A

Project

Reporton

"Design of Arduino based Seed Dryer System using Solar Energy"

Submitted to

Sant Gadge Baba Amravati University, Amravati

Submitted in partial fulfillment of the requirements for the Degree of Bachelor of Engineering in

Electrical (Electronics and Power) Engineering

Submitted by

Amogh Jaronde
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Under the Guidance of Mr. P. R. Dhabe
Electrical Department

Department of Electrical Engineering
Shri Sant Gajanan Maharaj College of Engineering,Shegaon – 444 203 (M.S.)

Session 2023-2024

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SHRI SANT GAJANAN MAHARAJ COLLEGE OF ENGINEERING,

SHEGAON – 444 203 (M.S.)

DEPARTMENT OF ELECTRICAL ENGINEERING

CERTIFICATE

This is to certify that **Mr. Amogh Jaronde, Mr. Prasad Deo, Mr. Pulkit Gaikee, Ms. Radhika Deshmukh, Mr. Shubham Changal and Ms. Vaishnavi Sushir** students of final year Bachelor of Engineering in the academic year 2023-24 of Electrical Engineering Department of this institute have completed the project work entitled "**Design of Arduino based Seed Dryer System using Solar Energy**" and submitted a satisfactory work in this report. Hence recommended for the partial fulfillment of degree of Bachelor of Engineering in Electrical (Electronics and Power) Engineering

Prof. P.R.Dhabe

Project Guide

Dr. S. R. Paraskar

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Internal Examiner	**External Examiner**
Name and Signature	**Name and Signature**
Date:	**Date:**

ACKNOWLEDGMENT

It is our utmost duty and desire to express gratitude to various peoplewho have rendered valuable guidance during our project work. We would have never succeeded in completing our task without the cooperation, encouragement, and help provided to us by then. Several people deserve recognition for their unwavering support and guidance throughout this report.

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Abstract

This project presents the design and development of a smart solar dryer using Arduino controller for the drying of agricultural products. The system uses solar power as the primary source of energy, making it cost-effective and environmentally friendly. An Arduino controller is used to automate the drying process, ensuring consistent and optimal drying conditions. Temperature and humidity sensors are used to monitor and control the drying process, ensuring that the products are dried to a high standard. The results of the research show that the smart solar dryer using Arduino controller is an efficient and effective solution for the drying of agricultural products, providing high-quality drying while reducing labor costs and increasing productivity. The system has several advantages over traditional drying methods, making it a promising solution for drying various products.

The process of evaporation of moisture content from the food grain drying is an important task for farmers to board their food grains. Drying the grains is a major part for storage of a grains for longer period or duration. since most of the harvested grains has a large moisture content, which is not ideal for storage we have to dry the grains. As India has abundant natural resources (Sun) for this process but it is time consuming, requires more ground area and labor. so in order to overcome these disadvantages we have designed an “solar powered grain dryer” system which takes less time for removing adequate moisture content from the grains and helps in better storage of grains.

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Chapter-1
INTRODUCTION

Introduction:

In numerous industries, including food processing, pharmaceuticals, and agriculture, where preserving and extending product shelf life is the main objective, drying is a crucial procedure. The drawbacks of traditional drying methods, such as intensive labor, inconsistent drying temperatures, and unsatisfactory outcomes, include mechanical drying, open-air drying, and solar drying. Therefore, more advanced and efficient drying techniques are critically needed to overcome these limitations.

An inventive and practical way to dry a variety of goods is with a smart solar dryer that uses Arduino. This system is economical and ecologically good since it uses solar energy as its main energy source. The drying process is automated by an Arduino controller, guaranteeing uniform and ideal drying condition. Temperature humidity sensors monitor and regulate drying process to ensure that goods have been carefully dried. Additionally, the system has a relay module and a fan for effective and quick drying.

This report describes the planning and construction of an Arduino-powered smart solar drier that dries agricultural goods. The goal is to increase productivity and decrease labor expenses while achieving high-quality drying. The system functions reliably and economically by utilizing automation and solar electricity, which makes it a desirable option for drying a range of goods. The paper's next sections will go into further detail about the parts and workings of the system.

In India, farmers encounter numerous challenges from pre-harvesting to post-harvesting stages. One such challenge is effectively drying grains post-harvesting to safeguard them against insects, birds, and moisture re-entry. Failure to properly dry grains can lead to significant losses for farmers, regardless of storage conditions. Technological advancements have brought about significant changes in our daily lives, including the agricultural sector, where innovations continue to address various challenges. Time constraints have consistently been a significant issue for farmers, leading to numerous post-harvesting problems. The proposed solution aims to alleviate the time constraints faced by farmers after harvesting.

The study report's objectives for the Arduino-powered smart solar dryer are as follows:

1. To construct an Arduino smart solar drier that may be utilized to dry agricultural goods.
2. To use an Arduino controller to automate the drying process, guaranteeing ideal and constant drying conditions.
3. To employ solar energy as the system's main energy source in an inexpensive and ecologically friendly way.
4. To use temperature and humidity sensors to monitor and regulate the drying process so that the items are dried to a high level.
5. To accomplish effective drying while cutting labor expenses and raising output

Chapter - 2
LITERATURE REVIEW

Literature Review:

A growing number of people are using solar drying, which is an effective and ecological way to dry agricultural products. Solar dryers have been the subject of numerous investigations, and the findings have demonstrated that they may produce excellent drying while using less energy and effort.

In one study, Singh and Tiwari (2007) created a solar dryer that uses natural convection to dry grapes. Temperature and humidity sensors were utilized to regulate the drying process in the system, which included a drying chamber and a solar collector. In comparison to sun drying, solar dryer shortened the drying period and enhanced the quality of the dry grapes, according to the results.

The development of solar dryers has recently seen a rise in the use of microcontrollers like Arduino. Easy to use and reasonably priced, Arduino microcontrollers offer a platform for monitoring and managing the drying process.

In one study, Srinivasan and Sangeetha (2016) used an Arduino to create a solar drier for drying mushrooms. The system employed a fan to facilitate effective drying and a temperature humidity sensor to monitor the drying process. Comparing the solar dryer to conventional drying methods, the results demonstrated a reduction in drying time and an improvement in product quality.

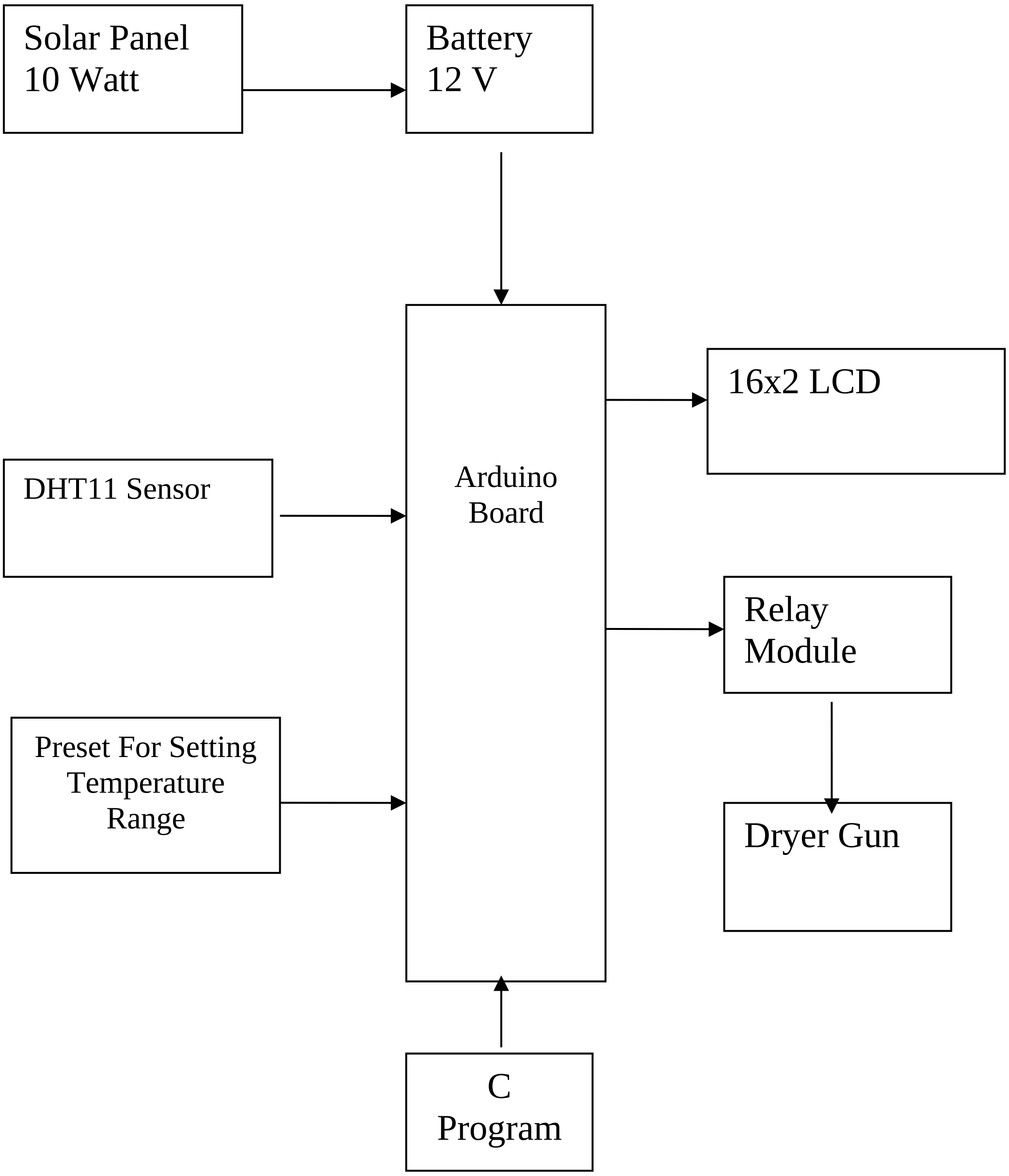
Overall, the analysis of the literature points to solar dryers as an effective and ecological way to dry agricultural products, especially ones that incorporate microcontrollers like Arduino. These solutions could lower labor costs, boost environmental sustainability, and enhance product quality.

