and medical professional's feedback, and lack of security and privacy of essential data have been also discussed.

Keywords Wearable monitoring systems · Wireless ECG monitoring systems · ECG tele-health care · Mobile monitoring systems · Expert ECG systems

1 Introduction

Today, researchers and engineers employ advanced concepts and techniques from the field of electrical engineering, computer science, biomedical engineering and medicine to collect ECG signal via smart and advanced monitoring systems using wearable technology. Electrocardiogram (ECG) is a diagnostic tool that measures and records the electrical activity of the heart in detail. Interpretation of these details enables the diagnosis of a wide range of heart conditions from minor to life threatening. Wearable monitoring systems involve the use of emerging and advanced communication techniques to collect and

ARTICLE SEARCHING TECHNIQUES

CRITERIA FOR SELECTING REFERENCE MATERIALS

When conducting research or writing a project proposal, it is crucial to choose reference materials that are credible, relevant, and contribute significantly to the study. The following criteria can guide the selection of high-quality references:

1. Accuracy

The selected sources must align closely with the research problem, objectives, and variables under investigation. Accuracy ensures that:

i. The materials directly support the research context.

ii. They provide reliable evidence or insights for addressing the identified research gaps.

For example, if your research focuses on renewable energy, select references that specifically address advancements or challenges in this field.

2. Clarity

The references should clearly define and discuss the variables, concepts, or issues being studied. This includes:

iii. Precise explanations of methodologies, findings, or theoretical frameworks.

iv. Easily understandable content, which aids in a more in-depth exploration of the research topic.

Clarity helps eliminate ambiguity, ensuring a robust foundation for your arguments.

3. Empirical Evidence

High-quality research often relies on empirical evidence. This refers to primary data obtained directly from real-world findings or fieldwork. Key points include:

v. Consistent empirical support strengthens the validity of the study.

vi. Using well-documented case studies, experiments, or surveys enhances the credibility of the research.

For example, references should ideally include primary data such as first-hand reports or research findings that are directly applicable to your study.

4. Current Sources

To ensure the research reflects recent developments, select references published within the last five years. The latest sources are critical because:

a. They incorporate updated knowledge, trends, or innovations in the field.
b. They help maintain the relevance of the research in rapidly evolving disciplines.

For instance, studies on artificial intelligence or renewable energy should focus on the most recent advancements.

5. Relevance

References must be directly related to the research topic or objectives. This ensures:

i. The materials provide insights that contribute to answering the research questions.
ii. Irrelevant or tangential sources are avoided, maintaining focus and coherence in the study.

For example, a study on climate change adaptation should include references addressing mitigation strategies and their effectiveness.

6. Authoritative Sources

The credibility of references is significantly enhanced by using authoritative sources such as:

i. **Indexed Journals:** Articles published in Web of Science (WOS) or SCOPUS.
ii. **High-Quality Articles:** Peer-reviewed publications or those authored by recognized experts in the field.

Relying on well-respected sources ensures the research is built upon a solid and credible foundation.

LITERATURE SEARCH DATABASES

No.	Databases	URL Links
	All Subject	
1	Google Scholar	https://scholar.google.com/
2	Science Direct	https://www.sciencedirect.com/
3	Springer	https://www.springer.com/gp
4	Elsevier	https://www.elsevier.com/en-xs
5	Web of Science	https://jcr.clarivate.com/
6	Scopus	https://www.scopus.com/sources
7	Arxiv by Cornell	https://arxiv.org/
8	Ulrich's Web	http://ulrichsweb.serialssolutions.com/login
9	Directory of Open Access	https://doaj.org/
10	JSTOR	https://www.jstor.org/
	Engineering	
1	IEEExplore	https://ieeexplore.ieee.org/Xplore/home.jsp
2	INSPIRE-HEP	https://inspirehep.net/
3	IMech	https://imeche.summon.serialssolutions.com/#!/advanced
	Social Science Data	
1	SciELO	https://scielo.org/en/
2	ERIC	https://eric.ed.gov/
	Medical	
1	iCITE	https://icite.od.nih.gov/analysis
2	PubMed	https://pubmed.ncbi.nlm.nih.gov/

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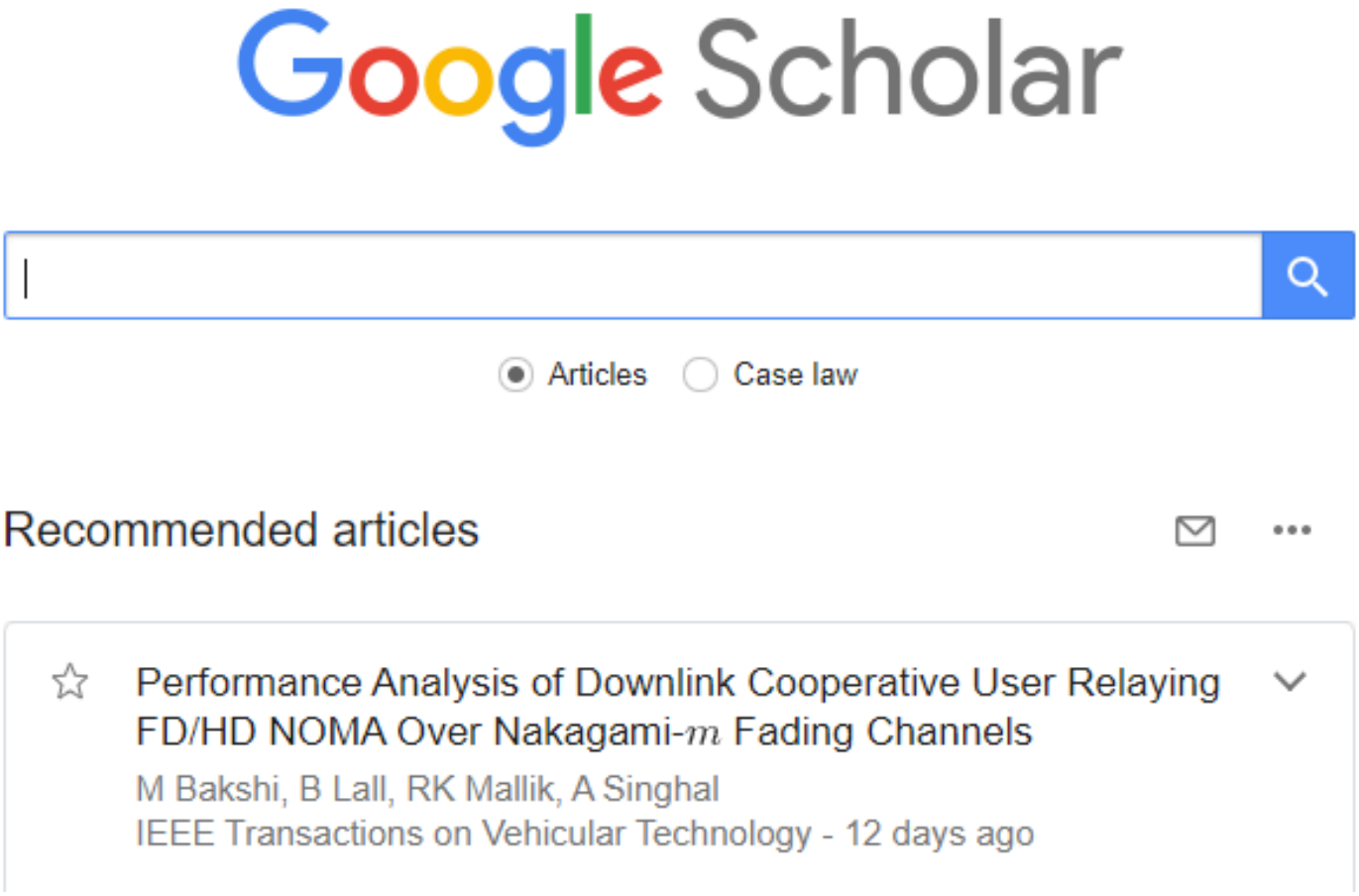

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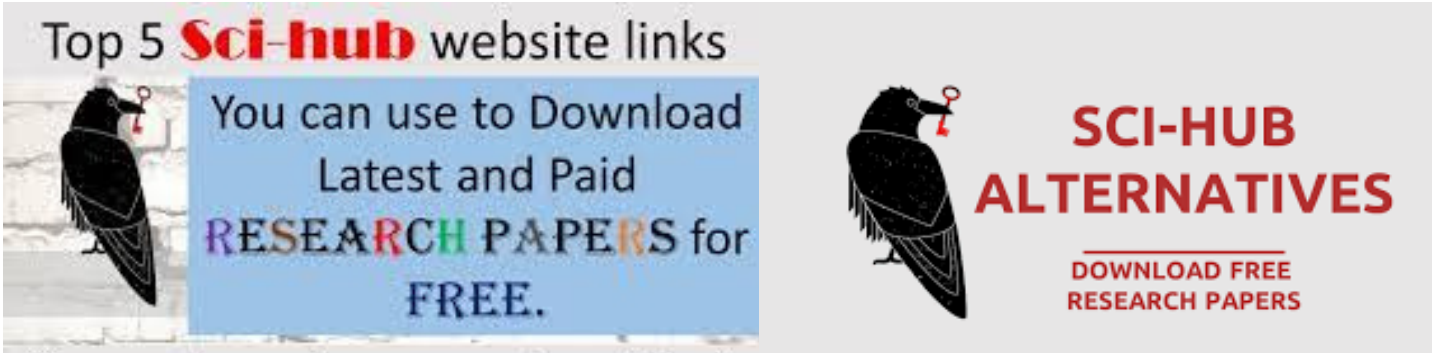

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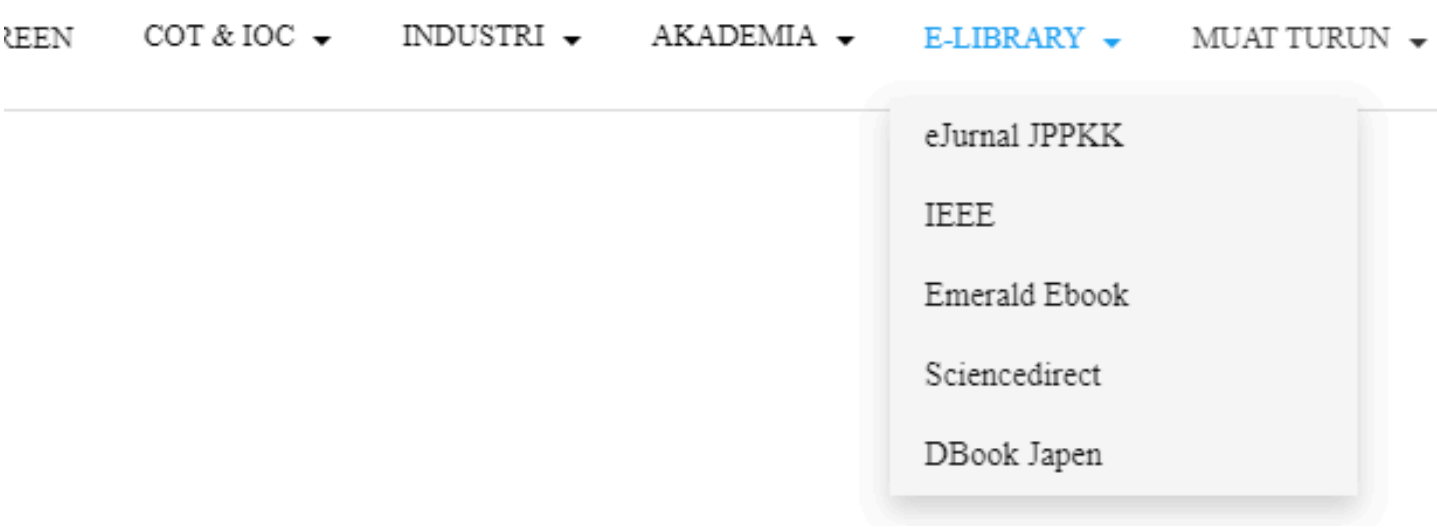


https://www.mypolycc.edu.my/

CONFERENCE VS JOURNAL ARTICLE

NO.	ASPECT	CONFERENCE ARTICLE	JOURNAL ARTICLE
1.	Publishing	Published in a conference or academic meeting.	Published in a peer-reviewed scientific or academic journal.
2.	Focus	More emphasis on concise presentation of new research and development.	Tends to focus more on comprehensive and in-depth research outcomes with the active involvement of primary researchers in the study's development and data analysis.
3.	Review Process	lighter	a tighter review process by experts in the field.
4.	Publication Time	usually published shortly after a conference or academic meeting is held	Requires a longer time for publication due to a tighter review process.
5	Accessibility	can be accessed openly or at a lower cost	can be accessed through institutional subscriptions or per-article payment
6.	Level of Knowledge	sometimes considered a lighter source of information.	tends more often to be higher academic recognition and is considered more important by academics than conference
7.	Conclusion	considered as a source of information that is lighter and faster to access.	considered a more serious and meaningful form of publication

“KEYWORDS” FOR LITERATURE SEARCHING

1. Identify Your Research Topic: - Clearly define your research topic question or objective. You should have a specific idea of what you're looking for.

2. Use Online Tools: - Some online tools and databases can help you identify keywords and phrases. Google Scholar, databases like IEEE Xplore or PubMed, and academic libraries often provide keyword suggestions.

3. Review Relevant Articles: - Look for a few relevant articles related to your topic. Examine the keywords and phrases used in these articles. They can provide valuable insights into terminology.

4. Use Online Databases and Search Engines: - Once you have a list of keywords, use them to search in relevant online databases, academic search engines, and library catalogs.

5. AI Tools: ChatGpt – Example Prompt “List the keywords on the research topic “YOUR TOPIC TITLE”

WHY SEARCH THROUGH GOOGLE SCHOLAR

Google Scholar is a widely recognized platform that has transformed the way researchers access and explore scholarly literature. Its unique features and advantages make it an indispensable tool for students, academics, and professionals across various disciplines. Below, we discuss the key reasons why searching through Google Scholar is highly recommended.

1. Free Access

One of the primary benefits of Google Scholar is its free accessibility. Unlike many academic databases that require costly subscriptions or institutional access, Google Scholar allows anyone with an internet connection to access a vast repository of scholarly materials without any financial barriers.

2. Comprehensive Search

Google Scholar offers a broad and inclusive range of scholarly resources. It encompasses journal articles, theses, books, conference articles, and even grey literature, providing a one-stop resource for academic needs.

i. Researchers can find not only peer-reviewed articles but also preprints, dissertations, and technical reports.

ii. This comprehensive scope ensures that users can gather diverse materials relevant to their research.

3. User-Friendly Interface

The platform is designed with simplicity and ease of use in mind, making it accessible to users of all technical skill levels. The intuitive interface provides straightforward search functionalities while offering advanced options to refine results by date, author, or journal.

iii. Users can search for articles with specific keywords, phrases, or Boolean operators to narrow down results effectively.

4. Citation Metrics

Google Scholar provides citation counts for each academic article, offering a useful measure of its impact and relevance within the scholarly community.

iv. The citation count helps researchers identify influential works and seminal articles in their field.

v. Furthermore, related articles and co-cited materials are easily accessible through the platform.

5. Alerts for Updates

Google Scholar allows users to set up email alerts for specific keywords, authors, or topics of interest. This feature ensures that researchers stay updated on the latest publications and advancements in their field.

6. Interdisciplinary Resource

The platform supports a wide variety of disciplines, making it a valuable resource for researchers with interdisciplinary interests.

i. It includes research from the sciences, social sciences, humanities, law, and more.

ii. This breadth makes it suitable for projects that span multiple fields of study.

7. Global Reach

Google Scholar has a global scope, providing access to international research materials from universities, organizations, and institutions worldwide.

iii. This reach ensures that researchers can include diverse perspectives and findings in their work.

8. Inclusion of Legal Documents

In addition to academic materials, Google Scholar offers access to legal opinions, case law, and patents, making it a valuable resource for law professionals, students, and researchers in technical fields.

9. Researcher Profiles

Google Scholar provides author profiles where users can explore an individual researcher's publications, citation metrics, and research impact.

iv. These profiles allow collaboration opportunities and give visibility to influential authors in specific fields.

10. Integration with Reference Management Tools

Google Scholar supports seamless integration with reference management tools such as EndNote, Mendeley, or Zotero.

v. Users can easily save citations, organize their literature, and generate bibliographies in various citation styles.

BOOLEAN SEARCH OPERATOR

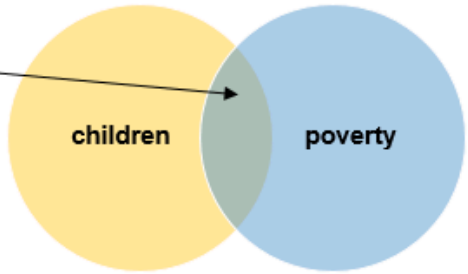
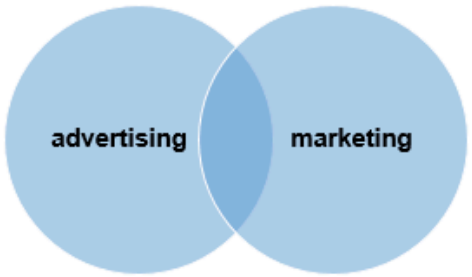
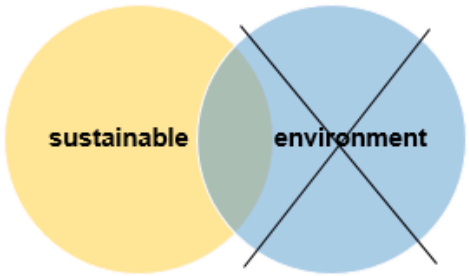
Boolean operators	Search examples	How it works?	Results
AND	children **AND** poverty	**AND** narrows a search. It will retrieve results that have both keywords.	
OR	advertising **OR** marketing	**OR** expands your search. It will retrieve results that have either keyword. It's useful for synonyms.	
NOT	sustainable **NOT** environment	**NOT** narrows your search. It will exclude results that have the unwanted keyword. Be careful you may omit too many results!	

Figure : Boolean Search Operator

BOOLEAN SEARCH OPERATOR

Boolean search operators play a pivotal role in information retrieval, offering researchers and students an efficient way to refine and control their search queries. By using these operators strategically, users can navigate vast databases and search engines to pinpoint relevant and specific information. Below is an explanation of Boolean search operators, their purpose, and their applications.

