CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION TO THE PROJECT

Outdoor clothes drying is a widely practiced method known for its cost-effectiveness and eco-friendliness. However, the unpredictability of weather, particularly rain, presents a significant challenge to this practice. Rain can abruptly disrupt the drying process, leaving clothes damp and necessitating additional indoor drying, which consumes more time and energy.

In response to this challenge, this project introduces an automated rain cover system for outdoor clothes drying. This system utilizes advanced technology, including weather sensors, to detect rain and automatically deploy a cover to protect the drying clothes. By seamlessly integrating technology with user-friendly design, the system aims to provide a convenient and reliable solution to ensure dry laundry regardless of weather conditions.

This report outlines the comprehensive development, implementation, and evaluation of the automated rain cover system. It discusses the underlying design principles, technological components, and operational workflow of the system. Furthermore, the report presents the findings from extensive field highlighting the system's effectiveness, ease of use, and potential areas for enhancement. Additionally, it explores the system's broader implications for sustainability and its potential applications across various sectors.

Ultimately, this project seeks to address a pertinent need in outdoor clothes drying while promoting eco-friendly practices and fostering innovation in this field. By offering a practical solution to mitigate the impact of rain on outdoor drying, the automated rain cover system aims to enhance user convenience, reduce energy consumption, and contribute to sustainable living practices. Through this endeavor, we aim to contribute to the advancement of solutions that promote environmental sustainability and improve daily living experiences.

1.2 BACKGROUND OF STUDY

Outdoor clothes drying has been a customary practice for generations, valued for its cost-effectiveness and environmental benefits. Across diverse cultures worldwide, the practice of hanging clothes outdoors to dry under the sun and breeze has been ingrained as a sustainable alternative to mechanical drying methods. Beyond reducing energy consumption, outdoor drying also imparts a natural freshness to clothes, enhancing their cleanliness and scent.

However, the efficacy of outdoor clothes drying is frequently challenged by inclement weather conditions, particularly rainfall. The sudden onset of rain poses a significant obstacle, often leading to interrupted drying cycles and dampened clothes. This necessitates additional efforts and resources to dry the clothes indoors, resulting in increased energy consumption and time investment.

In response to this challenge, the concept of an automated rain cover system for outdoor clothes drying emerged. This innovative system aims to seamlessly integrate technology with the traditional practice of outdoor drying, offering a solution to mitigate the impact of rain. By automating the process of covering the drying area during rain, the system seeks to provide users with convenience and assurance that their laundry remains dry, regardless of weather conditions.

The development of the automated rain cover system is rooted in leveraging existing technologies such as weather sensors, motorized mechanisms, and remote control systems. These components are carefully integrated and engineered to create a robust system capable of accurately detecting rainfall and deploying a cover to shield the drying clothes. Through innovative design and engineering, the automated rain cover system represents a significant advancement in the field of outdoor clothes drying.

This project aims to enhance the sustainability and efficiency of outdoor clothes drying practices by addressing the challenges posed by rain. By providing a reliable and user-friendly solution, the automated rain cover system promotes the continued adoption of eco-friendly laundry practices while minimizing energy consumption and reducing reliance on mechanical drying methods. In doing so, it contributes to a greener and more sustainable future for laundry care.

1.3 STATEMENT OF THE PROBLEM

The traditional method of outdoor clothes drying is widely practiced due to its cost-effectiveness and environmental friendliness. However, the unpredictability of weather conditions, particularly rainfall, poses a significant challenge to this practice. When rain occurs unexpectedly, it disrupts the drying process, leaving clothes damp and necessitating additional indoor drying efforts. The problem at hand is the need for a solution that addresses the impact of rain on outdoor clothes drying. Specifically, there is a requirement for a practical and efficient system that seamlessly integrates technology with the traditional practice of outdoor drying to ensure that clothes remain dry regardless of weather conditions.

Key aspects of this problem include:

1. Disruption Caused by Rain: Unpredictable weather patterns, such as rain showers, disrupt the outdoor drying process, leading to dampened clothes and the need for additional indoor drying.
2. Inconvenience and Resource Usage: Users must constantly monitor weather conditions and intervene manually to protect drying clothes during rain, leading to inconvenience and increased resource consumption.
3. Sustainability Implications: The reliance on indoor drying methods during rainy weather leads to higher energy consumption and environmental impact, undermining the sustainability benefits of outdoor clothes drying.

In summary, the problem revolves around the necessity for an automated rain cover system that effectively detects rain and deploys a cover to protect drying clothes. This system aims to enhance the convenience, efficiency, and sustainability of outdoor clothes drying practices by providing users with a reliable and user-friendly solution for ensuring dry laundry irrespective of weather conditions.

1.4 OBJECTIVE OF STUDY

This study aims to develop an automated rain cover system tailored for outdoor clothes drying. The primary goal is to tackle the challenge presented by rain during outdoor drying by creating a practical and effective solution ensuring clothes remain dry despite weather conditions.

Design and Development: Develop a reliable automated rain cover system capable of promptly detecting rain and deploying a cover to safeguard drying clothes.

Technology Integration: Integrate advanced technologies like weather sensors, motorized mechanisms, and remote control systems to enhance the system's functionality and user experience.

Field Testing and Evaluation: Conduct thorough field tests to assess the system's performance, reliability, and user satisfaction in diverse weather conditions.

Optimization and Enhancement: Identify areas for improvement based on field test results and user feedback, refining the system to enhance its effectiveness and usability.

Sustainability Promotion: Promote eco-friendly laundry practices and reduce energy consumption by advocating for the adoption of the automated rain cover system as a sustainable alternative to indoor drying methods

Knowledge Dissemination: Share study findings through reports, presentations, and publications to contribute to advancements in outdoor clothes drying and sustainable technologies.

CHAPTER 2

LITERATURE SURVEY

. The literature survey for the Automatic Rain Cover System (ARCS) project involves a systematic examination of existing research, studies, and innovations related to outdoor clothes drying and rain protection systems. It encompasses the identification and evaluation of current methods, technologies, and user experiences associated with outdoor clothes drying. By analyzing recent advancements in sensor technology, mechanical engineering, and weather forecasting algorithms, the literature survey aims to inform the design and development of ARCS, ensuring that it meets user needs effectively and leverages cutting-edge technologies. Additionally, the survey explores regulatory requirements, standards, and environmental considerations to ensure compliance and sustainability in the implementation of ARCS. Overall, the literature survey serves as a critical foundation for the ARCS project, providing valuable insights and guidance for the development of an innovative and reliable solution to address the challenges of outdoor clothes drying in unpredictable weather conditions.

2.1 Automatic Clothing Drying Using Rain Sensors and Ldr Sensors Based on Arduino UNO

The study examined the use of an automatic clothing drying system using rain and light sensors based on Arduino Uno to alleviate anxiety associated with drying clothes during the rainy season. It uses an H-bridge circuit to regulate electric motor function and actuator control by a microcontroller. The Arduino Uno board features 14 input pins, including PWM outputs, analog input pins, and a 16 MHz crystal oscillator. The Light Dependent Resistor (LDR) sensor measures light intensity, while the rain sensor detects rain droplets. The authors conducted a literary study to gather theoretical information and data for the device's design, using sources like books, the internet, and interviews. The system works by automatically retracting the clothesline when rain is detected and extending it when light is detected. However, an error in motor rotation speed was identified, and the study emphasized implementing the prototype design. The study's outcome revealed that this system improves the process of drying clothes in response to weather conditions. The findings demonstrate the potential for such automated systems to alleviate anxiety associated with clothes drying in unpredictable weather conditions.

2.2 Automatic Protection of Clothes from Rain

The paper "AUTOMATIC PROTECTION OF CLOTHES FROM RAIN" discusses the development of low cost and simple construction project in the field of electronics, aiming to enhance human comfort and convenience by automatically protecting clothes from rain. The study emphasizes the increasing needs and the progression of science and technology, highlighting the importance of the advancement. The system described in the paper is an embedded system consisting of an 8-bit microcontroller and a sensing system using LDR with 555 timers to monitor sun rays and rainy conditions. The tray opens and closes based on sun rays and is controlled through a driver circuit via relay. The authors conducted a literature survey to analyze existing cloth protection products during rain and identified the demerits, leading them to develop an automatic system that does not require manual operation and includes rain sensors. The hardware requirements are discussed, including the use of a microcontroller, power supply circuit, line driver, and continuity sensor. The paper also explains the engineering design approach used to solve the problem and describes the block level specifications and engineering design steps. The study used software tools such as Keil MicroVision and WELPRO for program development and burning. Overall, the paper presents a detailed account of the development of an automatic clothes protection system, focusing on the integration of software and hardware components to achieve the desired functionality

The literature survey highlights the demerits of existing products for cloth protection during rain, such as the need for manual operation and the inability to operate for disabled individuals. The paper describes the motivation behind the project as well as the hardware and software requirements, including the use of a microcontroller and various supporting devices. The paper also discusses the engineering design approach used to solve the problem, focusing on user-friendliness and multiple solutions to achieve the goal.

