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ಬೆಳಗಾವಿ, ಕರ್ನಾಟಕ

A Mini Project Report on

"AUTOMATIC RAINWATER SENSING UMBRELLA"

Submitted to Visvesvaraya Technological University in partial fulfillment ofthe requirement for the award of Bachelor of Engineering degree in Electronics & Communication Engineering.

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Towards the partial fulfillment of the requirement for the award of the Bachelor Degree in Electronics & Communication Engineering as per the University regulations. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated and it satisfies the academic requirement in respect of Mini Project (21ECMP67) prescribed.

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ABSTRACT

An automatic sensor-based umbrella designed to address the challenges posed by various weather conditions, including rain, summer heat, snowfall, and dense fog. Unlike traditional umbrellas, this advanced design aims not only to protect clothing, street produce, and fruits but also to potentially save lives in critical situations. Central to the concept is the integration of Arduino programming, which enables the umbrella to open and close automatically based on environmental cues.

The work presents a sophisticated smart rain sensing system capable of detecting precipitation and initiating the deployment of the umbrella's link support. Additionally, a raindrop sensing mechanism has been incorporated into this smart system, providing real-time readings that correlate with the intensity of rainfall. This feature enhances the umbrella's adaptability and responsiveness to changing weather conditions. The aim of the smart system is comprised of a rack and pinion mechanism. Here, the rack is securely fixed to the umbrella, and when the rain sensor detects an exceeding value of raindrops, it sends a signal to the pinion connected to a motor. Subsequently, the motor engages and begins rotating, prompting the umbrella to open automatically. This integration of advanced sensor technology and programmable mechanisms offers a multifaceted solution to weather-related challenges. By leveraging Arduino programming, the umbrella becomes a dynamic and versatile tool capable of enhancing both convenience and safety for users. Whether shielding clothing, perishable goods, or even human lives, this automatic sensor-based umbrella represents a significant advancement in weather protection technology.

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Chapter 1

PREAMBLE

1.1 Introduction

During the monsoon season, unexpected rain showers cause significant inconvenience, particularly for open-air sellers like street vegetable vendors who need to protect their produce and customers. Traditional solutions, such as tarpaulins, often fail during heavy rains and thunderstorms. To address these issues, we propose an automatic rain-sensing umbrella system. This smart system detects rain and automatically deploys an umbrella, providing timely protection without manual intervention. It features a rainwater sensor that detects rainfall intensity and activates the umbrella's opening mechanism when rain exceeds a predefined threshold.

The system uses a rack and pinion mechanism driven by a DC gear motor. The rain sensor signals the motor to move the rack and open the umbrella. Infrared (IR) sensors ensure precise control by detecting the fully opened and closed positions of the umbrella, preventing over-extension. This automatic rain-sensing umbrella system is designed to offer a hands-free, efficient solution for protecting goods, people, and spaces from rain. It is particularly beneficial for street vendors, open-air market stalls, and other outdoor setups where quick and reliable protection from rain is essential. By automating the process of opening and closing the umbrella, the system enhances user convenience and provides a practical approach to managing rain-related challenges during the monsoon season.

1.2 Literature survey

An automated umbrella means that it works flawlessly. In 1928, Hans Hauptinvented the pocket umbrella. In Vienna, Hans Haupt was a student studying sculpture when she developed a prototype for an improved compact foldable umbrella for which she received a patent in September 1929. The umbrella was made by an Austrian company. In Germany, the small foldable umbrellas were made by the company Knirps.At the US University of central Florida students worked on automated umbrella. They designed an automated umbrella that worked with the help of a control system. The

umbrella canopies of the year 1600's were woven out of silk, which provided limited water resistance when compared to today' s rain umbrellas, but the distinct canopy shape was unchanged from the earliest documented designs., even rain umbrellas were still considered a product only for distinguished women, while men facing ridicule if they were seen with one. Hanway came up and took the rain umbrella on the streets of London in year 1750. Infect, in the late year 1700's and early year 1800's, a "Hanway" evolved to become another name for a rain umbrella[1] [2].

Through the year 1800's until the present time, the materials used to make rain umbrellas have evolved, but the same basic canopy shape remains. One of the most important discoveries came in the early year 1850s, when Samuel Fox took the idea of using "U" molded metal rods on the ribs and stretcher to make a simple, stronger frame. Previously, English umbrellas were made of cane or whalebones. Modern umbrellas are made by a hand-assembled process that, with the exception of a few sensitive areas, can be made by skilled workers. First, a shaft - whether of wood, metal, or fiberglass - is made, and the ribs and tails are attached. Next, the nylon canopy is hand-stitched in sections. They were large and unpopular. Ribs and stretchers are often seen only today on parasols and patio umbrellas. Advances in metal technology have made round metal ribs and holes easily accessible, but some manufacturers are producing umbrellas with these features. Current rain umbrellas are made of fabrics (nylon, most commonly) that are resistant to rain that draws, dries quickly, folds easily, and is available in a variety of colors and designs. Whalebones have been replaced with wood, then steel, aluminum and now fiberglass to manufacture the shaft and ribs, and now-a-days nylon fabrics have replaced silks, leaves and feathers as a more weatherproof option [3].

A sensor is a device that receives information from a physical quantity or other disturbances in the environment and transforms it into another quantity, usually electrical, that can be quantified and manipulated. It consists of three main components: (1) the sensitive area contains the sensor system based on a given technology, (2) the processing circuitry converts the physical variable into an electrical variable, and (3) the signal output contains electronics that are connected to a control system [4].

Two-dimensional (2D) soft materials, especially in their self-supported forms, demonstrate attractive properties to realize biomimetic morphing and ultrasensitive sensing. Although extensive efforts on design of self-supported functional membranes and integrated systems have been devoted, there still remains an unexplored regime of the combination of mechanical, electrical and surface wetting properties for specific functions. Here, we report a self-supported film featured with elastic, thin, conductive and super hydrophobic characteristics. Through a well-defined surface modification strategy, the surface wettability and mechanical sensing can be effectively balanced. The resulted film can function as a smart umbrella to achieve real-time simulated raining with diverse frequencies and intensity. In addition, the integrated umbrella can even response sensitively to the sunlight and demonstrate a positively correlation of current signals with the intensity of sun illumination [5].

