

Fabrication of
Solar Powered coin based water dispenser system

Submitted in partial fulfilment of the requirements for the award of
Bachelor of Engineering degree in Mechanical Engineering

By

Yesh Negi (37150227)

Navin Kumar (37150707)



DEPARTMENT OF MECHANICAL ENGINEERING
SCHOOL OF MECHANICAL ENGINEERING

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
Accredited with Grade "A" by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119
APRIL – 2021



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JeppiaarNagar, Rajiv Gandhi Salai, Chennai 600 119
www.sathyabama.ac.in



DEPARTMENT OF MECHANICAL ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **YESH NEGI (37150227)** and **NAVIN KUMAR (37150707)** who carried out the project entitled **"Fabrication of Solar powered coin based water Dispenser system"** under our supervision from ____ to ____ .

Internal Guide

Mr. KAJA BANTHA NAVAS

Head of the Department

Dr. G. ARUNKUMAR, M.E., Ph.D.,

Submitted for Viva voice Examination held on _____

Internal Examiner

External Examiner

DECLARATION

We **YESH NEGI (37150227)** and **NAVIN KUMAR (37150707)** hereby declare that the Project Report entitled “**FABRICATION OF SOLAR POWERED COIN BASED WATER DISPENSER SYSTEM**” done by me under the guidance of **Mr. KAJA BANTHA NAVAS** is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Mechanical Engineering.

DATE:

SIGNATURE OF THE CANDIDATE

PLACE: CHENNAI

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ABSTRACT

Water has become the most important product of human life. There is many stresses on multiple water resources. And on the other hand the rapid increase of population and changing lifestyles has increased the need for fresh water. As we see in present scenario it would clear that in most of the areas like households, public areas like railways station, bus stop, malls etc. are paying far more for more water supply than earlier. Also if this cost of fetching water which is almost equivalent. Now a days vending machines are available but the problem is that these machine are depend on single source of power which is the main source due to which in summer there will be so much load on main power supply but our aim is to design a dispenser system which take the power form three sources which are Sun, battery and main source. In India there is also a problem of public hygiene and water wastage and as corona is there social distance and public hygiene is very important but in most of the public area these things are not get followed specially in public areas like railway stations, bus stop etc. So to solve these problem we have design a system which work on the principle of detection and dispenser of water and the name of system is Solar powered coin based water dispenser system. By this project we can give pure water to people in cheaper rate in public areas by using microcontroller and sensors based on mechatronics principle. It will be cheaper, economical, hygienic and efficient.

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Chapter 1

INTRODUCTION

Water has become the most important product of human life. There is many stresses on multiple water resources. And on the other hand the rapid increase of population and changing lifestyles has increased the need for fresh water. As we see in present scenario it would clear that in most of the areas like households, public areas like railways station, bus stop, malls etc. are paying far more for more water supply than earlier. Also if this cost of fetching water which is almost equivalent. In summer, we face the problem of drinking water. So is the panic over drinking water supply in the city as well as in villages. The reservoir has just 35.63 feet of water, which is not even half of the total water level.

With the improvement in the technology there are many advanced devices and machines that are useful to the mankind. One of them is coin operated telephone. As we know the function of it and how it works. With the same technology used we are going to design a project which is based on liquid (water). Coin Operated Water Dispensing System as the name indicates it is based on COIN operation. It has been specially designed for use on Railway station, Bus deposes, public places etc. And the system will take the power from 3 sources which are solar, battery and main power supply. This system is based on microcontroller. The inputs to the microcontroller are coin and output in the form of water. Looking at the specifications required for Water Dispensing System and for simplicity of our application, microcontroller was found to be best suited.

Now-a-days, automated vending machines are most in use as they make various activities not only easier but also more efficient. The machine has numerous input and outputs to provide service to the customer. This machine is similar to vending machine. It is coin operated machine. It accepts only coins as input like Rs.1 in any sequence and delivers drinking water. The main motto of this system is to avoid the environmental pollution and also to avoid the wastage of water. We know that the available water resources have initiated towards the end. This problem is quietly related to poor water allocation, inefficient use, and lack of adequate and integrated water management. Since last few decades, several monitoring systems integrated with water level detection have been accepted; therefore, water controlling system implementations have potential significance in the society. Vending machine is going to be developed in such a way that water will get served to the customers. As it is coin operated machine, the required quantity of water and respective amount of money is decided that are affordable for common people.

1.1 Tap Water v/s Bottled Water v/s Canned Water

Bottled water may have reduced amounts of copper, lead, and other metal contaminants since it does not run through the plumbing pipes where tap water is exposed to metal corrosion, however, this varies by the household and plumbing system. In much of the developed world, chlorine often is added as a disinfectant to tap water. If the water contains organic matter, this may produce other by-products in the water such as trihalomethanes and halo acetic acids, which has shown to increase

the risk of cancer. The level of residual chlorine found at around 0.0002 g per litre, which is too small to cause any health problems directly. The chlorine concentration recommended by World Health Organization is between 0.0005 and 0.0002 g/L. The Natural Resources Defence Council, Sierra Club, and World Wildlife Fund have urged their supporters to consume less bottled water. Anti-bottled-water- campaigns and organizations, such as Corporate Accountability International, typically argue that bottled water is no better than tap water, and emphasize the detrimental environmental side-effects of disposable plastic bottles.

The recent documentary Tapped argues against the bottled water industry, asserting that tap water is healthier, more environmentally sustainable, and more ecologically sound than bottled water. The film focuses on the bottled water industry in the United States. The film has received largely positive reviews, and has spawned college campus groups such as Beyond the Bottle. Yet, as many people remain generally unaware of the negative health and environmental impacts associated with bottled water, recent research in environmental psychology has started to investigate how to reduce the public's consumption of bottled water. Canned water is drinking water packaged in tin cans or beverage cans, a less common alternative to bottled water.

Canned water is used primarily where storage or distribution systems are set up for cans, or when canning systems are used to make emergency water supplies. Water was stored in steel cans, lined with plastic bags, under the United States Civil Defence program. Approximately twelve million 17.5-US-gallon (66 L) cans were deployed, and could hold water for more than ten years. Later, some manufacturers started to use Nitrogen flush to remove air and bacteria from their cans to prolong shelf life to 30 years or longer, making the water suitable for long term storage.

CHAPTER 2

LITERATURE SURVEY

In the nineteenth century, the first vending machine to be successfully commercialized by Thomas Adams was used for the sale of their chewing gum in underground stations of New York. Only in 1902 the first company of vending machines emerged, Horn & Hardart Baking Company in Philadelphia. In turn, the Committee Definitions of the American Marketing Association define vending machines as “retail sales of products or services by operating machines that are used by end consumers” (STEIN, 1964).

Market developed via automatic vending machines has grown quickly since it is convenient, faster and cheaper (KIM, YOO, 2012). According to history, the coffee vending machines emerged in the 50s since profits decreased and managers needed to reduce costs. They concluded that could save money by using coffee automatic machines (STEIN 1964). The vending machine also had an important role in the new economy of America, being a generator of Employment (WEEK, 1999; Apud LEE, 2003). Yet there is some vulnerability in this kind of business. When the economy is in recession, sales of this business also decreased (LEE, 2003). For example, the consumption of products from vending machines decreased by 5% in 2001 due to the economic downturn (National Automatic Merchandising Association, 2002; Apud LEE, 2003). Nowadays, vending services include a large number of products such as coffee, drinks, snacks, books, toys and other products located in stations, schools, universities, companies and hospitals (KIM, YOO 2012). However, STEIN (1964) pointed out a limitation, clearly stating that is not possible to serve a “full meal” in a vending machine.

Regarding the evolution of the vending machine itself, in the ‘30s, there was the coin changers’ development. Also in the ‘30s, small refrigerator was placed inside the vending machine, which allowed the sale of chilled drinks and ice cream at competitive prices compared to sales in stores. In turn, in the 50s, the automatic coffee machines expanded to several small businesses. Its clean look and beautiful design would be appropriate in cafeterias or classrooms. In the ‘60s, two manufacturers have introduced machines with the hypothesis of automatic note changers (STEIN, 1964). In 1961, a million and a half of the U.S. population bought at least one product in the vending machines every day (STEWART, 1961; Apud STEIN, 1964).