Chapter - 3
COMPONENTS AND MECHANISM

1. Materials and Components:

- Arduino UNO Board
- Solar Panel 10 Watt
- 12v Rechargeable Battery
- DHT11Temperature and Humidity Sensor
- Hair Dryer Gun
- Voltage Regulators 7805
- Resistors
- Diodes
- LED
- Zero PCB
- 16x2 LCD
- Switches
- PB2 Connectors
- Preset 10k
- Heat Sink
- 12v male/female connectors
- Wires
- 12V Gear Motor 10RPM
- Mini Conveyer Belt
- Motor Clamps
- L293D Motor Driver Module
- 12V SPDT Relay

2. Block Diagram:



3. Components Description:

a) Solar Panel:

Fig 1: Solar Panel

A group of electrically connected solar photovoltaic modules is called a solar panel. An integrated, packed solar cell assembly is called a photovoltaic module. The solar panel can produce & deliver power for usage in home and commercial settings when it is a part of a larger photovoltaic system. Every module is always rated according to the DC output power under a typical test circumstances (e.g., 100–320 watts). The area of a module is determined by its efficiency.

Since the power output of a single solar module is limited, most installations consist of numerous modules. Generally speaking, a photovoltaic system consists of a panel or array of the solar modules, an inverter, occasionally connector cables, battery, and solar track.

Photovoltaic Principles:

As mentioned above, semi-conductors exhibit the best performance in solar light out of all the materials found in nature that exhibit the photovoltaic effect. There needs to be an electric field in order to force the higher energy free electrons produced when solar photons are absorbed in a semiconductor to flow out of semiconductor & perform useful work. In most solar cells, the electric field for the photo-interaction in a semi-conductor is provided by a junction of materials with disparate electrical characteristics.

b) Battery:

Fig 2: Battery

A solar dryer's battery is an essential part, particularly in off-grid or isolated locations with sporadic or limited connection to the electrical grid. The energy produced by the solar panel in the day-time is stored in the battery, which can then be utilized to run the dryer at night or at times when there is less sunlight.

c) Zero PCB:

Fig 3: Zero PCB

Zero PCB for general purpose. General purpose PCBs, as their name implies, are frequently used to incorporate circuits at random for hardware operation. Because of the copper coating on it, soldering can be done correctly and without creating a short circuit.

d) Resistors:

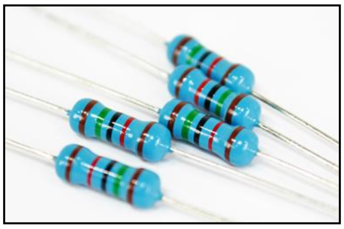


Fig 4: Resistor

Electrical resistance is implemented as a circuit element by resistor, passive 2 terminal electrical components. In addition to acting to lower voltage levels inside circuits, resistors can be employed to reduce current flow.

e) Voltage Regulators (7805):

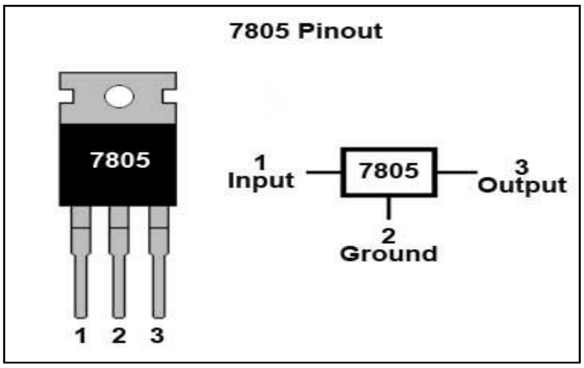


Fig 5: 7805 Voltage Regulator

The circuit's oscillations prevent any voltage source from producing a constant output. The voltage regulators are used to provide a continuous and stable output. Voltage regulators are the integrated circuits (ICs) that are used to regulate voltage. We are able to talk about IC 7805 here. The voltage regulator integrated circuit IC 7805 is a member of the 78xx series. Fixed linearity is present in this voltage regulator. The xx in 78xx indicates the fixed output voltage value supplied by this particular integrated circuit. It is a 7805 integrated circuit power supply that is regulated by +5V DC. This regulator IC additionally adds a heat sink option. Up to 35 V can be applied as an input voltage to this voltage regulator. The threshold limit of the IC is 35V, therefore for any input value less or equal to that level, the output voltage will always be 5V.

f) DHT11 Sensor:

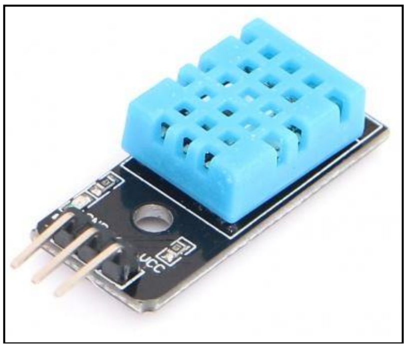


Fig 6: DHT11 Sensor

The DHT11 Temperature and Humidity Sensor combines the ability to measure temperature and humidity with a calibrated digital signal output. It has an 8-bit, very performant microprocessor built in. Its method ensures outstanding long-term dependability and stability. This sensor has a resistive element and a sensor for wet NTC temperature measurement devices. It works effectively and has exceptional quality, responsiveness, and anti-interference properties.

The humidity calibration chamber of each DHT11 sensor is calibrated with incredibly high accuracy. During the operation, signals are detected by internal sensors. These signals are referred to as the calibration coefficients, which are kept in the OTP program memory. It is integrated to provide a quick and easy single-wire serial interface method. The most demanding applications can be accommodated by its compact design, low power consumption, and signal transmission range of up to 20 meters. The item is a four-pin, single-row bundle. simple connection; user requirements can be taken into account to give bespoke packages.

Specifications:-

- Supply Voltage: +5 V
- Temperature range :0-60 °C error of ± 2 °C
- Humidity :20-90% RH ± 5% RH error
- Interface: Digital

g) 12V SPDT Relay:

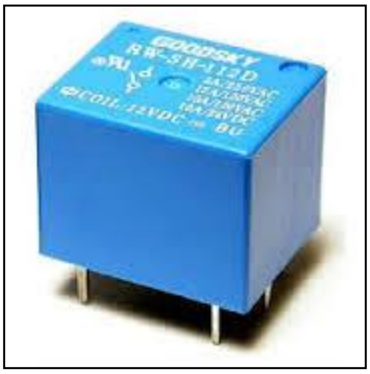


Fig 7: SPDT Relay

What is a relay?

We are aware that relays are essential to the efficient operation of the majority of high-end industrial application devices. Relays are basic switches that can be turned on and off physically or electrically. An electromagnet and a set of contacts make up a relay. The electromagnet facilitates the operation of the switching mechanism. Its operation is also based on additional operating principles. However, they vary depending on how they are used. Relays helps in the majority of the electronics devices.

Why is a relay used?

When a circuit can only be operated by a low-power signal, relays are typically used. In situations where a single signal may control several circuits, it is also utilized. The invention of telephones marked the first application for relays. They were essential in phone exchanges for call transfer. Long-distance telegraphy also made use of them. They were used to replace the original source of the signal with a new one. When computers were invented, they were also used to do logical operations such as Boolean logic. Electric motors and other high-power sources are required to power relays used in high-end applications. We refer to these relays as contactors.

Construction of Relay:

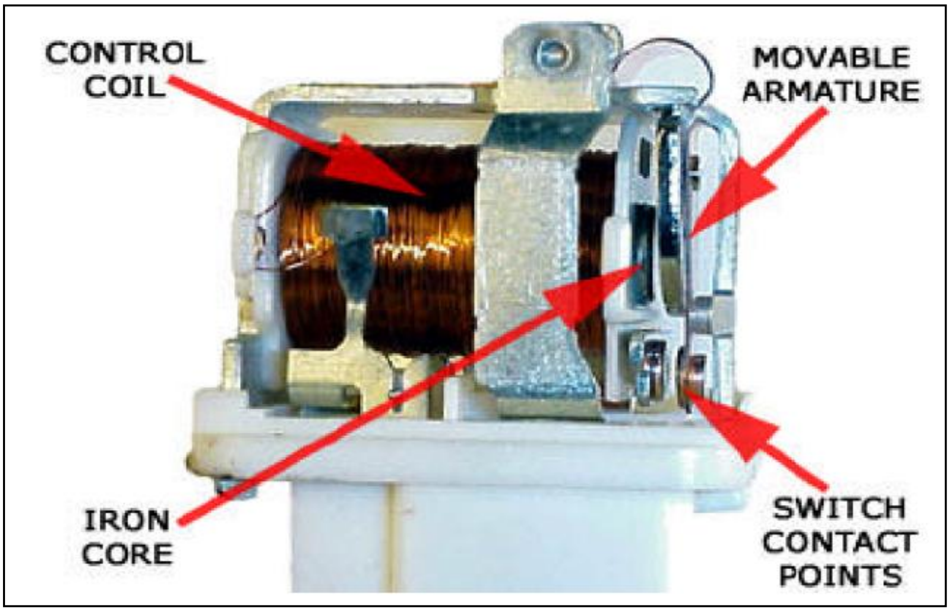


Fig 8: Construction of Relay

This is an iron core-enclosed wire coil electro-magnetic relay. Both the moveable armature and the switch point contacts have a route with extremely low resistance for the magnetic flux. The yoke, which is mechanically fastened to the switch point contacts, is connected to the moving armature. A spring provides a secure hold on these parts. When the relay de-energizes, the spring's job is to open a gap in the circuit.

