FAKULTI TEKNOLOGI DAN KEJURUTERAAN

ELEKTRONIK DAN KOMPUTER

BERL 2135: EMBEDDED SYSTEM PROGRAMMING TOOL

GROUP ASSIGNMENT

ASSIGNMENT: PROJECT-BASED LEARNING (PBL) EMBEDDED SYSTEM BASED APPLICATION

Prepared by:

NO	STUDENT NAME	NO. MATRIC
1.	MOHAMMAD DANISH HAMIMI BIN NORHISHAM	B122310625
2.	MUHAMMAD AZRUL BIN REDZUAN	B122310626
3.	AHMAD TAUFIQ NURHAZIQ BIN SAMSUDDIN	B122310633
4.	NURSERI BINTI WASRI	B122310552

Program:

BACHELOR OF TECHNOLOGY IN INDUSTRIAL ELECTRONICS

AUTOMATION WITH HONOURS (BERL)

Prepared for:

AHMAD IDIL BIN ABDUL RAHMAN

1.0 INTRODUCTION

A smart house is one where internet-connected gadgets enable remote monitoring and control of temperature and humidity, motion, rain and other systems and appliances. Home automation is another term for a smart home. This offers energy savings, comfort, convenience, and security by granting homeowners control over smart devices. Homeowners often use a smartphone or other networked device to access a smart home app.

This smart home system is a single unit that consists of input sensors, a processing unit, and output devices that respond to the inhabitants' urgent demands. By combining the DHT22, motion sensor, IR sensor, LDR sensor, and rain sensor in different ways, this Raspberry Pi Pico W-based smart home automation system aims to automatically improve comfort, security, and energy efficiency.

Real-time reactions to the processed data are intelligently and effortlessly provided by output devices such as relays, servo motors, fans, LEDs, and LCDs. Since smart home technologies are always improving and becoming an even more alluring option in today's world, the capacity for more sophisticated systems and the ease of operation can only grow in the near future.

In addition to raising residents' standards of living, it has spawned sustainable activities that will contribute to a more efficient, greener, and better future.

Lastly, instead of using the Internet of Things (IoT), our project will make use of a graphical user interface (GUI).

2.0 OBJECTIVE

1. Automatically adjusts conditions based on real-time data inputs.
2. To reduce unnecessary energy use.
3. Alerts homeowners to any questionable activity.
4. By automating monotonous tasks, it enables workers to focus on more important activities.
5. To simplify and ease the lives of homeowners

3.0 SYSTEM REQUIREMENTS

3.1 List of hardware requirements:

Table 3.1.1 list of hardware requirement

INPUT	PROCESS	OUTPUT
Temperature and humidity sensor (DHT22)	Raspberry Pi Pico W	Servo motor
Motion sensor		Fan 5v
Infrared sensor (Ir sensor)		light-emitting diode (LED)
Light dependent resistor (LDR sensor)		liquid-crystal display (LCD)
Rain sensor		
Push button		

The list for input, process and output that used for smart home project. 6 input device that used and 4 device for output and using raspberry pi pico W for process the data.

Table 3.1.2 List of hardware requirements

Category	Requirement
Operating System	Thonny
CPU/Microcontroller	Raspberry Pi Pico W
Display Resolution	LCD i2c
Power Supply	5 Volt
Sensors	1. Temperature and humidity sensor (DHT22) 2. Motion sensor 3. Infrared sensor (Ir sensor) 4. Light dependent resistor (LDR sensor) 5. Rain sensor 6. Push button
Output Components	1. Servo motor 2. Fan 5v 3. light-emitting diode (LED) 4. liquid-crystal display (LCD) 5. relay

In this project operating system that used is Thonny to transfer the code to raspberry pi pico W (microcontroller).

3.2 List of software requirements:

Table 3.2.1 list of software requirements

Bil	Software
1	Library DHT22
2	Thonny.IDE
3	Wokwi simulator
4	Draw.io
5	Fritzing

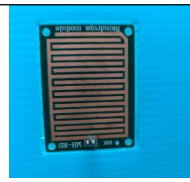
Table 3.2.1 show the list of software requirement for make the project successful. 5 software that are listed in the table.