Vending machines were developed further, which led to a focus on installation, training and / or existence of effective instruction, maintenance and repair, being essential to achieve customer needs and satisfaction in different markets. In turn, the development of new machinery found a wide range of design requirements in project stage (GOFFIN, 2000). In an advanced perspective, operations strategy is a set of decisions on the strategic management of competence, skills, processes, technologies, resources and materials/stocks management in a supply chain in order to create and deliver products and services according to customers’ requests (BROWN et al., 2005).

Services firms acquired vending machine to self-service businesses (GOFFIN, 2000; KIM, YOO, 2012). However, these machines are a complex mix of mechanical and electronic technologies, security and display. Due to the wear and tear of a number of

components, maintenance and repair are required. In these terminals, communication channels (links, machine to machine) may exist via modem to a central computer showing performance data, sales activities and stock levels in the chain of vending machines. With the updating of these channels of communication in services, companies of vending machines had good management practices reflected in a maintenance management and in an efficient and effective supply planning in record time (GOFFIN, 2000). If there is a problem, the customer may contact the vending company and a compensation will be given. In order to achieve a better services quality, vending machine services companies normally have a department that is responsible for repairing any identified damage. All repairs are carried out in the place where the machine is located. Technicians make regular visits to carry out periodic inspections and preventive maintenance during times that do not have to make repairs (KIM, YOO, 2012). According to the authors, KIM and YOO (2012), vending machines can be distinguished by two types of failure mechanisms. The mechanism I group which includes transaction currency, delivery mechanism(s) of product(s) -, and the mechanism II group - which includes the electronic part. According to statistics, most faults relate to this group. The group of mechanisms II are related with the engine cooler in the case of ice creams or beverages refrigerator vending machines. This mechanism includes the compressor, control of ice and refrigerant charge. For this group, the repair mechanisms are necessarily more expensive because of technical resources as well as heavier equipment needed. According to different breakdowns of the two groups of mechanisms I and II, it is important to distinguish two types of technicians for the manpower planning and repair process to be effective. After contact with the technicians, they move to repair the mechanisms of group I. If the detected failure is part of the mechanisms of group II, they contact colleagues to conduct the visit and repair. However, the group I did not leave without first carrying out inspections of the mechanisms of this group. The optimal preventive maintenance interval was determined to minimize the total average cost for the maintenance compound, additional expects and capacity loss (HSU, TAPIERO, 1987; Apud KIM, YOO, 2012). It is true that if they for preventive maintenance, the probability of failure decreases and vending machines in the near future may witness a reduction of costs and an increased level of customer satisfaction (KIM, YOO, 2012).

From a design perspective, the following question could be asked: what is the influence of the design in the vending machines? The design influences both the necessity of handling and the way of distribution (GARVIN, 1988; Apud GOFFIN, 2000). The decisions obtained in the phase of design / development machine, affect equipment reliability and consequently the requirements for maintenance of that machine (LELE, 1986; Apud GOFFIN, 2000). Some companies develop products / machines with a good assistance level. They reach this level because they get an excellent grasp and understanding of customer needs and to support the equipment evaluation. This will be carried out during the project development stage (GOFFIN, 2000).

GOFFIN (2000), a Senior Operations Manager, argues that machine assistance is the key role of marketing either in technology practiced either in development of engineering machinery. Technical assistance was a significant change in many

industries over the last ten years. GOFFIN (2000) considers not only the types of maintenance and repair but also includes other elements like support via phone or online and contact customers. A research study focuses on a mathematical model of integration and planning of the technical department of the vending machines. Closely, related to preventive maintenance and failures. Planning determines levels of technical work (full-time and temporary), preventive maintenance and repairs to minimize the total cost (KIM, YOO, 2012). However, surprisingly, in practice, many companies maintain these services to a minimum number of human resources (technical) dedicated to fault repair and preventive maintenance. This strategy can even keep labor costs lower, but in terms of total costs, in the long run these are not minimal (KIM, YOO, 2012). The market success of vending machines depends on the customers' knowledge of their needs before offering products in the machines. It can even exist a disagreement according to the quality of the products but they should be part of the list of consumer preferences (STEIN, 1964). The stronger the exposure of products and / or vending machines, the larger image and recognition it will be. This is an open path to marketing communications. This strategy is valid in the many countries because of reputable brands of products to dispose of this type of vending service (LEE, 2003). As people are adapted to use different types of vending machines, these will expand and represent increasingly different types of services. Interestingly, STEIN (1964, p.51) stresses that: "to be successful the desire should override the machine and not vice versa!"

In the current services economy, the use of information technologies increases significantly (WEBSTER, 1992; SHETH, 1994; SHETH, PARVATIYAR, 1995a; GRONROOS, 2000; GUMMESON, 2002; Apud HUNT, ARNETT, 2006), and therefore it is each time more important to understand customers' opinions and feedback (SHETH, PARVATIYAR, 1995b).

Vending machine market in India is still at a nascent stage and is expected to witness dynamic growth in the near future. The market will be boosted by the increasing consumerism coupled with changing lifestyle, resulting in increased demand for vending machines. A market analysis studies the attractiveness and the dynamics of a special market within a special industry. It is part of the industry analysis and thus in turn of the global environmental analysis. Through all of these analyses the opportunities, strengths, weaknesses and threats of a company can be identified. Finally, with the help of a SWOT analysis, adequate business strategies of a company will be defined. The goal of a market analysis is to determine the attractiveness of a market, both now and in the future. Organizations evaluate the future attractiveness of a market by gaining an understanding of evolving opportunities and threats as they relate to that organization's own strengths and weaknesses. In most of the developed countries the vending machines are situated at public places. These machines dispense the snacks, cold drinks, coffee, tea, etc. to the people. Also in developing countries the vending machines are used to provide these things. (Hong Gu, and Shuang Qiao Jiang Tian, 2006; Bhuvaneshwari et al., 2013 and Ana Monga Balwidar Singh, 2012) The invention of coin operated vending machine is done in London. Initially it was used to dispense the post cards. As time passes the vending machines become much popular because of its numerous advantages. Coin operated vending

machines are most popular in all the vending machines. The customer is able to get required quantity of product by inserting coins in vending machine through coin discriminator. The basic idea of proposed system is originated from these existing systems. Majorly we are developing a system in which water tank is set to provide water to customer. Now a day's water vending machines are available and operated on only one coin but our aim is to design water vending machine which is portable within limited amount. In India, there is problem of safe drinking water therefore we are going to provide hygienic mineral water. Water has become the most commercial products of the century. This may sound bizarre, but true. The stress on the multiple water resources is a result of a multitude of factors. On the one hand, the rapidly rising population and changing lifestyles have increased the need for fresh water. If opportunity costs were taken into account, it would be clear that in most rural areas, households are paying far more for water supply than the often - normal rates charged in urban areas. Also, if this cost of fetching water which is almost equivalent. To 150 million women days each year, is covered into a loss for the national exchequer, it translates into a whopping 10 billion rupees per year. In summer, we face the problem of drinking water. So is the panic over drinking water supply in the city as well as in villages. The reservoir has very low level of water, which is not even half of the total water level.

SURVEY DATA

The Primary sources include Survey questionnaires were distributed among the participants, 75 were Filled and returned, and 50 fully filled questionnaires were taken for the final analysis. Thus, the Effective response rate of paper based survey is 67%. The secondary sources include journals, magazine, newspaper, and internet websites. The secondary Data are being utilized for review of literature on history of Market Analysis, growth and development of Vending machine for theoretical survey.