The literature survey on automatic umbrellas traces their evolution from Hans Haupt's invention of the pocket umbrella in 1928 to modern designs using advanced materials and technology. Early umbrellas, primarily for distinguished individuals, used limited water-resistant materials like silk and whalebone. Over the years, the materials evolved to more durable options like nylon and fiberglass. Modern automatic umbrellas incorporate sensor technology to convert environmental data into electrical signals for control, and recent advancements include the use of two-dimensional (2D) materials to enhance their functionality. The survey highlights the progression from traditional to high-tech designs, showcasing significant improvements in durability, functionality, and user convenience.

1.3 Problem Statement

During the monsoon season, open shops, neighbors drying clothes outside, and many similar situations can cause inconveniences in our lives. For street vegetable sellers, it is essential to protect their vegetables, fruits, and customers from the rain. Even tarpaulins often fail during torrential rains accompanied by thunderstorms. To overcome such problems and help us manage these inconveniences, this auto rain-sensing umbrella smart system provides an effective solution. This smart system detects rain and automatically opens an umbrella, offering timely protection without the need for manual intervention.

1.3 Aim of the project

The aim is to design an Automatic Rainwater Sensing Umbrella.

1.4 Objectives

The following are the objectives of this project:

1. To accurately detect the presence of rain to ensure timely response.
2. To enable automatic opening and closing of the umbrella without manual intervention.
3. To detect the position of fully opened and fully closed umbrella.

1.5 Methodology

1. The Methodology used to carry out this project are as follows:
2. The rainwater sensor is used to detect the presence of raindrops.
3. To enable automatic opening and closing of umbrella, rack and pinion mechanism is used.
4. To detect the position of fully opened and fully closed umbrella, ir sensors are used.

1.5 Scope of the project

This project aims to enhance the convenience and efficiency of managing rain protection for open shops, street vendors, and similar scenarios during the monsoon season. By developing an automatic rain-sensing umbrella system, the project addresses common issues such as the need for manual intervention during unexpected rains and the inadequacy of traditional tarpaulins in severe weather. The smart system's ability to detect rain and autonomously operate an umbrella ensures continuous protection for goods and individuals, minimizing disruption and potential damage. This innovation is particularly beneficial for street vegetable sellers, providing a reliable solution to keep their produce and customers dry, ultimately improving their operational resilience and customer experience.

1.6 Limitations

Following are the limitations of Automatic Rainwater Sensing Umbrella:

1. Environmental Sensitivity: The system may not perform accurately in extremely windy conditions or heavy thunderstorms, potentially leading to malfunction or damage.
2. Power Dependency: The reliance on continuous power supply for the sensors, microcontroller, and motor could limit its effectiveness during power outages.
3. Maintenance Requirements: The mechanical and electronic components require regular maintenance to ensure reliability, which could be a challenge for some users.
4. Cost and Accessibility: The initial cost of setting up the system might be high, andthe technology may not be easily accessible or affordable for all intended users, such as small street vendors.

1.7 Organization of the report

The report is organized into four chapters. The Chapter 1 includes the Introduction aboutthe project with objectives and methodology. The Chapter 2 includes the Design and Implementation of the project which includes block diagram, Circuit description, Implementation and Hardware & Software description. The Chapter 3 includes the Results of the project. Lastly, the Chapter 4 includes the Conclusion and the future scope of the project.

Chapter 2

DESIGN AND IMPLEMENTATION

2.1 Introduction

An automated mechanism designed to control the rotation of a pinion using an Arduino Uno microcontroller and a rainwater sensor. The primary function of the system is to adjust the direction of the pinion's rotation based on the input from the sensor. By utilizinga motor driver and a DC motor, the Arduino Uno processes sensor data to determine whether the pinion should rotate clockwise or anticlockwise. This setup allows for real- time adjustments and automated responses to changes in sensor readings, providing an efficient and responsive control mechanism for applications requiring precise rotational movements**.** The system is built using a combination of hardware and software components to achieve seamless functionality. The hardware includes an Arduino microcontroller, which serves as the central control unit, a rainwater sensor to detect precipitation, a DC gear motor to drive the rack and pinion mechanism for opening and closing the umbrella, and infrared (IR) sensors to determine the fully opened and closed states of the umbrella. On the software side, the Arduino is programmed with a code thatprocesses the input from the rainwater sensor and IR sensors, and accordingly controls the motor's operation to ensure the umbrella opens and closes automatically in response to rain. This integration of hardware and software enables the system to provide an efficient, hands-free solution to rain protection.