How relay works?

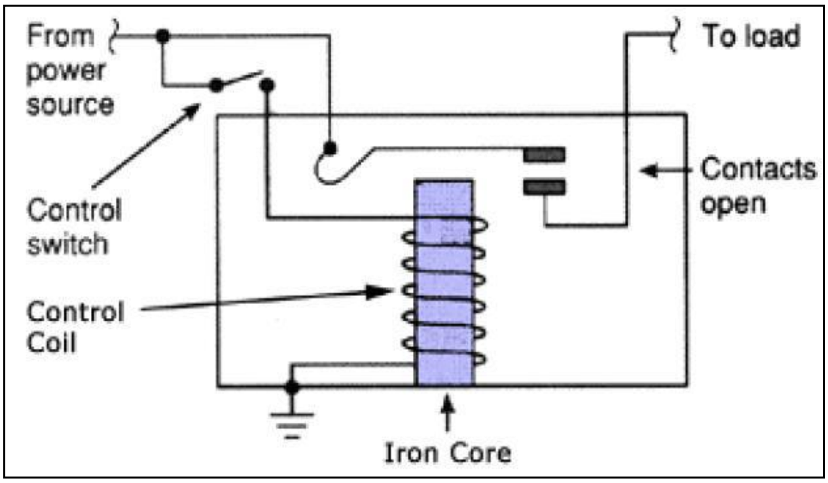


Fig 9: Relay Working

The illustration displays a relay's internal section schematic. A control coil encircles an iron core. As can be observed, the control switch & connectors that link to the load allow the electromagnet to accept electricity from the power source. As current flows through the control coil, the electromagnet energizes and intensifies the magnetic field. Thus, the upper contact arm and the lower, fixed arm start to draw near to one another, shutting the contacts & cutting down the load's power. On the other hand, the contacts could shift in the other direction and result in an open circuit if they had closed and if the relay already de-energized.

When the current through the coil is switched off, a force will bring the moving armature to its initial position. This force will be almost half that of the magnetic force. This force originates from two main places. They are the spring and gravity. There are two main uses for relays. There are two types of applications: high voltage and low voltage. For low voltage applications, reducing the circuit's overall noise will be given more priority. Their main function in high-voltage applications is to reduce arcing.

Relay Basics

The same principles are applied to all relays. Look closely at the 4-pin relay shown below. There are two colors visible. The color red represents the load circuit, and the color green represents the control circuit. A small control coil is connected to the control circuit. A switch is attached to the load. This switch is controlled by the coil of the control circuit. Now let's look at the several phases that make up a relay.

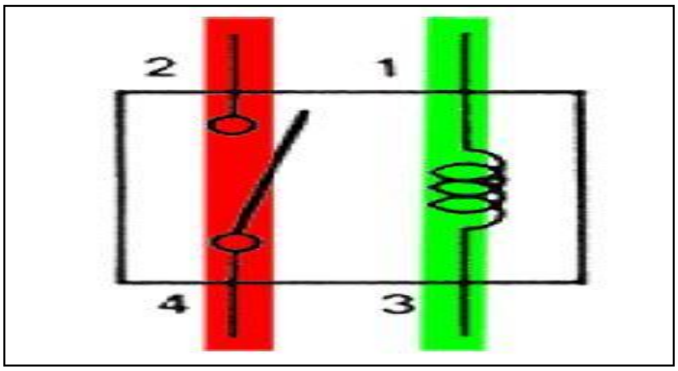


Fig 10: Relay Basics

Energized Relay (ON)

As can be observed in the circuit, the current flowing through the coils indicated by pins 1 and 3 creates a magnetic field. This magnetic field causes pins 2 and 4 to shut. The switch is therefore essential to the relay's functionality. Since it is a part of the load circuit, it is used to control the electrical system that is attached to it. Consequently, when a relay is energized, current will flow through pins 2 and 4.

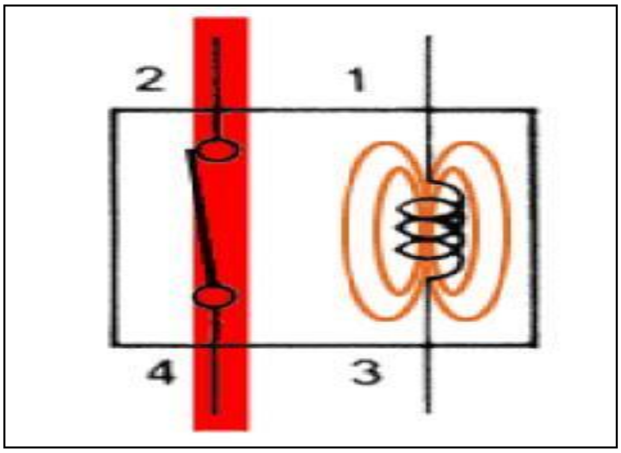


Fig 11: Relay ON

De-Energized Relays (OFF)

As soon as the current flowing across pins 1 and 3 ceases, a switch opens & an open circuit prevents the current flowing over pins 2 and 4. The power supply de-energizes and transitions to the off state as a result.

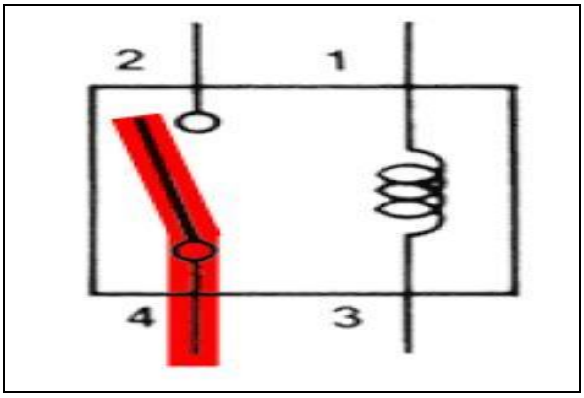


Fig 12: Relay OFF

Stated differently, a closed circuit is formed when a voltage is applied to pin 1, which in turn triggers the electromagnet and produces a magnetic field that shuts off pins 2 and 4. Without a voltage applied to pin 1, there will be no magnetic field or electromagnetic force. Consequently, the switches remain open. A 12-volts SPDT, a (single pole double throw) relays is what we're using for this project.

h) DC Gear Motor:

Fig 13: DC Gear Motor

A gear motor is a specific type of electrical motor designed to produce great torque at low engine speed with minimal horsepower. There are many uses for gear motors, and you may probably find them in a lot of household equipment. Electric alarm clocks, washing machine time control knobs, garage door openers, can openers, and even electric alarm clocks are ubiquitous gadgets that use gear motors. Hospital beds, shop jacks, cranes, and an endless number of other commercial applications are typical uses for gear motors.

Basic Principles of Operation:

An electric motor that runs on direct-current (DC) or alternating-current (AC) can be a gear motor. The majority of gear motors can produce 1,200 - 3,600 revolutions / minute (RPMs). Additionally, this motor types have 2 distinct speed specifications- the torque standards at stall speed and the normal speed. The main purpose of gear motors is to decrease the speed of a chain of gears, increasing torque in the process. This is achieved by attaching a gear box or integrated set of gears to a main motor shaft & rotor through a 2nd reduction shaft. Next, gearbox or set of gears is linked to the second shaft to produce what is referred to as a set of reduction gears. In general, the output of the last, or end, gear will be lower the longer the train of reduction gears. We are employing 10 RPM gear motors in this setup.

Gear Motors and Increased Force:

Commercial applications frequently use gear motors when piece of machinery have to be able to apply lot of effort in order to move the large object. These kinds of devices would include lift-jacks and cranes.

If you've ever watched a crane operate, you've witnessed a fantastic illustration of the operation of a gear motor. Very heavy objects can be lifted and moved with a crane, as you have undoubtedly observed. The majority of cranes employ gear motors, an electric motor type that increases torque or force by utilizing the fundamentals of speed reduction.