A survey was undertaken using paper based techniques through questionnaire and personal interview. After collection of data of 80 respondents in different places of Mysore city were considered for final analysis. The respondents comprised of 62 males (77.5%) and 18 females (22.5%). Out of total sample size 36.3% are belongs from age group of 15- 25 years. As well 51.3% are belongs from age group of 25-40 years. It shows that now a day 's youngsters are consuming more purified mineral water than Municipal water. Only 10% respondents are belonging from the age group of 40-55 years prefer municipal water. Out of total respondents 46.3% are service holder and 25.0% are business bodies. 25% respondents are students and 2.5% respondents are housewives. Out of that only 1.3 % respondents are engaged in other profession. From the above data, we found that more service holders are consume mineral water more than the others. Our survey shows that all respondents consume mineral water except 10% respondent in. 13 respondents are consuming mineral water less than 2 times per day which is 16.3% out of whole. Only 36(45.0%) respondents consume mineral water 2-3 times in a day. 24 respondents are consuming mineral water 3-4 times in a day which is quite less as compare to 2-3 times consumed respondents. Only 7 respondents are consuming more than 5 times as per our survey which is only 8.8% out of whole.

Chapter 3

AIM, SCOPE, OBJECTIVE AND METHODOLOGY

In any railway station and public places when we went to refill his bottle we did not find any water dispenser System instead we found one water cooler but the problem was that the place was not only crowded but people were not taking any necessary precautions in this pandemic as a result we bought a new water bottle instead of refilling the old one from there we got the idea because of public might facing the same problem. So our main objective is to modify and replace the existing product with this technology in which the power is produce by both solar panels and direct power source to run the product without any brake and also including the system by which the social distance also maintain.

The problem face by the existing product is that it is unhygienic because people make direct contact with the machine by drinking directly from the tap. During Summer time there is heavy load on electric power plants by using this technology we get power from alternate source (Solar panel) and it reduces the load on electric power plant during summer time.

The aim of our project is to build a water dispensing system which dispenses water on the detection of the right coin (correct denomination) and it will run on Solar power produced by Sun. The dispenser is designed using microcontroller. It can be used in public places like Roads, Railway stations, shopping Malls etc. It can prove to be of great use and comfort for people and their health.

Scope

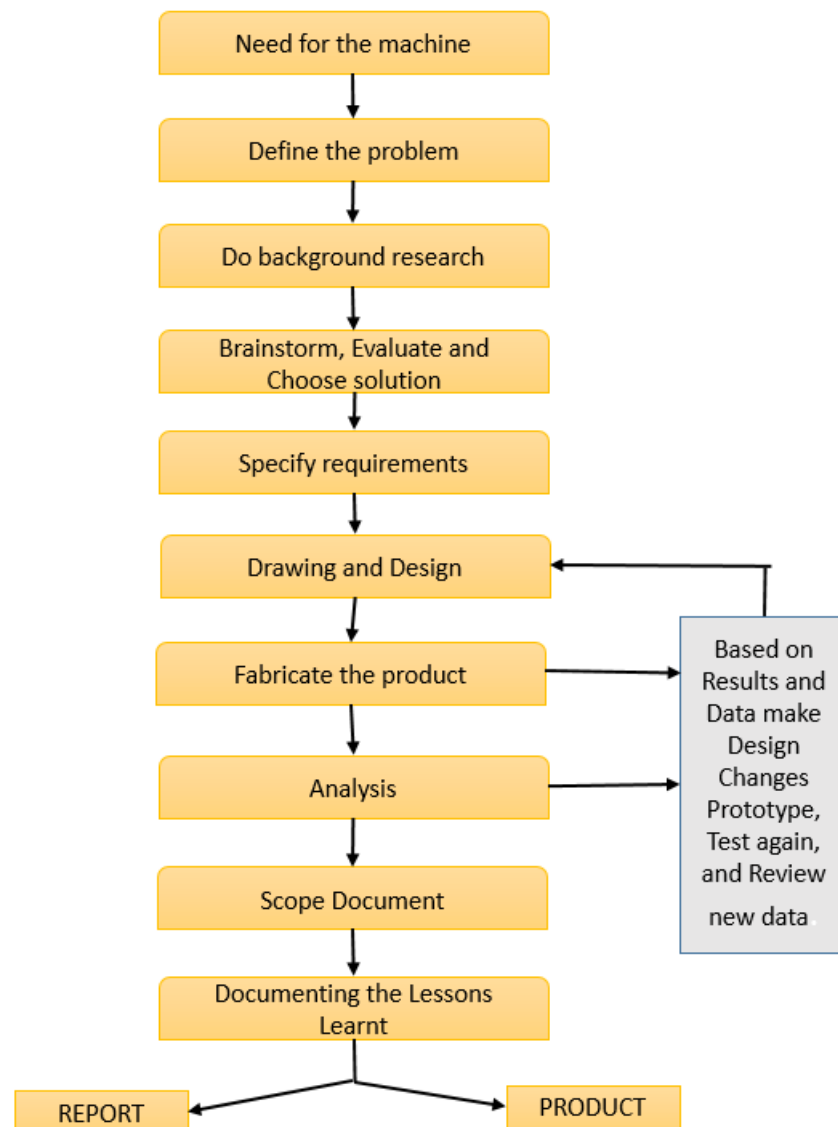
Here we put forward a fully automated coin based water dispenser using microcontroller and coin sensor, which will be run on solar power having solar tracker also for better performance of solar panels. The system is capable of fully automated water dispensing using motor and sensors. The system is having a coin detector that is used to sense particular coins and send the information to microcontroller about valid coins. On detecting a valid coin the system now sends a signal to the controller and then it starts the motor to pour water in glass using motor till the particular set timings (i.e. 10 seconds) and after 10 seconds conveyor start and pass the glass further and next glass will take place. Thus we here put forward a smart water dispenser system with water saving feature and consumer hygiene also.

Objective

- The objective of this project is to construct a Solar Powered based system that will automatically dispense water on the detection of the right coin. It provide a means of fetching water from the dispenser that requires lesser human effort.
- To adopt simple design mechanism that can be easily maintained.
- To encourage local Entrepreneurs.

- To reduce load on main power plants.
- To focus more on renewable source of energy to produce electricity.
- To control or reduce public unhygienic practices.
- To provide water in cheaper rate.

Methodology



INVESTIGATION

SIMILAR PRODUCT

Coffee Vending Machine



Fig: 3.1 Coffee vending machine Product

Product Description:

It's a unique entity in the industry, actively committed towards offering an optimum quality range of Automatic Coffee Vending Machine. In accordance with the set industry standards, this machine is manufactured by skilled professionals using high grade components and latest technology. Owing to its smooth operation and long service life, the offered machine is highly demanded among clients. Moreover, to ensure optimum performance, this machine is stringently tested by quality experts on various quality parameters. This machine gives coffee when inserted coin. Cost of this vending machine: ₹100k

Milk Vending Machine



Fig.: 3.2 Milk vending machine

Product Description:

Automatic Milk Vending Machine, which is developed by accomplished professionals who employ the industry-accepted material and superior techniques. These products are existing in the market in numerous specifications that meet on clientele demand. In addition, quality checkers also examine these products in order to offer fault-free series to the clientele. Features: Easy installation Hassle free operation Temperature Resistance Descriptions: SS 304 Construction Refrigerated tank for maintaining the temperature at 4 C. Single delivery with SS float balance tank 20 liters. Float balance tank fitted with 3 port valve and 500 ml beaker used as an extension to main tank. Electronic push button /remote control operated panel with separate buttons for dispensing 250 ml, 500 ml and 1000 ml Optional buttons are available on request for bulk sale of 2000 ml and 4000 ml. Multiple Vending Options Operation: Manual & with Remote Battery Backup 2X16 Character crystal display with light Wheels/fix type arrangement

Automatic Snack Vending Machine



Fig. : 3.3 Automatic Snack Vending Machine

Product Description:

To meet variegated demands of clients, they are engaged in manufacturing, exporting and supplying an exclusive range of Automatic Snack Vending Machine. Specifications: Dimensions H XW X D mm): 1845 X 810 X 905 Axial levering Port at optimum setting) Weight: 275 Kgs. Electrical: 230 V. 50 Hz. 0.12 Amps. Selections: 26 as standard, 42 maximum Factory Configuration: 9 Snacks. 10 small sized Snacks. 7 Candy. 200- 400 ferns Styling: Clam Front Application: Suitable for Potato Chips, Cheese Puffs and Crackers. Cookies, Cupcakes and Biscuits Features: Electronic Controller with Digi

M1 Display 24VDC Motorized Vending Mechanism Supports 2 Add-on Machines

Adjustable Tray Partition and Height Product Vend Sensor Fast and Easy Product Loading

Price: ₹2.75 lakhs.