2.3 Rain Water Detection and Automatic Clotheretrieval Machine

In the paper, "Rain Water Detection Automatic Cloth Retrieval Machine," the researchers introduce a system designed for household use to automatically retrieve wet clothes to a shaded area when it rains, and return them to an open space when the rain stops. The system involves the conversion of electrical energy into mechanical energy, and utilizes sensors such as rain and light detectors, a microcontroller, limit switches, and a 12-volt DC motor. The rain sensor, consisting of electrodes, detects raindrops and sends signals to the microcontroller to actuate the system, while the light sensor senses sunlight to retrieve the clothes back to the open atmosphere. The system includes a DC motor, LDR sensors, and a microcontroller to manage the retrieval process. The researchers highlight the benefits of such a system, including energy and time savings, and environmental protection. The paper also discusses the future scope for the system, including the potential use of a heater and the ability to set a dry timer. The system is particularly useful for working couples who may not have time to manage their laundry during changing weather conditions. The paper outlines the experimental setup, components used, and the basic blocks of a regulated DC power supply. The researchers also discuss the use of sensors and photometers in the system, highlighting the importance of sensors in automated plants and their varied applications. Overall, the paper presents a detailed and technical exploration of the design, components, and functionality of the rain water detection automatic cloth retrieval machine.

2.4 Propose design of smart clothesline with the tree diagram approach analysis and quality function deployment method for indonesia weather

The research paper focuses on addressing the uncertainty in rainfall levels in tropical countries like Indonesia by proposing the design of a smart clothesline tailored to societal conditions and seasons. It emphasizes the anxiety experienced by individuals during the rainy season due to concerns about clothes getting wet when hung outside. The economic impact of using electric clotheslines is highlighted, leading to the need to understand consumer preferences for a new clothesline design. The research methodology involves tree diagram analysis and the Quality Function Deployment (QFD) method, leading to the identification of priority product attributes based on customer demand, such as an additional rain sensor, sturdy material structure, and easy removal and folding of clothes dryers. The paper reviews the existing research on clothesline designs and proposes a new design of automatic clothes dryers that is more ergonomic for consumers and aims to decrease the use of electric power. It further discusses technical responses, production processes, and cost calculations for the proposed smart clothesline design. The conclusion emphasizes the specifications of the proposed clothesline design based on consumer preferences identified using the QFD method.

CHAPTER 3

EXISTING SYSTEM

Currently, outdoor clothes drying relies predominantly on traditional methods, such as hanging clothes on clotheslines or racks outdoors to air dry naturally. While this approach is economical and environmentally friendly, it is vulnerable to weather conditions, particularly rain.

In response to rain, users typically resort to manual interventions, like hastily removing clothes from the drying area and transferring them indoors or covering them with improvised solutions like tarps or plastic sheets. However, these methods are often labor-intensive, inconvenient, and may not provide adequate protection against rain, resulting in damp clothes and the need for additional indoor drying.

Commercially available solutions for rain protection in outdoor clothes drying include manual retractable awnings or canopies designed to cover the drying area during adverse weather. However, these solutions require manual operation and may not offer the level of automation and convenience desired by users.

Overall, the current system for outdoor clothes drying lacks an automated and efficient solution to address the challenge posed by rain. There is a clear need for a practical and user-friendly system that seamlessly integrates technology to detect rain and deploy a cover automatically, ensuring clothes remain dry regardless of weather conditions. This gap in the existing system underscores the importance and potential benefits of developing an automated rain cover system for outdoor clothes drying.

3.1 Limitations of Existing System:

1. Manual Intervention: Currently, outdoor clothes drying relies heavily on manual intervention during rain. Users need to constantly monitor weather conditions and take prompt action to protect drying clothes, which can be inconvenient and time-consuming.

2. Inadequate Protection: Improvised solutions like using tarps or plastic sheets may offer limited protection against rain. They might fail to fully shield clothes from moisture, leading to dampened laundry and the need for additional indoor drying. Moreover, these makeshift covers can be prone to tearing or being blown away by strong winds, reducing their effectiveness.

3. Lack of Automation: While some available solutions provide rain protection through retractable awnings or canopies, they require manual operation. Users must manually deploy or retract the cover, which may not be feasible during sudden rain showers or when users are absent.

4. Limited Convenience: The manual nature of existing solutions hampers their convenience and usability. Users might find it burdensome to continuously monitor weather conditions and intervene manually, especially when they have other tasks to attend to.

5. Reliability Issues: Improvised solutions might not consistently provide reliable protection, especially during heavy rain or prolonged periods of precipitation. This leaves clothes exposed to moisture for extended periods, potentially resulting in damage or mold growth.

6. Environmental Impact: Inefficiencies in rain protection may lead to additional indoor drying, increasing energy consumption and environmental impact. This contradicts the sustainability advantages associated with outdoor clothes drying.

CHAPTER 4

PROPOSED METHODOLOGY

4.1 INTRODUCTION

Integrating water, Light sensors with Arduino board for the development of the Automatic Rain Cover System (ARCS) involves several key steps to ensure seamless operation and effective rain protection. Firstly, we connect the sensors to the Arduino board, allowing it to gather real-time data on ambient temperature, rainfall, and gas concentrations if applicable. This connectivity enables the system to monitor environmental conditions accurately.

Next, we develop algorithms within the Arduino code to process the sensor data and determine when to activate the ARCS. By analyzing factors like moisture increase, temperature decrease, and rain detection, the system intelligently decides when conditions warrant cover deployment. This ensures that clothes on outdoor drying racks are protected from rain effectively.

In addition to control algorithms, we design a user interface using Arduino-compatible displays and input devices. This interface provides real-time status updates to users and allows them to adjust settings as needed. It enhances user interaction with the ARCS system, making it more intuitive and user-friendly.

After the Rain Cover Deployment user will receive a notification about rain status and Deployment.

1. PIC Micro Controller : PIC is a Peripheral Interface Microcontroller which was developed in the year 1993 by the General Instruments Microcontrollers. It is controlled by software and programmed in such a way that it performs different tasks and controls a generation line.

3. Rain Sensor: The rain sensor is a crucial component responsible for detecting raindrops. It utilizes conductive properties to detect the presence of water, sending a signal to the Arduino board when rain is detected. This triggers the deployment of the tarp cover to protect the drying clothes.

4. Mechanical Frame: The mechanical frame serves as the support structure for the system, holding the motor setup and providing stability. It is typically constructed from durable materials such as aluminum or steel, designed to withstand outdoor conditions and accommodate the weight of the tarp cover.

5. Motor Setup: The motor setup consists of motors, gears, and pulleys responsible for deploying and retracting the tarp cover. The motors are controlled by the Arduino board, which activates them in response to signals from the rain sensor. The gears and pulleys ensure smooth and synchronized movement of the tarp cover.

6. Tarp Cover: The tarp cover is the protective layer that shields the drying area from rain. Made from waterproof and UV-resistant material, such as polyethylene or PVC, it is attached to the mechanical frame and deployed over the clothes drying area when rain is detected.

7. Motor: The motor is the driving force behind the movement of the tarp cover. It is typically a DC motor with adequate torque and speed capabilities to deploy and retract the cover smoothly and efficiently. The motor's speed and direction are controlled by the Arduino board, ensuring precise operation.

8. GSM Module: The GSM module enables remote monitoring and control of the system via SMS or call. It communicates with the Arduino board, allowing users to receive notifications about rain detection and system status, as well as manually activate or deactivate the system if needed.

By integrating these components into a cohesive system, the proposed automated rain cover system offers a reliable and user-friendly solution for protecting outdoor clothes drying from rain. It enhances convenience, efficiency, and peace of mind for users, ensuring dry laundry regardless of weather conditions.