4.0 SYSTEM LAYOUT

This section outlines the various input and output devices used in the system, along with their corresponding diagrams and functions.

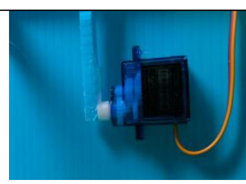
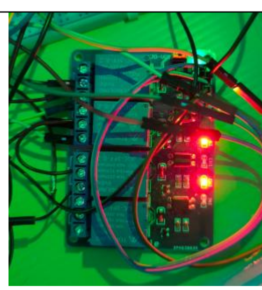
4.1 Input

Table 4.1.1 input and function

Input	Diagram	Function
Rain sensor		To detect water and give signal to system to control servo motor.
Temperature and humidity sensor (DHT22)		To monitor the temperature.
Infrared sensor (Ir sensor)		Detect the door and give signal to system to on red led.
Motion sensor		To detect human presence and movement.
Light dependent resistor (LDR sensor)		For detect light
Push button		To change display on LCD.

4.2 Output

Table 4.2.1 Output and function

Sensor	Diagram	Function
LCD		For display all system
Fan		Output of humidity sensor
Led		Output for motion & light sensor
Servo motor		Moves the roof to cover clothes drying rack from rain
Relay		To control fan and led current.

4.3 Layout project

This section displays the system's layout views, which include the top, left, front, and right views. Every diagram offers a unique viewpoint on the parts of the system and how they are arranged.

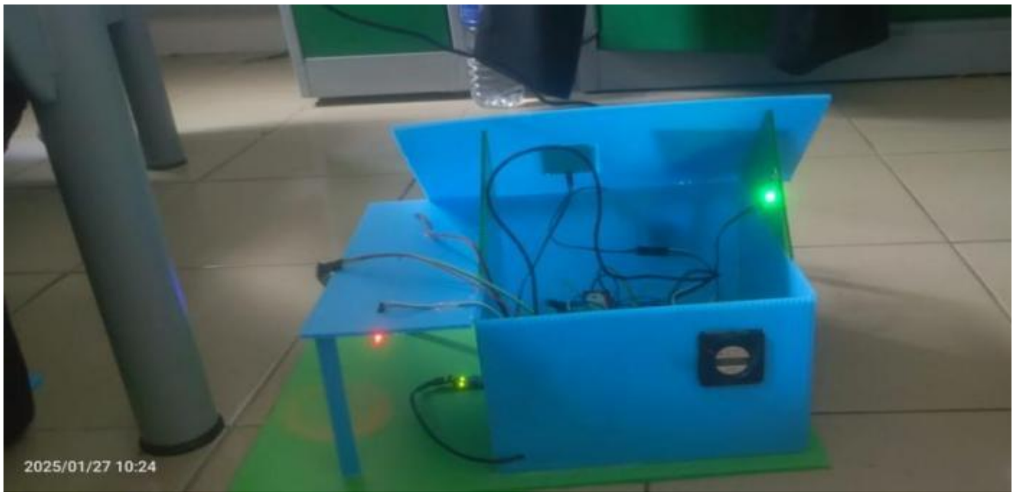


Diagram 4.3.1 Right Side view

For right side layout project, have a fan and LDR sensor (light sensor) at top right. The fan that are like a ventidator tha on if humidity sensor scanning that temperature are too high. And LDR sensor for monitoring the value of light.

Diagram 4.3.2 Front view

Diagram 4.3.2 show the Front view of project layout that have lcd display, ir sensor, led and motion sensor.

Diagram 4.3.3 Left Side view

Diagram 4.3.3 show the left view for project layout that have rain drop sensor at roof top, lcd display from left view and servo motor that function as roof cover for wet clothes rack.

Diagram 4.3.4 Top view

Diagram 4.3.4 show the top view for project layout. Humidity sensor inside the house for monitoring temperature inside house and led for monitoring state for door if open or closed.

5.0 I/O ASSIGMENT TABLE

The pin assignments for the Raspberry Pi Pico W are listed in this table, along with the voltage levels of the pins that are utilised for input and output.