Coin Operated Water Vending Machine



Fig. : 3.4 Coin operated water vending machine

Product description:

Item: Water ATM/Purified Water Vending Machine Water Source: Municipal Tap Water/Raw Water Power Supply: AC220V 50Hz / AC110V 60Hz. Production Capacity(GPD): 400,600,800,1300,1600 and 3000 Water Tank Capacity: 200L UV Power: 20w Ozone Capacity: 1000mg Filling Flow Rate: 8L/min Selling Method(Refundable): IC Card+ Coins + Paper note Size of Filling Bottle: 200ml,500ml,1L,2L,20Ltr(at a time in one tap) Filtration Step: 9 Steps Size: L80cmxW68cmxH200cm Packing: Carton for FCL or Poly Wood case for LCL LCD Panel: 19inch for advertisement Technology: Pre Filtration (German Technology) + Reverse Osmosis (RO)+Ultra Violet(UV) Technology + Ozonating
Price= ₹5lakh

Soda Vending Machine



Fig. : 3.5 Soda vending machine Product

Product Description:

Soda vending Machine with high efficiency. Under the stern supervision of nimble professionals, the offered machine is developed using quality checked components and innovative technology. The provided machine is broadly used for making several types of beverages and cold drinks in bars, restaurants, clubs and many other places. Moreover, the offered soda machine is obtainable for our patrons at pocket friendly rates.

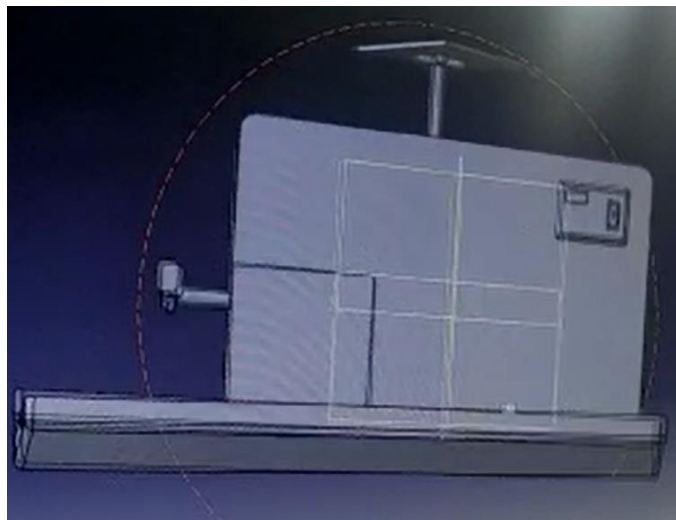
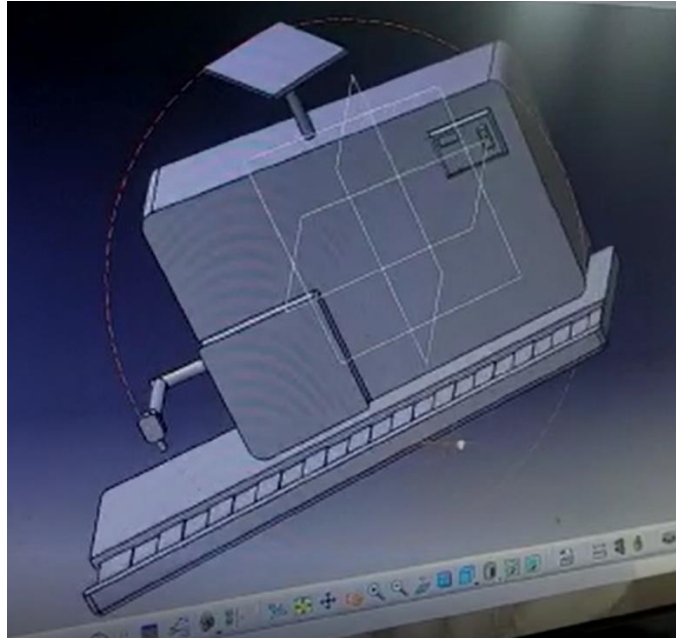
Features:

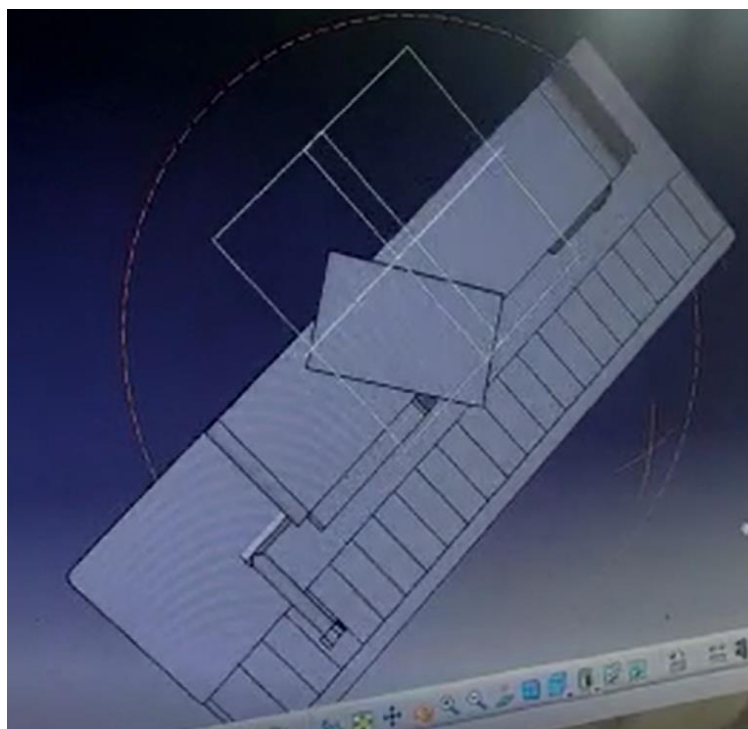
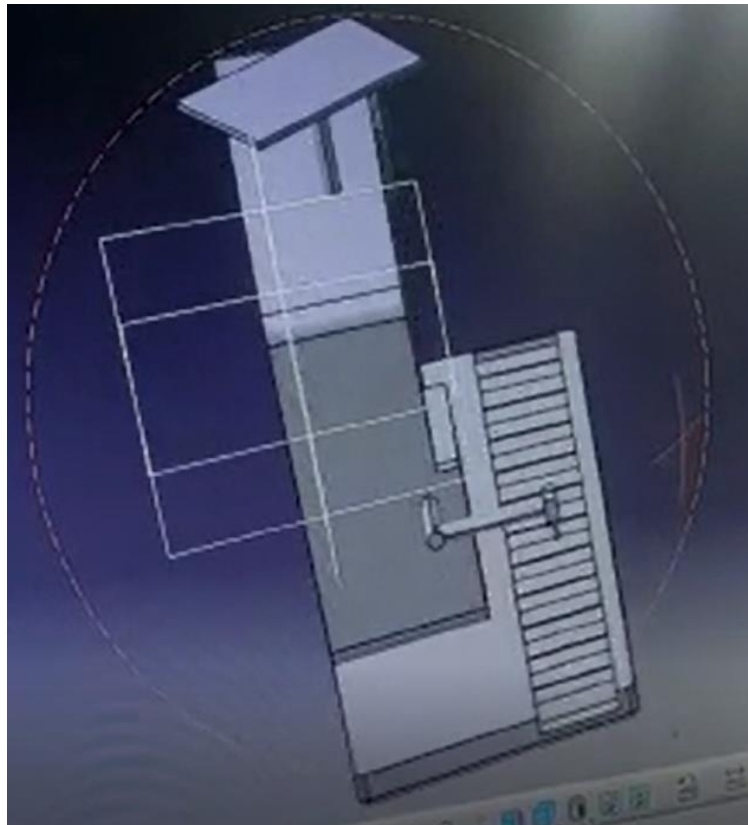
- Superior quality
- Fine finishing
- Reliable