2.2 Block Diagram

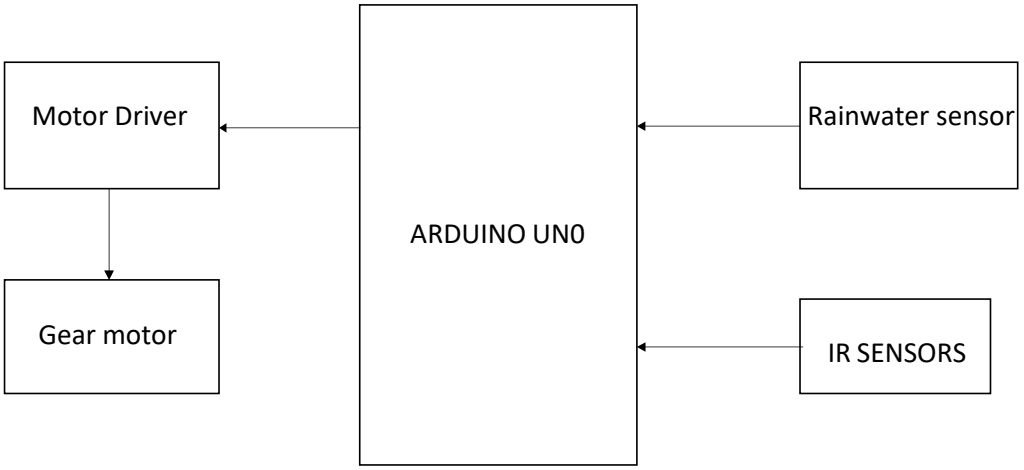

Figure 2.1: Block Diagram of Automatic Rainwater Sensing Umbrella

The block diagram of the Automatic Rainwater Sensing Umbrella as shown in Figure 2.1 depicts the key components and their interconnections. At the center is the Arduino Uno, which serves as the main control unit. It receives input signals from both the rainwater sensor and the IR sensors. Upon detecting rain, the Arduino processes the input from the rainwater sensor and sends a command to the motor driver. The motor driver then activates the gear motor, which controls the opening mechanism of the umbrella. The IR sensors provide additional environmental data to ensure optimal operation. This setup allows the umbrella to automatically open when it senses rain, enhancing user convenience and protection.

2.3 Circuit Description

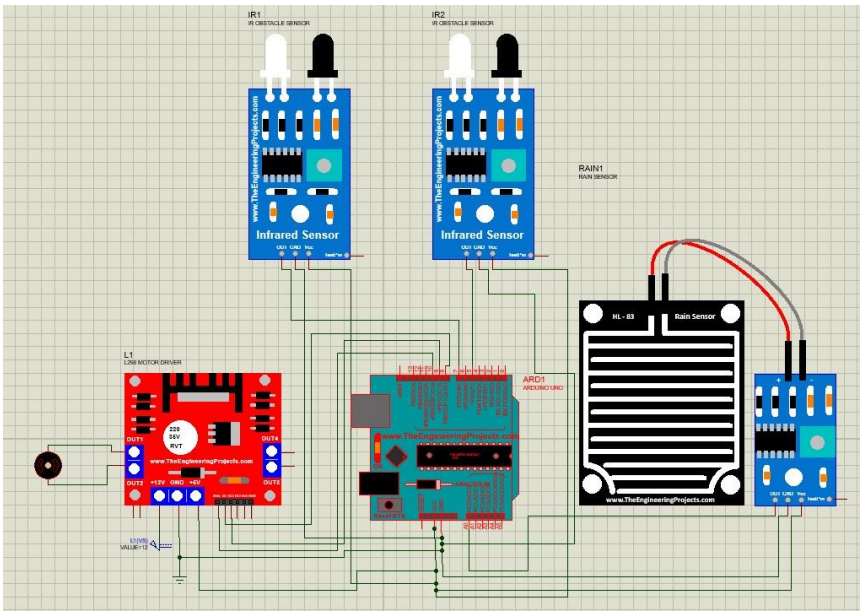

Figure 2.2: Circuit Diagram of Automatic Rainwater Sensing Umbrella

Following are the connections of Automatic Rainwater Sensing Umbrella Circuit diagram shown in Fig 2.2.

1. **Arduino to Rain Sensor:**

   A0 -> Rain Sensor OUT
   5V -> Rain Sensor VCC
   GND -> Rain Sensor GND

2. **Arduino to IR Sensors:**

   D5 -> IR Sensor (fully open) OUT
   5V -> IR Sensor (fully open) VCC
   GND -> IR Sensor (fully open) GND
   D7 -> IR Sensor (fully closed) OUT
   5V -> IR Sensor (fully closed) VCC
   GND -> IR Sensor (fully closed) GND

3. **Arduino to L298N Motor Driver:**

   D8 -> L298 IN1
   D9 -> L298 IN2

D10 -> L298 ENA

4. L298N to Motor:

OUT1 -> Motor Terminal 1

OUT2 -> Motor Terminal 2

5. Power Connections:

Arduino: Powered via USB or an external source.

L298: VCC to the external power source (e.g., 12V), GND to common ground.

The rain sensor provides an analog signal to the Arduino. A value less than 500 indicates rain, while a value greater than or equal to 500 indicates no rain. The Arduino reads this value through analog pin A0.

IR sensors detect whether the umbrella is fully open or closed by providing digital signals. The fully open sensor is connected to digital pin D5 and the fully closed sensor to pin D7. Based on the sensor readings, the Arduino controls the motor driver to open or close the umbrella. If it is raining and the umbrella is not fully open, the Arduino activates the motor to open the umbrella. If it is not raining and the umbrella is not fully closed, the Arduino activates the motor to close the umbrella. The motor is stopped when the umbrella is fully open or fully closed.

This automated umbrella system utilizes an Arduino to process inputs from a rain sensor and two IR sensors, controlling a motor driver (L298N) to open or close the umbrella. The system ensures the umbrella opens automatically when it rains and closes when it stops raining, providing convenience and protection without manual intervention.