Table 5.1 input and output assignment

Pi Pico W (Pin)	INPUT	Voltage	OUTPUT
Pin 0		5v	Servo Motor
Pin 4			LCD i2c (SCL)
Pin 5			LCD i2c (SDA)
Pin 10	IR sensor		
Pin 11	LDR sensor		
Pin 12	DHT sensor		
Pin 13	Push Button		
Pin 14			Green Led
Pin 15			Red Led
Pin16	Motion Sensor		
Pin 17	Relay 1		
Pin 18	Relay 2		
Pin 19			Fan
Pin 27	Rain Sensor		

6.0 I/O CONNECTION DIAGRAM

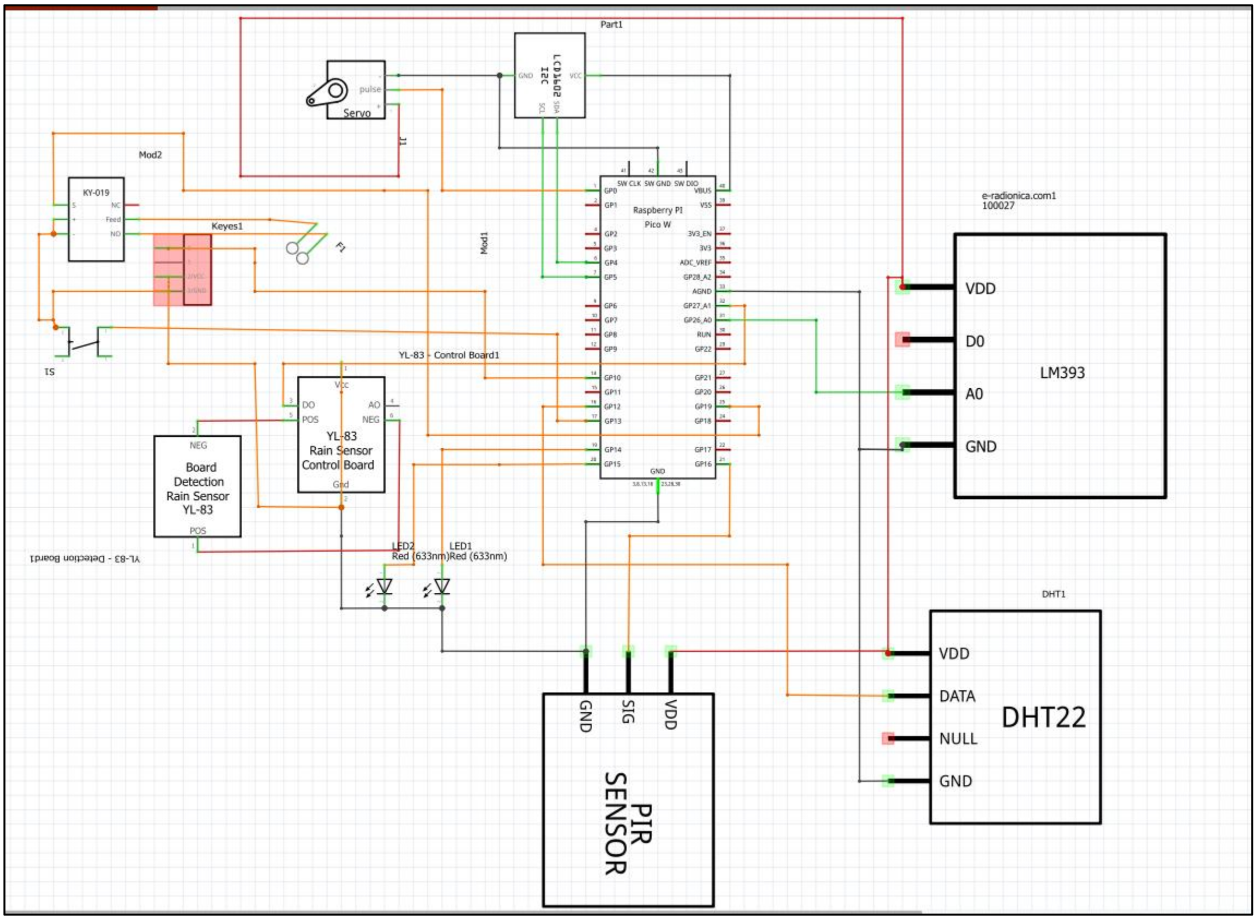


Diagram 6.1: Schematic diagram

Diagram 6.1 show schematic diagram for component that are used to make this project look like smart house. This schematic are make by using fritzing software.