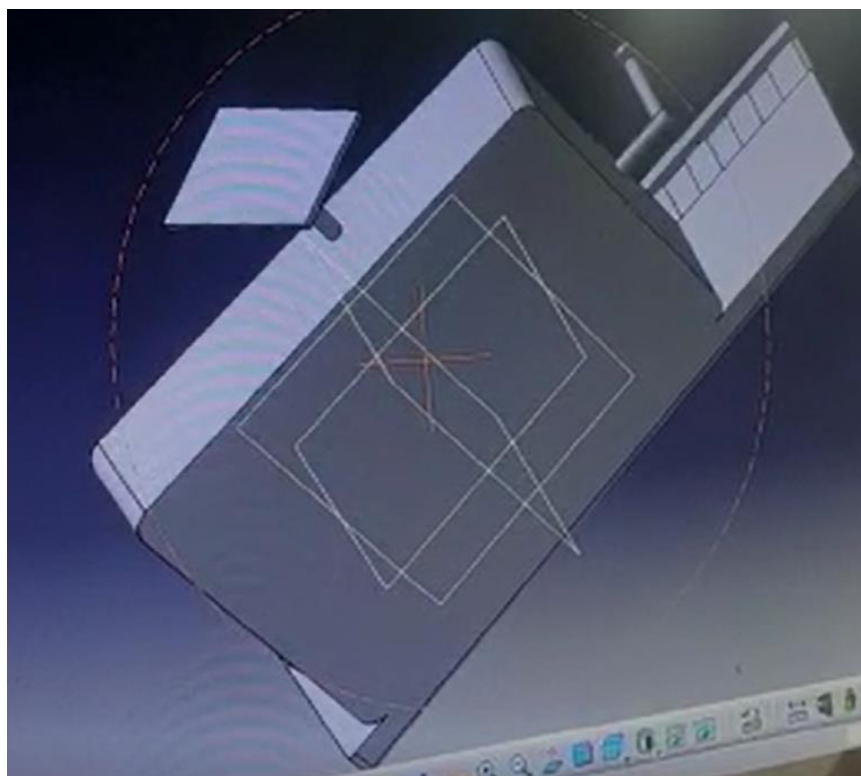
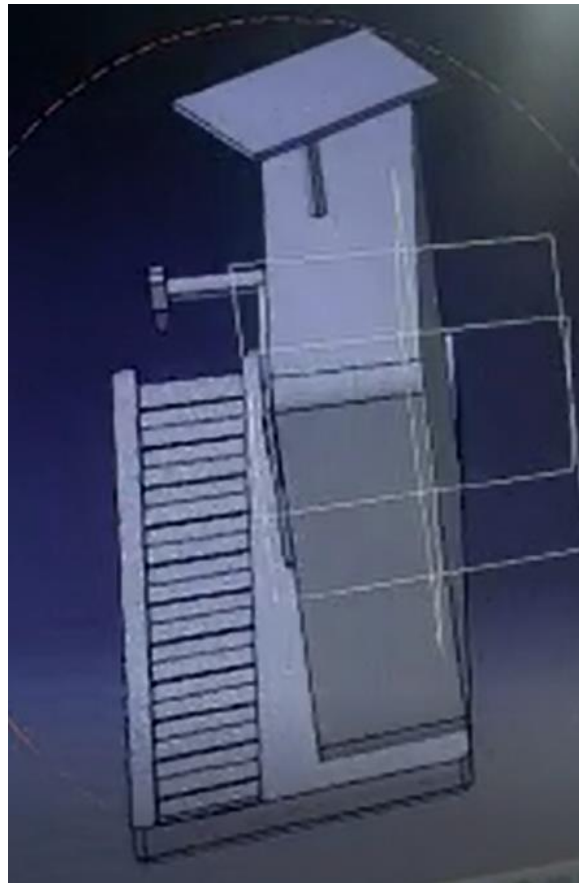
Approximate Price: ₹1.6 Lakh / unit

DESIGN & MODELLING

3D Model







Chapter 4

COMPONENTS & DISCRPTION

The major parts that are effectively employed in the fabrication of the Solar powered coin based water dispenser system are describe below:-

- Coin Mechanism with Controller
- Arduino Uno
- Motor Driver
- Display
- Solar Panel
- Water pump
- LDR
- Battery
- Transformer
- Rectifier
- Motor

4.1 Coin Mechanism with Controller



Fig. : 4.1 Coin Mechanism with Controller

4.1.1 Product Specification

- Accept coin size: 10.8mm -31 in diameter. 1.2mm-3.0mm in thickness.
- Temperature: -10 degree to 60 degree.
- Work voltage: DC+12 v $\pm$ 20percent. Quiescent current below 25mA. Dynamic current below 400 mA
- Ample coin comparison type validator -Programmable for one coin type based on coin Material. thickness and size
- Connection Diagram
 - a) Gray wire
 - b) Black wire —Ground
 - c) White wire —COIN signal
 - d) Red wire —DC+12V
- Quick release face plate for easy maintenance -Black color face plate with push button type coin release

4.2 Arduino Uno R3 Atmega 328 Compatible Board



Fig. : 4.2 Arduino Uno R3 Atmega 328 Compatible Board

4.2.1 Product Details

The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means hardware is reasonably priced and

development software is free. This guide is for students in ME 2011, or students anywhere who are confronting the Arduino for the first time.

For advanced Arduino users, prowl the web; there are lots of resources.

This guide covers the Arduino Uno board (Spark fun DEV-09950, \$29.95), a good choice for circuits to read switches and other sensors, and to control motors and lights with very little effort. Many of the pictures and drawings in this guide were taken from the documentation on the

The Demilune board features an Atmel ATmega328 microcontroller operating at 5 V with 2 Kb of RAM, 32 Kb of flash memory for storing programs and 1 Kb of EEPROM for storing parameters. The clock speed is 16 MHz, which translates to about executing about 300,000 lines of C source code per second. The board has 14 digital I/O pins and 6 analogue input pins.

There is a USB connector for talking to the host computer and a DC power jack for connecting an external 6-20 V power source, for example a 9 V battery, when running a program while not connected to the host computer. Headers are provided for interfacing to the I/O pins using 22 g solid wire or header connectors.

The Arduino programming language is a simplified version of C/C++. If you know C, programming the Arduino will be familiar. If you do not know C, no need to worry as only a few commands are needed to perform useful functions.

An important feature of the Arduino is that you can create a control program on the host PC, download it to the Arduino and it will run automatically. Remove the USB cable connection to the PC, and the program will still run from the top each time you push the reset button. Remove the battery and put the Arduino board in a closet for six months. When you reconnect the battery, the last program you stored will run. This means that you connect the board to the host PC to develop and debug your program, but once that is done, you no longer need the PC to run the program.

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, 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 a AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

4.2.2 Product Features:-

- Microcontroller: ATmega328
- Operating Voltage: 5V
- Input Voltage (recommended): 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 (ATmega328) of which 0.5 KB used by bootloader
- SRAM: 2 KB (ATmega328)
- EEPROM: 1 KB (ATmega328)

4.2.3 Pin Configuration

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall- wart) or battery. The adapter can be connected by plugging a 2.1mm centre-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector.

The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts. The power pins are as follows:

- **VIN.** The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- **5V.** this pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board.

- **3V3.** A 3.3-volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- **GND.** Ground pins.

IOREF. This pin on the Arduino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs for working with the 5V or 3.3V.