2.4 Implementation

2.4.1 Flowchart

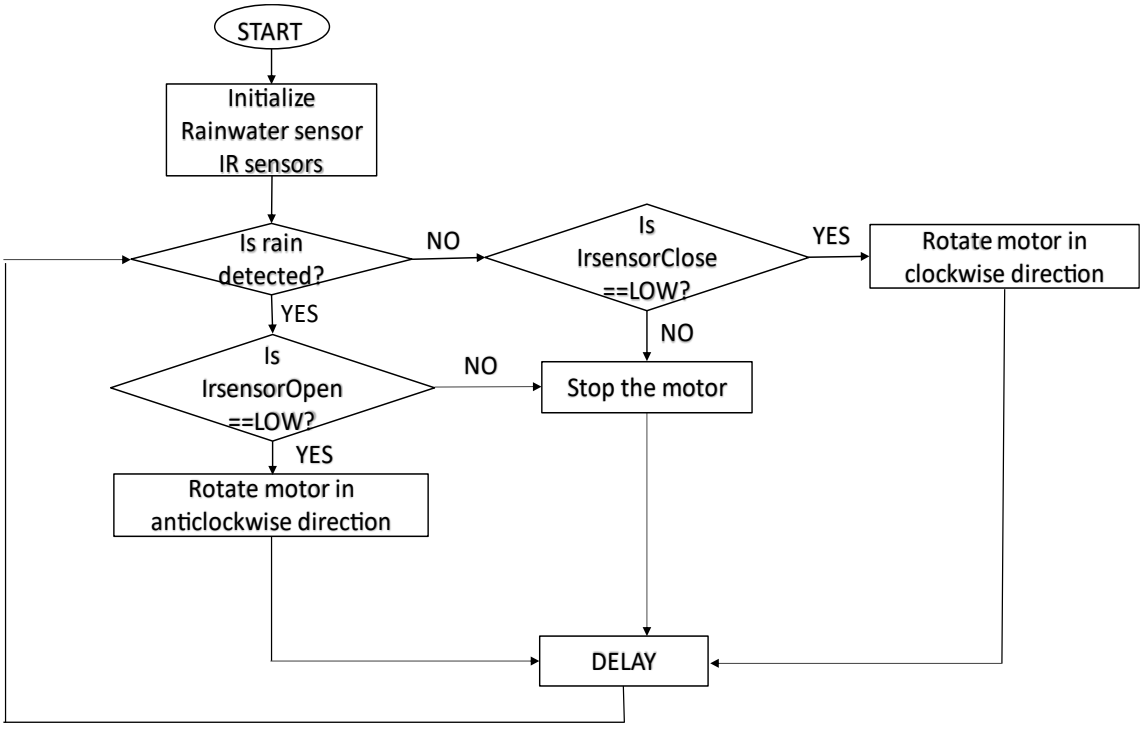

Figure 2.3: Flowchart of Automatic Rainwater Sensing Umbrella

The flowchart shown in Figure 2.3 begins with the initialization of the rainwater sensor and infrared (IR) sensors. Once initialized, the system checks if rain is detected. If rain is detected, it then checks the state of the "IsensorOpen" sensor. If the "IsensorOpen" sensor is low, indicating the umbrella is not opened; the system rotates the motor in an anticlockwise directionto open the umbrella. If the "IsensorOpen" sensor is not low, the system stops the motor. If the rain is not detected, it then checks the state of “IrsensorClose” sensor. If the “IrsensorClose” sensor is low, indicating the umbrella is not closed; the system rotates the motor in the clockwise rotation to close the umbrella. If the "IsensorClose" sensor is not low, the system stops the motor. A delay is then introduced before the system repeats the cycle, ensuring continuous monitoring and automatic control of the umbrella based on the presence or absence of rain.

2.5 Hardware Description

The hardware components used for this project are Arduino UNO, Rainwater sensor, Motor driver, Gear motor and Rack and pinion. The detailed description of these components is discussed in the following subsections.

2.5.1 Arduino UNO

Arduino Uno shown in Figure 2.4 is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. Table 2.1 contains the Arduino UNO hardware specifications.

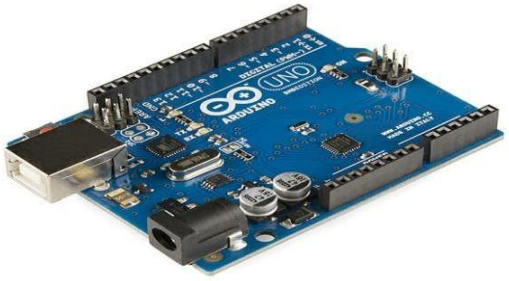

Figure 2.4: Arduino UNO

Table 2.1: Arduino UNO hardware specifications

Microcontroller	ATmega168
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328)
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

2.5.2 Rainwater sensor

A sensor that is used to notice the water drops or rainfall is known as a rain sensor and is depicted in Figure 2.5. This kind of sensor works like a switch. This sensor includes two parts like sensing pad and asensor module. Whenever rain falls on the surface of a sensing pad then the sensor modulereads the data from the sensor pad to process and convert it into an analog or digital output. So, the output generated by this sensor is analog (AO) and digital (DO).

Figure 2.5: Rainwater sensor

Working principle

The rain sensor working principle is pretty simple. The sensing pad includes a set of uncovered copper traces which mutually work like a variable resistor or a potentiometer.Here, the sensing pad resistance will be changed based on the amount of water falling onits surface. So, here the resistance is inversely related to the amount of water. When the water on the sensing pad is more, the conductivity is better & gives less resistance. Similarly, when the water on the surface pad is less, the conductivity is poor & gives highresistance. So, the output of this sensor mainly depends on the resistance.

Specifications

1. Operating voltage ranges from 3.3 to 5V
2. The operating current is 15 mA
3. The sensing pad size is 5cm x 4 cm with a nickel plate on one face.
4. Comparator chip is LM393
5. Output types are AO (Analog o/p voltage) & DO (Digital switching voltage)

2.5.3 Motor Driver

L298N motor driver shown in Figure 2.6 is a high voltage, high current dual full-bridge motor driver module for controlling DC motor and stepper motor. It can control both the speed and rotation direction of two DC motors. This module consists of an L298 dual-channel H-Bridge motor driver IC. This module uses two techniques for the control speed and rotation direction of the DC motors. These are PWM – For controlling the speed and H-Bridge –For controlling rotation direction. These modules can control two DC motor or one stepper motor at the same time. Table 2.2 contains the L298N module specifications and features.