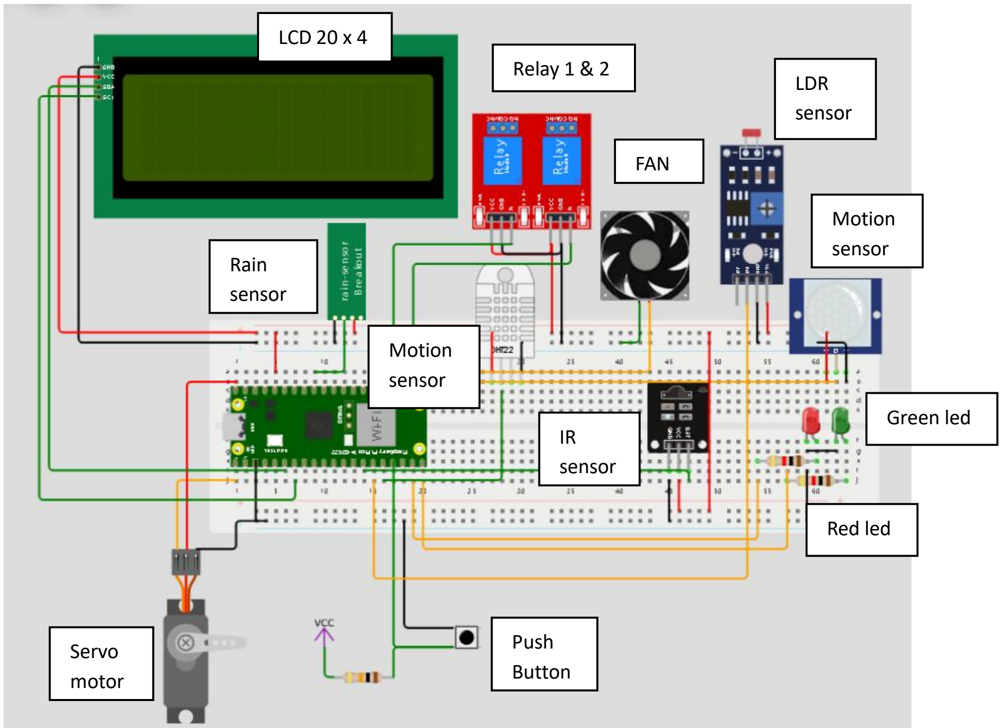


Diagram 6.2 circuit diagram

Circuit diagram that are make using wokwi simulation. All component are combined and wired on breadbord.

Table 6.1: Component and Pin to raspberry pi pico

Component	Pi Pico W (Pin)
Servo Motor	Pin 0
LCD i2c	Pin 4 (scl) Pin 5 (sda)
IR sensor	Pin 10
LDR sensor	Pin 11
DHT sensor	Pin 12
Push Button	Pin 13
Green Led	Pin 14
Red Led	Pin 15
Motion Sensor	Pin16
Relay 1	Pin 17
Relay 2	Pin 18
Fan	Pin 19
Rain Sensor	Pin 27

7.0 SYSTEM OPERATION FLOW CHART

Each sensor's flow chart will be shown, outlining its unique capabilities and the system's response to them.

