**CAPSTONE PROJECT**

TITLE

**A Syntax Analyzer for Error Detection**

**A PROJECT REPORT**

**Submitted by**

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## **ABSTRACT**

This project focuses on the development of a Syntax Analyzer, an essential tool for ensuring code correctness in software development. The Syntax Analyzer detects syntax errors and unexpected tokens while parsing source code, identifying issues such as missing semicolons, mismatched parentheses, and invalid keywords. By automatically pinpointing these errors, the Syntax Analyzer helps developers catch mistakes early in the development process, reducing debugging time and improving overall code quality. The project involves designing and implementing a robust lexical analyzer, parser, and error reporting module, followed by comprehensive testing to ensure accuracy and reliability. The resulting tool aims to enhance the efficiency of software development by providing precise and user-friendly error detection.

## **INTRODUCTION**

In the realm of software development, ensuring the syntactic correctness of code is crucial for the seamless functionality of applications. Syntax errors, ranging from missing semicolons to mismatched parentheses and invalid keywords, can cause compilation failures, runtime errors, and unpredictable behavior in programs. These errors are often time-consuming and costly to debug, especially in large codebases. To mitigate these issues, developers rely on tools that can automatically detect and report syntax errors during the code writing process.A Syntax Analyzer, a key component of a compiler, serves this exact purpose. It parses the source code to verify its adherence to the grammatical rules of the programming language. By identifying syntax errors early in the development process, a Syntax Analyzer enables developers to correct mistakes before they propagate through the later stages of development, thereby enhancing code quality and reducing the overall development time.

This project aims to design and implement a Syntax Analyzer capable of detecting a wide range of syntax errors and providing meaningful feedback to the developer. The proposed tool will include a lexical analyzer to tokenize the source code, a parser to analyze the token sequence, and an error reporting module to deliver detailed error messages. Through comprehensive testing and evaluation, the project seeks to develop a reliable and efficient Syntax Analyzer that can be integrated into various development environments, ultimately contributing to more efficient and error-free software development practices.

## **PROBLEM STATEMENT**

The presence of syntax errors in code can lead to compilation failures, runtime errors, and unexpected behavior. These issues can be time-consuming and costly to debug, especially in large codebases. Current tools may provide basic syntax checking, but there is a need for a more comprehensive solution that can accurately detect a wide range of syntax errors and provide meaningful feedback to the developer. The goal of this project is to create a Syntax Analyzer that can efficiently parse source code, detect syntax errors, and report them in a user-friendly manner.

## **METHODOLOGY**

The development of the Syntax Analyzer will follow a structured methodology, including the following steps:

**Requirement Analysis**: Identify the types of syntax errors to be detected and define the scope of the syntax analyzer.

1. **Design**: Develop the architecture of the syntax analyzer, including the lexical analyzer, parser, and error reporting modules.
2. **Implementation**: Write the code for the syntax analyzer, focusing on the lexical analyzer, parser, and error detection mechanisms.
3. **Testing**: Test the syntax analyzer with various code samples to ensure accurate detection of syntax errors.
4. **Evaluation**: Evaluate the performance of the syntax analyzer and refine it based on feedback and test results.

## **IMPLEMENTATION DETAILS**

### **1. Requirement Analysis**

The syntax analyzer will be designed to detect the following types of syntax errors:

* Missing semicolons
* Mismatched parentheses
* Invalid keywords
* Unexpected tokens
* Incorrect statement structure

### **2. Design**

The syntax analyzer will consist of the following components:

* **Lexical Analyzer**: Tokenizes the source code into meaningful symbols.
* **Parser**: Analyzes the token sequence to ensure it conforms to the language's grammar rules.
* **Error Reporting Module**: Provides detailed error messages to the developer.

### **3. Implementation**

The implementation involves writing the code for each component:

#### **Lexical Analyzer**

The lexical analyzer will scan the source code and convert it into a list of tokens. Each token represents a basic element such as keywords, operators, identifiers, and literals.

#### **Parser**

The parser will take the list of tokens from the lexical analyzer and check if the token sequence follows the predefined grammar rules. It will detect syntax errors during this process.

#### **Error Reporting Module**

The error reporting module will generate detailed messages indicating the type and location of the syntax errors.

### **4. Testing**

The syntax analyzer will be tested with a variety of code samples to ensure it correctly detects and reports syntax errors (e.g., missing semicolons, mismatched parentheses, invalid keywords). Test cases will include both syntactically correct and incorrect code snippets.

### **5.Evaluation**

### The performance of the syntax analyzer will be evaluated based on its accuracy in detecting errors and the clarity of the error messages provided. Feedback from users will be incorporated to refine the tool.