1. Purpose of Boolean Search Operators

Boolean search operators are designed to enhance the search process by enabling users to combine keywords and phrases in a logical and structured manner. These operators act as connectors, helping to filter and organize search results.

For example:
When researching a topic like "renewable energy in urban planning," Boolean operators allow users to exclude unrelated results or include synonymous terms.

2. Key Boolean Operators

There are three primary Boolean operators **AND**, **OR**, and **NOT** each serving a distinct purpose in search construction:

AND
The "AND" operator narrows the search by including only results that contain all the specified keywords.

Usage:
i. Combines multiple terms to focus the search.
ii. Ensures the results are highly specific and relevant to the topic.

Example:

Searching for *"renewable energy AND urban planning"* will retrieve articles that discuss both terms together, eliminating results that only mention one of them.

OR

The "OR" operator broadens the search by including results that contain any of the specified keywords.

Usage:

i. Useful for finding synonyms or related terms.
ii. Expands the scope of the search to ensure comprehensive coverage.

Example:

Searching for *"solar energy OR wind energy"* will include results discussing either topic, providing a wider range of information.

NOT

The "NOT" operator excludes specific keywords from the search, helping to eliminate irrelevant results.

Usage:

iii. Filters out unwanted or unrelated terms from the results.

Example:

Searching for *"renewable energy NOT fossil fuels"* will exclude articles that discuss fossil fuels, focusing solely on renewable energy.

3. Applications of Boolean Operators

Boolean operators are powerful tools that help construct precise search queries. They are widely employed in:

a. Online Databases: Academic platforms like PubMed, IEEE Xplore, and ProQuest.
b. Search Engines: Google, Bing, and other internet search platforms.
c. Library Catalogues: University and public library systems for accessing books, articles, and journals.

By using these operators effectively, researchers can save time and improve the quality of their search results.

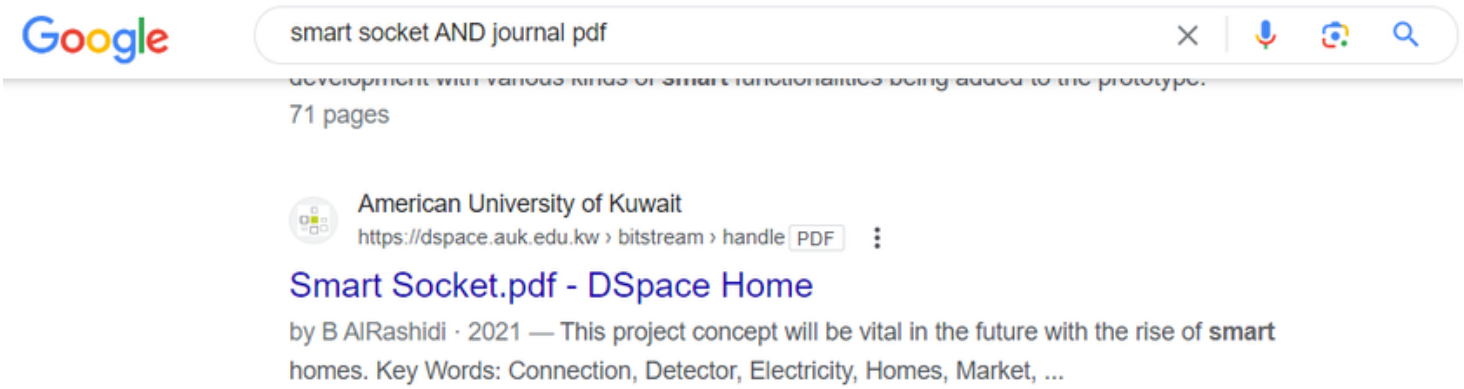
4. Benefits of Using Boolean Search Operators

i. **Refinement of Search Results:** Boolean operators allow users to filter out irrelevant results, ensuring greater accuracy.
ii. **Efficiency in Research:** With precise queries, users can locate the required information faster, saving valuable time.
iii. **Customization:** Users can tailor their searches to match their specific research needs.
iv. **Exploration of Broad or Narrow Topics:** By combining operators like "AND" and "OR" users can delve into broad topics while also focusing on specific aspects.

For instance:

A researcher studying climate change can use "*climate change AND mitigation OR adaptation NOT policy*" to explore various mitigation and adaptation strategies while excluding policy-related discussions.

Example Search using the Boolean Search Operator



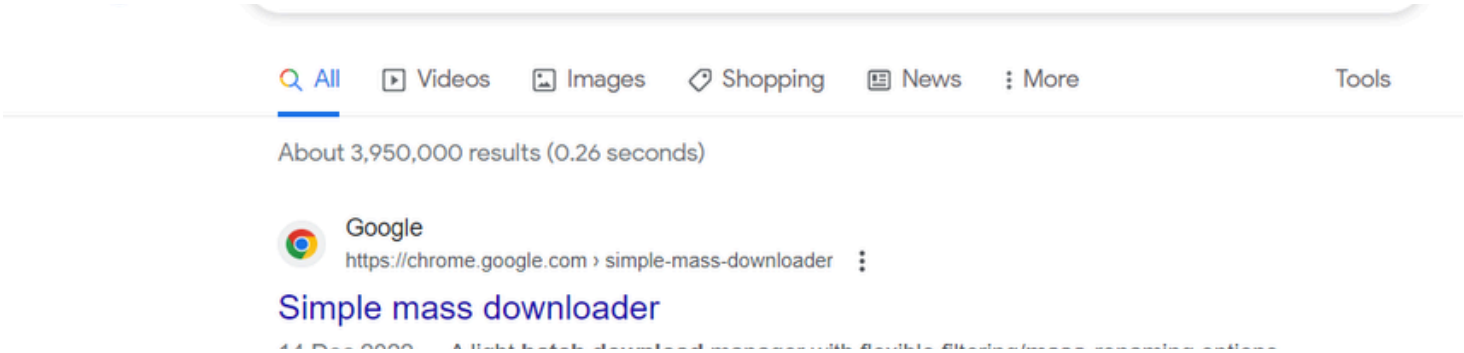
HOW TO DOWNLOAD ARTICLES IN LARGE QUANTITIES

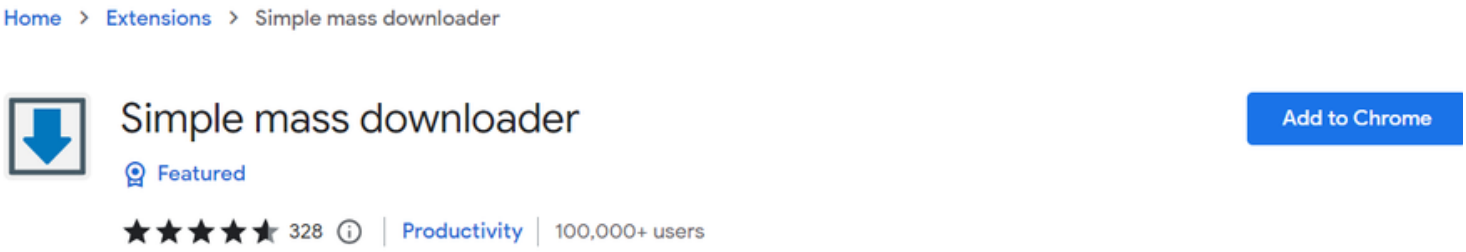
i. Simple mass downloader (for Google)
https://www.youtube.com/watch?v=yUT2o2u5YA8

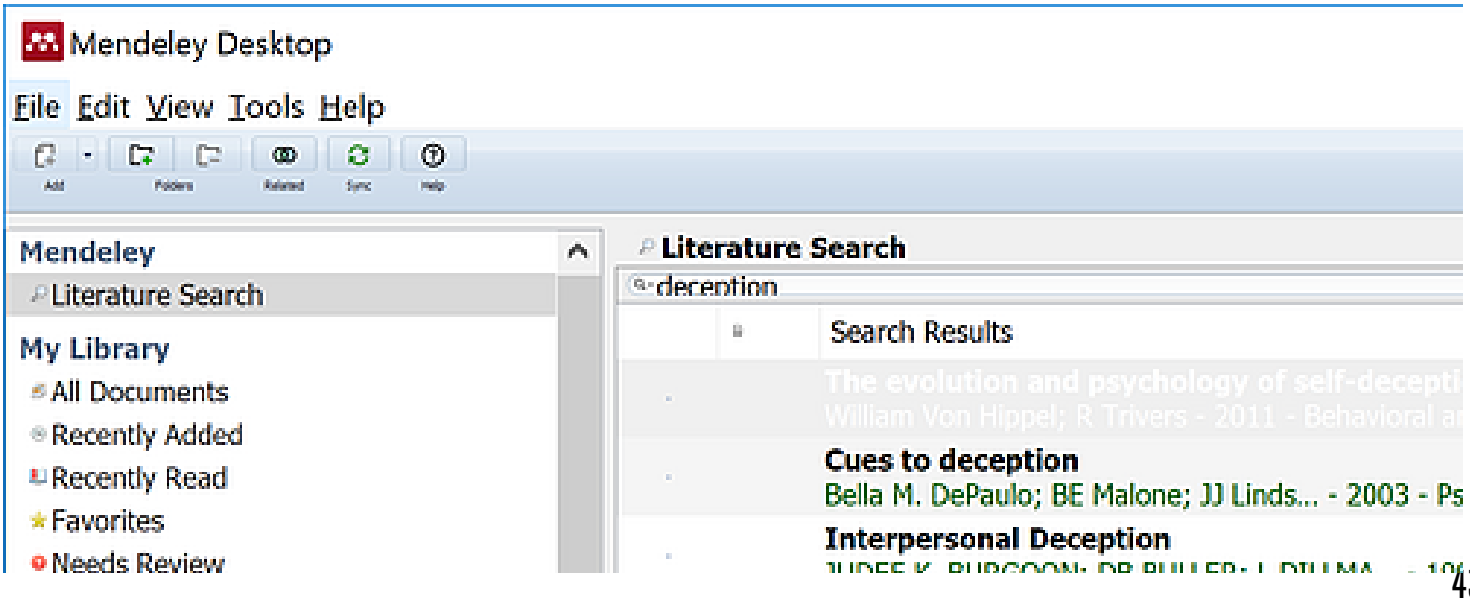
ii. Reference Manager software (Mendeley, EndNote & Zetero)
- Organize Reference
- Forming Citations
- Creating Folders

MENDELEY

iii. How to use Mendeley
(https://www.youtube.com/watch?v=PJXnfBSq4Lg)







TOOLS TO ASSIST PROJECT PROPOSAL WRITING

Tools for your Literature Reivew Project

Designed by: Asad Naveed

Literature Search	Knowledge Maps	Writing	Citations
PubMed PubMed is a free tool by NIH that supports the search and retrieval of biomedical and life sciences literature.	Research Rabbit Research Rabbit is a free, literature review tool that visualizes the complex relationships in the literature.	Grammarly Grammarly is a writing assistant that checks for spelling, grammar, punctuation errors, and vocabulary usage	Zotero Zotero is a powerful, easy-to-use research tool that helps you organize, analyze and cite academic literature sources.
Google Scholar Google Scholar is a free tool that lets you search the latest scholarly articles, documents and books,	Connected Papers Connected Papers is a visual tool to help researchers find and explore papers and trends relevant to their field of work.	PaperPal Paperpal helps academics write better, faster with real-time suggestions for in-depth language and grammar correction.	Mendeley Mendeley is a citation management tool that lets you collect & organize citations, & then easily insert them into documents.
Elicit Elicit is a free AI app that helps you find papers, extract data, summarize, brainstorm ideas, and more.	LitMaps Litmaps helps you find articles and papers for your literature search. It generates a map of the most relevant articles related to your seed paper.	Quillbot QuillBot's AI-powered paraphrasing tool helps to rewrite, edit, and change the tone of their text to improve clarity	EN EndNote EndNote is a personal citation/bibliography manager tool that helps researchers create bibliographies and format references in MS word

TOOLS TO ASSIST PROJECT PROPOSAL WRITING

AI Tools for Literature Reviews

RAZIA ALIANI

A Step-by-Step Toolkit for Modern Researchers

Literature Search	Knowledge Maps	Note-taking
Semantic Scholar A free, AI-powered research tool for scientific literature	CONNECTED PAPERS Visual tool to help researchers and applied scientists find academic papers relevant to their field of work.	Glasp Web highlighter and annotation tool, that helps organize literature from the web, & access other like-minded people's learning
scinapse AI-powered Search Engine, revolutionizing how researchers access and interact with research findings.	Litmaps Combines interactive citation maps, modern search tools, & targeted updates, to create research discovery experience	LATERAL Machine learning software for organizing and analyzing research papers, and exporting them to Excel or Word.
consensus Search engine that uses AI to find insights in research papers	ResearchRabbit Free citation-based literature mapping tool, that connects your research interests to related articles and authors	ClioVis visualizing connections Visualization tool that helps researchers connect with papers, cite, collaborate, categorize, and create presentations
Perplexity AI-chat-based conversational search engine that delivers answers to questions using language models.	**Reading Papers**	**Writing**
Discovery By researcher.life App for researchers to simplify literature search, research reading, listening, organising and collaboration.	enago Read AI-enabled tool that helps with resource exploration, literature review, critical *reading*, collaboration, and organizing.	Paperpal By researcher.life Advanced AI grammar checker and online academic writing tool that identifies errors and provides instant suggestions for correction.
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PROJECT PROPOSAL CONTENT

PROJECT PROPOSAL CONTENT

Chapter 1: Introduction
1.1 Overview
1.2 Project Background
1.3 Problem Statement
1.4 Project Objectives
1.5 Project Scope
1.6 Project Significance
1.7 Expected Project Results
1.8 Chapter Outline

Chapter 2: Literature Review
2.1 Introduction
2.2 Previous Studies/Reviews/Investigations
2.3 Chapter Summary

Chapter 3: Methodology
3.1 Introduction
3.2 Project Design
    3.2.1 : Project Block diagram
    3.2.2 : Project Flowchart
3.3 Project Hardware
    3.3.1 : Schematic Circuit
    3.3.2 : Description of Main Component
3.4 Project Software
    Flowchart of the System
    Description of System Flowchart
3.5 Sustainability Element in the Design Concept
3.6 Chapter Summary

Chapter 3: Project Management and Costing
4.1 Introduction
4.2 Gantt Chart and Activities of the Project
4.3 Milestone
4.4 Cost and Budgeting
4.5 Chapter Summary

References

Appendices
Appendix A-Data Sheet (if applicable)
Appendix B-Programming (if applicable)

CHAPTER 1: INTRODUCTION

Chapter 1: Introduction

1.1 Overview
1.2 Project Background
1.3 Problem Statement
1.4 Project Objectives
1.5 Project Scope
1.6 Project Significance
1.7 Expected Project Results
1.8 Chapter Outline

1.1 OVERVIEW

Content

1. Introducing the general topic of the project.
2. State all the chapter 1 subtopic.
3. General overview of each chapter 1 subtopic.

Example

[1] This chapter discusses the overview of the project focuses on ECG monitoring system. [2] The overview of the project includes the project background, problem statement, project objectives, project issues, project scope, project significance, definition of terms/operational definitions, expected project findings/results, and summary. [3] The chapter begins by the project Background provides a comprehensive understanding of the historical context and development of ECG monitoring systems leading to the Problem Statement, which clearly state the specific challenge the project aims to address. This is followed by Project Objectives, which outlines the goals of the project. Next, Project Scope defines the boundaries and limitations of the project, while Project Significance explains the importance and potential impact of implementing ECG monitoring systems, particularly in the healthcare field. Then, Expected Project Results outlines the expects outcomes of the project. Finally, the Chapter Outline gives a preview of the subsequent chapters, providing a structured overview of the entire project proposal.

1.2 PROJECT BACKGROUND

1. The background of the project refers to CURRENT INFORMATION related to contemporary ISSUES that are the focus of the project.
2. Its purpose is to inform the reader about the CURRENT STATUS in the industry regarding these issues.
3. Typically, the background is SUPPORTED BY REFERENCES (such as books, journal articles, reports, newspapers, or government policies).
4. Some of the points that can be presented include the following:
(a) What is the CURRENT SITUATION IN THE INDUSTRY?
(b) Why is this study necessary? (Project RATIONALE)

Content

1. **Introduction**:
    1. Provide an **overview** of the project background, introducing the topic of Portable ECG Monitoring Devices.
    2. Highlight the **significance** of cardiac monitoring in healthcare and the role of ECG technology in diagnosing and managing cardiovascular conditions.
2. **Evolution** of ECG Monitoring:
    1. Trace the **historical** development of ECG monitoring technology, from the invention of the electrocardiograph to modern advancements in portable devices.
    2. Discuss **key** milestones and innovations that have shaped the evolution of ECG monitoring, including improvements in signal processing, hardware miniaturization, and wireless connectivity.
3. **Challenges** with Traditional ECG Monitoring:
    1. Identify **limitations and challenges** associated with traditional ECG monitoring methods, such as the immobility of bulky equipment, limited accessibility in remote areas, and challenges with continuous monitoring.
4. **Advantages** of Portable ECG Monitoring Devices:
    1. Discuss the potential **benefits** of portable ECG monitoring devices over traditional methods, including increased mobility, convenience, and accessibility.
    2. Highlight the **potential impact** of portable devices on improving patient outcomes, facilitating early detection of cardiac abnormalities, and enabling timely intervention.
5. **Current Landscape** of Portable ECG Devices:
    1. Provide an overview of the **current market landscape** for portable ECG monitoring devices, including existing products, technologies, and market trends.
    2. Discuss **strengths and weaknesses** of current portable devices, as well as gaps and opportunities for innovation.
6. **Rationale** for the Project:
    1. Explain the **rationale behind** the proposed project to develop a new portable ECG monitoring device, addressing the identified gaps and shortcomings in existing solutions.
    2. Highlight the **project's potential** to address unmet needs in cardiac monitoring, improve patient care, and advance the field of cardiovascular medicine.

1.2 PROJECT BACKGROUND

EXAMPLE:

1. Introduction:

Portable ECG monitoring devices have emerged as vital tools in modern healthcare, facilitating convenient and efficient cardiac monitoring for patients in various settings. With the increasing prevalence of cardiovascular diseases and the growing demand for remote healthcare solutions, the development of portable ECG devices has garnered significant attention from researchers, clinicians, and healthcare organizations. These devices offer the promise of real-time monitoring, early detection of cardiac abnormalities, and improved patient outcomes, making them invaluable assets in the management of cardiovascular conditions.