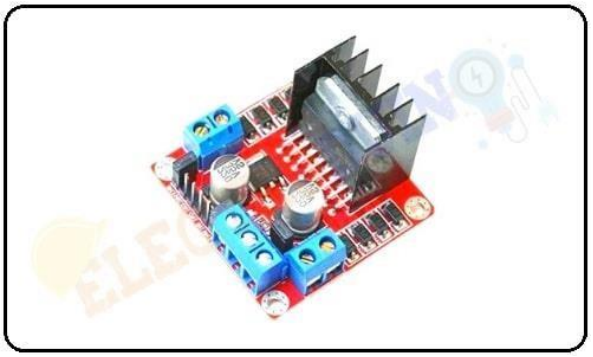

Figure 2.6: L298N Motor Driver

Table 2.2: L289N module specifications and features

Parameter	Value
Operating Voltage	5V – 46V
Operating Current	2A
Logic Voltage	5V
Logical Current	0-36mA
Maximum Power (W)	25W
Driver Chip	L298 dual-channel H-Bridge motor driver IC
LED lights indicators	Power-On LED indicator
Drives motor	Drives up to 4 motors (2 for each motor output terminal block) or One Stepper Motor
Module Dimensions	44 x 44 x 28 (LxWxH)mm

2.5.4 Gear Motor

A gear motor shown in Fig 2.7 is an integrated electric motor and gearbox unit designed to produce high torque at low speed, enabling more precise control over mechanical movement. The gearbox, composed of a series of gears, reduces the speed of the motor while increasing its torque. This combination is ideal for applications requiring both power and precision,such as robotics, conveyor systems, and various types of industrial machinery.

Figure 2.7: Gear motor

Specifications

1. RPM: 45.
2. Operating Voltage: 12V DC
3. Gearbox: Attached Plastic (spur)Gearbox
4. Shaft diameter: 6mm with internal hole
5. Torque: 4.2 kg-cm
6. No-load current = 60 mA (Max)
7. Load current = 300 mA (Max).

2.5.5 Rack and Pinion

A rack and pinion shown in Figure 2.8 are a type of linear actuator that comprises a circular gear (the pinion)engaging a linear gear (the rack), which operates to translate rotational motion into linearmotion. A rack and pinion drive can use both straight and helical gears. Driving the pinioninto rotation causes the rack to be driven linearly. Driving the rack linearly will cause thepinion to be driven into a rotation.

Figure 2.8: Rack and Pinion

Working mechanism

The rack and pinion mechanism consists of a pinion gear and a linear toothed bar (the rack). The pinion gear is attached to a motor or handle, which when rotated, moves the gear and the rack. As the gear turns, its teeth engage with the teeth on the rack and move it linearly. This linear motion is then used for steering, lifting, or other applications. Rackand pinion systems are designed with precision in mind, ensuring that the teeth on both the rack and the pinion gear are perfectly aligned. This alignment allows for smooth andefficient operation while reducing the wear and tear on the components. The rack and pinion system is commonly used in steering systems in automobiles, and in various machines that require linear motion control.

2.5.6 IR Sensor

The IR sensor or infrared sensor shown in Figure 2.9 is one kind of electronic component, used to detect specific characteristics in its surroundings through emitting or detecting IR radiation. These sensors can also be used to detect or measure the heat of a target and its motion. Inmany electronic devices, the IR sensor circuit is a very essential module. This kind of sensor is similar to human's visionary senses to detect obstacles.

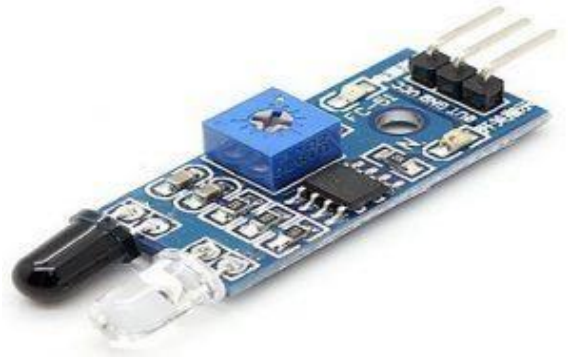

Figure 2.9: IR Sensor

An infrared sensor includes two parts namely the emitter & the receiver (transmitter & receiver), so this is jointly called an opt coupler or a photo-coupler. Here, IR LED is usedas an emitter whereas the IR photodiode is used as a receiver. The photodiode used in thisis very sensitive to the infrared light generated through an infrared LED. The resistance of photodiode & output voltage can be changed in proportion to the infrared light obtained. This is the fundamental IR sensor working principle.

The main specifications and features of the IR sensor module include the following.

1. The operating voltage is 5V DC
2. I/O pins – 3.3V & 5V
3. Mounting hole
4. The range is up to 20 centimeters
5. The supply current is 20mA
6. The range of sensing is adjustable
7. Fixed ambient light sensor

2.6 Software Description

The Software components used for this project are Arduino IDE. The detailed descriptionof these components is discussed in the following subsections.

Arduino IDE

1. Arduino IDE is open-source software, designed by Arduino.cc and mainly used for writing, compiling & uploading code to almost all Arduino Modules.
2. It is official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process.
3. It is available for all operating systems i.e. MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role in debugging, editing and compiling the code.
4. A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro and many more.
5. Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code.
6. The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board.
7. The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploadingthe code into the given Arduino Module.
8. This environment supports both C and C++ languages.

2.7 Summary

The project involves designing automatic rainwater sensing umbrella system using a combination of hardware and software. The block diagram outlines the overall system architecture, showcasing components such as the rainwater sensor, IR sensors, motor, and microcontroller. The circuit diagram provides detailed wiring instructions, connecting sensors and motor to the microcontroller. Implementation is guided by a flowchart, which ensures the umbrella opens and closes automatically based on rain detection. Key hardware components include rainwater sensors, IR sensors, a DC motor, and an Arduino microcontroller. The software description focuses on the Arduino IDE, where code is written and uploaded to the microcontroller to control sensor readings and motor operations, facilitating automatic opening and closing of umbrella.