Once the hardware and software components are integrated, we conduct rigorous testing and debugging to ensure proper functionality and communication between sensors, actuators, and the Arduino board. Field tests in outdoor environments help us evaluate the system's responsiveness, accuracy, and reliability in detecting rain and deploying covers.

Overall, integrating sensors with an Arduino board for ARCS development offers a flexible and cost-effective solution for automatic rain protection. It leverages the capabilities of Arduino technology to create a reliable and user-friendly system that meets the needs of outdoor clothes drying in various environments.

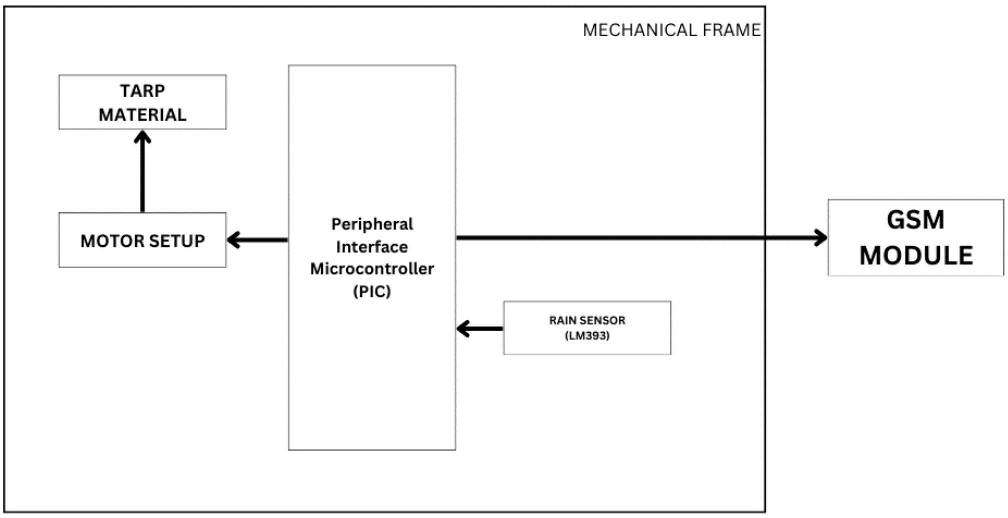

Fig 4.1 Block diagram

4.2 BLOCK DIAGRAM DESCRIPTION

PIC:

- Acts as the brain of the system, controlling its operation.
- Receives inputs from sensors and sends commands to the motor setup.

Rain Sensor:

- Detects raindrops.
- Signals the Arduino Board when rain is detected, prompting it to deploy the tarp cover.

GSM Module:

- Allows remote monitoring and control via SMS or call.
- Notifies users about rain detection and system status, enabling manual control.

Motor Setup:

- Consists of motors, gears, and pulleys.
- Deploys and retracts the tarp cover based on commands from the Arduino Board.

Mechanical Frame:

- Provides support for the system.
- Holds the motor setup and tarp cover securely.

Motor:

- Powers the movement of the tarp cover.
- Operates according to commands from the Arduino Board.

Tarp Cover:

- Made of waterproof material.
- Covers the drying area to protect clothes from rain.

CHAPTER 5

HARDWARE DESCRIPTION

5.1 PERIPHERAL INTERFACE MICROCONTROLLER (PIC)

5.1.1 DESCRIPTION

The pic 16f877a microcontroller represents a pinnacle of innovation in the realm of embedded systems, offering a blend of versatility, performance, and efficiency that caters to a myriad of applications across diverse industries. Developed by Microchip Technology, a leading provider of microcontroller solutions, the PIC16877Aembodies the hallmark characteristics of the PIC family while introducing novel features and enhancements to meet the evolving needs of modern embedded design.

At its core, the PIC16877Aadheres to the principles of the PIC architecture, boasting an 8-bit RISC (Reduced Instruction Set Computing) design that prioritizes efficiency and simplicity in instruction execution. This architecture, coupled with a Harvard architecture configuration, enables seamless parallelism between program and data memory spaces, enhancing overall throughput and responsiveness.

Operating at clock speeds ranging from a modest few megahertz to a robust tens of megahertz, the PIC16877A delivers a balance of computational power and energy efficiency, making it well-suited for a wide spectrum of applications. One of the distinguishing features of the PIC16877A is its memory architecture, which comprises three essential components: Flash program memory, SRAM (Static Random Access Memory), and EEPROM (Electrically Erasable Programmable Read-Only Memory). The Flash program memory serves as the repository for firmware code, accommodating sizes ranging from a few kilobytes to an expansive 64 KB, thus enabling the implementation of complex algorithms and functionalities. Complementing the program memory is the SRAM, which provides

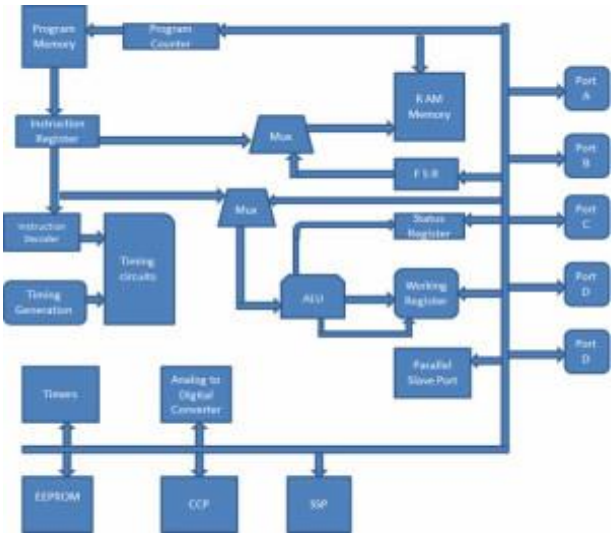

Fig 5.1 Architecture of PIC Controller

5.1.2 Memory Structure

The PIC architecture consists of two memories: Program memory and Data memory.

Program Memory: This is a 4K14 memory space. It is used to store 13-bit instructions or the program code. The program memory data is accessed by the program counter register that holds the address of the program memory. The address 0000H is used as reset memory space and 0004H is used as interrupt memory space.

Data Memory: The data memory consists of the 368 bytes of RAM and 256 bytes of EEPROM. The 368 bytes of RAM consists of multiple banks. Each bank consists of general-purpose registers and special function registers.

Working Register:

It consists of a memory space that stores the operands for each instruction. It also stores the results of each execution.

Status Register: The bits of the status register denotes the status of the ALU (arithmetic logic unit) after every execution of the instruction. It is also used to select any one of the 4 banks of the RAM.

File Selection Register: It acts as a pointer to any other general-purpose register. It consists of a register file address, and it is used in indirect addressing.

5.1.3 I/O Ports

PIC16 series consists of five ports, such as Port A, Port B, Port C, Port D, and Port E.

Port A: It is a 16-bit port, which can be used as an input or output port based on the status of the TRISA register.

Port B: It is an 8-bit port, which can be used as both an input and output port. 4 of its bits, when used as input, can be changed upon interrupt signals.

Port C: It is an 8-bit port whose operation (input or output) is determined by the status of the TRISC register.

Port D: It is an 8-bit port, which apart from being an I/O port, acts as a slave port for connection to the microprocessor bus.

Port E: It is a 3-bit port that serves the additional function of the control signals to the A/D converter.

5.1.4 Timers

PIC microcontrollers consist of 3 timers, out of which the Timer 0 and Timer 2 are 8-bit timers and the Time-1 is a 16-bit timer, which can also be used as a counter.

5.1.5 A/D Converter

The PIC Microcontroller consists of 8-channels, 10-bit Analog to Digital Converter. The operation of the A/D converter is controlled by these special function registers: ADCON0 and ADCON1. The lower bits of the converter are stored in ADRESL (8 bits), and the upper bits are stored in the ADRESH register. It requires an analog reference voltage of 5V for its operation.

5.1.6 Oscillators

Oscillators are used for timing generation. PIC microcontrollers consist of external oscillators like crystals or RC oscillators. In the case of crystal oscillators, the crystal is connected between two oscillator pins, and the value of the capacitor connected to each pin determines the mode of operation of the oscillator. The different modes are low-power mode, crystal mode, and the high-speed mode. In the case of RC oscillators, the value of the Resistor and Capacitor determines the clock frequency. The clock frequency ranges from 30 kHz to 4 MHz.

5.1.7 CCP module:

A CCP module works in the following three modes:

Capture Mode: This mode captures the time of arrival of a signal, or in other words, captures the value of the Timer1 when the CCP pin goes high.