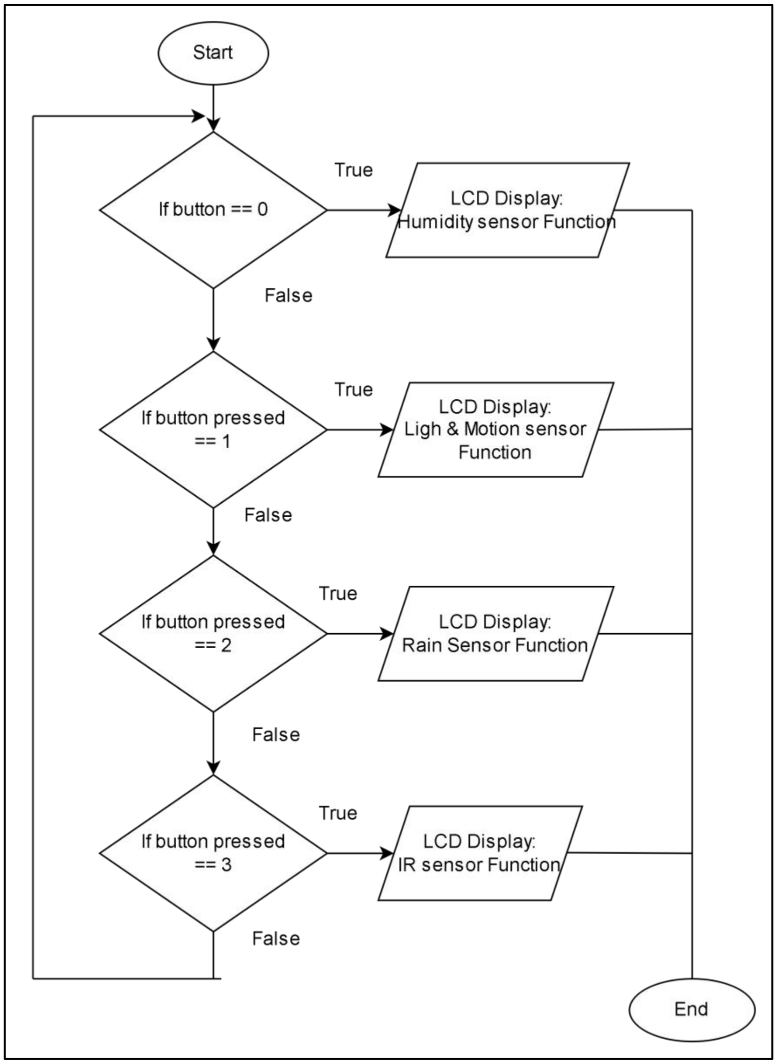


Diagram 6.1 LCD display flow chart

Diagram 6.1 show that LCD flow operating system for this project. By default lcd will display humidity sensor function. If pb pressed, lcd will change to display light and motion sensor function. Pressed again, lcd display rain sensor function. And last pressed, lcd will show ir sensor function. After that it will repeat the same function display with sequence if continue pressed.

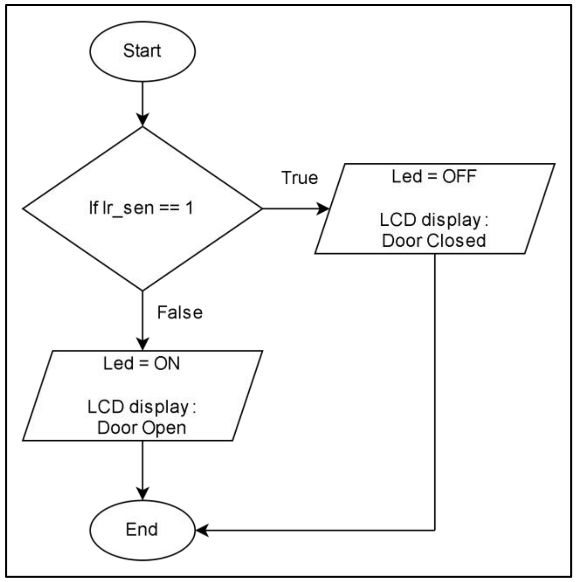


Diagram 6.2 IR sensor flow chart

Diagram 6.2 show IR sensor function for this project., if ir sensor off (==1) led (warning light) will off and lcd will display ‘Door closed’ else led on and lcd display ‘Door Open’