2. Evolution of ECG Monitoring:

The evolution of ECG monitoring technology has been marked by significant advancements over the years. From the early electrocardiographs developed in the 20th century to the latest generation of portable devices, ECG technology has undergone continuous innovation. The miniaturization of hardware components, advancements in signal processing algorithms, and integration of wireless connectivity have revolutionized the field, enabling the development of compact, lightweight, and user-friendly portable ECG devices.

3. Challenges with Traditional ECG Monitoring:

Despite the advancements in ECG technology, traditional monitoring methods pose several challenges. Conventional ECG machines are often bulky, stationary, and require trained personnel to operate, limiting their use in ambulatory and home settings. Additionally, the intermittent nature of in-clinic monitoring may miss transient cardiac events, hindering timely intervention and diagnosis. These limitations underscore the need for portable ECG monitoring solutions that offer continuous, non-invasive cardiac monitoring outside clinical settings.

* Supporting statement with an in-text citation

1.2 PROJECT BACKGROUND

EXAMPLE:

4. Advantages of Portable ECG Monitoring Devices:
Portable ECG monitoring devices offer several advantages over traditional methods. Their compact size and lightweight design make them suitable for use in various environments, including hospitals, clinics, ambulances, and patients' homes. Moreover, these devices enable continuous monitoring, allowing for the detection of arrhythmias, ischemic events, and other cardiac abnormalities in real-time. By providing actionable insights into a patient's cardiac health, portable ECG devices empower both healthcare providers and patients to make informed decisions and take proactive measures to manage cardiovascular conditions.

5. Current Landscape of Portable ECG Devices:
The current market for portable ECG monitoring devices is characterized by a diverse range of products and technologies. From single-lead handheld devices to wearable patches and smartphone-based apps, there is a wide variety of options available to consumers. While some devices focus on basic ECG recording and analysis, others offer advanced features such as cloud connectivity, remote monitoring, and artificial intelligence-driven diagnostics. Despite the growing adoption of portable ECG devices, challenges remain in terms of accuracy, usability, and regulatory compliance, highlighting opportunities for further innovation and improvement.

6. Rationale for the Project:
Against this backdrop, the proposed project seeks to develop a new generation of portable ECG monitoring devices that address the limitations of existing solutions and meet the evolving needs of healthcare providers and patients. By leveraging the latest advancements in hardware, software, and connectivity technologies, the project aims to create innovative devices that offer reliable, user-friendly, and clinically validated cardiac monitoring capabilities. Through collaborative research, development, and validation efforts, the project team aims to make significant contributions to the field of portable ECG monitoring, ultimately improving patient care and outcomes in cardiovascular medicine.

* Supporting statement with an in-text citation

1.3 PROBLEM STATEMENT

WHAT IS PROBLEM STATEMENT?

1. The problem statement refers to an ISSUE/PROBLEM that requires a SOLUTION based on the introduction to the project.
2. It outlines the PROBLEM to be addressed and the CONTRIBUTION of the project findings to solve the problem either in whole or in part.
3. The problem statement must have a clear CONNECTION with the BACKGROUND of the project taking into account the following:
(a) FACTORS/causes of the problem;
(b) effects/IMPACT on the country/society/economy/environment; and
(c) REFERENCES to the issue such as:

- **Preliminary Research Method**
- **Articles/Journals/Reports/Previous Studies**

CONTENT

Problem Identification: Identify the problem or need that the project aims to address, such as the limitations of traditional ECG monitoring methods in terms of mobility, accessibility, and ease of use.

Why Significance: Justify why addressing the identified problem is important, citing relevant statistics, research findings, or real-world examples to support the need for a portable ECG monitoring device.

EXAMPLE

[PROBLEM IDENTIFICATION] Traditional ECG machines are often bulky and stationary, limiting their use to clinical settings and hindering continuous monitoring of patients outside hospital environments. This poses significant challenges for patients with chronic heart conditions who require regular monitoring or for those who experience cardiac events in non-clinical settings, such as at home or during daily activities. Additionally, the lack of user-friendly interfaces and connectivity features in existing portable ECG devices makes it difficult for healthcare professionals to access and interpret patient data efficiently. **[WHY SIGNIFICANCE]** Therefore, there is a critical need for a compact and user-friendly portable ECG monitoring device that can provide accurate cardiac monitoring in various settings while ensuring ease of use for both patients and healthcare providers.

1.4 PROJECT OBJECTIVES

WHAT IS PROBLEM STATEMENT?

1. The research objectives need to be linked to the PROBLEM STATEMENT and clearly state HOW the problem can be addressed.
2. The suggested NUMBER of research objectives is between two (2) and three (3).
3. SMART criteria (SPECIFIC, MEASURABLE, ACHIEVABLE, REALISTIC, and TIME-BOUND) are recommended as a guide for writing project/research objectives.

VERB To Formulate Project Objectives

- Bloom's Taxonomy is useful when formulating project objectives, ensuring a comprehensive approach to project development and assessment.
- The verbs from Bloom's Taxonomy along with examples of how they can be used to create project objectives:

Verb	1. Create	2. Apply	3. Analyze
Similar Verb	• Design • Develop • Construct • Generate	• Implement • Apply • Demonstrate • Solve	• Analyze • Evaluate • Compare • Differentiate
Example Objective	To **design** and **develop** a user-friendly interface for the ECG monitoring system, ensuring ease of operation for healthcare professionals.	To **apply** the developed signal processing algorithm to enhance the accuracy of ECG readings in real-time scenarios.	To **evaluate** the efficiency of the implemented ECG monitoring system by analyzing its data transmission speed in various healthcare settings.

1.4 PROBLEM OBJECTIVES

EXAMPLE

These Objectives aim to develop a portable ECG device for rural area and implement a portable ECG device for rural healthcare, ensuring accessibility and reliability, and then evaluate its efficiency and accuracy in real-world scenarios:

Objective 1: To Design and Develop a Compact and User-Friendly Portable ECG Device

Design a compact and user-friendly portable ECG device that is easy to operate, lightweight, and suitable for use in diverse environments. This objective aims to create a device that is accessible and user-friendly for individuals in rural areas.

Objective 2: To Implement the Portable ECG Device for Rural Healthcare Initiatives

Implement the developed portable ECG device in rural healthcare initiatives, ensuring widespread access to cardiac monitoring in underserved areas. This objective focuses on deploying the device in real-world settings to address the specific healthcare needs of rural populations.

Objective 3: To Evaluate System Efficiency and Accuracy in Rural Healthcare Settings

Conduct a thorough evaluation of the portable ECG device in rural healthcare settings to assess both efficiency and accuracy. Measure efficiency by evaluating data transmission speed, battery life, and user satisfaction. Assess accuracy through comparison with standard clinical ECG machines and diagnostic accuracy metrics.

1.5 PROJECT SCOPE

WHAT IS PROBLEM SCOPE?

- Clearly state what **aspects** of ECG monitoring your project **covers**.
- Acknowledge any **limitations** or constraints.

EXAMPLE

[INTRODUCTION] The project scope for the Portable ECG Monitoring Device involves developing compact and user-friendly devices capable of accurate cardiac monitoring to address healthcare needs effectively. **[OBJECTIVES]** Primary objectives include designing portable ECG devices, optimizing portability and durability, implementing signal processing algorithms, integrating connectivity features, and ensuring regulatory compliance. **[ASPECTS COVERED]** Specific aspects covered encompass hardware design, software development, user interface design, connectivity features, and regulatory compliance. **[LIMITATIONS OR CONSTRAINTS]** Acknowledging potential limitations or constraints, such as budget constraints, time constraints, technical challenges, and regulatory requirements, is essential. **[CONCLUSION]** The project aims to advance portable ECG monitoring technology to enhance healthcare outcomes and patient care.

1.5 PROJECT SCOPE

ASPECTS COVER

1. **Hardware Design**: Designing compact, lightweight, and durable hardware components.
2. **Software Development**: Developing robust algorithms for signal processing, noise reduction, and data analysis.
3. **User Interface Design**: Creating intuitive interfaces for easy operation by healthcare professionals and patients.
4. **Connectivity Features**: Integrating wireless communication technologies for seamless data transmission to healthcare systems.
5. **Regulatory Compliance**: Ensuring compliance with relevant medical device regulations and standards.

LIMITATIONS OR CONSTRAINTS

1. **Budget Constraints**: Limited funding may restrict the extent of research and development activities.
2. **Time Constraints**: Project timelines may be limited, requiring efficient project management and prioritization of tasks.
3. **Technical Challenges**: Addressing challenges related to signal processing, hardware miniaturization, and power management.
4. **Regulatory Requirements**: Compliance with medical device regulations may impose constraints on device design and functionality.

1.6 PROJECT SIGNIFICANCE

WHAT IS PROJECT SIGNIFICANCE?

The project significance refers to the **importance, relevance**, and **impact** of a proposed project within a specific context.
It outlines why the project is **essential** and the potential **benefits** it could bring to stakeholders or the community.
The significance of a project is often described in project proposals to **justify the need** for the project and to convince stakeholders of its **value and importance**.
It provides a **rationale** for undertaking the project by highlighting its potential to address an identified problem or need, contribute to achieving organizational goals, or make a positive impact on society.

CONTENT

Introduction:

Briefly introduce the significance section, emphasizing its importance in understanding the project's broader impact.

Problem Statement Recap:

Recap the identified problem or need to provide context for the significance discussion.

Importance of Addressing the Problem:

Discuss why addressing the problem is crucial, emphasizing its impact on healthcare or societal needs.

Potential Benefits:

Outline the potential benefits of solving the problem, such as improved patient care or efficiency.

Conclusion:

Summarize the significance section, reaffirming the importance of the project in addressing the identified problem and achieving positive outcomes.

1.6 PROJECT SIGNIFICANCE

EXAMPLE

[Introduction] The significance of developing portable ECG monitoring devices lies in revolutionizing cardiac healthcare by offering convenient and accurate monitoring solutions. These devices address the pressing need for efficient cardiac monitoring outside traditional clinical settings, facilitating timely diagnosis and intervention for patients with cardiovascular conditions. **[Problem Statement Recap]** Traditional ECG monitoring methods are often limited by their lack of portability and accessibility, hindering continuous monitoring of patients outside hospital settings. This limitation results in missed opportunities for early detection and intervention, leading to adverse health outcomes and increased healthcare costs. **[Importance of Addressing the Problem]** Addressing the limitations of traditional ECG monitoring methods is crucial for improving patient outcomes and reducing healthcare burdens. By enabling continuous monitoring in various environments, portable ECG devices can facilitate early detection of cardiac abnormalities, prompt intervention, and personalized treatment strategies, ultimately leading to improved patient care and reduced healthcare costs. **[Potential Benefits]** The development of portable ECG monitoring devices offers several potential benefits, including enhanced patient care through continuous cardiac monitoring in daily life, leading to timely detection of cardiac abnormalities and proactive intervention. Moreover, portable devices enable cardiac monitoring in remote or underserved areas, improving access to healthcare for vulnerable populations. Additionally, early detection and intervention can prevent costly hospitalizations and complications associated with untreated cardiac conditions, resulting in significant cost savings for healthcare systems. Furthermore, continuous monitoring empowers patients to actively participate in their healthcare management, leading to better health outcomes and improved quality of life. **[Conclusion]** In conclusion, the development of portable ECG monitoring devices holds immense significance in advancing cardiac healthcare. By addressing the limitations of traditional monitoring methods and enabling continuous monitoring in diverse settings, these devices have the potential to revolutionize patient care, improve health outcomes, and reduce healthcare costs. Thus, investing in the development of portable ECG monitoring devices is essential for achieving positive impacts on healthcare delivery and patient outcomes.

1.7 EXPECTED PROJECT RESULTS

WHAT IS EXPECTED PROJECT RESULTS?

- Expected project results refer to the anticipated outcomes, deliverables, and achievements of a project.
- These results are the tangible (touched physically) and intangible (benefits or value) products, findings, or impacts that are expected to be realized upon the completion of the project.

CONTENT

1. **Introduction:**
   A brief overview of the section.
2. **Expected Outcomes:**
   A clear statement of the expected results or outcomes of the project.
3. **Deliverables:**
   List of tangible items, reports, software, prototypes, etc., that will be produced as a result of the project.
4. **Timeline:**
   Timeline or schedule for completing the project and delivering the expected results.
5. **Success Criteria:**
   Criteria or metrics used to measure the success of the project and its outcomes.
6. **Conclusion:**
   Summary of the expected project results and their importance.

1.7 EXPECTED PROJECT RESULTS

EXAMPLE

[Introduction] This section outlines the expected outcomes and deliverables of the project, highlighting its significance in advancing portable ECG monitoring technology. **[Expected Outcomes]** The primary expected outcome of the project is the development of a compact and user-friendly portable ECG monitoring device capable of accurate cardiac monitoring. Additionally, the project aims to optimize the device for portability, durability, and ease of use in various healthcare settings. **[Deliverables]** The deliverables for the project include a hardware prototype of the portable ECG monitoring device, comprising compact and lightweight hardware components. Additionally, software algorithms will be developed for signal processing, noise reduction, and data analysis to ensure precise ECG signal acquisition. The project will also entail designing intuitive user interfaces featuring touchscreen displays and button interfaces for easy operation by healthcare professionals and patients. Moreover, the integration of wireless communication technologies will facilitate seamless data transmission to healthcare systems. Finally, regulatory compliance documentation will be prepared to demonstrate adherence to relevant medical device regulations and standards. **[Timeline]** The project is expected to be completed within a timeframe of 12 months, with key milestones including hardware prototyping, software development, user interface design, testing, and regulatory approval. **[Success Criteria]** The success of the project will be determined by various criteria, including the accuracy and reliability of ECG signal acquisition, the usability of the device, and user satisfaction. Additionally, regulatory approval and compliance with relevant standards will be key indicators of success. Furthermore, the project's efficacy will be demonstrated through pilot testing and validation studies, showcasing improvements in healthcare outcomes. **[Conclusion]** In summary, the expected project results include the development of a state-of-the-art portable ECG monitoring device that meets the needs of healthcare professionals and patients. These outcomes are vital for advancing cardiac monitoring technology and improving healthcare delivery and patient outcomes.

1.8 CHAPTER OUTLINE

WHAT IS CHAPTER OUTLINE?

Briefly outline the structure of the project proposal, mentioning key chapters or sections.

EXAMPLE

In the project's final proposal, three chapters must be completed, including introduction, literature review, and methodology. All these chapters can be described as presented below.

Chapter 1: Introduction

In Chapter 1, the introduction discusses the overall project, project background, problem statements, project objectives, project scope, project significance, expected project results, and the chapter outline. The chapter begins with a chapter overview that previews what to expect in the introduction section. The project background presents relevant information about the topic. Next, the problem statement is introduced, identifying the specific issue or challenge that the project aims to address. This is followed by the project objectives, outlining the goals the project seeks to achieve. The project scope is then defined as aspects covered and the limitations of the project. Subsequently, the project significance is highlighting why the project is important. The expected project results outlined the outcomes and deliverables of the project. Finally, the chapter concludes with a chapter outline, summarizing the subsequent chapters.

Chapter 2: Literature Review

In Chapter 2, the literature review describes the background of the study related to ECG monitoring system development. Based on articles, journals, proceedings, and conference articles, the literature review was done on existing techniques and procedures.

Chapter 3: Methodology

In Chapter 3, the methodology explains the chosen project methodology from the literature review. This chapter begins with an introduction providing an overview of the methodology. Then, the project design section is subdivided into project block diagram, project flowchart, and project description. Following this, the project hardware is discussed, including the schematic circuit and description of the main component. Next, the project software system flowchart and its description project software are described. Then, the project prototype development into mechanical design and product layout are presented. Additionally, sustainability elements in the design concept are explained. The chapter ends with a summary by giving a brief review of the main points discussed in the methodology.

ABOUT LITERATURE REVIEW

WHAT IS LITERATURE REVIEW?

WHAT IS LITERATURE REVIEW?

1. Explains a BRIEF INTRODUCTION to the project/title of the study, CONCEPTS or THEORIES related to it, PREVIOUS STUDIES relevant to the project/study area, and concludes with a concise summary of the chapter.
2. A literature review is a REVIEW OF INFORMATION obtained from JOURNALS, BOOKS, PROCEEDINGS, and PAST studies for a RECENT study.
3. Requires research and skills in SEARCHING, COLLECTING, READING, and SUMMARIZING information in detail as it can provide IDEAS and DIRECTIONS regarding the studied issue.
4. Identify the FINDINGS of other researchers in the field to be studied.
5. REFERENCES used must be RELATED to the focus of the project.
6. reference materials are AT LEAST FIVE (5) scholarly references published within the PAST 5 YEARS.

NUMBER OF ARTICLES TO INCLUDE IN A LITERATURE REVIEW

“Dalam proses membuat kajian literatur, seseorang penyelidik akan mengenal pasti dapatan-dapatan penyelidik lain dalam bidang yang akan dikaji. Rujukan yang digunakan mestilah berkaitan dengan fokus projek/kajian. Jumlah bahan rujukan yang diperlukan adalah sekurang-kurangnya **LIMA (5) rujukan ilmiah** yang diterbitkan dalam jangka masa 5 tahun terdahulu. Elemen utama yang perlu diambil perhatian di dalam membuat analisis.”