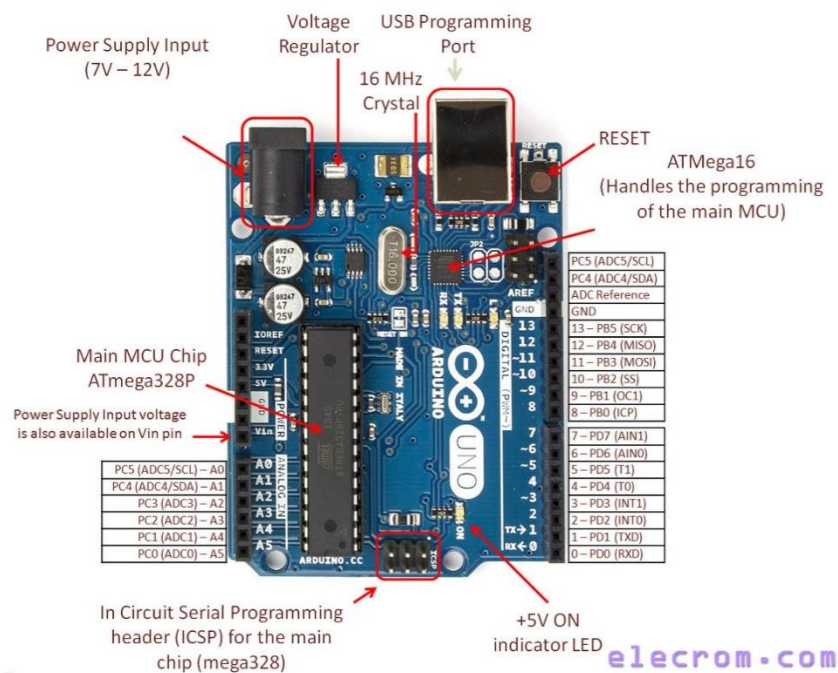


Fig. : 4.3 Arduino Pin Configuration

4.2.4 Memory

The ATmega328 has 32 KB (with 0.5 KB used for the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM.

Input and Output

Each of the 14 digital pins on the Uno can be used as an input or output, using pin Mode (), digital Write (), and digital Read () functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 ohms. In addition, some pins have specialized functions:

- **Serial: 0 (RX) and 1 (TX).** Used to receive (RX) and Transmit (TX) TTL serial data.

- These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- **External Interrupts: 2 and 3.** These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the `attachInterrupt()` function for details.
- **PWM: 3, 5, 6, 9, 10, and 11.** Provide 8-bit PWM output with the `analogWrite()` function.
- **SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK).** These pins support SPI communication using the SPI library.
- **LED: 13.** There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
- The Uno has 6 analog inputs, labelled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default, they measure from ground to 5 volts, though it is possible to change the upper end of their range using the AREF pin and the `analogReference()` function. Additionally, some pins have specialized functionality:
- **TWI: A4 or SDA pin and A5 or SCL pin.** Support TWI communication using the Wire library.
- There are a couple of other pins on the board:
- **AREF.** Reference voltage for the analog inputs. Used with `analogReference()`.
- **Reset.** Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

4.2.5 Communication

Microcontrollers depend on a host computer for developing and compiling programs.

The software

used on the host computer is known as an integrated development environment, or IDE. For the Arduino, the development environment is based on the open source Processing platform (www.processing.org) which is described by its creators as a “programming language and environment for people who want to program images, animation, and interactions. “The Arduino programming language leverages an open source project known as Wiring (wiring.org.co). The Arduino language is based on good old- fashioned C. If you are unfamiliar with this language, don't worry; it's not

hard to learn, and the Arduino IDE provides some feedback when you make mistakes in your programs.

The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1). A Software Serial library allows for serial communication on any of the Uno's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus; see the documentation for details. For SPI communication, use the SPI library.

As you go through the list of programming statements available in the Arduino IDE (choose Help->Reference), you might think there isn't much power for doing things like running servos, operating stepper motors, reading potentiometers, or displaying text on an LCD. Like most any language based on C, the Arduino supports the notion of "libraries" code.

4.2.6 Schematic Diagram:-

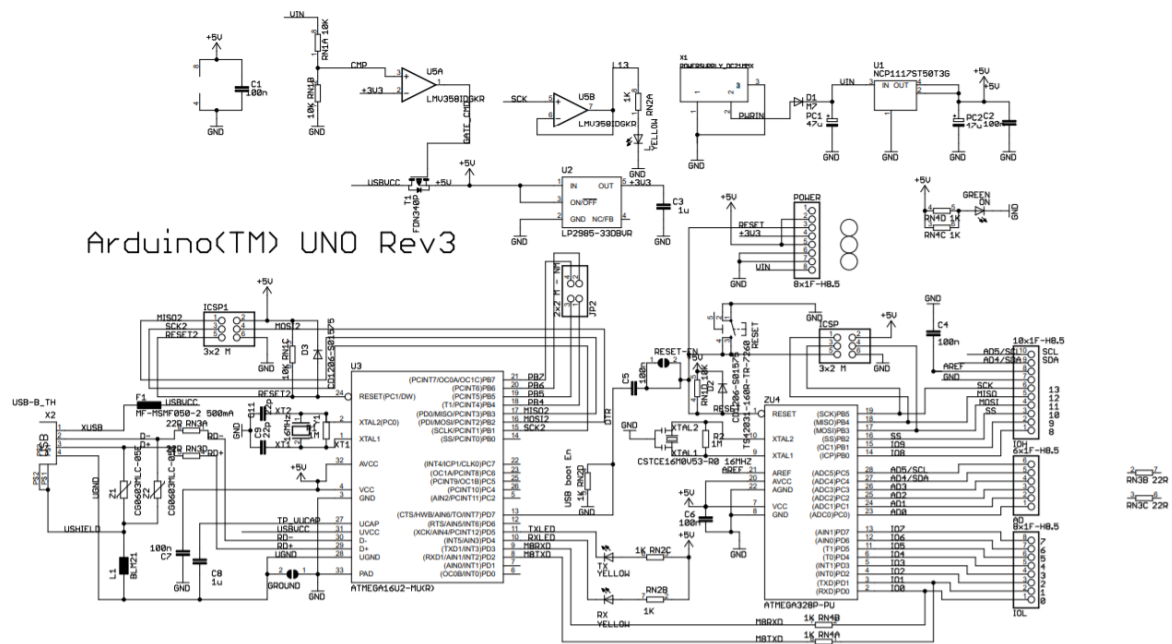


Fig. : 4.4 Arduino Schematic Diagram

4.3 L293D Motor Driver



Fig. : 4.5 L293D Motor Driver

4.3.1 Product Details

This L293D Motor Driver Shield for Arduino is probably one of the most versatile on the market and features 2 servo and 4 motor connectors for DC or stepper motors. That makes it a great shield for any robotic project.

This Arduino compatible motor Driver shield is a full-featured product that it can be used to drive 4 DC motor or two 4-wire steppers and two 5v servos. It drives the DC motor and stepper with the L293D, and it drives the servo with Arduino pin9 and pin10.

L293D is a monolithic integrated, high voltage, high current, 4-channel driver. Basically, this means using this chip you can use DC motors and power supplies of up to 36 Volts, that some pretty big motors and the chip can supply a maximum current of 600mA per channel, the L293D chip is also what's known as a type of H-Bridge. The H-Bridge is typically an electrical circuit that enables a voltage to be applied across a load in either direction to an output, e.g. a motor.

The shield contains two L293D motor drivers and one 74HC595 shift register. The shift register expands 3 pins of the Arduino to 8 pins to control the direction of the motor drivers. The output enables the L293D is directly connected to PWM outputs of the Arduino

4.3.2 Specifications

- 2 connections for 5V 'hobby' servos connected to the Arduino's high-resolution dedicated timer.
- 4 H-Bridges: L293D chipset provides 0.6A per bridge (1.2A peak) with thermal shutdown protection, internal kickback protection diodes. Can run motors on 4.5VDC to 25VDC.
- Up to 4 bi-directional DC motors with individual 8-bit speed selection (so, about 0.5% resolution).
- Up to 2 stepper motors (unipolar or bipolar) with single coil, double coil or interleaved stepping.
- Pull down resistors keep motors disabled during power-up.
- Big terminal block connectors to easily hook up wires (18-26AWG) and power.
- Arduino reset button brought up top.
- 2-pin terminal block and jumper to connect external power, for separate logic/motor supplies.
- Tested compatible with Arduino Mega 1280 & 2560, Diecimila, Duemilanove, and UNO.

