CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the research methods, design, tools, and procedures used in developing the solar-powered plastic waste-to-fuel converter. It includes the process of prototype development, data collection techniques, system design methodology, and materials used.

3.2 Research Design

This study adopts a practical, engineering-based research design focused on the development and testing of a prototype system. The approach is largely experimental and iterative, involving design, construction, programming, and performance evaluation of the converter system.

3.3 System Development Methodology

The system was developed using the V-model design methodology, which allows for verification and validation at every stage of development. The key stages included:

- Requirement analysis and specification

- System design and component selection

- Hardware and software development

- Integration and testing

- Evaluation and refinement

3.4 Block Diagram of the System

The system consists of the following major blocks:

- Solar power supply unit

- Microcontroller unit (Arduino)

- LM35 temperature sensor

- Heating element (simulated by LED)

- LCD display for temperature and system status

- Pyrolysis chamber (mechanical component)

3.5 Tools and Materials

The following tools and components were used:

- Arduino Uno microcontroller

- LM35 temperature sensor

- 16x2 LCD

- LEDs for heating simulation

- Breadboard and jumper wires

- Proteus software for simulation

- Solar panel (simulated with DC source)

- Relay module (optional for future expansion)

3.6 Software Tools

- Arduino IDE for code development and uploading

- Proteus for circuit simulation and PCB design

- MS Word and Excel for documentation and data analysis

3.7 Data Collection

Data was collected through:

- Temperature readings from the LM35 sensor

- Observations of system behavior (heater ON/OFF) at various thresholds

- LCD output monitoring during tests

- Output fuel volume (for physical implementation phase)

3.8 System Testing

The prototype was tested to verify:

- Accuracy of temperature readings

- Correct switching of the heating element (LED)

- Stability of the power supply

- Readability and correctness of LCD display output

3.9 Limitations of the Methodology

- Solar power was simulated, not physically harnessed in the current prototype.

- Only one type of plastic was tested due to time and resource constraints.

- Heating chamber was represented in simplified mechanical form.

3.10 Summary

The research methodology employed combines simulation, hardware development, and iterative testing. The approach ensures that the prototype functions according to specifications and demonstrates proof of concept for a solar-powered plastic-to-fuel converter.