Specialty gear motors, which provide enormous torque at very low rotational speeds, are typically employed in cranes. But the gear motor in a crane operates on the exact same principles as the electric time clock in the example. Through a succession of big gears, the rotor's output speed is lowered until the final gear's rotational speed (RPM) is extremely low. The high force that is produced by the low RPM speed can be utilized to move and raise big things.

i) L293D Motor Driver:

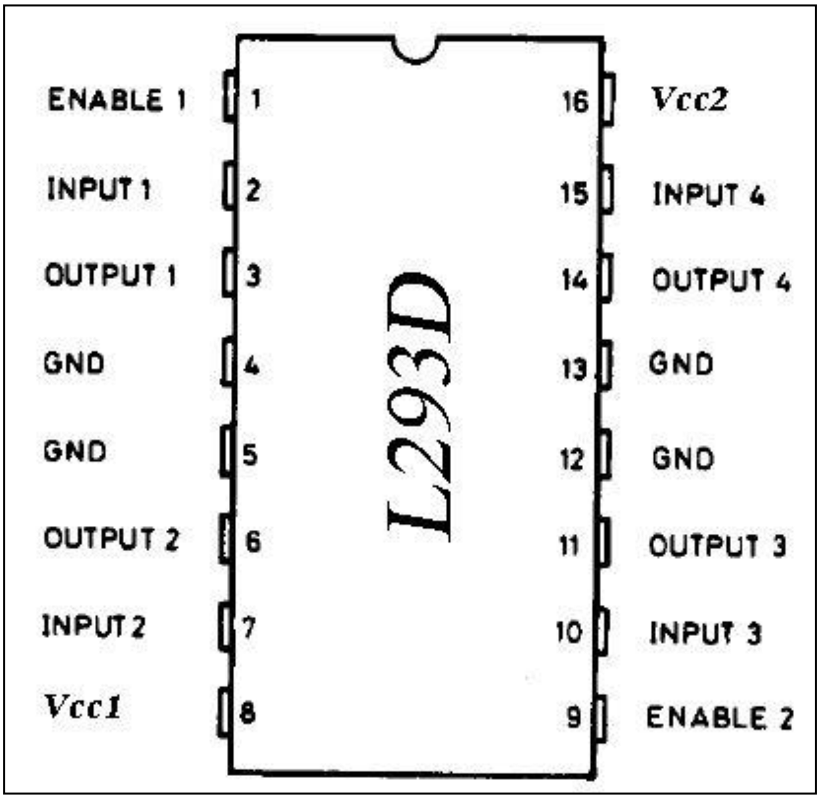


Fig 14: L293D Motor Driver

An integrated circuit (IC) for twin H-bridge motor drivers is called L293D. Because they create a higher-current signal from a low-current control signal, motor drivers function as current amplifiers. This signal has a higher current and drives the motors. L293D has two integrated circuits for H-bridge drivers. Its normal mode of operation allows for the simultaneous driving of two DC motors in forward as well as backward motions. The motor actions of two motors can be controlled by logic inputs at ports 2 & 7, and 10 & 15. The appropriate motor will be stopped by input logic 00 or 11. It will rotate in clockwise and counterclockwise directions, respectively, according to logic 01 and 0. For the 2 motors corresponding to help pins 1 and 9 to begin running, they must be higher. The related driver is enabled when an enable input is high. The outputs then turn on and operate in tandem with their inputs. In a same manner, when the input to enable is low, the driver is disabled, its outputs are switched off, and they are in the high-impedance condition.

Pin Description:

Pin No	Function	Name
1	Enable pin for Motor 1; active high	Enable 1,2
2	Input 1 for Motor 1	Input 1
3	Output 1 for Motor 1	Output 1
4	Ground (0V)	Ground
5	Ground (0V)	Ground
6	Output 2 for Motor 1	Output 2
7	Input 2 for Motor 1	Input 2
8	Supply voltage for Motors; 9-12V (up to 36V)	Vcc_2
9	Enable pin for Motor 2; active high	Enable 3,4
10	Input 1 for Motor 1	Input 3
11	Output 1 for Motor 1	Output 3
12	Ground (0V)	Ground
13	Ground (0V)	Ground
14	Output 2 for Motor 1	Output 4
15	Input2 for Motor 1	Input 4
16	Supply voltage; 5V (up to 36V)	Vcc_1

Fig 15: Pin Diagram of L293D Motor Driver

L293D H-Bridge:

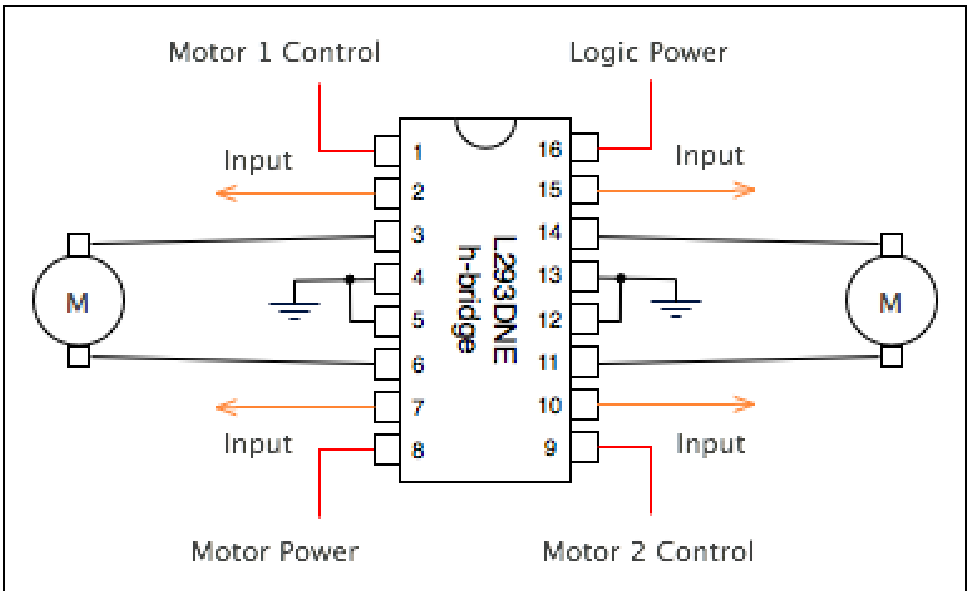


Fig 16: L293D H-Bridge

j) 16x2 LCD:

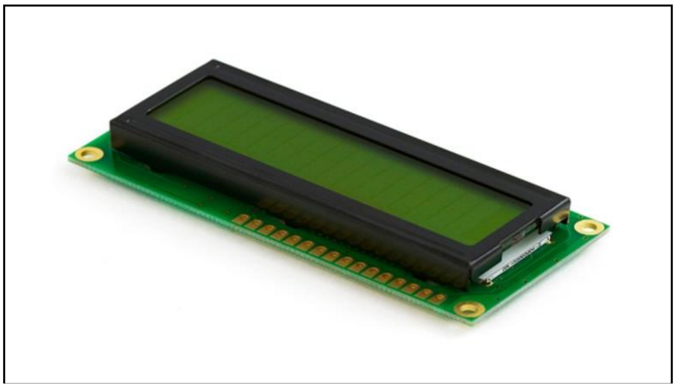


Fig 17: LCD Panel

The LCD screen is a type of electrical display module that has numerous applications. In many various types of circuits and devices, a 16 x 2 LCD display is a reasonably simple module. These are better modules than other multi-segment LEDs, especially the ones with seven segments. These are the reasons why: LCDs are affordable, easily programmed, and capable of displaying animations and additional content. They can also display special and bespoke characters (as opposed to characters in seven segments). With a 16 by 2 LCD, one of its two lines of text can display up to 16 characters. A 5x7 pixel matrix represents each character on this LCD. Command and Data are the two registers included on this LCD.

The command register contains the commands given to the LCD. Commands can be used to tell an LCD to carry out a certain task, such as setting up, cleaning its screen, changing the display, or moving the cursor to a specific spot. The register of data holds the data that will appear displayed on the LCD. The data is the ASCII value of the character that will appear on the LCD.

Pin Configuration:

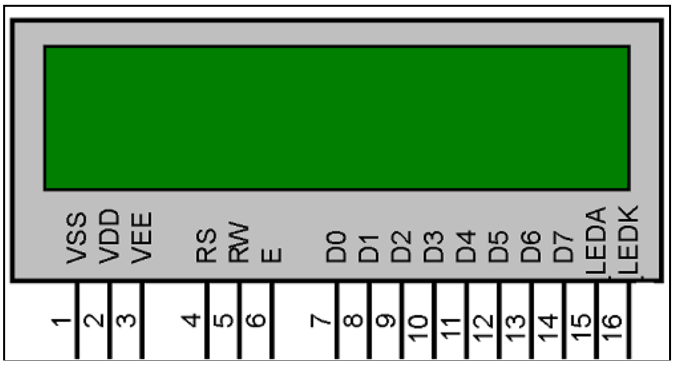


Fig 18: Pin Diagram of LCD Panel

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 from the register	Read/write
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-

k) Microcontroller (ATmega328):

- ### Introduction :

This powerful Atmel 8-bit AVR RISC-based the microcontroller features a byte-oriented 2-wire serial. The user interface an SPI serial port, 32KB ISP flash drive with read-while-write capacity, 1KB EEPROM, 2KB SRAM, 23 general-purpose input/output lines, 32 general purpose performing registers, all 3 flexible timer/counters using compared modes, internal as well as external interruptions, serial programmed USART, an 6-channel 10-bit A/D Converters (8-channels within TQFP plus QFN/MLF packages), a programmable monitor timer along with internal oscillators, and 5 software-selectable power-saving modes. Operationally, the device runs on 1.8–5.5 volts.