Compare Mode: It acts as an analog comparator that generates an output when the timer1 value reaches a certain reference value.

PWM Mode: It provides pulse width modulated output with a 10-bit resolution and programmable duty cycle.

5.1.8 APPLICATIONS

Embedded Systems:

PIC microcontrollers are widely used in embedded systems for various applications such as home automation, industrial control systems, smart appliances, and IoT (Internet of Things) devices. In home automation, PIC microcontrollers can control lighting, heating, ventilation, air conditioning (HVAC) systems, security cameras, and door locks, offering convenience and energy efficiency.

In industrial control systems, PIC microcontrollers are employed in PLCs (Programmable Logic Controllers), motor control systems, process automation, and monitoring equipment for manufacturing processes.

Consumer Electronics:

PIC microcontrollers are found in numerous consumer electronic devices including remote controls, gaming consoles, digital cameras, smart TVs, and audio systems. In remote controls, PIC microcontrollers handle the processing of user inputs, encoding of IR signals, and communication with the target device, providing seamless control and functionality.

In gaming consoles and digital cameras, PIC microcontrollers manage user interfaces, input/output peripherals, display interfaces, and data processing tasks, enabling interactive and immersive user experiences.

Automotive Systems:

PIC microcontrollers play a crucial role in automotive systems, powering various functions such as engine control, transmission control, chassis control, safety systems, and infotainment systems. In engine control systems, PIC microcontrollers manage fuel injection timing, ignition timing, throttle control, and emissions monitoring, ensuring optimal engine performance and efficiency.

In safety systems such as airbag control units (ACUs) and ABS (Anti-lock Braking System) controllers, PIC microcontrollers execute real-time algorithms for collision detection, vehicle stability control, and occupant protection.

Medical Devices:

PIC microcontrollers are utilized in medical devices and healthcare systems for patient monitoring, diagnostic equipment, drug delivery systems, and assistive devices. In patient monitoring systems, PIC microcontrollers acquire physiological data from sensors, perform signal processing, and transmit data to external displays or medical databases for analysis.

In drug delivery systems such as insulin pumps and infusion pumps, PIC microcontrollers control drug dosing, infusion rates, and safety interlocks, ensuring accurate and reliable drug administration.

Instrumentation and Measurement:

PIC microcontrollers are employed in instrumentation and measurement systems for data acquisition, signal processing, and control in laboratory, industrial, and scientific applications.In data acquisition systems, PIC microcontrollers interface with sensors, transducers, and measurement instruments to acquire analog or digital data, perform real-time processing, and store or transmit data for analysis. In control systems such as PID (Proportional-Integral-Derivative) controllers and closed-loop feedback systems, PIC microcontrollers regulate process variables, maintain setpoints, and ensure system stability and performance.

5.2 GSM MODEM

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. A GSM modem can be an external device or a PC Card / PCMCIA Card. Typically, an external GSM modem is connected to a computer through a serial cable or a USB cable. A GSM modem in the form of a PC Card / PCMCIA Card is designed for use with a laptop computer. It should be inserted into one of the PC Card / PCMCIA Card slots of a laptop computer. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate.

5.2.1 TECHNICAL DESCRIPTION

GSM is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. GSM networks operate in four different frequency ranges. Most GSM networks operate in the 900 MHz .GSM-

900 uses 890–915 MHz to send information from the mobile station to the base station (uplink) and 935–960 MHz for the other direction (downlink).This 25MHz band width is subdivided into 124 carrier frequency channels, each spaced 200 KHz apart. The channel data rate is 270.833Kbit/s

GSM has used a variety of voice codec's to squeeze 3.1 kHz audio into between 5.6 and 13 kbit/s. Originally, two codec's, named after the types of data channel they were allocated, were used, called Half Rate (5.6 kbit/s) and Full Rate (13 kbit/s). These used a system based upon linear predictive coding (LPC). In addition to being efficiency with bit rates, these codec's also made it easier to identify more important parts of the audio.

There are five different cell sizes in a GSM network—macro, micro, Pico, femto and umbrella cells. The coverage area of each cell varies according to the implementation environment. Macro cells can be regarded as cells where the base station antenna is installed on a mast or a building above average roof top level. Micro cells are cells whose antenna height is under average roof top level; they are typically used in urban areas. Pico cells are small cells whose coverage diameter is a few dozen meters; they are mainly used indoors. Femto cells are cells designed for use in residential or small business environments and connect to the service provider's network via a broadband internet connection. Umbrella cells are used to cover shadowed regions of smaller cells and fill in gaps in coverage between those cells.

5.2.2 GSM NETWORK

Global System for Mobile communication (GSM) [Theodore S. Rappaport, 2002] is a standard for digital communication. GSM uses the Time Division Multiple Access (TDMA). The switching system is responsible for performance call processing and subscriber-related functions. The concept of cellular service is the use of low - power transmitters where frequencies can be reused within a geographic area

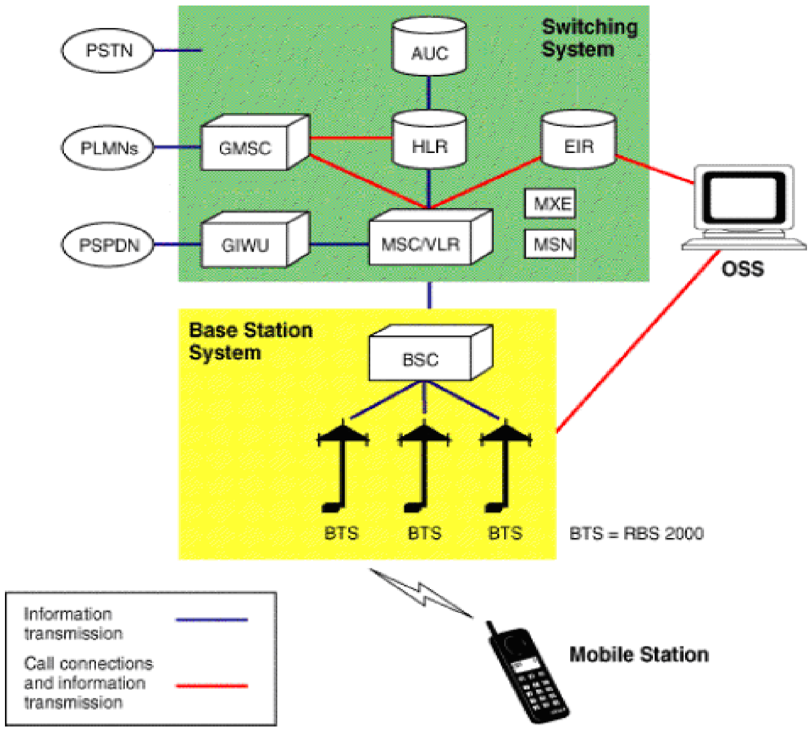

Fig 5.2 GSM Network Elements

5.3 LCD

A liquid crystal display (commonly abbreviated LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. It is often utilized in battery-powered electronic devices because it uses very small amounts of electric power.

5.3.1 Overview

Each pixel of an LCD typically consists of a layer of molecules aligned between two transparent electrodes, and two polarizing filters, the axes of transmission of which are (in most of the cases) perpendicular to each other. With no liquid crystal between the polarizing filters, light passing through the first filter would be blocked by the second (crossed) polarizer.

The surfaces of the electrodes that are in contact with the liquid crystal material are treated so as to align the liquid crystal molecules in a particular direction. This treatment typically consists of a thin polymer layer that is unidirectionally rubbed using, for example, a cloth. The direction of the liquid crystal alignment is then defined by the direction of rubbing.

