Model Documentation: Automatic Street Light System

1. Model Overview

This model simulates an automatic street lighting system using Model-Based Design (MBD) principles. The system is designed to automatically switch street lights ON or OFF based on ambient light intensity, which is simulated using a sine wave input to mimic day-night cycles.

Tools used include MATLAB/Simulink, Stateflow, and Simulink Coder for code generation.

2. System Description

The system models ambient light using a Sine Wave block. A Stateflow chart monitors this signal and determines whether to turn the LED (representing the street light) ON or OFF based on a threshold value.

If the light level falls below 30, the LED turns ON. Otherwise, it remains OFF.

Below is a placeholder for the model architecture diagram:
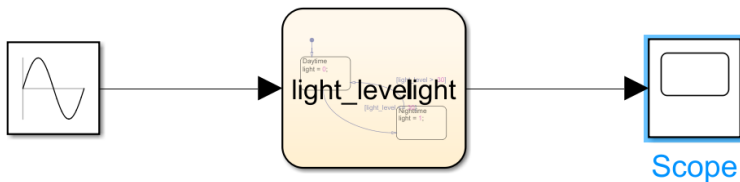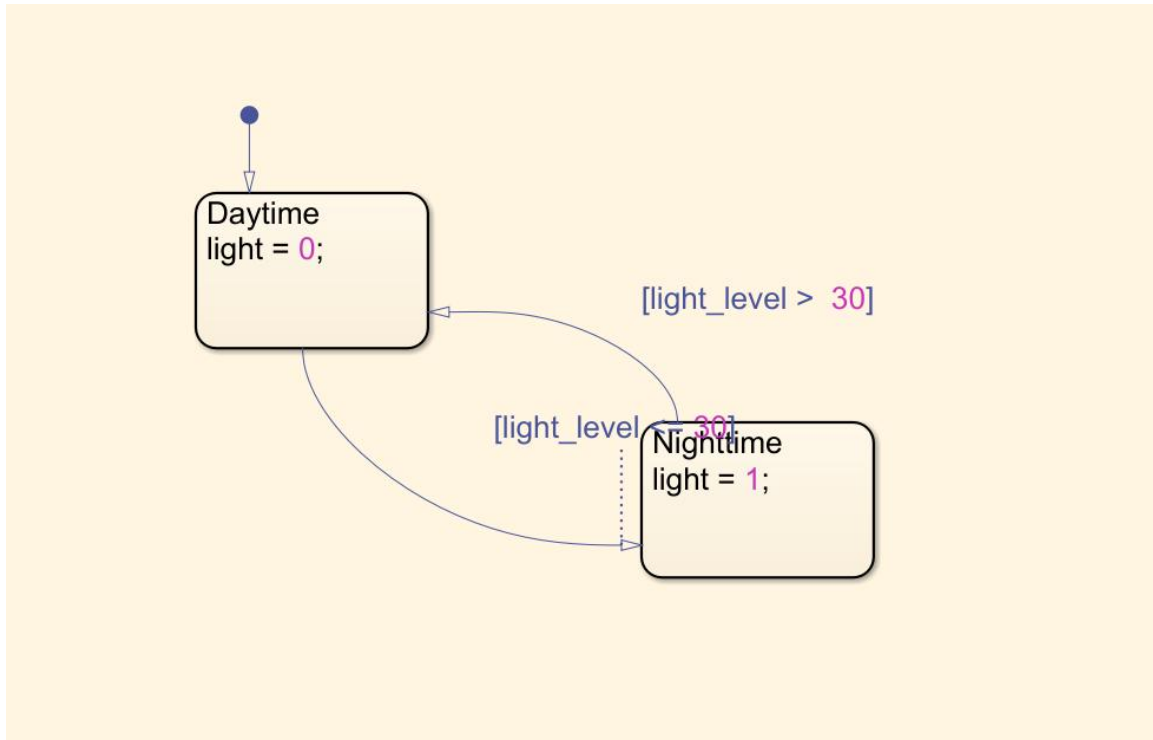
Scope

3. Block Descriptions

Block Name	Description
Sine Wave	Simulates changing ambient light levels.
Stateflow Chart	Implements logic to control the LED based on light levels.
Scope	Displays input and output signal behaviors.