The gadget balances power consumption and processing speed by achieving powerful instructions are executed in just one clock cycle, resulting in throughputs that approach 1 MIPS per MHz

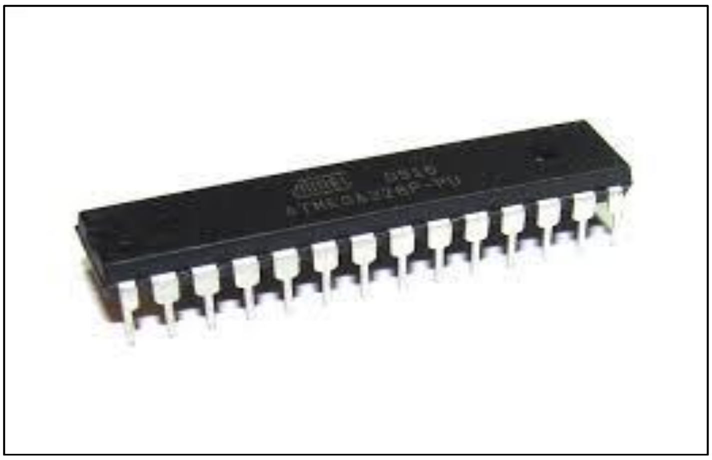


Fig 19: -ATmega 328 Microcontroller

- **Key parameters for ATmega328:**

Parameter		Value
Flash (Kbytes)	:	32 Kbytes
Pin Count	:	28
Max. Operating Freq. (MHz)	:	20 MHz
CPU	:	8-bit AVR
Touch Channels	:	16
Hardware Touch Acquisition	:	No
Max I/O Pins	:	23
Ext Interrupts	:	24
SPI	:	221
TWI (I2C)	:	1
UART	:	1
ADC Channels	:	8
ADC Resolution (bits)	:	10
ADC Speed (kbps)	:	15
Analog Comparators	:	1
DAC Resolution (bits)	:	0
Temp. Sensor	:	Yes
SRAM (kBytes)	:	2
EEPROM (Bytes)	:	1024
Self-Program Memory	:	Yes
Temp. Range (deg C)	:	-40 to 85
I/O Supply Class	:	1.8 to 5.5

Operating Voltage (VCC)	:	1.8 to 5.5
Timers	:	3
Output Compare Channels	:	6
Input Capture Channels	:	1
PWM Channels	:	6
32kHz RTC	:	Yes
Calibrated RC Oscillator	:	Yes
Watchdog	:	Yes
Debug Interface	:	debug WIRE
RTC	:	Counter

- **Block Diagram of Microcontroller:**

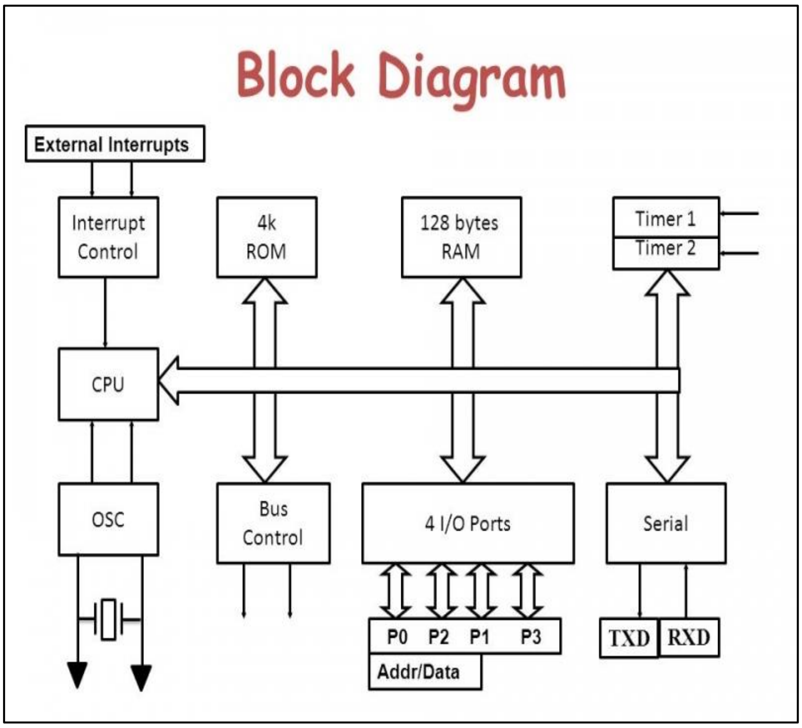


Fig 20: Microcontroller

microcontroller is a tiny computer that consists of a single integrated circuit (SOC) featuring a core CPU, memory, and programmable input/output peripheral. Programmable memory, such as Ferroelectric RAM, NOR flash, and OTP ROM, is often included on chip in addition to a typically negligible amount of RAM.

- **Pin Diagram:**

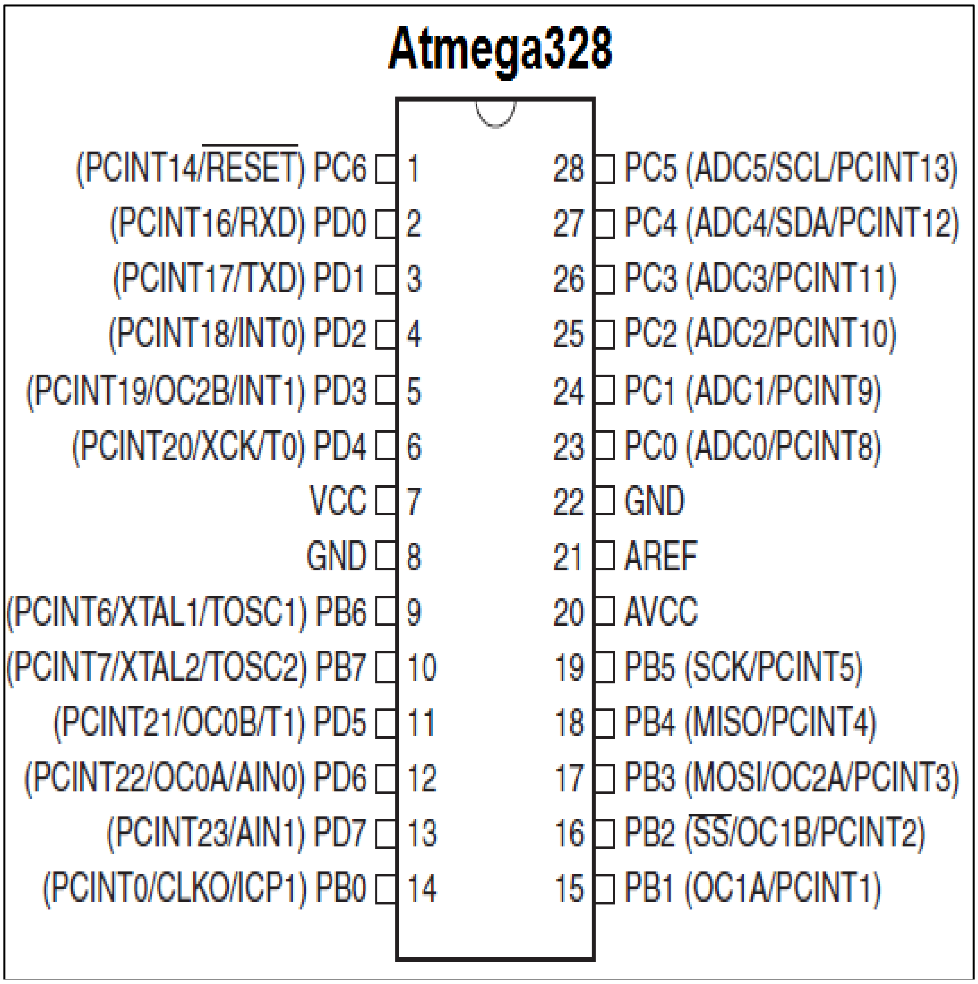


Fig 21: pin diagram of Atmega328

- **Pin Function:**

Pin Number	Description	Function
1	PC6	Reset
2	PD0	Digital Pin (RX)
3	PD1	Digital Pin (TX)
4	PD2	Digital Pin
5	PD3	Digital Pin (PWM)
6	PD4	Digital Pin

7	VCC	Positive Voltage (Power)
8	GND	Ground
9	**XTAL** 1	Crystal Oscillator
10	XTAL 2	Crystal Oscillator
11	PD5	Digital Pin (PWM)
12	PD6	Digital Pin (PWM)
13	PD7	Digital Pin
14	PB0	Digital Pin
15	PB1	Digital Pin (PWM)
16	PB2	Digital Pin (PWM)
17	PB3	Digital Pin (PWM)
18	PB4	Digital Pin
19	PB5	Digital Pin
20	AVCC	Positive voltage for ADC (power)
21	AREF	Reference Voltage
22	GND	Ground
23	PC0	Analog Input
24	PC1	Analog Input
25	PC2	Analog Input
26	PC3	Analog Input
27	PC4	Analog Input
28	PC5	Analog Input

Fig 22: Table of pin function

- **Pin Description:**

I/O ports make up twenty of the pins, as was previously mentioned. This suggests that they have the ability to function as the circuit's input or output. Whether they're considered input or output is determined by the software. Six of the sixteen pins can generate PWM output, with 14 of them being digital. Analogue input and output are supported by six pins. There are two pins for the crystal oscillator. This is done in order to supply a clock pulse to the Atmega chip. A clock pulse is necessary for synchronization in order to allow communication among the Atmega chip & the connected device to occur in synchrony.

2 of the pins, Vcc and GND, supply the chip with the electricity it needs to function. Because the Atmega328 is a low-power device, its operating voltage range is only 1.8 to 5.5 V.

An analog to digital converter (ADC) is a component of the Atmega328 microcontroller. This has to be the case in order for the Atmega328 to be able to understand analog signals. The chip includes six pins for analog input since it features an ADC, which allows it to read analog input. The three pins designated for the ADC's operation are AREF, GND, and AVCC. The positive voltage power source for the ADC is known as AVCC. For the ADC to function, it requires its own power source. The ground for the power source is GND. The ADC converts an analog signal into its corresponding digital value using a reference voltage, or AREF. When an analog voltage exceeds the reference voltage, digital quantities of one will be assigned, and when an analog voltage falls below it, digital values of zero will be assigned. To determine which digital quantities are high or low, one can use the AREF value as a guide. Being a 10-bit ADC, meaning that it produces a 10-bit digital value, the Atmega328 ADC converts an analog input to its digital value. Since it shows an analog signal's picture, this digital value is the analog signal's digital equivalent.

The RESET pin comes in last. This makes it possible to restart and run a program again.