Chapter 3

RESULTS AND DISCUSSIONS

3.1 Results Obtained

Fig 3.1: Initially closed Umbrella

In Fig 3.1, initially no rain is detected by the Rainwater sensor and the Ir sensor placed atthe bottom is detecting the bottom end of rack. So, the umbrella is in fully closed position.

Fig 3.2: Umbrella while opening

In Fig 3.2, As the Rainwater sensor detects the presence of rain and both IR sensors placedat top and bottom position of umbrella are detecting the presence of either ends

of the rack, the pinion attached with gear motor rotates anticlockwise making umbrella to open.

Fig 3.3: Fully opened umbrella

In Fig 3.3, the IR sensor placed at the top of the umbrella detects the presence of the topend of rack. So, the umbrella is in fully closed position.

Table 3.1: Operational states of Automatic Rainwater Sensing Umbrella

Rainwater sensor	IrSensor open	IrSensor close	Direction of pinion rotation	Status of Umbrella
Greater than Threshold	High	Low	No movement	Fully Opened
Greater than Threshold	Low	High	Anticlock-wise	Starts to Open
Less than Threshold	High	Low	Clock-wise	Starts to Close
Less than Threshold	Low	High	No movement	Fully Closed

The table 3.1 shows how the umbrella's motor responds to different sensor readings, either keeping the umbrella fully open, starting to open, starting to close, or fully closed, ensuring automatic and responsive operation based on weather conditions.

3.2 Summary

The results of the automatic rainwater sensing umbrella system are demonstrated throughimages and operational states tabulation. The images illustrate the umbrella in various states: fully closed, while opening, and fully opened. The tabulation outlines the operational states based on sensor readings, detailing conditions under which the umbrella remains fully opened, starts to open (anticlockwise motor rotation), starts to close(clockwise motor rotation), and remains fully closed. The results confirm that the systemeffectively responds to rain detection, ensuring the umbrella operates autonomously and adjusts its state based on the environmental conditions and sensor thresholds.

Chapter 4

CONCLUSION

4.1 Conclusion

The development of the automatic rainwater sensing umbrella has been a significant stepforward in enhancing user convenience and comfort during unpredictable weather conditions. By integrating sensors and automated mechanisms, this project successfully demonstrated a functional prototype capable of detecting rain and deploying the umbrellawithout human intervention.

1. **Innovation in Design:** The project showcased a novel design that integrates a rain sensorwith a mechanical system to automatically open and close the umbrella. This innovation reduces the need for manual operation and ensures users are protected from rain as soon as it starts.
2. **Technical Integration:** The project effectively combined various electronic components, including moisture sensors, microcontrollers, and motorized mechanisms. This integration highlights the potential of using simple electronic solutions to solve everydayproblems.
3. **User Convenience:** The automatic rainwater sensing umbrella offers a practical solution for users who need to carry items or operate in environments where manual operation ofan umbrella is inconvenient. This feature can be particularly useful for individuals with mobility challenges or those engaged in activities requiring both hands.
4. **Energy Efficiency:** The system was designed to be energy-efficient, utilizing low-power components and optimizing sensor activation to ensure prolonged battery life. This consideration is crucial for the practical deployment of the product.

4.2 Future scope

1. Durability and Weather Resistance: Enhancing the durability and weather resistance of the electronic components to ensure reliable operation in various environmental conditions.
2. Miniaturization: Further miniaturizing the electronic components to make the umbrella more lightweight and aesthetically pleasing.

3. User Interface: Developing a user-friendly interface for customizing settings and monitoring the umbrella's status through a smartphone application.
4. Market Research: Conducting market research to understand user preferences and potential commercial viability, including cost analysis and mass production considerations.

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APPENDIX

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IoT Based Smart Umbrella

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Abstract: ***Automatic sensor-based umbrella can be used during rainy, summer, snowfall and dense foggy seasons. It can be helpful not only to save the life of the cloth, street vegetables, fruits but in some situations also to save the human life. The idea is to design an umbrella that can be open and shut automatically with the help of NodeMCU programming. In present research work has come over with a smart rain sensing system that can detect the rain and opens up the umbrella's link support. A raindrop sensing system is adding in this smart system, which gives a reading proportional to the amount of rain pouring on it. The smart system consists of a rack and pinion system, the rack is fixed to an umbrella such that when a sensor senses the exceeding value of rain drops, it gives a signal to the pinion attached to a motor. Then the motor starts rotating and the umbrella opens.***

Keywords: NodeMCU, Arduino uno, Blynk

I. INTRODUCTION

Automatic sensor-based umbrella can be used during rainy, summer, snowfall and dense foggy seasons. It can be helpful not only to save the life of cloth, street vegetables, fruits but in some situations also to save the human life. The idea is to design an umbrella that can be open and shut automatically with the help of NodeMCU programming. In present research work has come over with a smart rain sensing system that can detect the rain and opens up the umbrella's link support. The smart umbrella not only blocks a rain but also provides a variety of services to customers. Existing smart umbrellas have various features such as giving an alarm for raining and a loss prevention. In this project, we propose new smart umbrella that guides the way to the destination on rainy days, collaborating with smartphone based on the IoT environment. It prevents accident which occurs due to operating the smartphone for navigating. Also, it provides a convenience to customer according to self navigating.