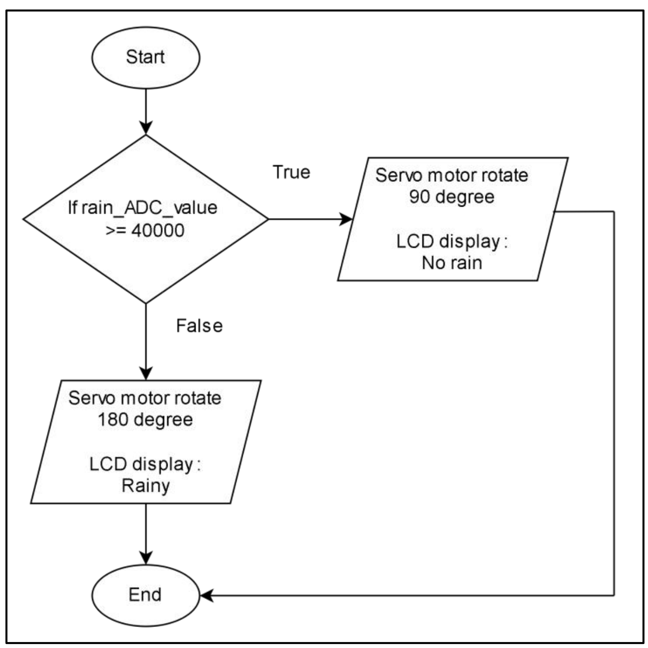


Diagram 6.3 Rain sensor flow chart

Diagram 6.3 show the operating flow for rain sensor in this project. If rain ADC value are more or equal to 40000, servo motor will rotate 90 degree for cover the dryingclothes rack, and lcd will display ‘rain’. If not, servo rotate 180 degree and lcd display ‘no rain’

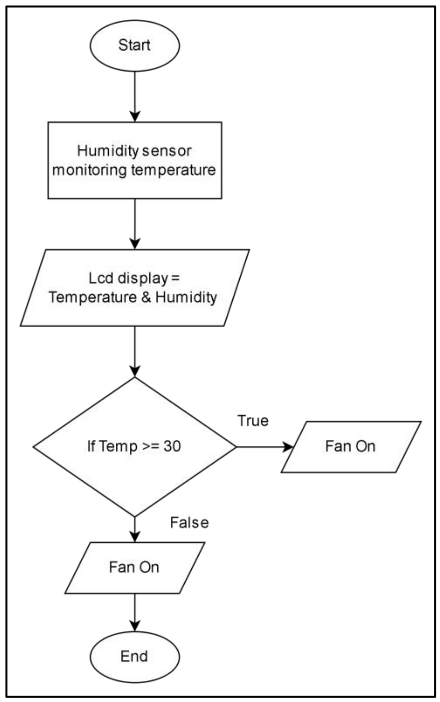


Diagram 6.4Temperature and humidity sensor flow chart

Diagram 6.4 show the flow operating system for humidity sensor. Humidity will scanning the temperature inside the house and lcd display the value of temperature that are humidity sensor scanning. If temperature are more or equal to 30 degree, fan will on to low down the temperature.