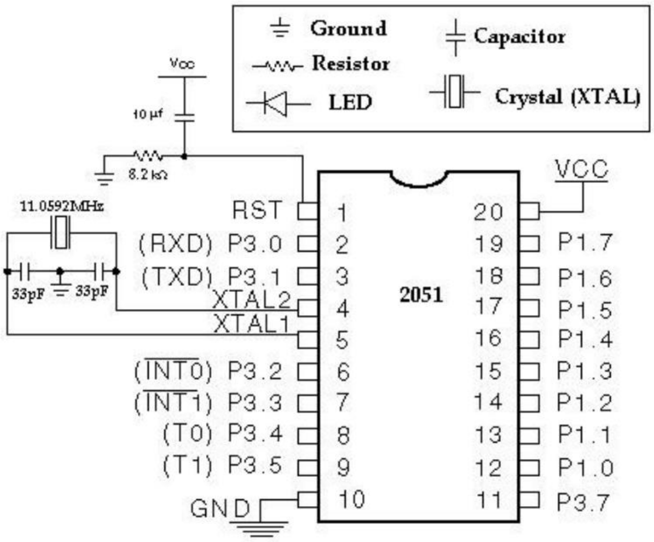

Fig 5.4 Pin Diagram of LCD

5.3.2 PIN DESCRIPTION:

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read	Read/write

	from the register	
6	**Sends data to data pins when a high to low pulse is given**	**Enable**
7	**8-bit data pins**	**DB0**
8		**DB1**
9		**DB2**
10		**DB3**
11		**DB4**
12		**DB5**
13		**DB6**
14		**DB7**
15	**Backlight V_{CC} (5V)**	**Led+**
16	**Backlight Ground (0V)**	**Led-**

5.4 POWER SUPPLY:

A power supply (sometimes known as a power supply unit or PSU) is a device or system that supplies electrical or other types of energy to an output load or group of loads. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others.

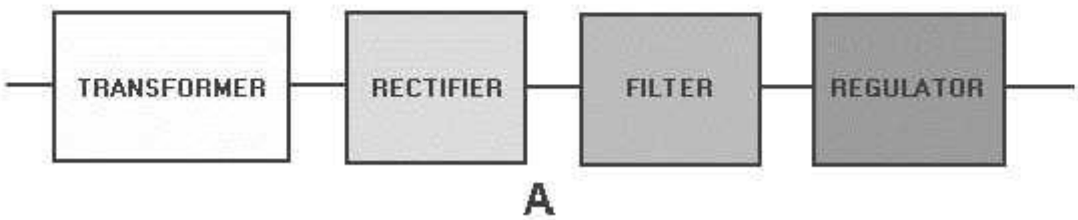

Fig 5.5 Block Diagram of Basic Power Supply

The final section, the REGULATOR, does just what the name implies. It maintains the output of the power supply at a constant level in spite of large changes in load current or input line voltages. Now that you know what each section does, let's trace an ac signal through the power supply. At this point you need to see how this signal is altered within each section of the power supply. Later on in the chapter you will see how these changes take place. In view B of figure 4-1, an input signal of 115 volts ac is applied to the primary of the transformer. The transformer is a step-up transformer with a turns ratio of 1:3. You can calculate the output for this transformer by multiplying the input voltage by the ratio of turns in the primary to the ratio of turns in the secondary; therefore, 115 volts ac ´ 3 = 345 volts ac (peak-to- peak) at the output. Because each diode in the rectifier section conducts for 180 degrees of the 360-degree input, the output of the rectifier will be one-half, or approximately 173 volts of pulsating dc. The filter section, a network of resistors, capacitors, or inductors, controls the rise and fall time of the varying signal; consequently, the signal remains at a more constant dc level. You will see the filter process more clearly in the discussion of the actual filter circuits. The output of the filter is a signal of 110 volts dc, with ac ripple riding on the dc. The reason for the lower voltage (average voltage) will be explained later in this chapter. The regulator maintains its output at a constant 110-volt dc level, which is used by the electronic equipment (more commonly called the load).

5.5 MOTOR SETUP

5.5.1 MOTOR

The Motor-60 rpm 12V DC gear motor is a compact and efficient solution for applications demanding controlled rotational speed and torque.

5.5.2 KEY FEATURES

The Motor-60 rpm 12V DC gear motor is a compact and efficient motor designed for various applications requiring precise control of rotational speed and torque. Here's a detailed description of its features and specifications:

1. Type: DC Gear Motor
2. Rated Voltage: 12V DC

3. Rated Speed: 60 revolutions per minute (rpm)
4. Gear Ratio: The gear reduction ratio determines the relationship between the motor speed and the output shaft speed. For example, if the gear ratio is 1:10, the motor spins 10 times to turn the output shaft once.
5. Torque: The motor's torque specifies its rotational force, typically measured in Newton-meters (Nm) or ounce-inches (oz-in). Higher torque enables the motor to exert greater rotational force.
6. Construction: The motor usually consists of a DC motor combined with a gearbox. The gearbox contains gears that reduce the motor's speed while increasing its torque, allowing the motor to deliver sufficient power for various applications.
7. Mounting Options: The motor may feature mounting holes or brackets for easy installation in different configurations.
8. Size and Weight: Compact size and lightweight design make it suitable for applications with space constraints.
9. Operating Temperature: The motor's operating temperature range should be considered to ensure reliable performance in various environments.
10. Efficiency: Modern DC gear motors are designed for high efficiency to minimize power consumption and heat generation.
11. Protection: Some motors may feature built-in protection mechanisms such as overcurrent protection, overvoltage protection, and thermal protection to prevent damage from electrical faults and overheating.
12. Applications: Common applications include robotics, automation systems, electric vehicles, medical devices, home appliances, and industrial machinery where precise control of rotational speed and torque is required.

The Motor-60 rpm 12V DC gear motor offers a balance of speed, torque, and efficiency, making it suitable for a wide range of applications in various industries.

5.6 COVERING MATERIAL

1.5mm soft leather offers a combination of flexibility, durability, and comfort, making it ideal for a variety of crafting and garment applications. Here's a detailed description:

1. Thickness: With a thickness of 1.5mm, this leather strikes a balance between being sturdy enough to hold its shape and soft enough to be pliable and easy to work with.
2. Texture: Soft leather typically has a smooth and supple texture, providing a luxurious feel to the touch. This makes it highly desirable for crafting projects where a premium finish is desired.
3. Flexibility: The softness of the leather allows it to bend and flex easily, making it suitable for applications where drape and movement are important, such as clothing, bags, and accessories.
4. Durability: Despite its softness, 1.5mm leather maintains a good level of durability, ensuring that crafted items are long-lasting and able to withstand everyday use.
5. Versatility: Soft leather of this thickness can be used for a wide range of projects, including garment making (such as jackets, skirts, and vests), accessory crafting (such as wallets, bags, and belts), and small leather goods (such as keychains and phone cases).

6. Ease of Stitching: The softness of the leather makes it easier to sew by hand or with a sewing machine, allowing for clean and precise stitching without the need for specialized equipment.
7. Color Options: Soft leather is available in a variety of colors and finishes, allowing for customization and creative expression in crafting projects.
8. Comfort: When used in clothing and accessories, the softness of the leather provides a comfortable wearing experience, molding to the body and offering freedom of movement.
9. Crafting Potential: Its versatility makes it suitable for both beginner and experienced crafters, offering endless possibilities for creating custom pieces and unique designs.

Overall, 1.5mm soft leather is a versatile and practical material that combines the luxurious feel of leather with the flexibility and durability required for a wide range of crafting and garment projects.

5.7 MECHANICAL FRAME

A mechanical frame for a rain cover system constructed from mild steel square pipes offers a sturdy and versatile structure to support and protect various objects from the rain. Here's a detailed description of its features and benefits:

1. Material: Mild steel square pipes are chosen for their strength, durability, and resistance to corrosion, making them suitable for outdoor use and exposure to the elements.

2. Square Pipe Dimensions: The dimensions of the square pipes depend on the size and weight of the objects to be covered, as well as the desired height and width of the frame. Common sizes include 25mm x 25mm, 30mm x 30mm, or 40mm x 40mm, with a thickness ranging from 1mm to 3mm for added strength.

3. Welded Construction: The frame is typically constructed by welding together the square pipes at the joints to form a rigid and stable structure. Welding ensures strong connections between the pipes, providing stability and support even under heavy rainfall or wind conditions.

4. Modular Design: The frame can be designed with a modular structure, allowing for easy assembly, disassembly, and transportation. Modular components can be connected using bolts and nuts for added convenience.

5. Adjustable Height and Width: The height and width of the frame can be adjusted according to the specific requirements of the rain cover system. Telescopic or adjustable legs and crossbars provide flexibility to accommodate different sizes of objects or areas to be covered.

6. Additional Reinforcements: Depending on the size and weight of the objects to be covered, additional reinforcements such as diagonal braces or support bars may be added to enhance the strength and stability of the frame.

7. Weather-resistant Finish: To protect the mild steel from rust and corrosion, the frame can be finished with a weather-resistant coating such as galvanization or powder coating. This ensures long-term durability and extends the lifespan of the frame, even in harsh outdoor environments.