II. LITERATURE SURVEY

Smart Umbrella for Safety Directions on Internet of Things [1], In this paper, they proposed new smart umbrella that guides the way to the destination on rainy days, collaborating with smartphone based on the IoT environment. It prevents accident which occurs due to operating the smartphone for navigating. Also, it provides a convenience to customer according to self-navigating. Existing smart umbrellas have a variety of features such as weather alarm, loss prevention but they can't be a solution for safety problems. In this paper, to solve the safety problem, they proposed a smart navigation umbrella to guide a way intuitively through the interaction between the umbrella and the smartphone. A customer does not need to see the screen of smartphone finding and identifying a way. Proposed system attaches LED light to the end of the umbrella ribs pointing to direction and it informs the direction to customer. It not only reduces the problem that the customer has to see the screen of smartphone, but also provides a more convenient navigation service with safety. It has been developed based on the MinT (Middleware for Cooperative Interactions of Things) framework to interconnect with umbrella and smartphone. The smartphone application has navigator to guide way from the current location to destination, and it sends the direction information to umbrella. When the smart umbrella receives the direction information from smartphone, it displays the direction using the eight LEDs attached to umbrella ribs. It updates the direction periodically using three-axis electronic compass sensors. The calculated direction is used to control of LEDs indicating direction to go. The Bluetooth communication module advertises itself continuously to connect with smartphone at the same time as the power on. The smartphone application consists of the Bluetooth controller for communication with the umbrella, the GPS controller for directions feature and the user location information. If a customer starts to use the application, it tracks the customer's location by GPS. User can specify a destination through searching or selecting a certain position on the map. When the application validates a connection with the umbrella, it sends the direction information to the umbrella using Bluetooth communication. A Way to Beautify Future Smart Cities [2], This project was chosen to improve existing umbrellas because umbrella is one of the indispensable tools in human life. However, the function of traditional umbrella has been limited to "rain" or "shade". Regions of world having tropical weather condition facing rains usually after every 2 hours required umbrella as mandatory tool/ equipment. Here In this paper, they proposed new smart umbrella the need of future cities are now of smart umbrella which can open up by its own using sensory signal during rain on large opening spaces of cities such as car parking's, pedestrians outside buildings, restaurant and also for individual need with option of connectivity with Wi-Fi and also able to closed itself as rain goes down.

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DESIGN AND CALCULATIONS OF AN AUTOMATED UMBRELLA

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Abstract— **The aim of this thesis is to make a smart umbrella which can reduce human effort due to its functionality and can target the market due to its unique design, is really important in modern society at risk of rainfall and wind without coverage in place. The purpose of this project is to make such an umbrella that is really sensitive in the incidences of rain and sunlight at domestic and market level. Specifically, in summer season the floor of open areas gets so warm due to sun light that makes difficulty for working. This umbrella covers the entire hall during the rain and sunlight. This umbrella operates with the help of different sensors like temperature sensors, water sensors and wind sensors. The opening and closing of umbrella is being controlled through a motor. Motor can give a quick and instant response to the shaft so that shaft can play a major role of power transmission for opening and closing of umbrella. Motor provides required rpm to the shaft. Whenever temperature of the atmosphere goes above 35°, temperature sensor sends signal to Arduino which is control unit box. Then Arduino sends signal further to the motor so that motor may activate and deliver required rpm to the coupling shaft. This project is a cost-effective way of providing automated controlled shade from high intensity sunlight and rain. So, the problems of open and vast areas can be solved by using such types of automated umbrellas.**

Keywords— **Temperature sensors; Water Sensors; Wind Sensors; Shaft Arduino**

I. INTRODUCTION

An umbrella is a folding canopy (overhead roof) supported by metal or wooden ribs that is usually mounted on a wooden, metal or plastic pole. It is designed to protect a person against sunlight and rain. Umbrellas and parasols are primarily hand-held portable devices sized for personal use. The largest hand-portable umbrellas are golf umbrellas. Umbrellas can be divided into two categories: fully collapsible umbrellas, in which the metal pole supporting the canopy retracts, making the umbrella small enough to fit in a handbag, and non-collapsible umbrellas, in which the support pole cannot retract and only the canopy can be collapsed. In summer season temperature of the atmosphere rises to high level and it's not bear able. People are looking out for shady places because sun's temperature is so high. Temperature in summer days is normally above 35°C so there is need of a system which provide shadow. Generally, sun shading big umbrellas are used at beaches, swimming pools or in courtyards, a lot of coffee shops or restaurants also use sun-shading big umbrellas on tables and rain-shielding but also for providing a good mood of being in the surrounding. Therefore, the big umbrellas are quite practical. For such types of purposes, an automated umbrella is required which is equipped with modern technology.

The vision is to make a optimize structure which is of low cost that fulfills the need of the people working in open areas. The main function of an automated umbrella is protection from sunlight. This umbrella meets these needs by using multiple sensors and a set of DC motors to automatically track the sun to maximize shading where it is being used. DC motor is used for direct and Instant response of a current having single phase. The selection of DC motor depends upon torque. It operates whenever sun rises in morning, sensors detect light and activate the motors of umbrella which further drives the shaft to open and close the umbrella. Now a days these types of umbrellas are also be used for car parking.

The purpose of doing this is to feel comfortable while working in open areas and to make a design which is really reliable for domestic and industrial purposes.

II. LITERATURE REVIEW

An automated umbrella means that it works flawlessly. In 1928, Hans Haupt invented the pocket umbrella. In Vienna, Hans Haupt was a student studying sculpture when she developed a

Smart Umbrella: A Way to Beautify Future Smart Cities

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Abstract

The population of world increasing day by day and due to this the demand of urban cities also becoming high in smarter way as compare to it before. As we are living in 4th generation of industrial revolution which caters human need in smarter way. It branded by means of a combination of knowledges that is clouding the streaks amongst the somatic, arithmetical, and biotic compasses, communally denoted to as cyber-physical structures. Regions of world having tropical weather condition facing rains usually after every 2 hours required umbrella as mandatory tool/ equipment. The need of future cities are now of smart umbrella which can open up by its own using sensory signal during rain on large opening spaces of cities such as car parking's, pedestrians, outside buildings, restaurant and also for individual need with option of connectivity with Wi-Fi, USB and Music App.for enjoying rain along beautification factors for cities. In this research paper author suggests smart umbrella for smart future cities in terms of opening up itself using sensory signals at the time of rain over car parking, canopies, large open spaces and also able to closed itself as rain goes down. These phenomena also help in getting enough sunlight after rain which helps in evaporation process too. Not only technological aspect, aesthetic aspect will also be added by using specific themes, colors, patters with respect to demand of space which adds beautification of cities in terms of added values or created ambiance for specific purpose .Similarly author also going to suggest a smart umbrella for individuals with design patters, colors which help them to connect with Wi-Fi, USB, Music App easily so that it can able user to enjoy the rain.