SYSTEMATIC LITERATURE REVIEW SEARCHING PROCESS

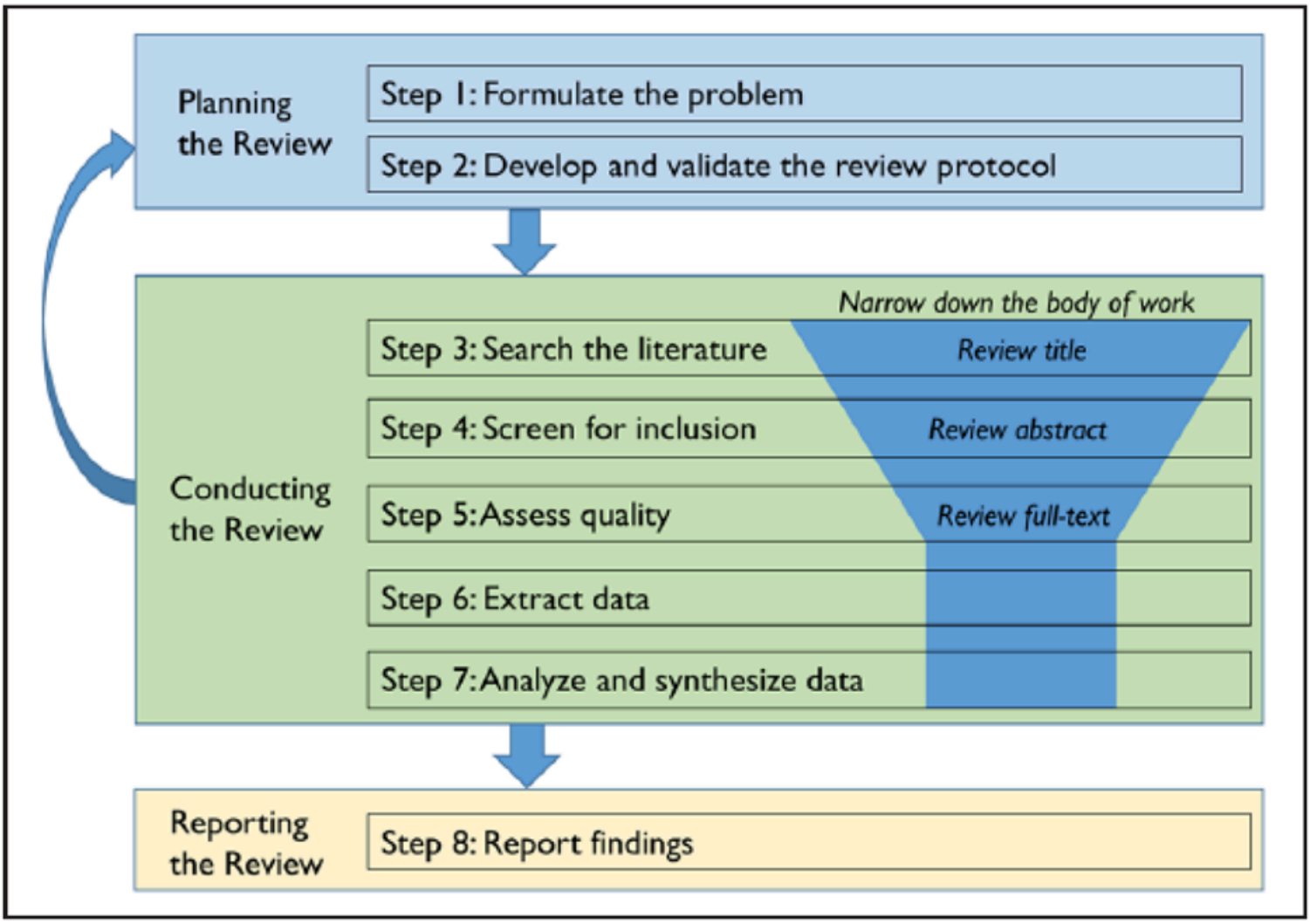
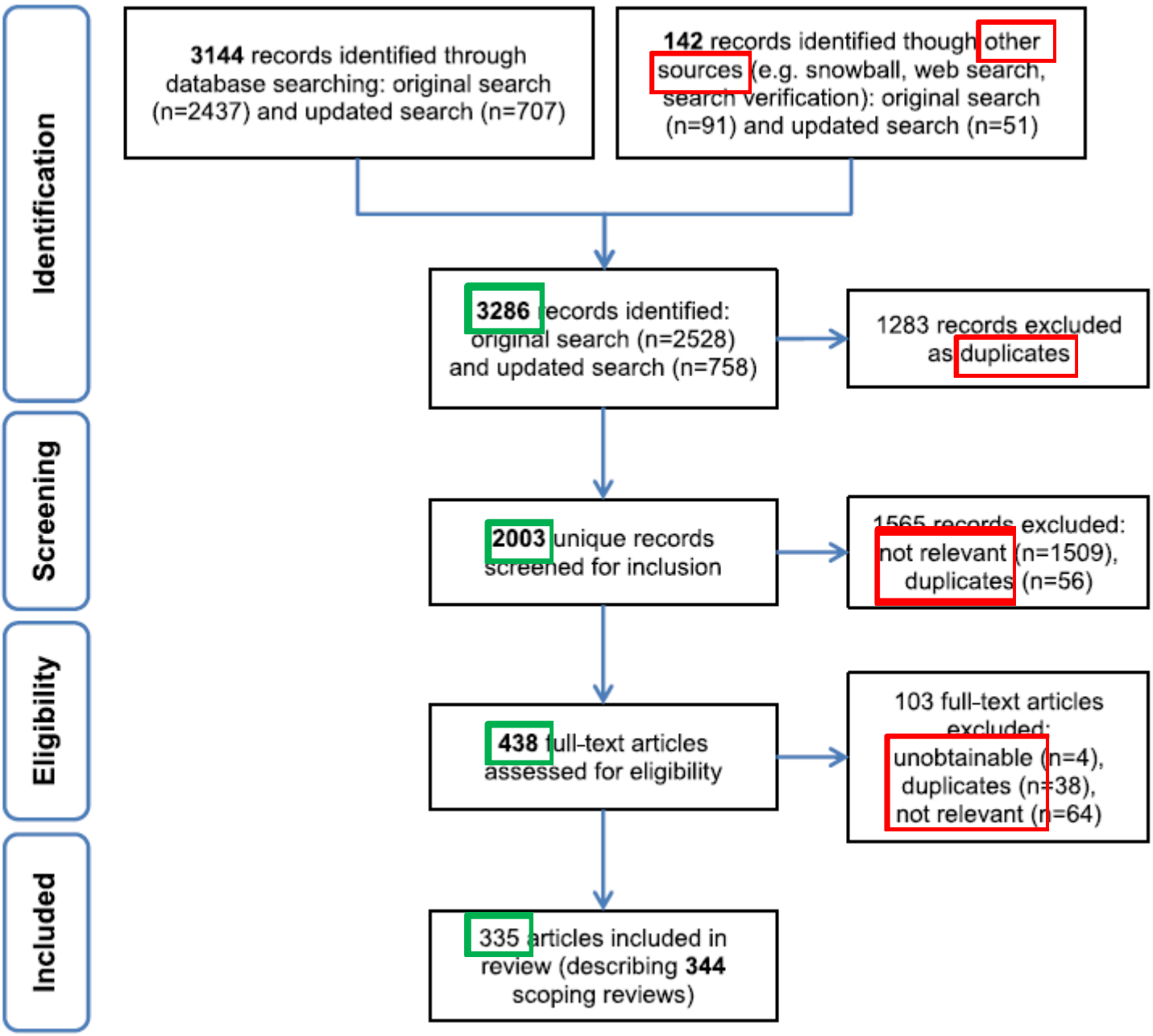


Figure I: Process of systematic literature review

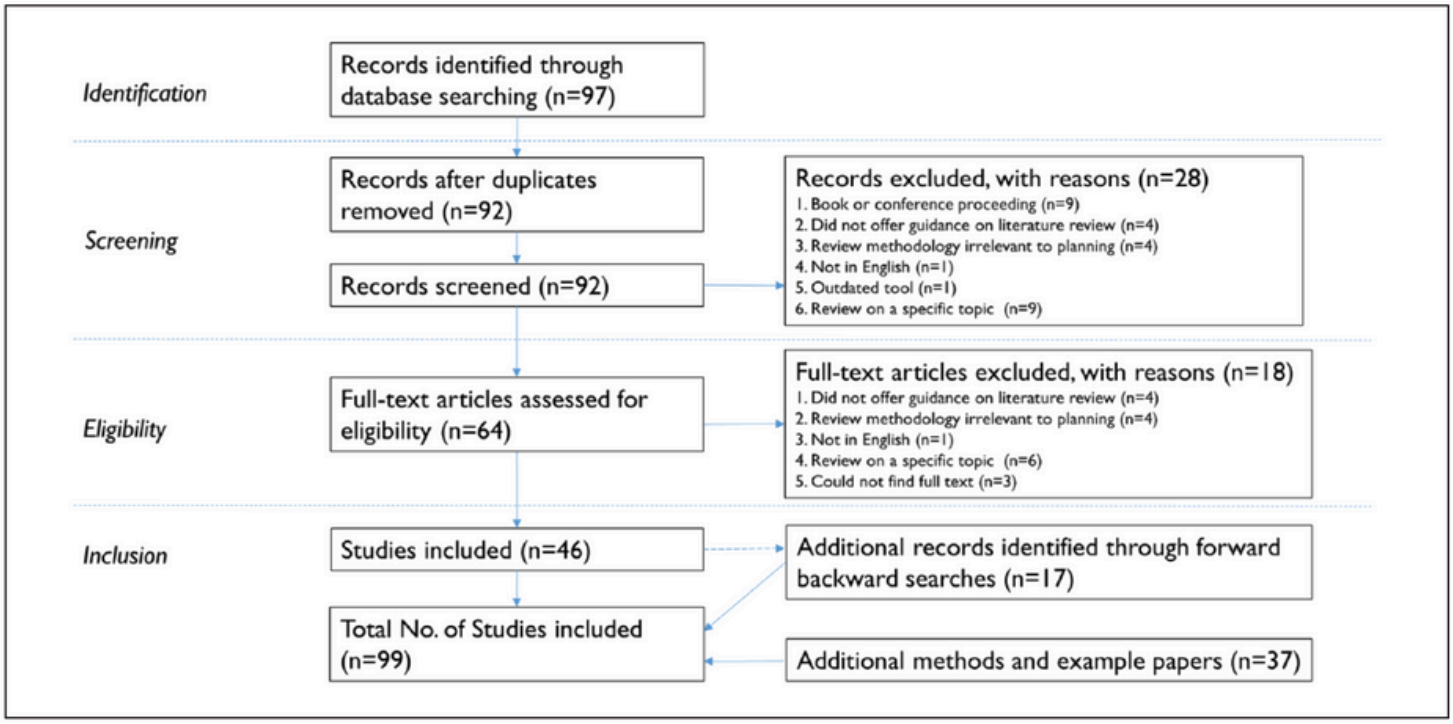
PRISMA ARTICLE SELECTION PROCESS

PRISMA

(TRANSPARENT REPORTING of SYSTEMATIC REVIEWS and META-ANALYSES)



INCLUSION & EXCLUSION LITERATURE REVIEW REFERENCE



SEARCHING STOPPING RULE

Stopping rule. A rule of thumb is that the search can stop when repeated searches result in the same references with no new results (Levy and Ellis 2006). If no new information can be obtained from the new results, the researchers can call the search to an end.

CHAPTER 2: LITERATURE REVIEW

Chapter 2: Literature Review

2.1 Introduction
2.2 Previous Studies/Reviews/Investigations
2.3 Chapter Summary

2.1 INTRODUCTION

CONTENT

1. Purpose and Scope:
Provide an overview of the literature review's aim, which is to synthesize existing research on the chosen topic to inform the current study.
2. Importance to the Field:
Explain the significance of the topic within the field of study, emphasizing its relevance for addressing key research questions or filling knowledge gaps.
3. Structure Overview:
Outline the structure of the literature review, which includes background information, organization of literature, synthesis, critical analysis, integration, and synthesis, and conclusion.

EXAMPLE

[Purpose and Scope] The literature review in this chapter serves the purpose of synthesizing existing research on the development of portable ECG monitoring devices to provide insights and inform the current study. This review aims to analyze the advancements, challenges, and trends in the field, ultimately contributing to the enhancement of portable healthcare technologies. **[Importance to the Field]** Furthermore, the significance of portable ECG monitoring devices within the healthcare field cannot be overstated. These devices play a crucial role in remote patient monitoring and the early detection of cardiac abnormalities, leading to timely interventions and improved patient outcomes. Therefore, understanding the evolution and current state of portable ECG monitoring devices is essential for healthcare professionals, researchers, and technology developers alike. **[Structure Overview]** To guide the reader through this comprehensive review, the structure will encompass critical analysis of the previous studies reviews and investigations on the development of portable ECG monitoring devices, and a conclusion summarizing key insights and suggesting future research directions. This structured approach ensures a comprehensive examination of the literature, providing a foundation for further advancements in portable ECG monitoring device development.

2.2 PREVIOUS STUDIES/REVIEWS/INVESTIGATIONS

1. Build LR Matrix Table

1. **Purpose:** To organize and summarize the key information from various sources (studies, articles, etc.) in a structured format.
2. **Components:** Typically includes columns for author(s), publication year, research objective, methodology, key findings, and relevance to your project.
3. **Process:** Populate the table with information from each source, ensuring that each entry is concise and informative. an overview of the literature review's aim, which is to synthesize existing research on the chosen topic to inform the current study.

2. Critical Writing Analysis of LR Matrix

1. **Purpose:** To critically evaluate the literature summarized in the matrix table.

2. **Components:** Involves analyzing the authorship, research objectives, methodologies, key findings, relevance to your project, strengths, weaknesses, gaps, and overall synthesis of the literature.

3. **Process:** Evaluate each source's credibility, relevance, and methodological rigor. Identify trends, patterns, contradictions, and gaps in the literature. Discuss how the literature informs your project and contributes to the existing knowledge.

2.2 PREVIOUS STUDIES/REVIEWS/INVESTIGATIONS

What is LR Matrix Table?

i. a tool used in academic research to organize and synthesize information from various sources during the literature review process

ii. to provide a structured framework for researchers to manage and analyze a significant volume of literature efficiently.

iii. a valuable tool for researchers to efficiently organize, compare, and synthesize information from multiple sources, aiding in the systematic and evidence-based construction of a literature review within academic and research contexts.

iv.

Number of articles to include in LR Matrix Table

BUKU PANDUAN
PELAKSANAAN
PROJEK PELAJAR
(PROGRAM DIPLOMA)
POLITEKNIK MALAYSIA

Dalam proses membuat kajian literatur, seseorang penyelidik akan mengenal pasti dapatan-dapatan penyelidik lain dalam bidang yang akan dikaji. Rujukan yang digunakan mestilah berkaitan dengan fokus projek/kajian. Jumlah bahan rujukan yang diperlukan adalah sekurang-kurangnya **LIMA (5)** rujukan ilmiah yang diterbitkan dalam jangka masa 5 tahun terdahulu. Elemen utama yang perlu diambil perhatian di dalam membuat analisis

2.2 PREVIOUS STUDIES/REVIEWS/INVESTIGATIONS

Basic LR Matrix

- A **basic literature review matrix template** is a structured tool used to organize, summarize and compare key aspects research papers or studies in a clear and systematic way. It helps researchers keep track of important details and identify patterns, gaps, and trends across the reviewed literature.
- **Explanation of the Template:**

1. **Headers:**

   The matrix includes column headers that represent key aspects of a study. In this example, the headers are:

   i. **No.:** A numerical identifier for easy reference.
   ii. **Year:** The publication year of the study.
   iii. **Author:** The authors of the study.
   iv. **Kind:** The type of publication (e.g., journal, conference proceedings).
   v. **Title:** The title of the study.
   vi. **Contribution:** The key contribution or focus of the study.
   vii. **How (Method, Example):** The methodology or approach used in the study, with specific examples if provided.
   viii. **Results:** The major findings or outcomes.
   ix. **Weakness:** Limitations or areas where the study could improve.

2. **Content Organization:**
   - Each row represents one study or paper.
   - Key information is summarized in each cell, making it easier to compare and contrast studies.
3. **Purpose of the Template:**
   - It facilitates the **systematic comparison** of studies.
   - It highlights **contributions, methodologies, and results** at a glance.
   - It helps identify **gaps in the research** or areas that need further exploration.

2.2 PREVIOUS STUDIES/REVIEWS/INVESTIGATIONS

4. Applications:

a. This template is especially useful for researchers writing a **literature review section** of a paper or dissertation.
b. It supports evidence synthesis and helps in formulating research questions or hypotheses.

- **Customisation:**
  - The columns can be modified based on the research context. For example, in other fields, you might add headers such as:
- **Theoretical Framework**
- **Data Source**
- **Practical Applications**
- **Future Recommendations**

EXAMPLE

No.	Year	Author	Kind	Title	Contribution	How(method, Example)	Results	Weakness
1	2015	Tripathy, Abinash Agrawal, Ankit Rath, Santanu Kumar	Procedia Computer Science	Classification of Sentimental Reviews Using Machine Learning Techniques	• Use machine learning algorithms to classify a sentimental review having either a positive review or a negative review	• Naive Bayes (NB) and Support Vector Machine (SVM) classification algorithm. • The dataset considered in this study is the Polarity movie review dataset which consist of 1000 positively labeled and 1000 negative labeled movie reviews15	94.06%	In this study, only two different classifiers have been implemented, Adding some other algorithms such as K nearest neighbour can be considered to implement and compare results of can be presented with SVM classifier.
2	2015	• Ramesh, B. • Sathiaseelan, J. G. R.	Procedia Computer Science	An Advanced Multi Class Instance Selection based Support Vector Machine for Text Classificatio n	The new method will increase the efficiency of support vector machine (in the text classification)	• Multi Class Instance Selection based support vector machine (AMCISSVM) - compared with Multi Class Instance Selection (MCIS) and Neighborhood Property based Pattern Selection (NPPS) algorithm. • Datasets are received from UCI machine learning repository	94.58%	• Long execution time algorithm • Small empirical dataset

2.2 PREVIOUS STUDIES/REVIEWS/INVESTIGATIONS

Methodological LR Matrix

- a structured approach to compare various methodological components employed in engineering studies. This type of matrix focuses on the technical details of methods or techniques used in the literature, enabling researchers to evaluate and synthesize the strengths, limitations, and applicability of these methods in different contexts.