- **Introduction to Arduino UNO Development Board :**

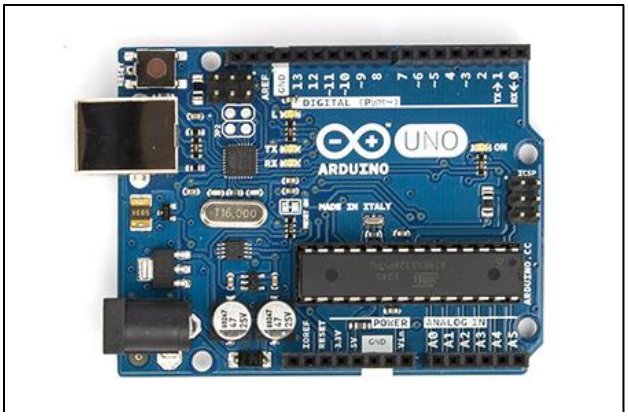


Fig 23:Arduino UNO

An ATmega328 microcontroller board functions as the Arduino Uno's foundation. In addition to a crystal oscillator with a frequency of 16 MHz, six analog inputs, a USB port, a power port, a header for ICSP, and a reset button, the device has fourteen digital input/output pins. There are also six analog inputs that can be used. Everything needed to support a microcontroller is included; all you have to do to get it started is power it with a battery or an AC-to-DC adapter, or you can use a USB cable for connecting it to a computer. The FTDIUSB-to-serial driver chip is not utilized by the Uno, in contrast to all earlier boards. The Atmega8U2 is instead outfitted with a USB-to-serial converters program.

The Italian word "uno" means "one," and it was selected to mark the approaching release of Arduino 1.0. In the future, version 1.0 and the Uno will be the Arduino reference versions. The standard design for the platform is the Uno, the latest in a series of USB Arduino boards.

- **Technical Specification:**

Microcontroller	:	ATmega328
Operating Voltage	:	5V
Input Voltage	:	7-12V
Input Voltage (limits)	:	6-20V
Digital I/O Pins	:	14 (of which 6 provide PWM

		output)
Analog Input Pins	:	6
DC Current per I/O Pin	:	40 mA
DC Current for 3.3V Pin	:	50 mA
Flash Memory	:	32 KB of which 0.5 KB used by boot loader
SRAM	:	2 KB
EEPROM	:	1 KB
Clock Speed	:	16 MHz

- **Documentation:**

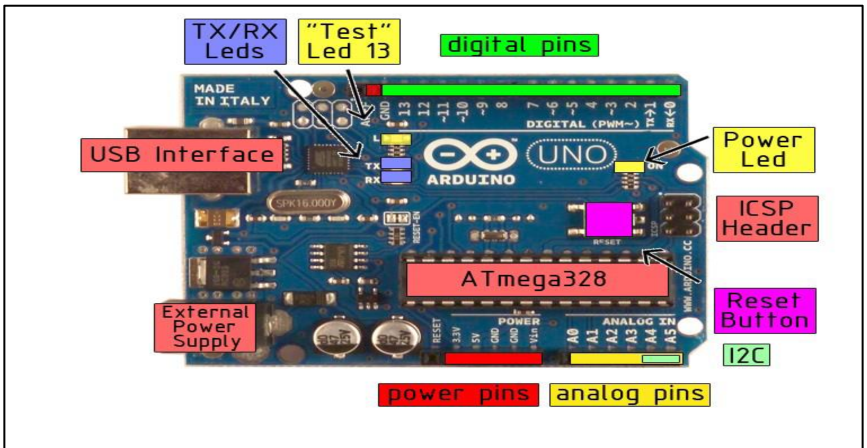


Fig 24: Arduino UNO Board

Power:

An external power supply or a USB connection can be used to power the Arduino Uno. It chooses the power source on its own. Batteries or wall-warts that convert AC to DC can supply external (non-USB) power. To connect the adapter, insert a 2.1mm center-positive connector into the power jack on the board. The Gnd and Vin pin headers of the POWER connection can accept battery leads.

An external supply of 6 to 20 volts can power the board. However, if the supply is less than 7V, the board can become unstable and the 5Vpin might supply less than 5V. The voltage regulator may overheat and harm the board if more than 12V is used. A voltage range of 7 to 12 volts is advised.

The power pins are as follows:

- **VIN:** The input voltage to the Arduino board (instead of 5 volts from the USB connection or another regulated power supply) when it is powered by an external source. This pin can be used to deliver voltage or to access voltage if it is being supplied via the power jack.
- **5V:** The microcontroller and other parts of the board are powered by this regulated power source. This can be supplied via USB or another regulated 5V source, or it can originate from the VIN via an on-board regulator.
- **3V3:** An on-board regulator-generated 3.3 volt supply. Draw of maximum current is 50 mA.
- Ground pins, or **GND**

Memory:

The Atmega328 features two KB of SRAM and one KB of EEPROM in addition to 32 KB of flash memory (of which 0.5 KB is required for the boot loader).

Input & Output:

With the pin Mode (), digital Write (), and digital Read() routines, each of the Uno's 14 digital pins can be utilized as an input or output. They run on five volts. Each pin features an inbuilt 20–50 kOhm pull-up resistor, which is unconnected by default, and may supply or receive a maximum of 40 mA. Furthermore, certain pins serve specific purposes:

- **Serial numbers: RX 0 and TX 1:** used to send and receive TTL serial data (RX and TX, respectively). These pins are linked to the ATmega8U2 USB-to-TTL Serial chip's matching pins.

- **2 and 3 External Interrupts**: These pins can be set up to respond to changes in value, rising or falling edges, or low values by triggering an interrupt. For more information, see the attach Interrupt() function.

- **PWM:** 3, 10, 11, 5, 6, and 9.Use the analog Write() method to produce an 8-bit PWM output.

- **SPI:** 10 SS, 11 MOSI, 13 SCK, 12 MISO. These pins enable SPI communication, which is not yet supported by the Arduino programming language, although being offered by the underlying hardware.

- **LED:** 13 Digital pin 13 has an integrated LED linked to it. The LED is on when the pin value is HIGH and off when the pin value is LOW.

The six analog inputs of the Uno each have a resolution of 10 bits, or 1024 distinct values. They measure between zero and five volts by default, but you can adjust the upper end of their range by utilizing the analog Reference () function and the AREF pin. Furthermore, certain pins are equipped with certain functions.

- **I2C:** SDA (4 and 5) (SCL). Use the Wire library to support I2C (TWI) communication.

A few additional pins are present on the board:

- **ARF:** The analog inputs' reference voltage. Incorporated with analog Reference().

- **Restart:** To reset the microcontroller, pull this wire down to zero. usually used to add a reset button to shields that obstruct the board's reset button.

Communication:

The Arduino Uno can interface with other Arduinos, computers, and microcontrollers thanks to a number of functionalities. The ATmega328's digital pins 0 (RX) and 1 (TX) enable a UART TTL (5V) serial connection. This serial communication is transmitted by USB by the ATmega8U2 on the board, which shows up as a virtual serial port to PC applications. The '8U2 firmware uses the regular USB COM drivers, so it does not need an additional driver. However, you require a *.inf file on Windows. The serial monitor included in the Arduino software can be used to send and receive simple text data between the Arduino board and computer. The RX and TX

LEDs on the board will flash and the USB link to the PC will establish when data is being transmitted via the USB-to-serial chip. (but not for serial transmission on pins 0 and 1).

A software serial library can be used to enable serial communication via any of the Uno's digital pins. The ATmega328 also has support for I2C (TWI) and SPI communication. The Arduino software includes a Wire library to make using the I2C bus simpler. Refer to the documentation for further details. Consult the ATmega328 datasheet for details on how to use SPI communication.

Programming:

The Arduino software (download) can be used to program the Arduino Uno. From the Tools >Board menu, choose "Arduino Uno w/ATmega328" (based on the microcontroller on your board). See the tutorials and reference for more information.The Arduino Uno's ATmega328 has a boot loader pre-burned into it, which enables you to upload new code to it without using an external hardware programmer. It uses reference and C header files of the original STK500 protocol for communication.For more information, refer to these instructions. Alternatively, you can program the microcontroller using the ICSP (In-Circuit Serial Programming) header and avoid the boot loader.

The source code for the ATmega8U2 firmware is accessible. The ATmega8U2 comes pre-installed with a DFU boot loader, which may be enabled by resetting the 8U2 and connecting the solder jumper located next to the Italian map on the board's rear. Next, you can load new firmware using the DFU programmer (Mac OS X and Linux) or Atmel's FLIP software (Windows).

Advantages:

- The Arduino Platform makes prototyping simple and quick.
- Having messages shown on an LCD screen that can be quickly connected and set up in just a few minutes.
- The Arduino hardware platform already includes circuitry for programming and resetting the microcontroller, as well as circuitry for USB communication and power.