Keywords: Smart Umbrella, Future Cities, Design

Introduction

Enlarged urbanization is sensation knowledgeable cutting-edge utmost of the emerging and industrialized capitals about the sphere. The rustic inhabitants in the sphere are nowadays nearby to

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Automatic Garden Umbrella Prototype with Light and Rain Sensor Based on Arduino Uno Microcontroller

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ABSTRACT

Park is a green open space widely used by the community to carry out various activities ranging from recreation, playing, sports, and other passive activities. Current weather conditions are often uncertain. This makes people inconvenient when it rains suddenly, especially when outdoors such as in parks. Because if they don't immediately take shelter when it rains, it can make the body sick, besides that, rainwater can damage the non-waterproof gadgets they carry. In other conditions, when the weather is bright, and the sun is shining hot, it can make people feel hot and lazy to do outdoor activities in the park. Therefore, an automatic umbrella tool was made that functions as a shelter in the garden. In this tool, there is a light sensor module and also a rain sensor, which is controlled with the Arduino Uno microcontroller as an input data processor and an L298N motor driver, which functions to regulate the speed and direction of the DC motor rotation (to the right and left) as an umbrella drive. When the motor rotates to the right, the umbrella will open, while when the motor rotates to the left, the umbrella will close again.

Keywords: Umbrella, Garden, DC Motor, LDR, Light and Rain Sensor, L298N, Arduino Uno

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I. INTRODUCTION

In recent times, the weather often changes erratically. This erratic changing weather can disrupt outdoor activities, especially in open spaces where there is little shelter, such as in parks. Even though it is very easy to get weather forecast information nowadays, sometimes people forget or even don't understand to see this information when they want to travel to do outdoor activities. So that makes them not aware of weather changes that will occur later. As a result, they do not bring umbrellas or raincoats, and when it rains or the sun is shining, it can interfere with ongoing outdoor activities.

Lack of facilities or places to take shelter in the park will make it difficult for people to find shelter. If they don't take shelter immediately when it rains, it will soak their whole body, and then it can damage the non-waterproof gadgets they carry. And if the condition of the body that is not fit is exposed to rain, it can result in falling sick or fever. If the weather is sunny, people will feel hot when the sun is shining hot, especially during the day.

In previous research, the Rain Sensor and LDR application are used for Automatic Car Lights to provide information to Arduino so that the lights on the car's front and rear will automatically turn on automatically [1]. Also, rain sensors and light sensors are used to make automatic drying tools based on Arduino Uno [2][3][6]. Therefore, the authors are interested in designing a similar sensor tool but applied it to make an automatic garden umbrella.

Based on the background described above, the problem identified is how to make a garden umbrella that can open and close automatically when the weather changes. The limitation of the issue discussed in this study is the design, manufacture, and testing of automatic garden umbrellas. This tool uses the Arduino Uno microcontroller to control the various components that are connected. The sensor functions as input, while the sensors used are rain sensors and light sensors (LDR-Light Dependent Resistor) [7] [9][10]. Motor Driver L298N as a regulator of speed and direction of DC motor rotation. Meanwhile, the use of a DC motor as an umbrella drive to open and close.

The objectives of this study are as follows to create a shelter for the general public when the weather is hot or when it rains, find out the operating system for the automatic garden umbrella based on Arduino Uno, and creating simple tools that can work automatically and have wide use in various levels of society.

II. METHOD

The research flow in the discussion of this paper refers to Figure 1. Before compiling a program on the Arduino Uno microcontroller, the first step that must be done is to collect a flowchart that will be used as a reference for the Arduino Uno microcontroller program to be made. In the beginning, the program initializes the system, declares the variables used, and activates

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CODE

```
// Define pins
const int rainSensorPin = A0; // Rain sensor data pin
const int motorIn1 = 8;       // Motor driver IN1
const int motorIn2 = 9;       // Motor driver IN2
const int motorEnable = 10;   // Motor driver ENA
 // IR sensor pin for fully open position
const int irsensorpinclose = 7;
const int irsensorpinopen =5; // IR sensor pin for fully closed position

void setup() {
  Serial.begin(9600); // Initialize serial communication
  // Set motor pins as outputs
  pinMode(motorIn1, OUTPUT);
  pinMode(motorIn2, OUTPUT);
  pinMode(motorEnable, OUTPUT);
  pinMode(irsensorpinopen, INPUT);
  pinMode(irsensorpinclose, INPUT);
  // Initially stop the motor
  digitalWrite(motorIn1, LOW);
  digitalWrite(motorIn2, LOW);
  analogWrite(motorEnable, 0);
}
  void loop() {
  // Read rain sensor value
  int rainValue = analogRead(rainSensorPin);
  Serial.print("Rain Sensor Value: ");
  Serial.println(rainValue);

  // If it's raining and not fully open, open the umbrella
 if (rainValue < 500 && (!digitalRead(irsensorpinopen)==LOW)) {
    digitalWrite(motorIn1, HIGH);
    digitalWrite(motorIn2, LOW);
    analogWrite(motorEnable, 255); // Full speed
  }
  // If it's not raining and not fully closed, close the umbrella
  else if (rainValue >= 500 && (!digitalRead(irsensorpinclose)==LOW)){
    digitalWrite(motorIn1, LOW);
    digitalWrite(motorIn2, HIGH);
     analogWrite(motorEnable, 255); // Full speed
  } else {
    // Stop the motor if fully open or fully closed
    digitalWrite(motorIn1, LOW);
    digitalWrite(motorIn2, LOW);
    analogWrite(motorEnable, LOW);
  }
  // Small delay to avoid too many serial prints
  delay(1000);
 }
```