EXAMPLE

Parameter	A. Kubal and C. K. [9]	A. Ahamed et al. [14]	S.LAVANYA et al. [15]	P.Kalaivan et. al. [16]	Z. U. Abideen and M. A. Shah. [17]
Data Reading	Heartbeat pulse, blood pressure and heart sound sensors kits	Bioprotech ECG T7016	Heart Beats sensor	AD8232 ECG sensor	The pulse oximeter, blood oxygen saturation, ECG, glucose sensors connected to a gateway router
Micro-controller	Raspberry Pi	Arduino Uno	Raspberry Pi	Arduino Uno	6LoWPAN
Transmission Technique	Wi-Fi	Bluetooth	GSM+Wi-Fi	Bluetooth	3G and 4G
Distance	Unlimited	10 meters	Unlimited	10 meters	Unlimited
Displaying Results	Web Page IP address	Processing application and smartphone	SMS Acknowledgment and Web page IP	Serial plotter and smartphone	Reporting emergency case as an email
IoT	Yes	No	Yes	No	Yes
Time	Real-time	Real-time	Real-Time	Real-time	Real-time
Cost-Effective	Yes	Yes	Yes	Yes	No

2.2 PREVIOUS STUDIES/REVIEWS/INVESTIGATIONS

Critical Writing Analysis of LR Matrix

i. Compare (Identify Similarities)
ii. Contrast (Identify Differences)
iii. Criticize (Identify weaknesses)
iv. Synthesize (Compare & Analyze)
v. Summarize

2.2 PREVIOUS STUDIES/REVIEWS/INVESTIGATIONS

Compare (Identify Similarities)

i. **Identify Similarities:** Review literature on the topic and identify shared features, technologies, or methodologies utilized across different studies or sources.
ii. **Organize Findings:** Create a structured comparison highlighting similarities between the reviewed sources. Use a matrix or table format to present common elements such as methodologies, key findings, theoretical frameworks, or practical implications.
iii. **Discuss Integration:** Emphasize how the identified commonalities contribute to a cohesive understanding of the topic. Discuss how these shared features interact or complement each other within the context of the research area.
iv. **Address Design Challenges:** If applicable, discuss any challenges encountered in the reviewed literature and how they were addressed. Explore how the identified similarities helped researchers overcome obstacles or limitations in their studies.
v. **Provide Examples:** Support your discussion with specific examples from the literature, citing relevant studies or projects that demonstrate the identified similarities effectively.
vi. **Highlight Implications:** Reflect on the significance of recognizing these similarities. Discuss how understanding commonalities can contribute to advancing knowledge in the field or improving practices.
vii. **Propose Future Directions:** Conclude by suggesting potential areas for further research or innovation based on the identified similarities. Consider how building upon shared features can lead to new insights or developments in the field.

2.2 PREVIOUS STUDIES/REVIEWS/INVESTIGATIONS

Compare (Identify Similarities)

Example 1

In reviewing the literature on designing and developing hardware and software for portable ECG monitoring devices, several commonalities emerge. Firstly, researchers commonly employ signal processing algorithms for ECG data analysis across different studies [1][2]. Additionally, power management strategies are emphasized to optimize device performance and extend battery life [1][2]. Sensor technologies, particularly polymer material sensors, are widely utilized for ECG signal acquisition [2][5]. Moreover, communication protocols such as Bluetooth and Wi-Fi facilitate seamless data transfer for analysis [3][4].

Integration of these commonalities contributes to a cohesive understanding of portable ECG monitoring device development. Signal processing algorithms, coupled with efficient power management strategies, enhance device efficiency and battery life. The use of advanced sensor technologies ensures accurate ECG signal acquisition, while communication protocols enable seamless data exchange for analysis.

Addressing design challenges, researchers have overcome obstacles such as sensor noise interference and power consumption through innovative hardware and software design approaches. For example, advanced signal processing algorithms effectively filter out noise, improving signal quality [6].

Recognizing these similarities is significant as it fosters collaboration among researchers and accelerates innovation in portable ECG monitoring technology. Understanding shared features can lead to improved device performance, interoperability, and ultimately, better patient outcomes.

Future research directions may focus on further optimizing signal processing algorithms, exploring novel sensor technologies, and standardizing communication protocols. Building upon shared features can lead to new insights and advancements in portable ECG monitoring, enhancing its clinical utility and accessibility [6].

Compare (Identify Similarities)

Example 2

Across the studies reviewed, several similarities emerge in the design of portable ECG monitoring devices. Firstly, there is a consistent utilization of specific Analog Front-End (AFE) circuits like AD8232 or AD823X, coupled with the integration of microcontroller units such as Arduino Nano, serving for data processing and control purposes. Additionally, wireless communication is a common feature, with many studies incorporating Bluetooth or ZigBee modules to facilitate wireless data transmission to external devices, enabling real-time monitoring. Moreover, electrodes play a crucial role in signal acquisition across all studies, albeit with variations in types. Finally, the need for compact, lightweight, and durable enclosure and packaging to safeguard internal components is evident, emphasizing the importance of device portability and longevity [1][2][3].

Contrast (Identify Differences)

i. **Identify Differences:** Review the literature to identify differences, discrepancies, or divergent approaches among the studies or sources.
ii. **Organize Findings:** Create a structured comparison highlighting the differences between the reviewed sources. You can use a matrix or table format to present these variations clearly, focusing on aspects such as methodologies, findings, theoretical frameworks, or practical implications.
iii. **Discuss Significance:** Emphasize the significance of these differences in shaping the landscape of research or practice in the field. Discuss how these variations contribute to a nuanced understanding of the topic or how they may impact decision-making or future developments.
iv. **Address Implications:** Explore the implications of these differences on the interpretation of research findings, the implementation of methodologies, or the adoption of practices. Discuss how acknowledging these distinctions can lead to more informed decisions or strategies.
v. **Provide Examples:** Support your discussion with specific examples from the literature, citing relevant studies or projects that illustrate the identified differences effectively.
vi. **Propose Insights:** Conclude by proposing insights gained from recognizing these differences. Consider how understanding disparities can contribute to refining research agendas, informing policy decisions, or guiding practical applications in the field.

Contrast (Identify Differences)

Example 1

In analyzing the contrast differences component from the Literature Review matrix table on designing and developing hardware and software for portable ECG monitoring devices, it's essential to scrutinize the divergent approaches evident in the literature. One significant contrast is observed in the methodologies employed for data acquisition and processing. Some studies focus on utilizing advanced sensors, such as polymer material sensors, coupled with deep learning algorithms to enhance signal processing [3], while others emphasize the design of wearable systems specifically tailored for fetal ECG monitoring [4]. Moreover, disparities exist in the hardware and software integration approaches, with certain research emphasizing the development of standalone hardware solutions [6], while others focus on mobile phone-based systems [2]. These differences significantly impact the field by offering diverse solutions catering to varying needs, such as clinical monitoring or remote patient management. Recognizing these contrasts is crucial for guiding the selection of appropriate methodologies and technologies, ensuring the development of effective and tailored solutions for portable ECG monitoring devices, thereby contributing to advancements in healthcare delivery and patient outcomes.

Example 2

Differences emerge across various aspects of portable ECG monitoring device designs. Firstly, in terms of wireless communication, there's a divergence between studies, with some employing Bluetooth modules while others favor ZigBee technology [1]. Secondly, variations in electrode composition are evident, as certain studies utilize graphene or composite materials [3]. Lastly, there's a lack of specificity regarding power management systems, highlighting a research gap in the optimization of power efficiency and battery life [4].

Criticize (Identify Weaknesses)

i. **Identify Weaknesses:** Review the literature to pinpoint weaknesses, flaws, or limitations within the sources. This involves critically evaluating the methodologies, data analysis techniques, interpretations, or theoretical frameworks used in each study.
ii. **Organize Findings:** Create a structured comparison highlighting the criticisms among the reviewed sources. Utilize a matrix or table format to present these criticisms clearly, with each row representing a study and columns indicating different aspects of criticism such as methodological shortcomings, biased interpretations, or inadequate evidence.
iii. **Discuss Significance:** Emphasize the significance of these criticisms in assessing the reliability and validity of the existing literature. Discuss how these weaknesses contribute to a nuanced understanding of the topic by identifying areas for improvement or further investigation.
iv. **Address Implications:** Explore the implications of these criticisms on the overall body of research, including how they affect the interpretation of findings, the generalizability of results, or the development of future research directions. Discuss how acknowledging these weaknesses can lead to advancements in research methodologies or theoretical frameworks.
v. **Provide Examples:** Support your discussion with specific examples from the literature, citing relevant studies or projects that illustrate the identified weaknesses effectively. This helps to demonstrate the practical implications of the criticisms identified and provides context for their significance.
vi. **Propose Insights:** Conclude by proposing insights gained from recognizing these weaknesses. Consider how addressing these criticisms can lead to improvements in research practices, theoretical constructs, or the interpretation of research findings. By following these steps, you can effectively write the Criticize opinion component of the Literature Review matrix table, providing a comprehensive evaluation of the limitations present in the reviewed literature.

Criticize (Identify Weaknesses)

Example 1

The Criticize opinion component from the Literature Review matrix table on designing and developing hardware and software for portable ECG monitoring devices identifies several weaknesses across the reviewed literature. Methodological shortcomings are evident, including inconsistent data collection techniques and a lack of standardized protocols [1]. Furthermore, discrepancies in the interpretation of ECG data and the implementation of signal processing algorithms are notable [4]. These weaknesses undermine the reliability and validity of research findings, impacting the overall body of knowledge in the field. The implications of these weaknesses extend to the interpretation and generalizability of research outcomes, hindering advancements in ECG monitoring technology [5]. For instance, limitations in deep learning methods for heart rhythm identification highlight the need for more robust algorithms and validation strategies [4]. Acknowledging these weaknesses can lead to improvements in research methodologies and theoretical frameworks, ultimately enhancing the accuracy and effectiveness of portable ECG monitoring devices [6]. literature.

Example 2

Criticisms arise regarding the lack of comprehensive information in several articles. Firstly, there's a notable absence of specific details concerning critical components such as power management, display screen, firmware, and user interface software. This deficit impedes a thorough comparison and understanding of the various portable ECG monitoring devices discussed in the literature. Secondly, a limited focus on signal processing is evident, as there is a lack of detailed information on the algorithms employed. This omission restricts insights into the diagnostic capabilities and data accuracy of these devices. Finally, there's a notable variability in wireless communication methods, particularly regarding the choice between Bluetooth and ZigBee. However, some studies fail to justify this choice adequately, highlighting the necessity for a comparative analysis to elucidate the most suitable option for wireless data transmission in this context.

Synthesize (Compare & Analyze)

i. Identify Main Ideas: Read each source carefully and extract the main ideas or key points presented in each one. This involves understanding the key arguments, findings, or themes of the literature.
ii. Find Similarities and Differences: Look for similarities and differences among the sources. Identify common themes, perspectives, or methodologies across multiple sources. Additionally, pinpoint any contrasting viewpoints, conflicting findings, or divergent approaches.
iii. Organize Information: Use a matrix or table format to organize the synthesized information. Create rows for each source and columns representing key categories or themes you are comparing. This could include variables, methodologies, findings, or theoretical frameworks.
iv. Record Relationships: Record how sources relate to each other within the matrix. Note connections, overlaps, or contradictions between sources. This helps to visualize the relationships between different pieces of literature.
v. Analyze and Interpret: Analyze the synthesized information to draw conclusions and insights. Discuss the implications of the similarities and differences identified. Consider how the synthesis contributes to a deeper understanding of the research topic or addresses gaps in the literature.
vi. Provide Examples: Support your synthesis with specific examples from the literature, citing relevant studies or arguments that illustrate the comparisons made effectively. This adds depth and credibility to your analysis.
vii. Conclude with Insights: Conclude the Synthesize component by summarizing the key findings and insights gained from comparing the literature. Discuss any new perspectives or understandings that have emerged as a result of the synthesis.

2.2 PREVIOUS STUDIES/REVIEWS/INVESTIGATIONS

Synthesize (Compare & Analyze)

Example 1

In synthesizing the literature on designing and developing hardware and software for portable ECG monitoring devices, several steps can guide the process. Initially, it's crucial to identify the main ideas by meticulously analyzing each source to extract key points regarding hardware and software advancements, innovative design methodologies, and developmental challenges [1][2][3][4][5][6]. Following this, it's imperative to find similarities and differences among the sources, highlighting commonalities like the utilization of wireless technology, signal processing algorithms, and the critical need for monitoring accuracy. Conversely, differences may encompass variations in hardware components, software interfaces, and clinical validation techniques. To effectively organize the information, constructing a matrix or table with rows for each source and columns representing hardware specifications, software algorithms, validation methods, and user interface design is recommended. Additionally, recording relationships between sources, analyzing and interpreting synthesized information, providing illustrative examples from the literature, and concluding with insights about future research directions and potential enhancements in portable ECG monitoring device design and development are integral components of the synthesis process.

Example 2

These criticisms highlight significant areas where improvements could enhance the comprehensiveness and effectiveness of portable ECG monitoring device research. Specifically, there is a need for more thorough reporting on hardware and software components to enable better comparison and understanding. Additionally, a greater emphasis on signal processing algorithms could enhance the devices' diagnostic capabilities and data accuracy. Moreover, a comparative analysis of wireless communication protocols could provide insights into optimizing connectivity for real-time monitoring applications.

2.2 PREVIOUS STUDIES/REVIEWS/INVESTIGATIONS

Summarize

Distilling the main ideas or findings of existing research into a concise statement while also identifying key gaps or areas for improvement. This process involves:

i. Condensing Key Points: Highlighting the most important contributions of the studies, such as insights into hardware components.
ii. Focusing on Relevance: Emphasizing aspects directly related to the review's theme, such as ECG device performance.
iii. Identifying Gaps: Pointing out what the research has not sufficiently addressed, such as power management or wireless communication.
iv. Connecting to Future Directions: Suggesting areas where further work is needed to advance the field.

Example 1

v. In summary, while existing studies provide insights into the hardware components of portable ECG monitoring devices, there is a need for more detailed research focusing on power management, signal processing algorithms, and wireless communication technology to enhance the devices' performance and usability in real-world applications.

2.3 CHAPTER SUMMARY

Involves concisely summarizing the key points discussed in the chapter while ensuring the focus remains on how the literature connects to the study's objectives. Below is a structured guide to writing this subsection:

1. Introduction Sentence
   Start with a brief overview of what was covered in Chapter 2.
2. Highlight Major Themes or Sections
   Summarize the main topics or themes discussed in the literature review.
   - Group similar topics and mention them briefly.
   - Emphasize how these relate to the study.
3. Identify Gaps in the Literature
   Briefly point out the research gaps identified in the review.
4. Connect to Research Objectives
   Link the chapter content to the purpose of your study.
5. Closing Sentence
   End with a transition to the next chapter.

Example 2

[**Introduction Sentence**] This chapter reviewed the relevant literature on low-cost ECG monitoring systems, focusing on the theoretical frameworks, essential components, and prior advancements in the field. [**Highlight Major Themes or Sections**] The review began by exploring the significance of affordable ECG monitoring systems, highlighting the growing need for cost-effective solutions in low-resource settings. It then examined hardware components such as microcontrollers, sensors, and power management units, emphasizing their role in reducing production costs. Additionally, the chapter analyzed advancements in signal processing algorithms and wireless communication technologies, showcasing their potential for enhancing system efficiency and usability. [**Identify Gaps in the Literature**] Despite the substantial progress made in the development of low-cost ECG devices, gaps remain in areas such as optimizing power consumption, improving data accuracy, and integrating user-friendly interfaces. These gaps underline the need for further research to address the challenges associated with scaling these systems for real-world applications. [**Connect to Research Objectives**] The insights from this review inform the study's focus on designing an affordable, efficient ECG monitoring system tailored to resource-constrained environments. This foundation paves the way for the detailed methodology outlined in the following chapter. [**Closing Sentence**] In conclusion, this chapter has provided a comprehensive overview of existing research, identifying critical gaps and guiding the development of innovative solutions in low-cost ECG monitoring technology.

EXAMPLE OF OUTCOME FROM LITERATURE REVIEW

Parameter	**Proposed System**	A. Kubal and C. K. [9]	A. Ahamed et al. [14]	S.LAVANYA et al. [15]	P.Kalaivan et. al. [16]	Z. U. Abideen and M. A. Shah. [17]
Data Reading	**AD8232 ECG sensor**	Heartbeat pulse, blood pressure and heart sound sensors kits	Bioprotech ECG T7016	Heart Beats sensor	AD8232 ECG sensor	The pulse oximeter, blood oxygen saturation, ECG, glucose sensors connected to a gateway router
Micro-controller	**Arduino Uno**	Raspberry Pi	Arduino Uno	Raspberry Pi	Arduino Uno	6LoWPAN
Transmission Technique	**Wi-Fi**	Wi-Fi	Bluetooth	GSM+Wi-Fi	Bluetooth	3G and 4G
Distance	**Unlimited**	Unlimited	10 meters	Unlimited	10 meters	Unlimited
Displaying Results	**Blynk Application on smartphone**	Web Page IP address	Processing application and smartphone	SMS Acknowledgment and Web page IP	Serial plotter and smartphone	Reporting emergency case as an email
IoT	**Yes**	Yes	No	Yes	No	Yes
Time	**Real-time**	Real-time	Real-time	Real-Time	Real-time	Real-time

CHAPTER 3: METHODOLOGY

CHAPTER 3: METHODOLOGY

Chapter 3: Methodology

WHAT IS METHODOLOGY?

- Most suitable **APPROACH** for conducting the project.
- Effective **PROCEDURES** to address the research/project issues.
- **WORKFLOW** aligning with the work plan outlined in the Gantt chart.

3.1 INTRODUCTION

CONTENT

1. Overview of Chapter:

Begin with a brief introduction to the chapter. Highlight the purpose of the methodology section, such as explaining how the research was conducted or how the project was implemented.

2. Restate the Project Objective or Problem Statement:

Provide a concise restatement of the project objectives or the main problem addressed. Connect the objectives to the need for specific methodologies.

3. Justification for the Methodology:

Explain why this methodology was chosen. Mention its suitability in addressing the research objectives or project requirements.

4. Scope of the Methodology:

Provide an overview of what the methodology will cover in this chapter. Mention the major components or steps, such as: Project Design, Project Hardware, Project Software and Sustainability Element in the Design Concept.

5. Structure of Chapter:

Summarize the sub-sections or steps included in the methodology chapter.