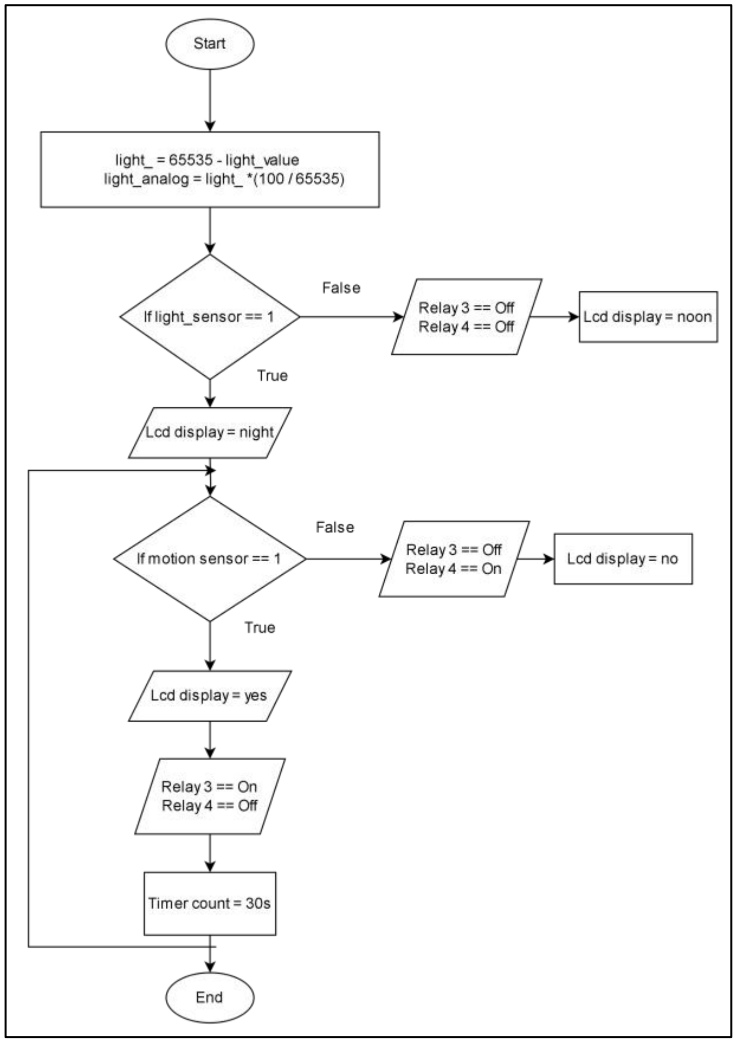


Diagram 6.5 LDR sensor flow chart

Diagram 6.5 show the operating system for LDR and Motion sensor. Light sensor will detect the light from sun, to clarify either morning or night. If morning the lamp will off and lcd display 'noon'. However if night lamp will on 50% and motion sensor will monitor the movement to bright the lamp to 100% if have movement. This function is also work for overcast.

8.0 DISCUSSION

This project is a **Smart Home** system using the Raspberry Pi Pico W as the main controller, integrating various sensors for home automation. The project provides an intelligent and efficient solution for managing elements such as lighting, temperature control, security, and weather protection automatically. With the rain sensor, the system can move a servo motor to move protective covers when rain is detected, protecting hanging clothes. Additionally, the use of a humidity sensor to control a fan at temperatures above 30°C enhances user comfort automatically without manual intervention.

For lighting, the combination of the LDR (light-dependent resistor) and motion sensor ensures that lights only turn on when necessary, reducing electricity consumption. Furthermore, the IR sensor, which activates a red light when no object is detected, has potential applications in security, for open door. The Raspberry Pi Pico W offers the advantages of low cost, compact size, and WiFi support for future IoT connectivity.

However, this project also faces some challenges. Sensor calibration is critical to ensure the accuracy of the data received, while managing the power supply and multiple component connections requires careful attention. The stability of the WiFi connection is another key factor, especially if the system relies on the network for remote operation or monitoring.

Overall, this project not only enhances the comfort of home occupants but also contributes to energy savings and security, making it a highly impactful solution for users.

8.0 CONCLUSION

This Smart Home project successfully demonstrates the use of sensors and automation to enhance home functionality. By leveraging the Raspberry Pi Pico W and a range of sensors, the system performs critical tasks such as weather-based protection using a rain sensor and servo motor, temperature regulation with a humidity sensor and fan, energy-efficient lighting via LDR and motion sensors, and safety monitoring with an IR sensor.

The project achieves a balance between simplicity and functionality, offering energy savings, enhanced comfort, and improved safety. Despite challenges such as sensor calibration and managing multiple components, this project provides a reliable and cost-effective foundation for automating essential home processes.

It is an excellent example of how microcontrollers and sensors can be used effectively to modernize and optimize home systems without relying on internet connectivity.

9.0 REFERENCE

Dr. Simon Monk (2016). Raspberry Pi Cook Book, Software and Hardware Problems and Solutions. Pdf

Imperial College London. Servo Motor SG90 Data Sheet.

http://www.ee.ic.ac.uk/pcheung/teaching/DE1_EE/stores/sg90_datasheet.pdf

Energy,c. (n,d.). What is a smart home and what are the benefits?

https://www.constellation.com/energy-101/what-is-smart-home.html.

Hayes, A (2024). Smart Home: Definition, How They Work, Pros and Cons.

https://www.investopedia.com/terms/s/smart-home.asp.