Chapter-4
CIRCUIT DESIGN AND SIMULATION

Circuit Diagram:

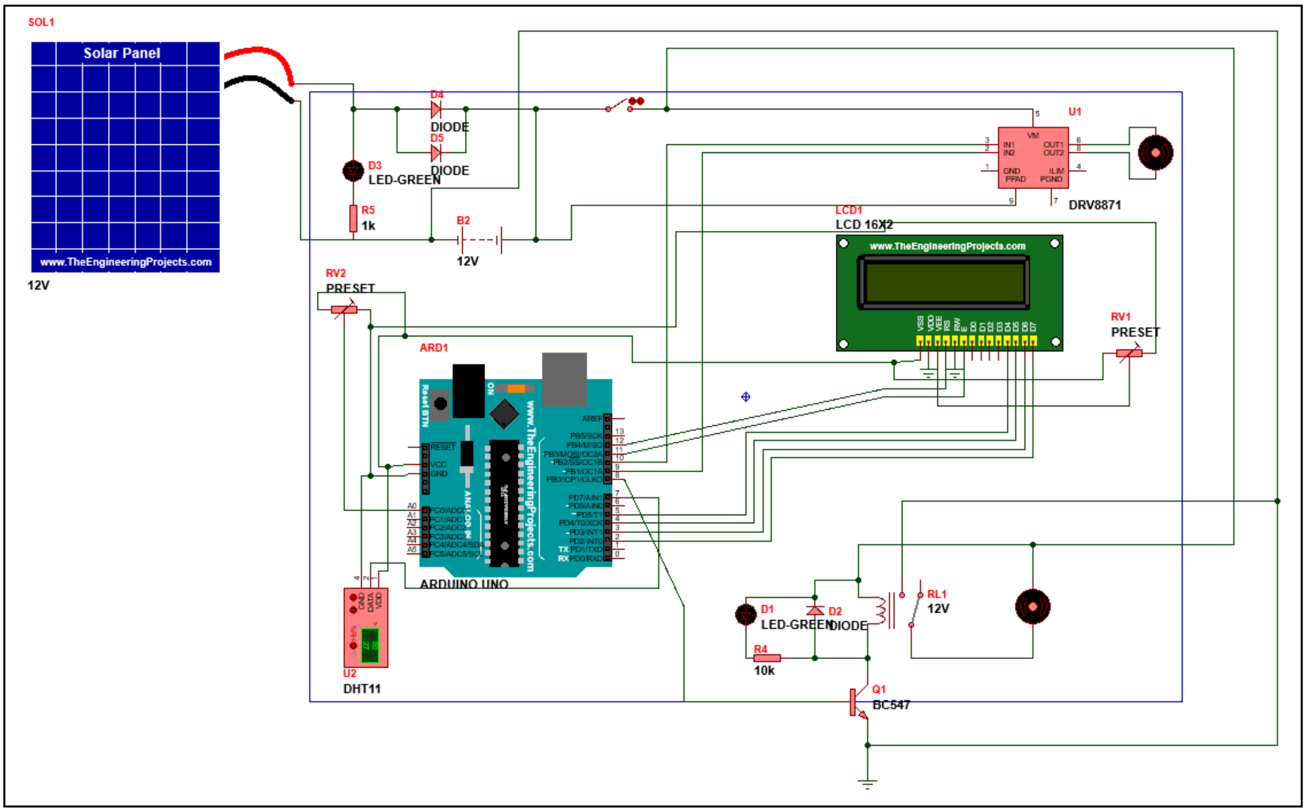


Fig 25: Simulation Diagram

Chapter-5
METHODOLOGY

Working Methodology:

A number of parts come together to form the smart solar dryer with Arduino Microcontroller system, which offers an effective and environmentally friendly way to dry agricultural products. Here's how the system is put into practice:

1. Solar panels: Solar energy is captured by the panels and transformed into electrical energy. The Arduino controller, LCD, relay, and gear motor are all powered by the energy gathered by the solar panels.
2. Batteries: In times when there is little solar radiation, the batteries supply the system with power by storing the electrical energy that the solar panels have captured.
3. Relay: The dryer gun is controlled by this circuit. It turns the gun on and off based on the Arduino controller when it is linked to the define the drying parameters.
4. Arduino controller: The system's brain is the Arduino controller. It is in charge of directing and observing the drying process. In order to offer ideal drying conditions, the controller is set up to continuously monitor the temperature and humidity levels inside the dryer box and to modify the fan and air pump as necessary.

All things considered, the smart solar dryer system implementation utilizing Arduino offers a productive and environmentally friendly way to dry agricultural products. Utilizing solar power and the automation offered by the Arduino controller, the system is inexpensive, eco-friendly, and simple to operate.

The Arduino IDE is a necessary piece of software, and the Arduino Microcontroller, solar panel, temperature sensor, heating element, fan, battery, and camera are necessary pieces of hardware.

The solar system unit block diagram for the seed drier. Here, the system's central component is the Arduino microcontroller. In this setup, the power supply is provided by solar panels. It observes light energy during the day and transforms it into electrical energy. The energy that is produced is transferred to the charge controller, which then controls the voltage and supplies further energy to a battery. The switch is linked to the battery in order to provide control. Here, the battery voltage is 12V, and the Arduino controller is powered by a 5V DC supply. We utilize a voltage regulator to lower the voltage from 12V to 5V. In this case, one temperature sensor is used to track the heat inside the chamber. In order to dry the seeds, the convection mode of heat transfer is employed by the solar heater to heat the air. The temperature sensor detects the current heat in the heating chamber; only exhaust fans are intended to operate within this temperature range in order to maintain the temperature there. The sensor pistol fires when the temperature falls outside of its detection range.

The DC motor drives the conveyer belt, allowing it to rotate at a very low rpm of less than 10. The primary microcontroller in the dryer is an Arduino. Other components of the system include a temperature and humidity sensor (DHT11) to measure the grains' temperature and humidity, a heating coil to raise their temperature, DC fans to force hot air onto the conveyor belts, and an L298N H bridge motor driver circuit to regulate the DC geared motors' speed. functioning of the temperature sensor Because the sensor is detachable, we can monitor the temperature and humidity levels of the grains both before and after they are dyed. Maintaining the grain's permitted temperature range of 35°C to 45°C, the fans are engineered to operate exclusively within this temperature range, assisting in the transfer of hot air to the conveyor belts. Consequently, the moisture level drops to 12–14% after using a drier to dry the grains, which is appropriate for storing them.

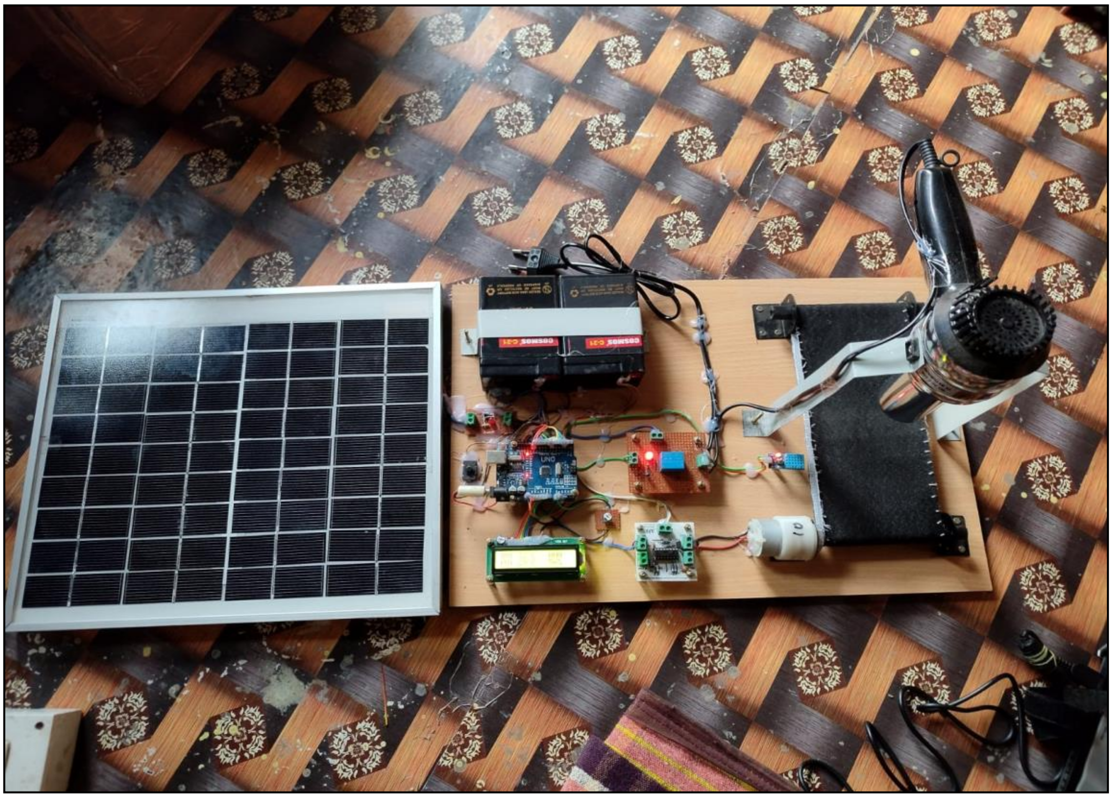
Chapter-6
RESULT

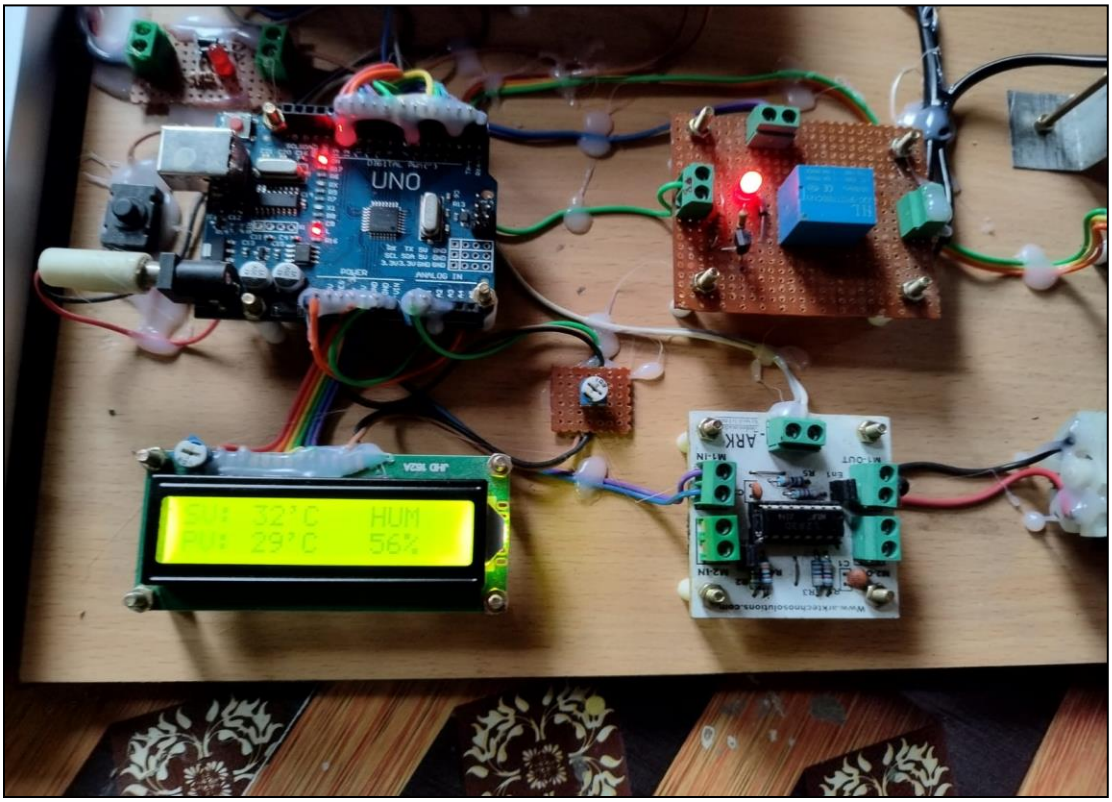
Result:

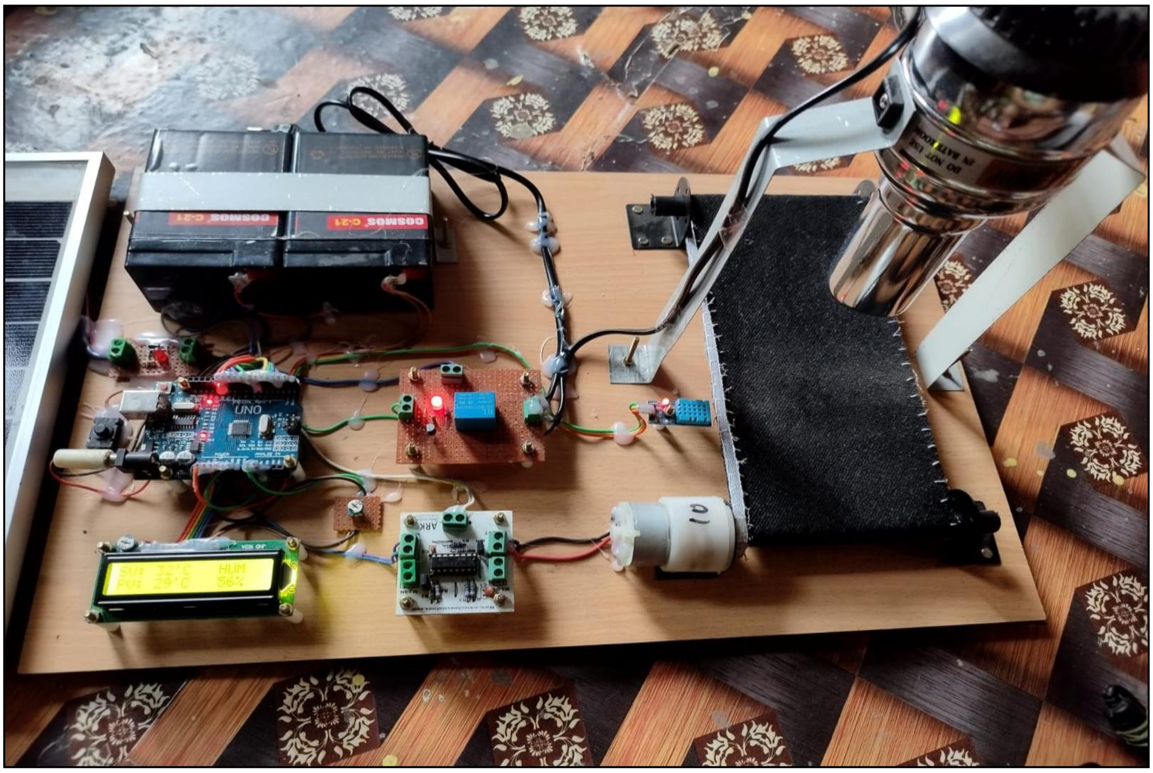
The Arduino-based seed dryer system demonstrated promising results in terms of efficiency, reliability, and sustainability:

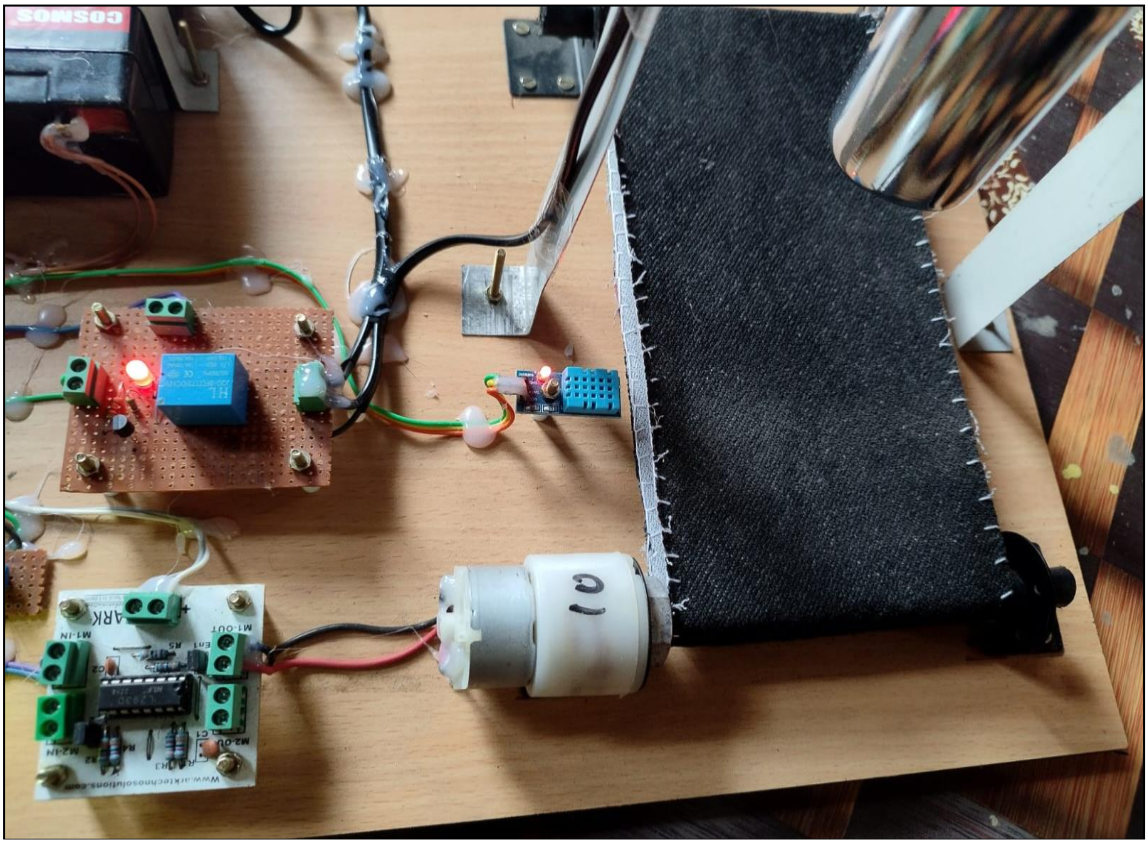
- Energy Efficiency: Solar panels efficiently harness solar energy, minimizing reliance on grid electricity or fossil fuels.
- Optimized Drying Conditions: The system maintains optimal drying conditions by continuously monitoring and adjusting temperature and humidity levels.
- Automated Operation: Arduino programming enables automated control of the drying process, reducing the need for manual intervention and ensuring consistency.
- Cost-Effectiveness: By utilizing freely available solar energy and open-source Arduino technology, the system offers a cost-effective alternative to conventional drying methods.
- Environmental Sustainability: The use of renewable energy sources and eco-friendly operation aligns with sustainability goals and reduces carbon footprint.

Final Implementation:









Chapter-7
CONCLUSION

Conclusion:

The report showcases a method for efficiently drying harvested grains without delay. This technique can be completed within a few hours, offering a significant time-saving benefit for farmers. The proposed system is designed to be portable and user-friendly, requiring minimal expertise for operation as it functions automatically. Moreover, the initial and ongoing costs of the proposed system are minimal, as it utilizes cost-effective components readily accessible in the market. This model provides a valuable insight into how such a system could be implemented on a larger scale with relative accuracy. In India farmers faces lots of problems in farming in pre harvesting to post harvesting. One of the problems is drying grains properly post harvesting and to protect the grains against insects and birds, and to prevent moisture from re-entering the grain. But, if the drying is not done properly, there will be loss to the farmer no matter how good the storage is. Technological advancements have brought a lot of changes in our day to day life and we have been grateful for that. The agricultural sector has been growing everyday either in its production or in the technological aspect. Time has always been the greatest problem and shortage of time has led many problems faced by every farmer. In order to reduce the time of the farmer postharvest, the proposed idea has been implemented. The motor-controlled conveyer belts made out of netted material is perfect in order to lay the grains conveniently and also for the proper penetration of hot air. It uses an Arduino Uno Microcontroller for the smart controlling action which needs to be implemented for the drying process. Natural sun drying technique would use the heat from the sun rays to dry the grains for a period of 10-15 days, making use of the same principle, in this paper it uses the heat generated from a heating coil along with the fan, which thereby produces heat required to dry the grains as per the specifications

Chapter-8
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