3.1 INTRODUCTION

EXAMPLE

[Overview of Chapter] This chapter outlines the methodology employed to achieve the objectives of the project. It provides a detailed description of the project design, hardware, software, and sustainability considerations incorporated into the development process. The selected methodology ensures a systematic approach to designing, implementing, and testing the system to achieve the desired outcomes effectively. **[Restate the Project Objective or Problem Statement]** The objective of this project is to design and develop a [specific project name, e.g., "Voice Recognition Lamp Using Node MCU ESP12"]. The methodology was chosen to ensure an organized framework that integrates both hardware and software components while incorporating sustainable design principles**. [Justification for the Methodology]** The methods and processes outlined in this chapter provide the foundation for building a reliable and efficient system. **[Scope of the Methodology]** The scope of the methodology includes the development of the project design through a block diagram and flowchart, followed by a detailed explanation of the hardware and software components. The hardware design includes the schematic circuit and descriptions of the main components, while the software section elaborates on the system flowchart and its implementation. Sustainability elements are also considered, ensuring the project's long-term viability**. [Structure of Chapter]** This chapter is organized into several sections. Section 3.2 focuses on the project design, which includes the block diagram and flowchart. Section 3.3 covers the hardware aspects, such as the schematic circuit and a detailed description of the main components. Section 3.4 discusses the software flowchart and its description. Section 3.5 highlights the sustainability elements in the design concept. Finally, Section 3.6 provides a summary of the main points discussed in this chapter

3.2 PROJECT DESIGN

CONTENT

1. Introduction to Project Design:

Begin with a brief introduction to the project design section. Highlight the importance of designing a clear and systematic framework for the project. Provide an overview of the subsections, i.e., the project block diagram and project flowchart.

2. Purpose of Project Design:

Explain why the design stage is crucial for project success. Link the design framework to the project's goal and how it facilitates efficient implementation.

3. Link to Next Section

Conclude with a transition statement leading to the subsections (e.g., block diagram and flowchart) for further details.

3.2 PROJECT DESIGN

EXAMPLE

[Introduction to Project Design]

The project design for the Voice Recognition Lamp Using Node MCU ESP12 involves a systematic approach to developing a functional and efficient system for automated voice-activated lighting control. The design framework encompasses hardware and software aspects to ensure seamless integration and operation. This section outlines the overall system design through the project block diagram and flowchart, which are essential tools for guiding the implementation and achieving the project objectives.

[Purpose of Project Design]

The project design is a critical stage that ensures the system's components are logically arranged and its operational process is well-defined. By employing a structured approach, the design minimizes errors during development, improves functionality, and facilitates efficient testing. The block diagram provides a high-level overview of the system architecture, showcasing the relationship between key components such as the microphone module, Node MCU microcontroller, and the LED light system. Meanwhile, the flowchart illustrates the sequence of operations, including voice command recognition, data processing, and system response. **[Link to next section]** The subsequent subsections will detail the project block diagram and flowchart, providing a comprehensive understanding of the system's design process.

3.2.1 PROJECT BLOCK DIAGRAM

CONTENT

1. Introduction to Block Diagram:

Define a block diagram and its relevance in illustrating the system's architecture. Briefly explain the components included in the block diagram.

2. Illustration of the Block Diagram:

Include a visual representation of the block diagram. Refer to the figure in the description.

3. Description of the Block Diagram:

Provide a detailed explanation of each block in the diagram. Explain how the components interact to achieve the desired functionality.

3.2.1 PROJECT BLOCK DIAGRAM

EXAMPLE

[Introduction to Block Diagram]

The project block diagram represents the system's architecture, showcasing the logical arrangement and interaction between its components. It is an essential tool for understanding the operational flow and ensuring efficient system implementation. For the Low-Cost ECG Monitoring System, the block diagram highlights the integration of hardware and software modules required for real-time electrocardiogram (ECG) signal acquisition, processing, and display. Key components include ECG electrodes, the AD8232 ECG sensor, the microcontroller (Arduino), and a computer interface for visualizing data.

[Illustration of the Block Diagram]

Figure 3.1 provides a clear and detailed overview of the system's structure, visually mapping the flow of data from signal acquisition to graphical display. The block diagram serves as a blueprint, ensuring the logical integration of components to meet the project's objectives effectively.

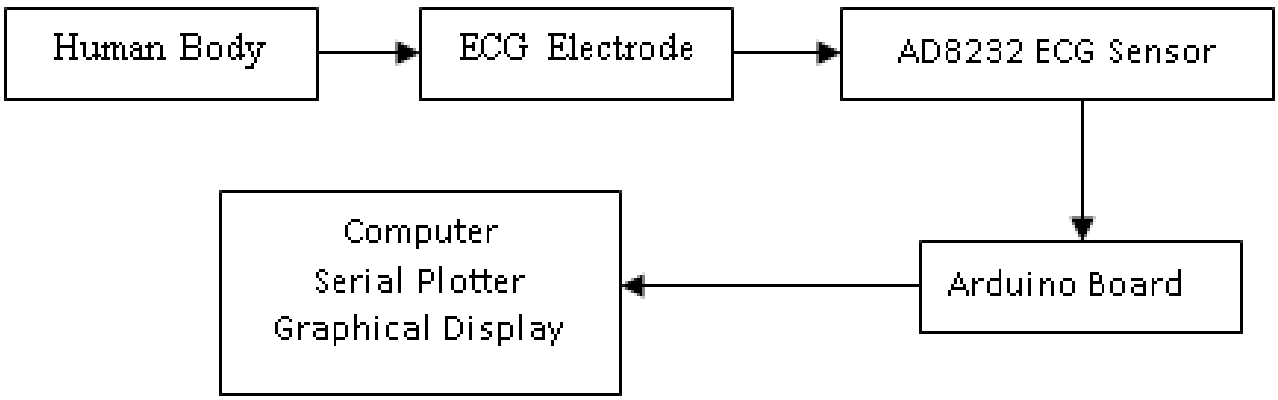


Figure 3.1: Project Block Diagram

3.2.1 PROJECT BLOCK DIAGRAM

EXAMPLE

[Description of the Block Diagram]

In the block diagram illustrated in Figure 3.1, the system initiates with the acquisition of electrical signals from the ECG electrodes, which detect the heart's electrical activity. These analog signals are sent to the AD8232 ECG sensor, where essential signal processing tasks such as amplification and filtering are performed to enhance the quality of the signals.

The processed analog signals are then converted into digital form using the Analog-to-Digital Converter (ADC) within the Arduino microcontroller. The microcontroller plays a critical role in performing further signal processing, including noise reduction and feature extraction, to ensure the accuracy of the data.

Once digitized, the ECG data is transmitted to a computer via a serial communication interface. The computer, in conjunction with the Arduino, processes the incoming data and visually represents the ECG signals using the Serial Plotter.

This process provides users with a real-time graphical display of the heart's electrical activity for analysis and monitoring purposes. The systematic flow of data and interaction among the components ensures the accurate capture, processing, and representation of ECG signals. This design is optimized for reliability, functionality, and cost-efficiency, making it suitable for various applications, including personal health monitoring.

3.2.2 PROJECT FLOWCHART

CONTENT

1. Introduction to Flowchart:

Define a flowchart and its role in visualizing the process flow of the project. Mention how it helps in understanding the step-by-step operation of the system.

Example:

"The flowchart provides a graphical representation of the project's operational process. It outlines the sequence of steps involved in the system, from initial inputs to final outputs, ensuring clarity in implementation.“

2. Illustration of the Flowchart:

Include a diagram of the flowchart. Refer to the figure in the text.

Example:

"Figure 3.2 depicts the flowchart of the project, illustrating the sequence of operations and decision-making processes embedded in the system.“

3. Description of the Flowchart:

Provide a step-by-step explanation of the flowchart. Describe the logic or decision points and their significance.

Example:

"The flowchart begins with the system’s initiation, followed by input signal detection from the sensors. The microcontroller processes these inputs and determines the appropriate output actions. Decision points are incorporated to handle conditional scenarios, such as system errors or specific triggers."

3.2.2 PROJECT FLOWCHART

EXAMPLE

[Introduction to Flowchart]

The flowchart is a graphical tool used to represent the sequential flow of operations in the Low-Cost ECG Monitoring System. It visualizes the step-by-step processes, decision points, and interactions within the system, ensuring a clear understanding of the project's functional logic. By illustrating the operational framework, the flowchart simplifies the design and debugging stages, aiding in the efficient implementation of the system.

[Illustration of the Flowchart]

Figure 3.2 illustrates the complete flow of operations within the system. It provides a detailed visual representation of the logical steps, decision points, and feedback loops critical to the successful implementation of the project.

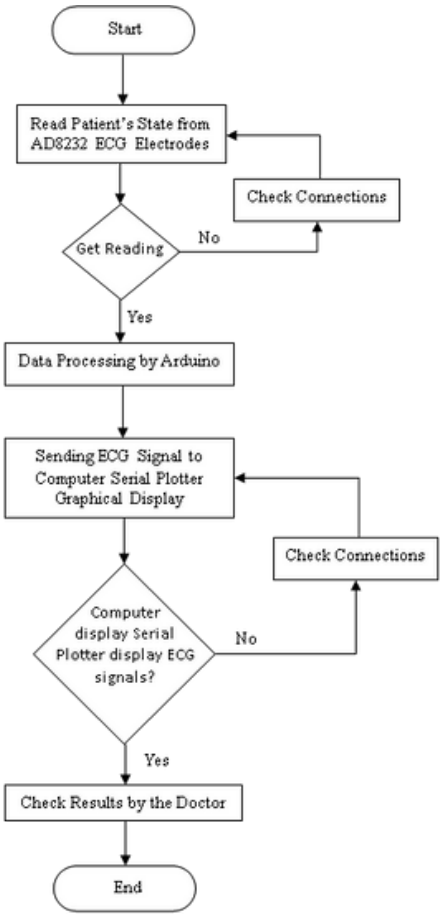


Figure 3.2: Project Flowchart

3.2.2 PROJECT FLOWCHART

EXAMPLE

[Description of the Flowchart]

The flowchart for the Low-Cost ECG Monitoring System (Figure 3.2) outlines the sequential steps and decision-making processes involved in its operation. The process begins with system initialization, where the ECG sensor and Arduino are powered up.

Following this, data acquisition takes place, with ECG signals being captured through the AD8232 sensor, which is connected to three adhesive electrodes labelled as R (right side), L (left side), and COM (ground), placed on the patient's body.

The system then verifies whether the ECG signals are successfully detected. If the signals are detected, they proceed to the next stage of processing; otherwise, the connections are checked, and the system attempts to re-establish signal acquisition.

Once the signals are acquired, they undergo processing within the Arduino, where tasks such as noise reduction and digitization are carried out. The processed signals are then transmitted to a computer for display. At this stage, the system checks whether the ECG signals are correctly displayed on the computer. If successful, the results are reviewed for analysis and diagnosis. If not, the system rechecks the connections and reattempts data transmission and display.

This systematic process ensures reliable data acquisition, accurate signal processing, and effective visualization of the heart's electrical activity, providing real-time monitoring capabilities.

3.3 PROJECT HARDWARE

CONTENT

3.3.1 Schematic Circuit

1. Introduction to Schematic Circuit:

Define what a schematic circuit is and its relevance in designing the hardware setup of the system. Mention the tools or software used to create the schematic circuit (e.g., Proteus, KiCAD, etc.).Highlight the importance of the schematic in guiding the physical implementation of the hardware.

Example:

"The schematic circuit serves as a blueprint for the hardware implementation of the Low-Cost ECG Monitoring System. It visually represents the connections and interactions between the system's components, ensuring an organized and efficient design process. Proteus software was utilized to design the schematic, providing clarity and precision in representing the hardware layout.“

2. Illustration of the Schematic Circuit:

Include the diagram of the schematic circuit. Reference the figure in the explanation.

Example:

"Figure 3.3 shows the schematic circuit design of the system, detailing the wiring connections between the ECG sensor, Arduino, and supporting components.”

3.3 PROJECT HARDWARE

CONTENT

3.3.1 Schematic Circuit

3. Description of the Schematic Circuit:

Explain the connections and interactions between the main components shown in the schematic. Highlight critical connections, such as sensor interfaces, microcontroller pins, and power supply arrangements. Discuss how the schematic supports the project's functionality.

Example:
"The schematic circuit (Figure 3.3) illustrates the connections between the AD8232 ECG sensor, the Arduino microcontroller, and the display module. The AD8232 sensor is interfaced with the Arduino's analogue input pin, enabling the acquisition of ECG signals. The power supply circuit ensures a stable voltage to all components, while the output module facilitates signal display and analysis."

3.3 PROJECT HARDWARE

CONTENT

3.3.2 Description of Main Components

1. Introduction to Components:

Provide a brief overview of the primary hardware components used in the project. Mention their role in the system's operation.
Example:
"The Low-Cost ECG Monitoring System incorporates several key components, each contributing to the functionality and efficiency of the design. The AD8232 sensor enables precise ECG signal acquisition, while the Arduino serves as the main controller for signal processing and communication."

2. Detailed Description of Each Component:

List and describe the main components individually. Highlight their technical specifications, purpose, and relevance to the project.
Example:

i. AD8232 ECG Sensor: Responsible for acquiring electrical signals from the heart. It amplifies and filters the ECG signals before sending them to the Arduino.
ii. Arduino Microcontroller: Serves as the processing unit, performing signal digitization, noise reduction, and communication with the computer.
iii. Power Supply: Provides stable and reliable power to the system, ensuring uninterrupted operation.

3. Connection and Integration:

Explain how these components are connected and integrated into the system. Relate their interaction with the schematic circuit.

3.3.1 SCHEMATIC CIRCUIT

EXAMPLE

[Introduction to Schematic Circuit]

The schematic circuit serves as the foundational blueprint for designing the hardware configuration of the Low-Cost ECG Monitoring System. It provides a detailed visual representation of the electrical connections and component interactions, enabling a systematic approach to implementation. The circuit design was created using Proteus software, ensuring precision and clarity in the hardware layout. This schematic guides the assembly and testing of the physical circuit, helping to prevent errors and ensure functionality.

[Illustration of the Schematic Circuit]

Figure 3.3 illustrates the schematic layout, showing the interconnections between the AD8232 ECG sensor, Arduino microcontroller, power supply, and display system. The diagram provides a clear understanding of how each hardware component functions within the system.

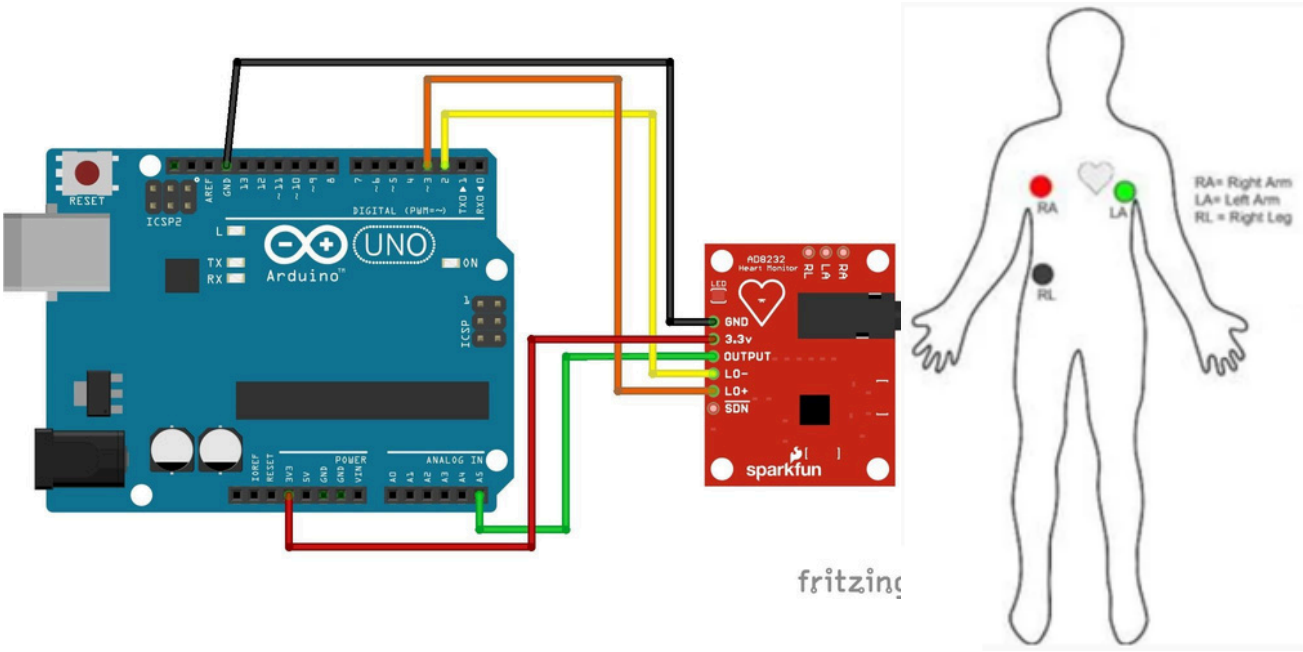


Figure 3.3: Schematic Diagram

3.3.1 SCHEMATIC CIRCUIT

EXAMPLE

[Description of the Schematic Circuit]

The schematic circuit (Figure 3.3) integrates several components essential to the operation of the ECG monitoring system. The AD8232 ECG Sensor is connected to the Arduino microcontroller through its analogue output pin, which transmits the ECG signals for processing. The sensor uses three adhesive electrodes with cables approximately 30 inches long, allowing for flexible placement on the patient's body. These cables are equipped with a male sound plug for easy connection and disconnection to the amplifier board. The Arduino Microcontroller processes the ECG signals, performing noise filtering and digitization. A stable Power Supply Circuit is included to ensure uninterrupted operation of all components. The processed signals are displayed on a computer using the Serial Plotter, facilitated by the system's output module.

3.3.2 DESCRIPTION OF MAIN COMPONENTS

EXAMPLE

[Introduction to Components] The Low-Cost ECG Monitoring System utilizes several essential hardware components to ensure effective signal acquisition, processing, and analysis. Each component has a specific role in the system, contributing to its overall functionality and reliability. The primary hardware elements include the AD8232 ECG sensor, Arduino microcontroller, ECG electrodes, a power supply, and connecting cables. These components work cohesively to monitor and display the heart's electrical activity in real-time.