8. Versatility: The mechanical frame can be used to support various types of rain cover systems, including fabric canopies, plastic tarps, or metal roofing panels. It can also be adapted for use in different applications such as outdoor events, construction sites, or storage areas.

9. Customization Options: The design of the frame can be customized to meet specific requirements, including the addition of features such as side panels, doors, or ventilation openings for increased protection and functionality.

10. Ease of Installation: The frame can be installed on various surfaces such as concrete, asphalt, or soil, using anchors, stakes, or concrete footings for secure anchoring and stability.

Overall, a mechanical frame for a rain cover system made from mild steel square pipes provides a robust and reliable solution for protecting objects and areas from the rain, offering durability, versatility, and ease of customization for a wide range of applications.

5.7.1 DIMENSIONS

The Frame for the clothesline is made from mild steel pipes with the dimensions of 2x2x2.5.

2.5 feet Length

2 feet height

2 feet Breadth

CHAPTER 6

SENSORS

6.1 Rain Drop Sensor

A raindrop sensor is a type of sensor used to detect rainfall or the presence of water. It typically consists of two conductive elements separated by a non-conductive gap. When water droplets bridge the gap between the conductive elements, it completes the circuit, allowing the sensor to detect the presence of water. These sensors are commonly used in various applications such as weather monitoring systems, automatic watering systems for plants, and in home automation projects for detecting rain and triggering actions like closing windows or activating alarms.There are different types of raindrop sensors available, ranging from simple DIY setups to more sophisticated commercial sensors with built-in processing capabilities. Some sensors may also include additional features such as adjustable sensitivity or digital output signals for easier integration with microcontrollers or other electronic systems.

Fig 6.2 Rain Drop Sensor

6.1.1 Description

The raindrop sensor is a compact electronic device designed to detect the presence of rain or moisture. It consists of several key components:

Sensor Surface: The top surface of the sensor is typically made of a material that is sensitive to moisture, such as a conductive material or a material with special coating. This surface is where raindrops or water droplets will come into contact.

Conductive Elements: Inside the sensor, there are usually two or more conductive elements arranged in a specific configuration. These elements are separated by a small gap, creating an open circuit when dry.

Non-Conductive Substrate: The conductive elements are mounted on a non-conductive substrate, such as a printed circuit board (PCB) or a plastic housing. This substrate provides support and insulation for the sensor components.

Wiring and Connectors: The conductive elements are connected to the sensor's electronic circuitry via wiring or conductive traces on the substrate. These connections allow the sensor to detect changes in conductivity when moisture is present.

Electronic Circuitry: The sensor is equipped with electronic circuitry responsible for detecting changes in conductivity and generating an output signal. This circuitry may include components such as transistors, resistors, and comparators to amplify and process the sensor's signals.

Output Interface: Depending on the sensor model and application, the sensor may provide various types of output interfaces. Common output types include analog voltage signals, digital signals (e.g., binary on/off), or serial communication protocols (e.g., UART or I2C).

Power Supply: The sensor requires a power supply to operate its electronic circuitry. This can range from a simple DC voltage source (e.g., batteries) to more sophisticated power management circuits for energy-efficient operation.

6.1.2 Operation

When raindrops or moisture come into contact with the sensor surface, they create a conductive path between the sensor's conductive elements, causing a decrease in resistance or an increase in conductivity. The sensor's electronic circuitry detects this change and generates an output signal indicating the presence of rain or moisture.

6.1.3 Applications

Raindrop sensors find applications in various fields, including:

Weather Monitoring Systems: Used to measure rainfall intensity and duration for meteorological purposes.

Automatic Irrigation Systems: Trigger watering of plants or crops based on detected rainfall.

Home Automation: Detect rain to automate actions such as closing windows, activating alarms, or controlling sprinkler systems.

CHAPTER 7
SOFTWARE REQUIREMENTS

7.1 MPLAB® X IDE

MPLAB® X Integrated Development Environment (IDE) stands out as a robust software tool crafted by Microchip Technology, tailored specifically for embedded software development on Microchip microcontrollers and digital signal controllers (DSCs). Serving as the central hub for the entire firmware development process, MPLAB X IDE offers an array of functionalities to streamline coding, compilation, debugging, and programming tasks, catering to the needs of developers working with Microchip's microcontroller products.

At the heart of MPLAB X IDE lies its user-friendly code editor, equipped with features like syntax highlighting, code completion, and code folding. These aids enhance the coding experience, improving code readability and developer productivity. Supporting multiple programming languages including C, C++, and assembly language, the code editor provides flexibility for developers to write firmware code in their preferred language.

MPLAB X IDE excels in project management, allowing developers to organize their firmware projects efficiently. Through its intuitive interface, developers can create, open, save, and manage multiple projects simultaneously, facilitating collaboration and version control. The seamless integration with Microchip's XC compilers and toolchains empowers developers to compile, build, and link firmware code directly within the IDE, leveraging the optimization features of Microchip's compiler toolchains.

The IDE's debugging tools offer advanced functionalities for real-time debugging and code analysis. Integrated debuggers like MPLAB X ICD (In-Circuit Debugger) and MPLAB X PICkit™ enable source-level debugging, step-by-step execution, breakpoint management, and variable monitoring, aiding developers in identifying and resolving bugs efficiently. Additionally, MPLAB X IDE includes powerful simulation capabilities, allowing developers to simulate firmware code in a virtual environment to validate and test their code before deployment to hardware.

Programming and flashing firmware code onto target microcontroller devices is simplified with MPLAB X IDE's support for various programming and flashing tools. Integrated programmers such as MPLAB X IPE (Integrated Programming Environment) and MPLAB X PICkit™ facilitate programming of flash memory, EEPROM, and other non-volatile memory devices with ease and reliability.

Another notable feature of MPLAB X IDE is its Peripheral Configurator tool, which simplifies the configuration of microcontroller peripherals and I/O pins. Developers can configure peripheral modules like UART, SPI, I2C, ADC, and PWM using an intuitive graphical user interface, reducing development time and complexity.

MPLAB X IDE's extensibility is enhanced through its plugin system, enabling developers to extend its functionality with custom plugins and extensions. This capability allows for the integration of third-party tools, addition of new features, and automation of repetitive tasks, further enhancing the versatility and usability of the IDE.

7.2 C and Embedded C

Looking around, we find ourselves to be surrounded by various types of embedded systems. Be it a digital camera or a mobile phone or a washing machine, all of them has some kind of processor functioning inside it. Associated with each processor is the embedded software. If hardware forms the body of an embedded system, embedded processor acts as the brain, and embedded software forms its soul. It is the embedded software which primarily governs the functioning of embedded systems.

During infancy years of microprocessor based systems, programs were developed using assemblers and fused into the EPROMs. There used to be no mechanism to find what the program was doing. LEDs, switches, etc. were used to check correct execution of the program. Some ‘very fortunate’ developers had In-circuit Simulators (ICEs), but they were too costly and were not quite reliable as well.

As time progressed, use of microprocessor-specific assembly-only as the programming language reduced and embedded systems moved onto C as the embedded programming language of choice. C is the most widely used programming language for embedded processors/controllers. Assembly is also used but mainly to implement those portions of the code where very high timing accuracy, code size efficiency, etc. are prime requirements.

Initially C was developed by Kernighan and Ritchie to fit into the space of 8K and to write (portable) operating systems. Originally it was implemented on UNIX operating systems. As it was intended for operating systems development, it can manipulate memory addresses. Also, it allowed programmers to write very compact codes. This has given it the reputation as the language of choice for hackers too.

As assembly language programs are specific to a processor, assembly language didn’t offer portability across systems. To overcome this disadvantage, several high level languages, including C, came up. Some other languages like PLM, Modula-2, Pascal, etc. also came but couldn’t find wide acceptance. Amongst those, C got wide acceptance for not only embedded systems, but also for desktop applications. Even though C might have lost its sheen as mainstream language for general purpose applications, it still is having a strong-hold in embedded programming. Due to the wide acceptance of C in the embedded systems, various kinds of support tools like compilers & cross-compilers, ICE, etc. came up and all this facilitated development of embedded systems using C.

Subsequent sections will discuss what is Embedded C, features of C language, similarities and difference between C and embedded C, andfeatures of embedded C programming.

7.2.1 EMBEDDED SYSTEMS PROGRAMMING

Embedded systems programming is different from developing applications on a desktop computers.