- Weight= 60g.

4.4 LCD Display

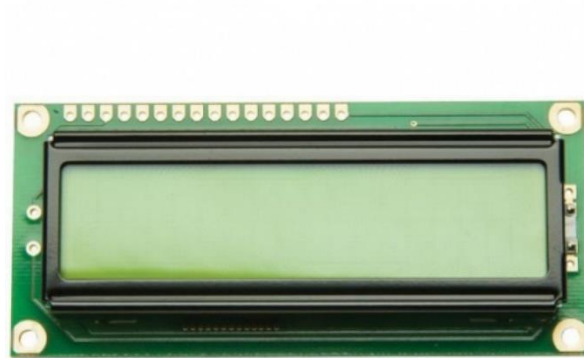


Fig. : 4.6 LCD Display

4.4.1 Product Details

This is a basic 16 character by 2 line Alphanumeric display. Black text on Green background. Utilizes the extremely common HD44780 parallel interface chipset . Interface code is freely available. You will need Minimum 6 general I/O pins to interface to this LCD screen. Includes LED backlight. Works in 4bit and 8 bit Mode.

4.4.2 Specifications

- 16 Characters x 2 Lines
- Green Backlight
- 5x7 Dot Matrix Character + Cursor
- HD44780 Equivalent LCD Controller/driver Built-In
- 4-bit or 8-bit MPU Interface
- Standard Type
- Works with almost any Microcontroller

4.5 Solar Panel



Fig. : 4.7 Solar Panel

4.5.1 Product Details

Photovoltaic modules use light energy (photons) from the Sun to get electricity through the photovoltaic effect. Most modules use wafer-based crystalline silicon cells or thin-film cells. The structural (load carrying) member of a module are often either the highest layer or the rear layer. Cells must be shielded from mechanical damage and moisture. Most modules are rigid, but semi-flexible ones supported thin-film cells also are available. The cells are connected electrically serial, one to a different to the specified voltage, then in parallel to extend amperage. The wattage of the module is that the product of the voltage and therefore the amperage of the module. The manufacture specifications on solar panels are obtained under standard condition which isn't the important operating condition the solar panels are exposed to on the installation site. A PV junction box is attached to the back of the solar panel and functions as its output interface. External connections for many photovoltaic modules use MC4 connectors to facilitate easy weatherproof connections to the remainder of the system. A USB power interface can also be used.

4.5.2 Order of configuration

Module electrical connections are made in series to achieve a desired output voltage or in parallel to provide a desired current capability (amperes) of the solar panel or the PV system. The conducting wires that take the current off the modules are sized consistent with the ampacity and should contain silver, copper or other non-magnetic conductive transition metals. Bypass diodes could also be incorporated or used externally, just in case of partial module shading, to maximise the output of module sections still illuminated. [citation needed] Some special solar PV modules include concentrators during which light is concentrated by lenses or mirrors onto smaller cells. This enables the utilization of cells with a high cost per unit area (such as gallium arsenide) in a cost-effective way.

4.5.3 Efficiency

Each module is rated by its DC output power under standard test conditions (STC) and hence the on-field output power might vary. Power typically ranges from 100 to 365 Watts (W). The efficiency of a module determines the area of a module given an equivalent rated output – an 8% efficient 230 W module will have twice the area of a 16% efficient 230 W module. Some commercially available solar modules exceed 24% efficiency. Currently, the simplest achieved sunlight conversion rate (solar module efficiency) is around 21.5% in new commercial products typically less than the efficiencies of their cells in isolation. The most efficient mass-produced solar modules [disputed – discuss] have power density values of up to 175 W/m² (16.22 W/ft²).

Scientists from Spectro lab, a subsidiary of Boeing, have reported development of multi-junction solar cells with an efficiency of quite 40%, a replacement record for solar photovoltaic cells. The Spectro lab scientists also predict that concentrator solar cells could achieve efficiencies of quite 45% or even 50% within the longer term, with theoretical efficiencies being about 58% in cells with more than three junctions.

4.5.4 Specifications

- Polycrystalline Solar Panel.
- Wattage: 3W.
- Voltage: 12V.
- 3W-12V Polycrystalline Solar Panel System for 9 V Battery Charge with 3 meter Dc 5521 Cable
- Length- 28cm
- Breadth- 12.5cm
- Thickness- 1.5cm
- Efficiency- 18.6%

4.6 Water Pump



Fig. : 4.8 Water Pump

4.6.1 Product Details

Micro DC 3-6V Micro Submersible Pump Mini water pump For Fountain Garden Mini water circulation System DIY project. This is a low cost, small size Submersible Pump Motor which can be operated from a 3 ~ 6V power supply. It can take up to 120 liters per hour with very low current consumption of 220mA. Just connect tube pipe to the motor outlet, submerge it in water and power it. Make sure that the water level is always higher than the motor. Dry run may damage the motor due to heating and it will also produce noise.

4.6.2 Specifications

- Operating Voltage : 3 ~ 6V
- Operating Current : 130 ~ 220mA
- Flow Rate : 80 ~ 120 L/H
- Maximum Lift : 40 ~ 110 mm
- Continuous Working Life : 500 hours
- Driving Mode : DC, Magnetic Driving
- Material : Engineering Plastic
- Outlet Outside Diameter : 7.5 mm
- Outlet Inside Diameter : 5 mm

4.7 Switch Drive High-power MOSFET Trigger Module

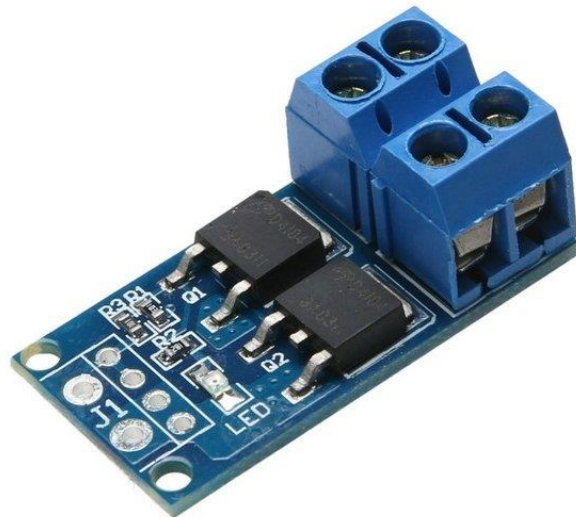


Fig. : 4.9 Switch Drive High-power MOSFET Trigger Module

4.7.1 Product Details

This 5-36v Switch Drive High-power MOSFET Trigger Module can control the output of power equipment, motors, light bulbs, LED lights, DC motors, micro-pumps, solenoid valves, PWM, motor speed control, lamp brightness.

The 5-36V SWITCH DRIVE HIGH-POWER MOSFET TRIGGER MODULE is of high power MOS trigger switch driver module and control board with a field-effect tube to adjust the electronic switch. It adopts imported double MOS parallel active output to show lower internal resistance, greater electric current, and power.

Besides it works at 15A, 400W under a common temperature which satisfies most devices usage and realizes the control of great power devices in a relaxed way. What's more, it can be applied to power devices which could be controlled by output terminals like electric motors and light bulbs to control the speed of the motor and the light of bulbs.

The use of imported dual-MOS parallel active output, lower resistance, more current, strong power at room temperature, 15A, 400W, to meet the most use of the equipment. Wide voltage, the perfect support for PWM. Easily control high power devices. Input PWM to achieve motor speed control, lamp brightness control.