[Description of Each Component]

3.3.2.1 AD8232 ECG Sensor

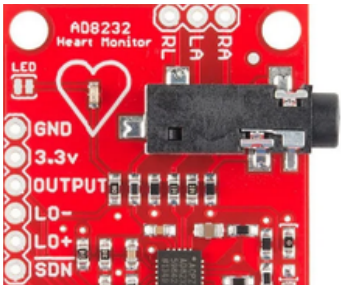


Figure 3.4: AD8232 ECG Sensor

The AD8232 ECG Sensor, as shown in Figure 3.4, is a compact and efficient device tailored for precise ECG signal acquisition and conditioning. It functions by capturing electrical signals from the heart, amplifying them, and filtering out noise for a clean and reliable output. This sensor incorporates an instrumentation amplifier along with high-pass and low-pass filters, enabling single-lead ECG measurements. Its noise-reduction capabilities make it ideal for motion-prone environments, ensuring consistent signal quality. As the core component of the system, the AD8232 extracts bio-potential signals for further processing by the Arduino microcontroller.

3.3.2 DESCRIPTION OF MAIN COMPONENTS

EXAMPLE

[Description of Each Component]

3.3.2.2 Arduino Uno Microcontroller

Figure 3.5: Arduino Uno Microcontroller

The Arduino Uno Microcontroller, illustrated in Figure 3.5, serves as the system's primary processing unit. Powered by the ATmega328P chip, it processes and digitizes ECG signals from the AD8232 sensor and facilitates data communication with a laptop or PC for visualization. The microcontroller features 14 digital I/O pins, 6 analogue input pins, a 16 MHz clock, USB interface, and onboard power regulation. Its compatibility with multiple sensors and the ease of programming via the Arduino IDE make it an excellent choice for low-cost biomedical applications.

3.3.2.3 ECG Electrodes

Figure 3.6: ECG Electrodes (3 pieces)

The ECG Electrodes, depicted in Figure 3.6, collect electrical signals generated by cardiac activity. Positioned strategically on the right arm, left arm, and left leg, these electrodes form the Einthoven's Triangle configuration, ensuring accurate signal acquisition. The silver/silver chloride (Ag/AgCl) pads enhance signal conduction, making them highly effective for monitoring cardiac activity with precision.

3.3.2.4 3.5 mm ECG Electrode Connectors

Figure 3.7: ECG Electrode Connectors

The 3.5 mm ECG Electrode Connectors, as shown in Figure 3.7, securely link the electrodes to the AD8232 sensor. These connectors transmit electrical signals from the electrodes to the sensor with minimal interference, ensuring high-quality signal acquisition. Featuring a standard 3.5 mm audio jack design, they are user-friendly and enable seamless integration of the electrodes with the hardware.

3.3.2 DESCRIPTION OF MAIN COMPONENTS

EXAMPLE

[Description of Each Component]

3.3.2.5 Power Supply Figure

3.8: Power Supply

The Power Supply, illustrated in Figure 3.8, ensures a stable energy source for the system's consistent operation. It provides regulated power to the Arduino and AD8232 sensor, either via a 5V USB power source or a battery pack, depending on user preference. This stability is essential to prevent voltage fluctuations that could disrupt signal acquisition and processing.

3.3.2.6 Connecting or Jumper Wires

Figure 3.9: Connecting Wires

The Connecting or Jumper Wires, shown in Figure 3.9, establish electrical communication between the hardware components. These wires feature secure male-to-female and male-to-male connectors, ensuring robust connections while maintaining a neat and organized layout. Their color-coded design facilitates efficient troubleshooting and debugging during system integration.

3.3.2.7 Laptop or PC

Figure 3.10: Laptop or PC

The Laptop or PC, depicted in Figure 3.10, acts as the interface for data visualization and analysis. Using software such as the Arduino IDE and serial plotter, it displays ECG waveforms in real time, enabling users to monitor, store, and interpret the data effectively. This user-friendly platform enhances the accessibility and practicality of the system for accurate ECG monitoring and analysis.

3.3.2 DESCRIPTION OF MAIN COMPONENTS

EXAMPLE

[Connection and Integration]

All components are interconnected as per the schematic circuit (Figure 3.3). The AD8232 ECG sensor interfaces with the Arduino's analog input pins for signal acquisition. The electrodes are connected to the sensor via 3.5 mm connectors. The Arduino communicates with the laptop through a USB cable, while jumper wires ensure all components are properly integrated. A stable power supply supports the entire setup, ensuring uninterrupted operation. This modular configuration enhances the system's portability, cost-effectiveness, and ease of use, making it ideal for ECG monitoring applications.

3.4 PROJECT SOFTWARE

CONTENT

Provide an introductory paragraph that outlines the importance of software in the project. Briefly mention the software tools used, the role of the flowchart in understanding system operations, and how the software components work with the hardware.

EXAMPLE

The low-cost ECG monitoring system relies heavily on the integration of hardware and software components to achieve its functional objectives. The software aspect of the project is essential for managing data acquisition, processing, and visualization. Arduino IDE is utilized for programming the microcontroller, enabling the collection and transmission of raw ECG data from sensors. Processing IDE, on the other hand, is employed for signal analysis, visualization, and data recording on a connected computer. Together, these software tools ensure seamless communication between hardware and software, enabling real-time monitoring and the option for data storage. The software design is structured and illustrated in the system flowchart, which provides a clear representation of the system's operation.

3.4.1 FLOWCHART OF THE SYSTEM

CONTENT

1. Introduction to the Flowchart

Briefly explain what a flowchart is and its significance in the project. Mention how the flowchart represents the logic or sequence of the system's operation.

2. Flowchart Diagram

Include the flowchart diagram with proper labeling. Provide a figure caption such as: Figure 3.x: System Flowchart.

EXAMPLE

Introduction to the Flowchart

The flowchart serves as a visual representation of the logical sequence of operations in the ECG monitoring system. It outlines the step-by-step process, ensuring clarity in understanding the system’s workflow. By depicting the flow of data from acquisition to processing and output, the flowchart highlights the integration of hardware and software components, making it easier to debug or enhance the system when needed.

3.4.1 FLOWCHART OF THE SYSTEM

EXAMPLE

Flowchart Diagram

The flowchart of the ECG monitoring system is illustrated in Figure 3.11. It provides a detailed view of the operational stages, from the initial start-up to data visualization and recording.

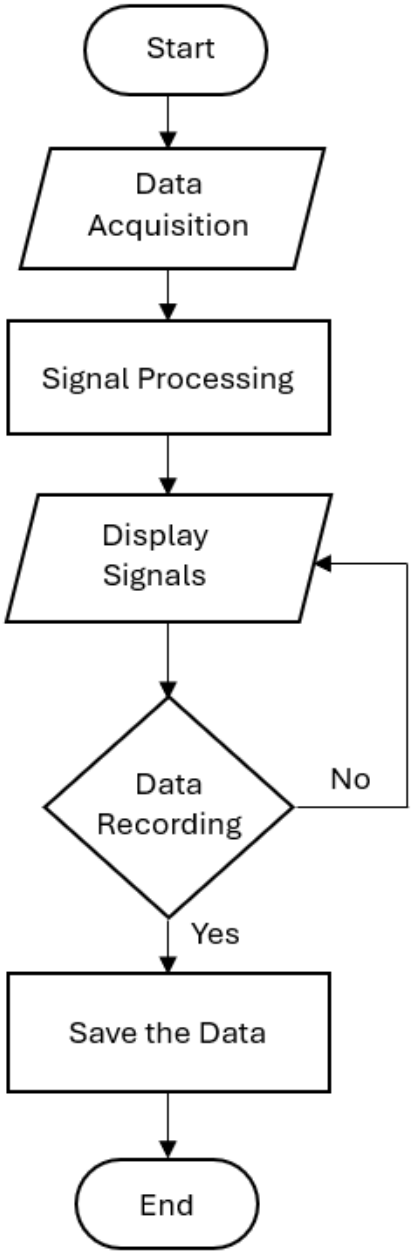


Figure 3.11: System Flowchart

3.4.2 DESCRIPTION OF SYSTEM FLOWCHART

CONTENT

1. Overview of the Flowchart

Summarize the main processes in the flowchart, starting with the initial state and progressing through the key operational stages.

2. Detailed Description of Each Step

i. Break down the flowchart into its major components or steps.
ii. Start: Describe the starting point of the system (e.g., power-up or input signals).
iii. Input Stage: Explain how input data (e.g., sensor readings) is received and processed.
iv. Processing: Outline the key operations performed by the software (e.g., signal conditioning, calculations).
v. Output Stage: Detail how the system generates outputs (e.g., displays ECG signals).
vi. Decision-Making Points: Describe any conditional logic or branching used in the system flow (e.g., “If the signal is valid, then...").
vii. End: Conclude with the final state or looping process of the system.

3. Relevance to System Functionality

Highlight how the flowchart ensures systematic operation and facilitates debugging or enhancements. Mention how the flowchart connects the software and hardware components of the system.

3.4.2 DESCRIPTION OF SYSTEM FLOWCHART

EXAMPLE

1. Overview of the Flowchart

Summarize the main processes in The system flowchart represents the core operations of the ECG monitoring system. It begins with the system's start-up and progresses through sequential stages, including data acquisition, signal processing, real-time display, and data recording. Each stage is designed to ensure efficient performance and user interaction. The process continues in a loop, allowing continuous monitoring until terminated by the user. flowchart, starting with the initial state and progressing through the key operational stages.

2. Detailed Description of Each Step

The system initiates when powered on, setting up the hardware and software components for operation. At the data acquisition stage, the AD8232 sensor collects raw ECG signals from the electrodes placed on the body. These signals are then transmitted to the Arduino Uno for processing. The Arduino Uno processes the raw ECG data using programmed algorithms to filter noise and enhance signal quality. The processed data is subsequently sent to the connected computer via a serial communication interface. The Processing IDE running on the computer receives the processed data and displays it as ECG waveforms in real time, enabling continuous monitoring of the heart's electrical activity. Additionally, the system offers the option to record and save the ECG data. Users can select whether to store the data for future analysis or documentation. At the decision-making point, the user determines whether to save the recorded data. If the decision is "Yes," the data is stored in a specified file format. If "No," the system loops back to the signal display stage for continued monitoring. Finally, the system concludes its operation when monitoring is terminated, either manually or automatically, depending on the system design.

3.4.2 DESCRIPTION OF SYSTEM FLOWCHART

EXAMPLE

3. Relevance to System Functionality

The flowchart provides a structured approach to understanding the system's operations. It ensures that all process stages are systematically aligned, promoting efficient integration between hardware and software. This design facilitates troubleshooting and paves the way for potential upgrades, such as incorporating additional features or improving system performance. Furthermore, the flowchart demonstrates how the Arduino microcontroller and Processing IDE work cohesively to achieve real-time ECG monitoring and data management.

3.5 SUSTAINABILITY ELEMENT IN THE DESIGN CONCEPT

CONTENT

Introduction

Define sustainability in the context of the project design. Highlight the importance of integrating sustainable practices in engineering design.

Environmental Sustainability

Explain how the project minimizes environmental impact. Use of energy-efficient components. Reduction in waste or harmful materials. Any recycling or eco-friendly material usage in the design.

Economic Sustainability

Discuss the cost-effectiveness of the project. Use of low-cost materials and components. Long-term affordability of maintenance and operation. Potential for scalability while maintaining low costs.

Social Sustainability

Describe how the design benefits society or its intended users. Accessibility for low-resource settings. Ease of use for a diverse range of users. Contribution to improving health, education, or livelihoods.

Sustainability Enhancements

Highlight any specific measures or innovative approaches included in the project to ensure sustainability. Example: Use of renewable energy sources, modularity for future upgrades, etc.

3.5 SUSTAINABILITY ELEMENT IN THE DESIGN CONCEPT

EXAMPLE

Introduction

Sustainability in the design concept of the low-cost ECG monitoring system is focused on reducing environmental impact, ensuring economic affordability, and contributing to societal well-being. Integrating sustainable practices is essential to develop a system that is environmentally responsible, economically feasible, and socially beneficial.

Environmental Sustainability

To minimize the environmental footprint, the project incorporates energy-efficient components, reducing overall power consumption. The design utilizes low-power microcontrollers such as the Arduino Uno and optimizes software algorithms to extend battery life. In addition, recyclable materials have been chosen for the hardware casing, ensuring that waste generated during production and disposal is minimized. The project avoids harmful materials, aligning with green engineering principles.

Economic Sustainability

The project prioritizes cost-effectiveness by selecting low-cost yet reliable components. The design uses widely available off-the-shelf parts, reducing the production cost while maintaining performance standards. Furthermore, the maintenance requirements are minimal, with readily replaceable parts ensuring long-term affordability. The system's scalability, achieved by modular hardware and software, makes it suitable for larger-scale applications without significant cost increases.

3.5 SUSTAINABILITY ELEMENT IN THE DESIGN CONCEPT

EXAMPLE

Social Sustainability

The low-cost ECG monitoring system is designed to benefit underserved communities, particularly in low-resource settings. Its affordability ensures that it can be accessible to healthcare facilities with limited budgets. The system's ease of use, enabled by user-friendly interfaces and clear instructions, accommodates a diverse range of users, including healthcare workers and patients with minimal technical knowledge. By improving access to affordable healthcare solutions, the project contributes to better health outcomes and promotes equitable healthcare opportunities.

Sustainability Enhancements

Specific measures to enhance sustainability include the modular design of the system, allowing for future upgrades without replacing the entire device. This reduces electronic waste and extends the product's lifespan. The inclusion of alternative power sources, such as rechargeable batteries, further supports the sustainability goals by reducing reliance on disposable energy sources.

3.6 CHAPTER SUMMARY

CONTENT

Overview of Chapter Content

Briefly summarize the methodology discussed in Chapter 3. Mention the key elements: Project design (block diagram, flowchart). Hardware and software descriptions. Sustainability elements incorporated.

Significance of Methodology

Emphasize the importance of the methodology in achieving project objectives. Highlight how the chosen methods ensure reliability, efficiency, and effectiveness.

Transition to the Next Chapter

Conclude with a statement about how the methodology lays the foundation for results and discussions in the following chapter.

3.6 CHAPTER SUMMARY

EXAMPLE

Overview of Chapter Content

This chapter outlined the methodology for designing and developing the low-cost ECG monitoring system. It detailed the project's design process, including the block diagram and flowchart, as well as the hardware and software development phases. The schematic circuit and main components were described, followed by a discussion of the system flowchart.

Significance of Methodology

The methodology adopted in this project ensured an efficient and reliable approach to achieving the project objectives. The integration of hardware and software solutions, combined with rigorous testing and optimization, contributed to the system's performance and usability. Incorporating sustainability elements further ensured that the design would be environmentally, economically, and socially viable.

Transition to the Next Chapter

The methodology outlined in this chapter forms the foundation for the results and analysis discussed in the subsequent chapter. The next chapter will present the findings from the testing phase and analyze their implications for the effectiveness and potential applications of the low-cost ECG monitoring system.

CHAPTER 4: PROJECT MANAGEMENT AND COSTING

Chapter 4: Project Management and Costing

WHAT IS PROJECT MANAGEMENT AND COSTING?

The structured process of planning, organizing, and controlling resources to achieve specific project objectives within a defined timeframe and budget. It combines management techniques with financial planning to ensure the successful completion of a project.

4.1 INTRODUCTION

CONTENT

4.1 Introduction

Provide a brief overview of the chapter.
Explain the significance of project management in ensuring the project's success.
Highlight the main aspects of the chapter: Gantt chart, activities, milestones, cost estimation, and budgeting.

EXAMPLE

4.1 Introduction

This chapter provides an overview of the project's management and costing aspects, which are critical for ensuring its success. Proper project management allows for efficient allocation of resources, adherence to timelines, and monitoring of progress to achieve the project objectives effectively. In this project, the implementation involves structured planning and execution of activities within a defined timeframe. Tools such as the Gantt chart are utilized to visualize the project schedule and monitor progress, while milestones serve as key indicators of the project's advancement. Additionally, this chapter outlines the cost estimation and budgeting for the project. By comparing prices from various suppliers such as Shopee, Lazada, and RS Component, cost-effective procurement of hardware components was achieved. This approach not only minimized expenses but also ensured the acquisition of quality materials within the allocated budget. The following sections will detail the Gantt chart and activities of the project, significant milestones achieved, and a comprehensive analysis of cost and budgeting to illustrate how this low-cost ECG monitoring system was managed and implemented efficiently.

4.2 GANTT CHART AND ACTIVITIES OF THE PROJECT

CONTENT

4.2.1 Gantt Chart and Activities of the Project

A Gantt chart is a visual project management tool that provides a detailed timeline of all activities involved in a project. It shows when activities start and finish their duration, and the relationships (dependencies) between activities. For example, in a Gantt chart, you can see that one activity must be completed before another can begin. This helps in tracking progress, managing schedules, and allocating resources efficiently. Key Feature: A Gantt chart focuses on processes and timelines, ensuring all steps are well-coordinated.

4.2 GANTT CHART AND ACTIVITIES OF THE PROJECT

EXAMPLE

Project 1 Gantt Chart

Activity	Week													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Registration and Project Briefing														
Logbook Writing														
Project Selection														
Project Management														
Project Planning and Scheduling														
Processes to Construct Project														
Investigation Report and Final Proposal (1st draf)														
Final Investigation Report and Final Proposal(Final Draf)														
Final Proposal Presentation Week														
Logbook Assessment Submission														
Investigation Report Subsmission														
Final Submission														

CONTENT

4.3 Milestone

A milestone represents a significant checkpoint or deliverable in the project. It does not focus on the details of individual activities but on achieving key outcomes that indicate progress. For instance, completing the "final project proposal" or "system testing phase" would be considered a milestone. Milestones serve as progress indicators, providing a quick overview of whether the project is on track.

4.3 MILESTONE

EXAMPLE

Project Milestone

Table 4.1: Milestone

No.	Milestone	Expected Completion Week	Percentage Completion
1	Registration and Project Briefing	Week 2	10%
2	Project Selection Completed	Week 3	15%
3	Project Management Initiated	Week 6	25%
4	Project Planning and Scheduling Finalised	Week 7	35%
5	Processes to Construct Project Begun	Week 10	50%
6	Investigation Report and Final Proposal (1st Draft)	Week 10	60%
7	Final Report and Proposal (Final Draft) Completed	Week 13	80%
8	Final Proposal Presentation	Week 14	90%
9	Submission of Final Report and Logbook	Week 14	100%

4.4 COST AND BUDGETING

CONTENT

4.4.1 Cost Breakdown

Provide a detailed breakdown of the project costs into categories:

- **Hardware components** (e.g., sensors, microcontrollers).
- **Software tools** (e.g., licensed software, subscriptions).
- **Miscellaneous costs** (e.g., transportation, printing).