Key characteristics of an embedded system, when compared to PCs, are as follows:

- Embedded devices have resource constraints(limited ROM, limited RAM, limited stack space, less processing power)
- Components used in embedded system and PCs are different;
    - o Embedded systems typically uses smaller, less power consuming components.
    - o Embedded systems are more tied to the hardware.

Two salient features of Embedded Programming are code speed and code size. Code speed is governed by the processing power, timing constraints, whereas code size is governed by available program memory and use of programming language. Goal of embedded system programming is to get maximum features in minimum space and minimum time.

Embedded systems are programmed using different type of languages:

- Machine Code
- Low level language, i.e., assembly
- High level language like C, C++, Java, Ada, etc.

- Application level language like Visual Basic, scripts, Access, etc.

Assembly language maps mnemonic words with the binary machine codes that the processor uses to code the instructions. Assembly language seems to be an obvious choice for programming embedded devices. However, use of assembly language is restricted to developing efficient codes in terms of size and speed. Also, assembly codes lead to higher software development costs and code portability is not there. Developing small codes are not much of a problem, but large programs/projects become increasingly difficult to manage in assembly language. Finding good assembly programmers has also become difficult nowadays. Hence high level languages are preferred for embedded systems programming.

Use of C in embedded systems is driven by following advantages

- It is small and reasonably simpler to learn, understand, program and debug.
- C Compilers are available for almost all embedded devices in use today, and there is a large pool of experienced C programmers.
- Unlike assembly, C has advantage of processor-independence and is not specific to any particular microprocessor/ microcontroller or any system. This makes it convenient for a user to develop programs that can run on most of the systems.
- As C combines functionality of assembly language and features of high level languages, C is treated as a ‘middle-level computer language’ or ‘high level assembly language’
- It is fairly efficient
- It supports access to I/O and provides ease of management of large embedded projects.

Many of these advantages are offered by other languages also, but what sets C apart from others like Pascal, FORTRAN, etc. is the fact that it is a middle level language; it provides direct hardware control without sacrificing benefits of high level languages.

Compared to other high level languages, C offers more flexibility because C is relatively small, structured language; it supports low-level bit-wise data manipulation.

Compared to assembly language, C Code written is more reliable and scalable, more portable between different platforms (with some changes). Moreover, programs developed in C are much easier to understand, maintain and debug. Also, as they can be developed more quickly, codes written in C offers better productivity. C is based on the philosophy 'programmers know what they are doing'; only the intentions are to be stated explicitly. It is easier to write good code in C & convert it to an efficient assembly code (using high quality compilers) rather than writing an efficient code in assembly itself. Benefits of assembly language programming over C are negligible when we compare the ease with which C programs are developed by programmers.

Objected oriented language, C++ is not apt for developing efficient programs in resource constrained environments like embedded devices. Virtual functions & exception handling of C++ are some specific features that are not efficient in terms of space and speed in embedded systems. Sometimes C++ is used only with very few features, very much as C.

Ada, also an object-oriented language, is different than C++. Originally designed by the U.S. DOD, it didn't gain popularity despite being accepted as an international standard twice (Ada83 and Ada95). However, Ada language has many features that would simplify embedded software development.

Java is another language used for embedded systems programming. It primarily finds usage in high-end mobile phones as it offers portability across systems and is also useful for browsing applications. Java programs require Java Virtual Machine (JVM), which consume lot of resources. Hence it is not used for smaller embedded devices.

Dynamic C and B# are some proprietary languages which are also being used in embedded applications.

Efficient embedded C programs must be kept small and efficient; they must be optimized for code speed and code size. Good understanding of processor architecture embedded C programming and debugging tools facilitate this.

7.3 Source Code

Here's the beautified version of the code you provided:

```c
#include <pic.h>

#define _XTAL_FREQ 4000000

// Function Declarations
void adc0();
void serial_init();
void serout(unsigned char);
void serconout(const unsigned char , unsigned char);
void gsm_init();
void mes_num1();
void delay(unsigned int);
void interrupt rcc(void);
void lcd_init();
void command(unsigned char);
void lcd_disp(unsigned char);
void write(unsigned char);
void lcd_condis(const unsigned char , unsigned int);
void hex_dec(unsigned char);
void dis_delay();
void msg_read();

// Variable Declarations
```

```
unsigned char k, v1, v2, v3, rc, d[80], COUNTER1 = 0, GG = 0, cu, FFF = 0, tee = 0;
unsigned char iii, vvv[95], n, m, e, y = 0, ss = 0, PP = 0, s = 0;
unsigned int temp1;
bit gfg = 0;

// Bit Declarations
static bit ON @ ((unsigned) &PORTB  8 + 0);
static bit OFF @ ((unsigned) &PORTB  8 + 1);
static bit M @ ((unsigned) &PORTC  8 + 0);
static bit pump @ ((unsigned) &PORTB  8 + 3);
static bit key @ ((unsigned) &PORTC  8 + 2);
static bit rs @ ((unsigned) &PORTC  8 + 5);
static bit en @ ((unsigned) &PORTC  8 + 4);

// Main Function
void main() {
   __CONFIG(0X2F02);
   TRISC = 0XC5;
   ADCON1 = 0X00;
   TRISA = 0XFF;
   TRISB = 0X00;

   pump = 0;
   ON = 1;

   lcd_init();
   command(0x80);
   lcd_condis("   W/L CONTROL  ", 16);
   command(0xc0);
   lcd_condis("RAIN MONRING SYS", 16);
   delay(65000);
   delay(65000);
   delay(65000);

   serial_init();
   command(0xc0);
   lcd_condis("GSM INITIALIZE..", 16);
   __delay_ms(25000);
```

```
gsm_init();

while (1) {
   CREN = 1;
   iii = 1;
   dis_delay();

   for (n = 0; n <= 85; n++) {
      if (vvv[n] == '+' && vvv[n + 1] == 'C' && vvv[n + 2] == 'M' && vvv[n +
3] == 'T' && vvv[n + 4] == 'I' && vvv[n + 5] == ':') {
         msg_read();
      }

      command(0xc0);
      lcd_condis("RAIN MONRING SYS", 16);
      adc0();
      command(0x82);
      hex_dec(v1);

      delay(20000);
      command(0x80);
      lcd_condis("S:              ", 16);
      command(0xc0);
      lcd_condis("RAIN MONRING SYS", 16);

      if (v1 < 50 && GG == 0) {
         ON = 0;
         command(0x80);
         lcd_condis(" RAIN DETECTED  ", 16);
         command(0xc0);
         lcd_condis("MOTOR TURN ON...", 16);
         delay(65000);
         delay(65000);
         delay(65000);
         command(0x01);
         command(0xc0);
         lcd_condis("MSG SENDING.....", 16);
         dis_delay();
         mes_num1();
```

```
            serconout("RAIN DETECTED SYSTEM COVERED THE CLATH ",
63);
            serout(0x1a);
            delay(65000);
            delay(65000);
            delay(65535);
            delay(65535);
            delay(65535);
            command(0xc0);
            lcd_condis("RAIN MONRING SYS", 16);
            GG = 1;
         } else if (v1 > 50 && GG == 1) {
            ON = 1;
            command(0x80);
            lcd_condis(" NO RAIN DETECTED", 16);
            command(0xc0);
            lcd_condis("MOTOR TURN OFF..", 16);
            delay(65000);
            delay(65000);
            delay(65000);
            command(0x01);
            command(0xc0);
            lcd_condis("MSG SENDING.....", 16);
            dis_delay();
            mes_num1();
            serconout("NO RAIN DETECTED SYSTEM COVER OPENED", 63);
            serout(0x1a);
            delay(65000);
            delay(65000);
            delay(65535);
            delay(65535);
            delay(65535);
            command(0xc0);
            lcd_condis("RAIN MONRING SYS", 16);
            GG = 0;
         }
      }
   }
}
```

```
// ADC Read Function
void adc0() {
    temp1 = 0;
    for (k = 0; k < 10; k++) {
        ADCON0 = 0X00;
        ADON = 1;
        delay(55);
        ADCON0 = 0X05;
        while (ADCON0 != 0X01);
        v1 = ADRESH;
        temp1 = temp1 + v1;
    }
    v1 = temp1 / 10;
    delay(2000);
}

// Serial Initialization Function
void serial_init() {
    GIE = PEIE = 1;
    SPBRG = 25;
    BRGH = 1;
    SYNC = 0;
    SPEN = 1;
    CREN = 0;
    RCIE = 1;
    TXEN = 1;
}

// GSM Initialization Function
void gsm_init(void) {
    serconout("AT+CMGF=1", 9);
    __delay_us(1000);
    serout(0x0d);
    __delay_ms(3000);

    serconout("AT+CPMS=", 8);
    serout("");
    serout('S');
```

```
    serout('M');
    serout('"');
    serout(0x0d);
    __delay_ms(1000);

    serconout("AT+CLIP=1", 9);
    serout(0x0d);
    __delay_ms(3000);

    command(0xc0);
    lcd_condis("  Msg. sending  ", 16);
    __delay_ms(1);

    mes_num1();
    __delay_us(65);

    serconout("UR SYS IS READY TO USE", 22);
    serout(' ');
    serout(0x

0d);
    serout(0x0d);
    serout(0x1a);
    delay(13000);

    command(0xc0);
    lcd_condis("UR SYS IS READY ", 16);
    __delay_ms(5000);
}

// Delay Function
void delay(unsigned int del) {
    while (del--);
}

// Interrupt Function
void interrupt rcc(void) {
    if (RCIF == 1) {
        RCIF = 0;
```

```
        vvv[iii] = RCREG;
        if (iii < 95) iii++;
        else iii = 0;
    }
}

// LCD Initialization Function
void lcd_init() {
    TRISD = 0;
    command(0x38);
    command(0x06);
    command(0x0c);
    command(0x01);
}

// LCD Command Function
void command(unsigned char com) {
    PORTD = com;
    en = 1;
    rs = 0;
    delay(125);
    en = 0;
    delay(125);
}

// LCD Display Function
void lcd_disp(unsigned char lr) {
    PORTD = lr;
    en = 1;
    rs = 1;
    delay(125);
    en = 0;
    delay(125);
}

// LCD Write Function
void write(unsigned char lr) {
    PORTD = lr;
    en = 1;
```

```
    rs = 1;
    delay(125);
    en = 0;
    delay(125);
}

// LCD Condition Display Function
void lcd_condis(const unsigned char word, unsigned int n) {
    unsigned char i;
    for (i = 0; i < n; i++) {
        lcd_disp(word[i]);
    }
}

// Hexadecimal to Decimal Conversion Function
void hex_dec(unsigned char val) {
    write(val % 1000 / 100 + 0x30);
    write(val % 100 / 10 + 0x30);
    write(val % 10 + 0x30);
}

// Display Delay Function
void dis_delay() {
    delay(65000);
    delay(65000);
    delay(65000);
    delay(65000);
    delay(65000);
    delay(65000);
}

// Message Sending Function
void mes_num1() {
    serconout("AT+CMGS=", 8);
    serout("");
    serconout("9865106810", 10);
    serout("");
    serout(0x0d);
    delay(65000);}
```