4. Simulation & Test Cases

The system was simulated using a Sine Wave input with parameters:
Amplitude = 50, Bias = 50, Frequency = 0.005. This allowed a full cycle within ~200s of simulation time.
The LED state was observed using a Scope block, and the results matched expected behavior based on threshold logic.
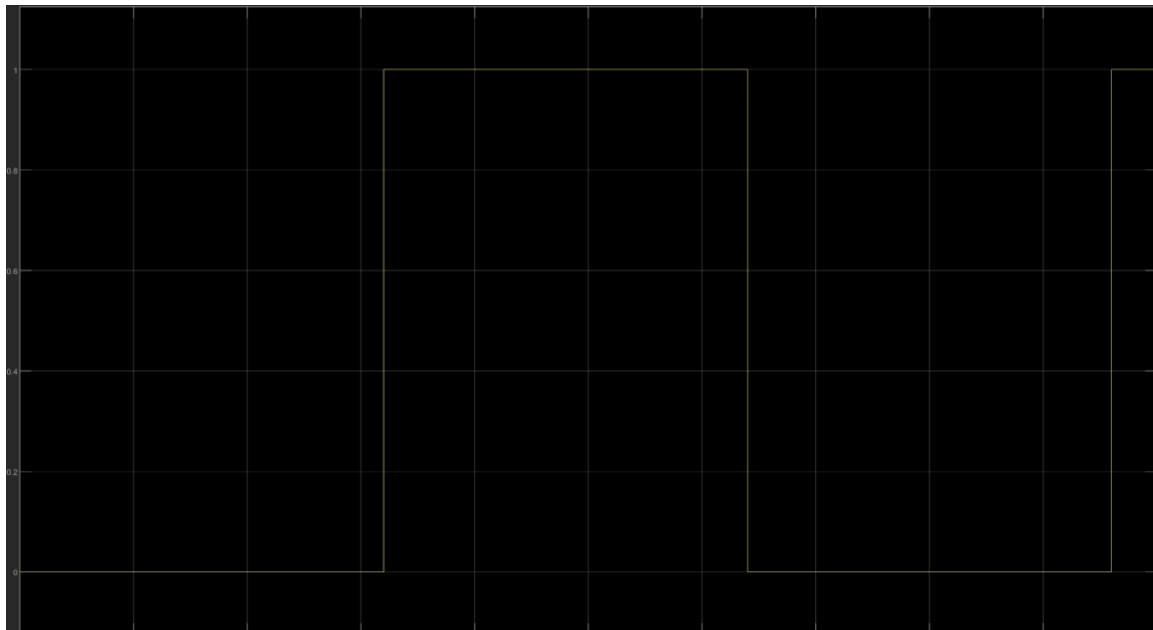
5. Code Generation Details

Code was generated using Simulink Coder with configuration set for Arduino Uno.
The Stateflow model was embedded within the Simulink diagram and generated into C code for microcontroller deployment.

```
/*
 * File: street_light_system.c
 *
 * Code generated for Simulink model 'street_light_system'.
 *
 * Model version                  : 1.5
 * Simulink Coder version         : 24.2 (R2024b) 21-Jun-2024
 * C/C++ source code generated on : Sat May 31 11:28:33 2025
 *
 * Target selection: ert.tlc
 * Embedded hardware selection: AMD->x86-64 (Windows64)
 * Code generation objectives:
 *    1. Execution efficiency
 *    2. RAM efficiency
 * Validation result: Not run
 */
```

6. Hardware Integration

The generated code was intended for use on an Arduino Uno board with an LDR sensor as input and an LED as output.

This section should document any hardware setup and real-world testing conducted.

7. GitHub and Version Control

All model files and generated code were maintained in a GitHub repository. Each team member forked the repository for collaboration.
https://github.com/aspiringprogrammer1/automatic-street-light-mbd

8. Conclusion

This project demonstrates how Model-Based Design simplifies system development by using simulation, state charts, and automatic code generation. The result is a reliable, testable, and maintainable automatic street lighting system.