4.4.2 Budget Allocation

Explain the budgeting process and allocation of resources. Include strategies for cost optimization (e.g., using low-cost components, and student discounts for software).

4.4.3 Funding Source

Mention the source of funding for the project (e.g., personal funding, sponsorship, institutional support).

4.4 COST AND BUDGETING

EXAMPLE

4.4 Cost and Budgeting

Cost and budgeting involve estimating and allocating financial resources to complete the low-cost ECG monitoring system project. This section outlines the anticipated expenses for hardware, software, and miscellaneous costs, providing a detailed breakdown, budget allocation, and funding source.

4.4.1 Cost Breakdown

The project costs are categorized into hardware components, software tools, and miscellaneous expenses as detailed below:

i. Hardware Components

The table below presents the required hardware components, their unit prices, quantities, and total costs.

Table 4.1: Cost and Budgeting

No.	Component	Unit Price (RM)	Quantity	Total (RM)
1	Arduino Uno	50	1	50.00
2	AD8232 ECG Module	40	1	40.00
3	OLED Display	30	1	30.00
4	Connecting Wires	5	1	5.00
5	Breadboard	10	1	10.00
Total (Hardware)				135.00

i. Software Tools

- Arduino IDE: RM 0.00 (Open-source software)
- Simulation tools (e.g., Tinkercad): RM 0.00 (Free online platform)

ii. Miscellaneous Costs

- Documentation and Printing: RM 15.00
- Transportation: RM 20.00. Total Project Cost: RM 170.00

4.4 COST AND BUDGETING

EXAMPLE:

4.4.2 Budget Allocation

The project budget was strategically allocated to ensure cost optimization while maintaining the system's functionality. The key strategies included:

Low-cost hardware: Affordable components such as the Arduino Uno and AD8232 ECG module were chosen without compromising quality.

Open-source software: Free tools like the Arduino IDE and TinkerCad were used to minimize software expenses.

Reusability: Common components such as connecting wires and breadboards were utilized from previous projects, reducing the need for additional purchases.

4.4.3 Funding Source

The project was entirely funded through personal contributions, ensuring all required components and tools were acquired within the allocated budget. The funding strategy ensured that the project adhered to financial constraints while achieving its objectives.

4.5 CHAPTER SUMMARY

CONTENT

4.5 Chapter Summary

Summarize the key aspects discussed in the chapter:

- Importance of project management.
- Overview of Gantt chart and project activities.
- Highlighted milestones and their significance.
- Cost estimation and budget planning.

  Conclude with the importance of proper planning and resource allocation for the project's success.

4.5 CHAPTER SUMMARY

EXAMPLE

4.5 Chapter Summary

This chapter has detailed the project management and budgeting aspects of the low-cost ECG monitoring system using Arduino Uno. It began by emphasizing the importance of effective project management, outlining how structured planning and organization ensure the project's successful execution. The Gantt chart and project activities were reviewed, providing a clear timeline and roadmap for each task, from initiation to completion. Key milestones were identified, highlighting their significance in tracking progress and ensuring timely delivery of the project outcomes. Cost estimation and budget planning were also discussed, with a detailed breakdown of expenses into hardware, software, and miscellaneous costs. This transparent budget overview demonstrates the financial feasibility of the project and reflects the commitment to achieving its objectives within a defined budget. In conclusion, this chapter underscores the critical role of proper planning and efficient resource allocation in ensuring the project's success. A well-defined plan, coupled with strategic management of time and resources, forms the foundation for delivering a cost-effective and functional ECG monitoring system.

ABOUT REFERENCES

SUPPORTING STATEMENT WITH AN IN-TEXT CITATION

1. **Make a Claim or Statement:**
   The implementation of an ECG monitoring system has been shown to enhance early detection of cardiac abnormalities.
2. **Find Credible Sources:**
   Identify a relevant research article or study on ECG monitoring systems.
3. **Quote or Paraphrase:**
   According to Jones et al. (2020), "the integration of ECG monitoring systems significantly improves the early detection of cardiac abnormalities, allowing for timely intervention" (p. 112).
4. **Provide In-Text Citations:**
   Include an in-text citation immediately after the statement: The implementation of an ECG monitoring system has been shown to enhance early detection of cardiac abnormalities (Jones et al., 2020, p. 112).
5. **Create a Reference List:**
   Include a reference list at the end of your document, listing the source in full detail.
6. **Format the Reference Citation:**
   In the reference list, format the citation according to APA style:
   Jones, A., Smith, B., & Johnson, C. (2020). Title of the Study. *Journal Name*, Volume(Issue), Page range. DOI or URL (if applicable).

IEEE STYLE IN-TEXT CITATION

IEEE in-text citation	Further discussion of constrained optimization can be found in Lindberg and Lee [1].
IEEE reference	[1] D. V. Lindberg and H. K. H. Lee, "Optimization under constraints by applying an asymmetric entropy measure," *J. Comput. Graph. Statist.*, vol. 24, no. 2, pp. 379–393, Jun. 2015, doi: 10.1080/10618600.2014.901225.

Example: IEEE in-text citations

Flann [11] argues strongly in favor of this method. However, as mentioned earlier [1], [3], [7]–[9], several objections have been made ...

Example: IEEE in-text citations treated as nouns

[11] argues strongly in favor of this method. However, as mentioned earlier, [1], [3], and [7]–[9 object to ...

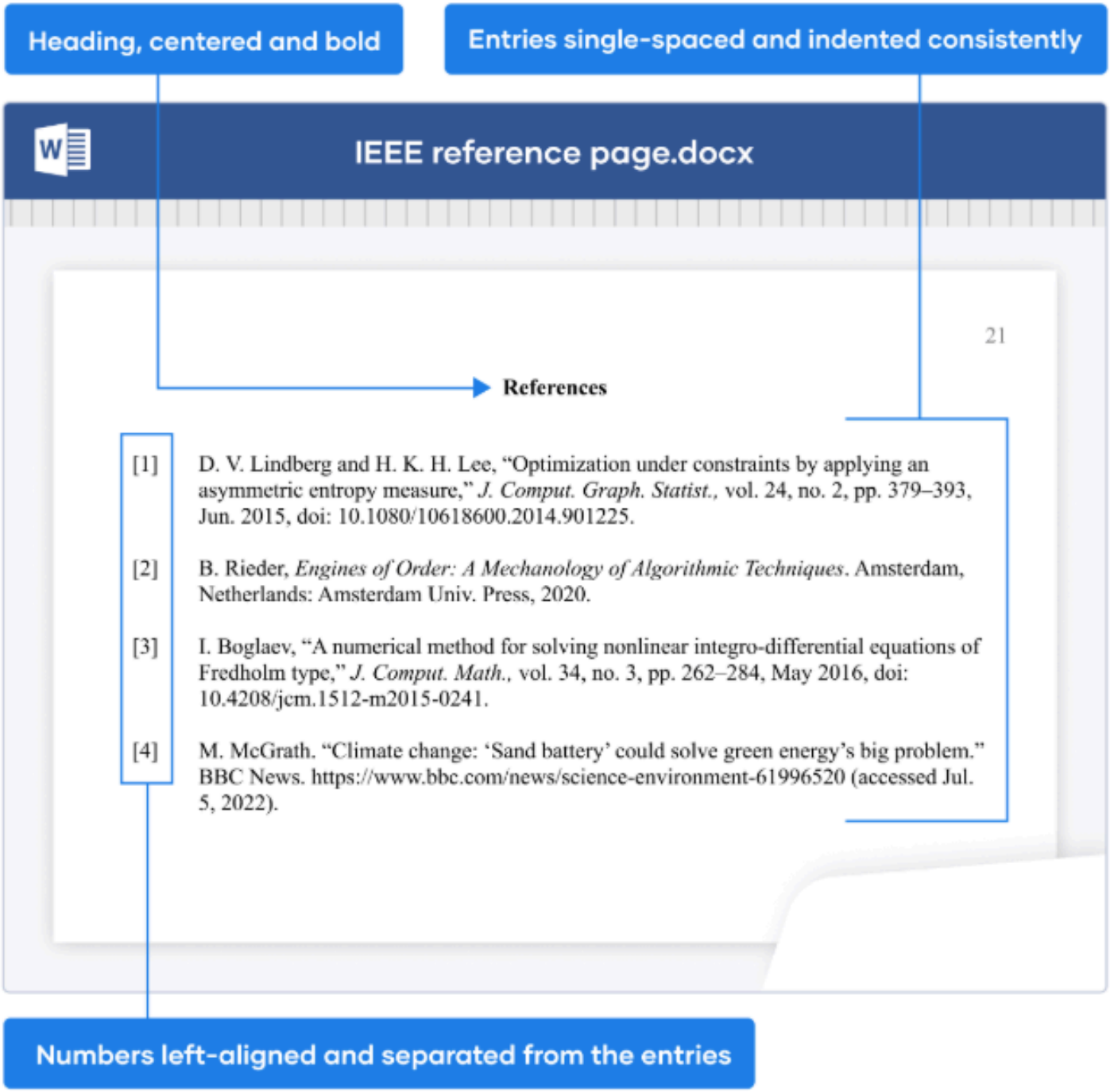
Example: IEEE in-text citation with page numbers

According to Smith, the chances of an error occurring with this technique are "infinitesimal" [3, p. 57].

Book **Journal article** **Website**

IEEE book citation format	Author initial. Last name, *Book Title*. City (and state if in US), Country: Publisher, Year.
IEEE reference	B. Rieder, *Engines of Order: A Mechanology of Algorithmic Techniques.* Amsterdam, Netherlands: Amsterdam Univ. Press, 2020.

IEEE STYLE FORMATTING THE REFERENCE PAGE



APA STYLE IN-TEXT CITATION

Parenthetical vs. narrative citation

The in-text citation can take two forms: parenthetical and narrative. Both types are generated automatically when citing a source with Scribbr's APA Citation Generator.

- **Parenthetical citation:** According to new research ... (Smith, 2020).
- **Narrative citation:** Smith (2020) notes that ...

Multiple authors in APA in-text citations

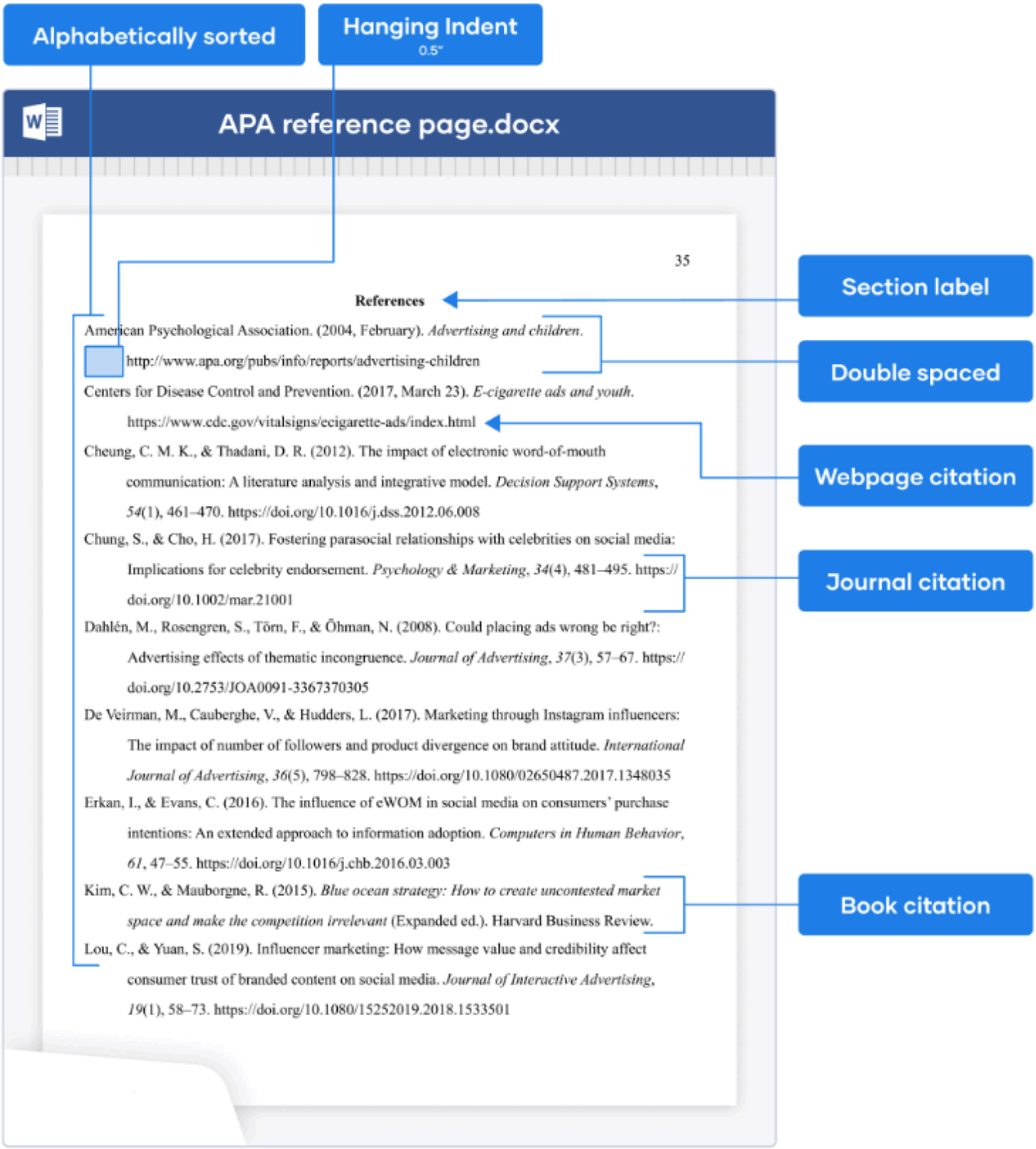
Author type	Parenthetical	Narrative
One author	(Harris, 2020)	Harris (2020)
Two authors	(Harris & Cook, 2020)	Harris and Cook (2020)
Three or more authors	(Harris et al., 2020)	Harris et al. (2020)
Group authors	(Scribbr, 2020)	Scribbr (2020)
Abbreviated group author • **First citation** • **Subsequent citations**	(Centers for Disease Control and Prevention [CDC], 2020) (CDC, 2020)	Centers for Disease Control and Prevention (CDC, 2020) CDC (2020)

No author, date or page number

Missing information in APA in-text citations

Unknown element	Solution	In-text citation
Author	Use the source title.	(*Source Title*, 2020)
Date	Write "n.d." for "no date".	(Harris, n.d.)
Page number	Use an alternative locator or omit the page number.	(Harris, 2020, 03:46) or (Harris, 2020)

APA STYLE FORMATTING THE REFERENCE PAGE



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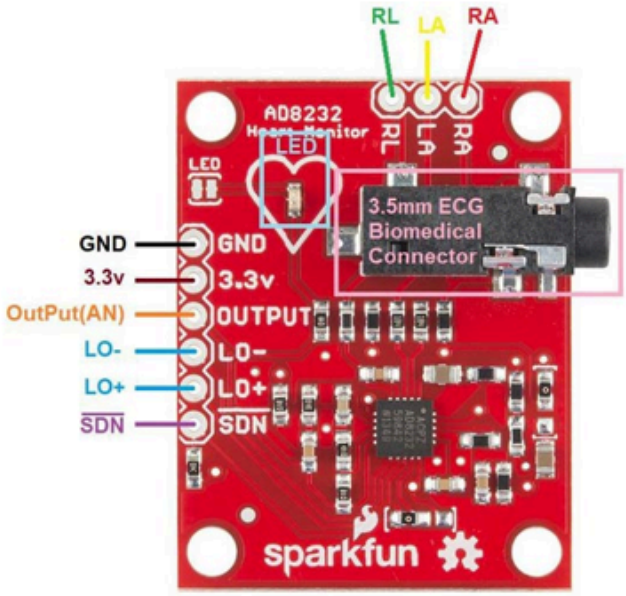
Contain

1. **Data Sheet**
2. **Programming**
   And any applicable

Example

Appendix A – Data Sheet



ANALOG DEVICES

Single-Lead, Heart Rate Monitor Front End

Data Sheet **AD8232**

FEATURES

- Fully integrated single-lead ECG front end
- Low supply current: 170 µA (typical)
- Common-mode rejection ratio: 80 dB (dc to 60 Hz)
- Two or three electrode configurations
- High signal gain (G = 100) with dc blocking capabilities
- 2-pole adjustable high-pass filter
- Accepts up to ±300 mV of half cell potential
- Fast restore feature improves filter settling
- Uncommitted op amp
- 3-pole adjustable low-pass filter with adjustable gain
- Leads off detection: ac or dc options
- Integrated right leg drive (RLD) amplifier
- Single-supply operation: 2.0 V to 3.5 V
- Integrated reference buffer generates virtual ground
- Rail-to-rail output
- Internal RFI filter
- 8 kV HBM ESD rating
- Shutdown pin
- 20-lead, 4 mm × 4 mm LFCSP and LFCSP_SS package

FUNCTIONAL BLOCK DIAGRAM

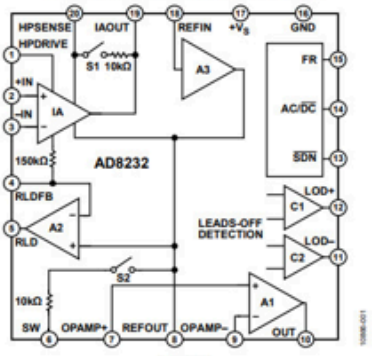


Figure 1.

Appendix B – Programming

```
#include <U8g2lib.h>
#include <Wire.h>
#include <math.h>

U8G2_SSD1306_128X64_NONAME_F_HW_I2C u8g2(U8G2_R0);  // Initialize the OLED display object

void setup() {
  // Initialize serial communication at 9600 baud rate:
  Serial.begin(9600);

  // Set pin 10 and pin 11 as input for leads off detection:
  pinMode(10, INPUT);  // LO+0

  pinMode(11, INPUT);  // LO-

  // Initialize the OLED display
  u8g2.begin();
}

void loop() {
  // Clear the display buffer
  u8g2.clearBuffer();

  // Check if either LO+ or LO- is detected
  if (digitalRead(10) == HIGH || digitalRead(11) == HIGH) {
```

Terbitan

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PROJECT PROPOSAL A STEP BY STEP GUIDE

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