**SOURCE CODE**

#include <stdio.h>

#include <ctype.h>

#include <string.h>

#include <stdlib.h>

// Define token types

typedef enum {

TOKEN\_INT, TOKEN\_RETURN, TOKEN\_IDENTIFIER, TOKEN\_NUMBER,

TOKEN\_LPAREN, TOKEN\_RPAREN, TOKEN\_LBRACE, TOKEN\_RBRACE,

TOKEN\_SEMICOLON, TOKEN\_UNKNOWN

} TokenType;

// Token structure

typedef struct {

TokenType type;

char value[100];

} Token;

// Global variables

Token tokens[100];

int token\_count = 0;

int current\_token = 0;

// Function prototypes

void add\_token(TokenType type, const char \*value);

void tokenize(const char \*code);

void print\_tokens();

void syntax\_error(const char \*message);

void match(TokenType expected\_type);

void statement();

void function();

void parse();

void run\_tests();

// Lexer: Add token to the list

void add\_token(TokenType type, const char \*value) {

Token token;

token.type = type;

strcpy(token.value, value);

tokens[token\_count++] = token;

}

// Lexer: Tokenize the source code

void tokenize(const char \*code) {

token\_count = 0; // Reset token count

const char \*ptr = code;

while (\*ptr != '\0') {

if (isspace(\*ptr)) {

ptr++;

continue;

}

if (isdigit(\*ptr)) {

char number[100];

int len = 0;

while (isdigit(\*ptr)) {

number[len++] = \*ptr++;

}

number[len] = '\0';

add\_token(TOKEN\_NUMBER, number);

continue;

}

if (isalpha(\*ptr)) {

char identifier[100];

int len = 0;

while (isalnum(\*ptr)) {

identifier[len++] = \*ptr++;

}

identifier[len] = '\0';

if (strcmp(identifier, "int") == 0) {

add\_token(TOKEN\_INT, identifier);

} else if (strcmp(identifier, "return") == 0) {

add\_token(TOKEN\_RETURN, identifier);

} else {

add\_token(TOKEN\_IDENTIFIER, identifier);

}

continue;

}

switch (\*ptr) {

case '(': add\_token(TOKEN\_LPAREN, "("); break;

case ')': add\_token(TOKEN\_RPAREN, ")"); break;

case '{': add\_token(TOKEN\_LBRACE, "{"); break;

case '}': add\_token(TOKEN\_RBRACE, "}"); break;

case ';': add\_token(TOKEN\_SEMICOLON, ";"); break;

default: add\_token(TOKEN\_UNKNOWN, (char[]){\*ptr, '\0'}); break;

}

ptr++;

}

}

// Print tokens (for debugging purposes)

void print\_tokens() {

for (int i = 0; i < token\_count; i++) {

printf("Token Type: %d, Value: %s\n", tokens[i].type, tokens[i].value);

}

// Parser: Report syntax error and exit

void syntax\_error(const char \*message) {

printf("Syntax Error: %s at token %d\n", message, current\_token);

exit(1);

}

// Parser: Match the current token with the expected token

void match(TokenType expected\_type) {

if (current\_token < token\_count && tokens[current\_token].type == expected\_type) {

current\_token++;

} else {

syntax\_error("Unexpected token");

}

// Parser: Parse a statement

void statement() {

match(TOKEN\_RETURN);

match(TOKEN\_NUMBER);

match(TOKEN\_SEMICOLON);

}

// Parser: Parse a function

void function() {

match(TOKEN\_INT);

match(TOKEN\_IDENTIFIER);

match(TOKEN\_LPAREN);

match(TOKEN\_RPAREN);

match(TOKEN\_LBRACE);

statement();

match(TOKEN\_RBRACE);

}

// Parser: Parse the whole program

void parse() {

function();

if (current\_token < token\_count) {

syntax\_error("Unexpected tokens at the end");

} else {

printf("Parsing successful!\n");

}

}

// Test cases for the syntax analyzer

void run\_tests() {

const char \*test\_cases[] = {

"int main() { return 0; }", // Valid code

"int main() { return 0 }", // Missing semicolon

"int main( { return 0; }", // Mismatched parentheses

"int main() { retrn 0; }" // Invalid keyword

};

for (int i = 0; i < 4; i++) {

printf("Testing case %d:\n", i + 1);

tokenize(test\_cases[i]);

parse();

current\_token = 0; // Reset for next test case

token\_count = 0; // Reset token count

}

}

int main() {

run\_tests();

return 0;

}

## **OUTPUT**

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## **CONCLUSION**

The Syntax Analyzer project aims to enhance software development by ensuring code correctness through the early detection of syntax errors. This tool automatically identifies common mistakes such as missing semicolons, mismatched parentheses, and invalid keywords by parsing the source code. Comprising a lexical analyzer, parser, and error reporting module, the Syntax Analyzer provides precise and user-friendly feedback, enabling developers to correct errors promptly and efficiently. Rigorous testing has demonstrated its reliability and accuracy, making it an invaluable asset for improving code quality and reducing debugging time. This project highlights the critical role of syntax analysis in compiler design and its contribution to producing robust, error-free software.

**REFERENCES:**

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