CHAPTER 8

RESULT AND OUTPUT

The results and output of the proposed project, which incorporates an automated rain cover system for outdoor clothes drying, include:

1. System Activation: When rain is detected by the rain sensor, the PIC16f877a microcontroller processes the input and triggers the motor to deploy the tarp cover.

2. Tarp Cover Deployment: The 60 RPM 12-volt DC motor, coupled with a gear setup, facilitates the smooth deployment of the tarp cover made from leather material. The gear setup ensures precise and controlled movement of the cover. The tarp frame moves upto 270 degree.

3. Protection Against Rain: Once deployed, the tarp cover effectively shields the drying area from rain, preventing clothes from getting wet.

4. Notification to User: Upon rain detection and tarp cover deployment, the GSM module integrated with the Arduino Uno sends a notification to the user via SMS. The notification alerts the user about the rain and the activation of the rain cover system.

5. User Interaction: The user receives the SMS notification on their mobile device, informing them of the rain and the protective action taken by the system. Additionally, the user can remotely monitor the system's status and manually control its operation via SMS commands.

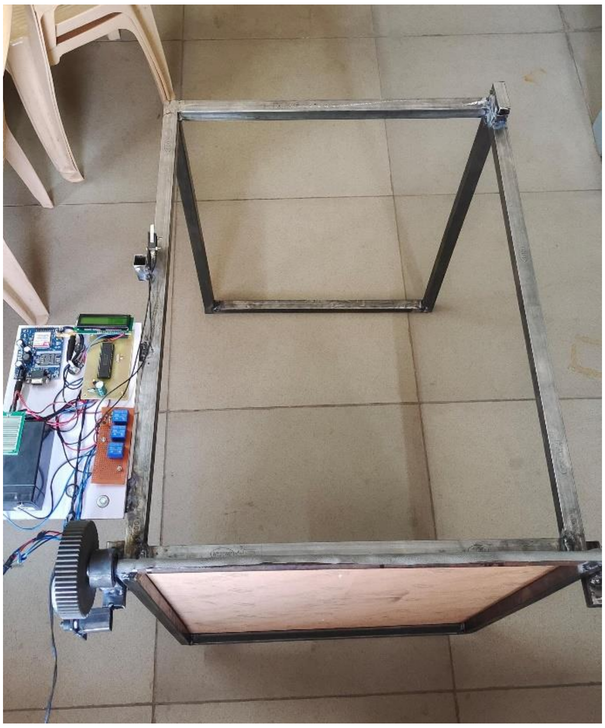

Fig 8.1 System Setup

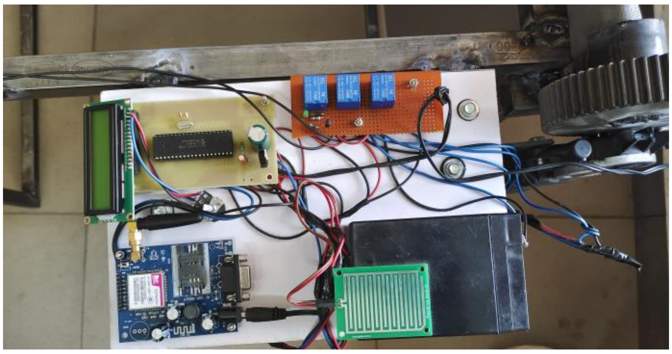

Fig 8.2 Component Setup

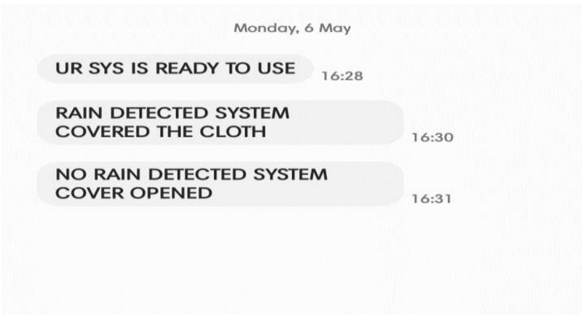

Fig 8.3 Mobile Notification

CHAPTER 9

CONCLUSION

In summary, the development and execution of the automated rain cover system for outdoor clothes drying have been successfully achieved. The project effectively met its objectives, demonstrating a robust system that safeguards clothes from rain while providing user convenience and control. Throughout the project, a variety of components were integrated, including the Arduino Uno microcontroller, rain sensor, DC motor, gear setup, and GSM module. The Arduino Uno functioned as the central control hub, orchestrating system operations based on inputs from the rain sensor and user directives. The rain sensor proved adept at detecting rainfall, prompting the deployment of the leather material tarp cover. This was made possible by the 60 RPM 12-volt DC motor and gear arrangement, ensuring smooth and controlled cover movement for comprehensive rain protection. A notable achievement was the inclusion of remote monitoring and notification features through the GSM module. Users received timely SMS alerts upon rain detection and system activation, enabling swift response to ensure laundry safety. In conclusion, the automated rain cover system provides a practical and effective solution to the rain's adverse effects on outdoor clothes drying. It enhances user convenience, mitigates moisture damage risks, and promotes sustainable laundry practices by reducing reliance on indoor drying methods. Looking ahead, potential system enhancements may involve integrating additional environmental sensors, refining motor control algorithms for enhanced performance, and developing a user-friendly mobile application for seamless remote system management. Ultimately, the automated rain cover system marks a significant advancement in outdoor clothes drying technology, offering a reliable and user-centric solution to counter rain-related challenges effectively.

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in the " 6th International Conference on Emerging Trends in Engineering and Technology (ICETET 2024) " Conducted by St. Joseph College of Engineering, Chennai, Tamil Nadu, on 17.04.2024 and 18.04.2024.

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