4.7.2 Specifications

Operating Voltage (VDC)-	5 ~ 36
Peak Current (A)-	30
Continuous Current (A)-	15
No. of Channels-	1
Battery Protection Mode-	N0
Operating temperature-	-40 ~ +85
Cooling Fan-	No
Arduino Shield-	No can be used with Wire connection.
Speed Control-	Yes
Polarity Protection-	No
Dimensions in mm (Lx W x H)-	34 x17x 12
Weight (gm)-	6

4.8 Step Down Transformer

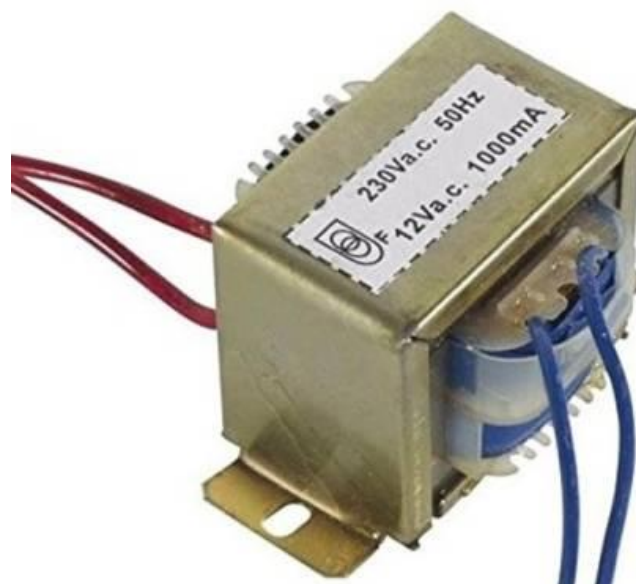


Fig. : 4.10 Step Down Transformer

4.8.1 Product Details

Transformers work on the principle of mutual induction. A changing magnetic field in one loop of wire induces an electromotive force (EMF) in an adjacent loop of wire, inductively coupled to the first. In very basic terms, a transformer consists of two coils of wire with high mutual inductance. These coils are electrically separated while they share a common magnetic circuit

For a step-down transformer, the second coil has fewer windings than the first, allowing for a decrease in voltage in the exiting electrical stream.

The primary winding, which is the first set of coils, connects to an alternating-current voltage source, or primary voltage inflow. The secondary coil connects to the load, or secondary voltage outflow, distributing the electrical power away from the transformer.

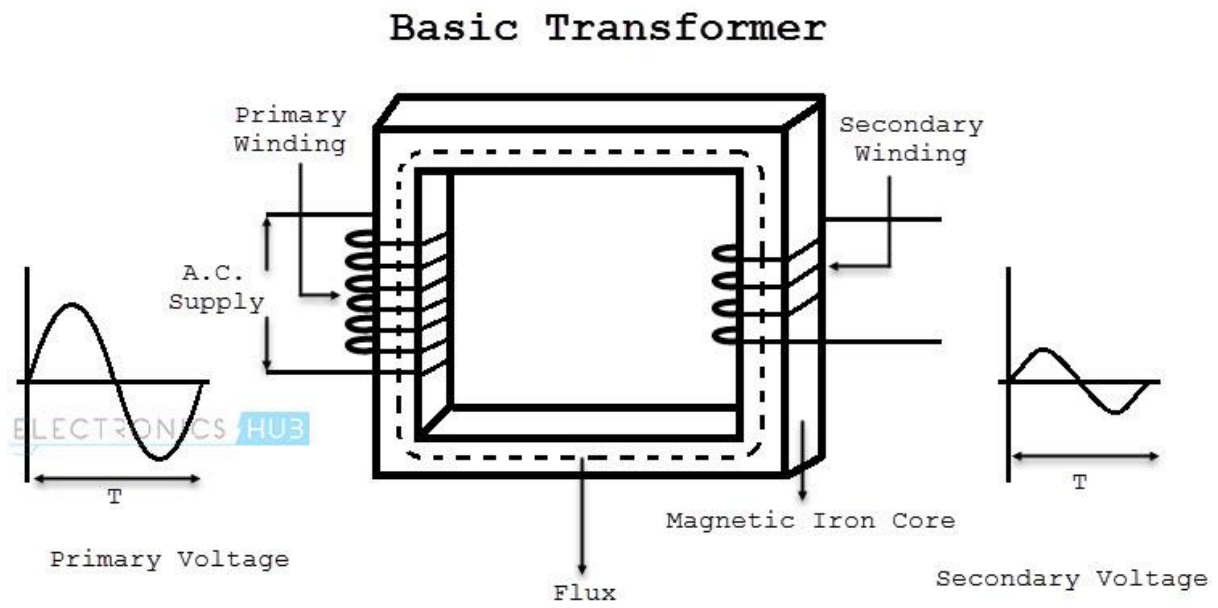
The alternating current flowing in at the primary voltage creates an alternating magnetic flux. This induces a similar current in the secondary coil, creating a secondary voltage. Here, the decreased number of windings in the secondary coil effectively reduces the resultant voltage, hence “stepping down” the voltage to a lower value while maintaining a constant frequency.

Note that while the voltage decreases, the current increases for the frequency to remain constant. For this reason, the secondary coil in step-down transformers usually has a larger-gauge wire for the secondary coil than for the primary coil. Since the primary voltage’s current is low, the wiring of the primary coil doesn’t require an overly thick wire. Conversely, the increased current flowing through the secondary coil necessitates an increase in wire thickness. If the wire in the secondary coil is too thin, the wire melts due to the resistive heat build-up, causing catastrophic failure.

It’s possible to use both step-up and step-down transformers backward. By switching the inflow and outflow, the direction of the electrical stream is reversed. In this manner, a step-up transformer can carry out the function of a step-down transformer and vice versa.

4.8.2 Specifications

- Power Source: AC
- Material: Copper
- Weight: 150



4.9 Rectifier



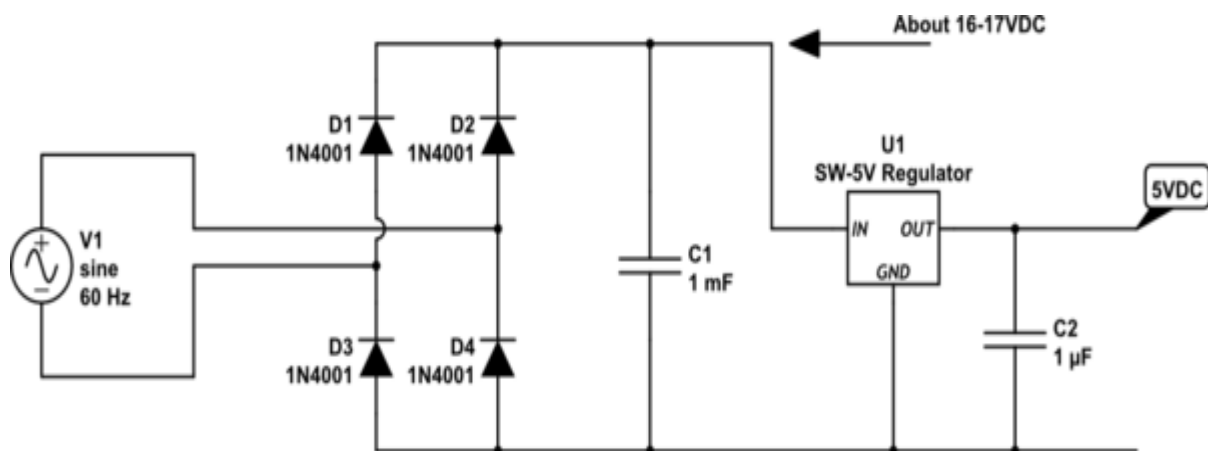
Fig. : 4.11 Rectifier

4.9.1 Product Details

A **rectifier** is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The reverse operation is performed by the inverter. The process is known as rectification, since it "straightens" the direction of current.

4.9.2 Specifications

- Input 12V AC
- Output 12V DC and 5V Constant DC
- Current 1A
- Supply for Controller board, GSM, GPS, SENSORS, any other 12V/5V rated Circuit.



4.10 Servo Motor

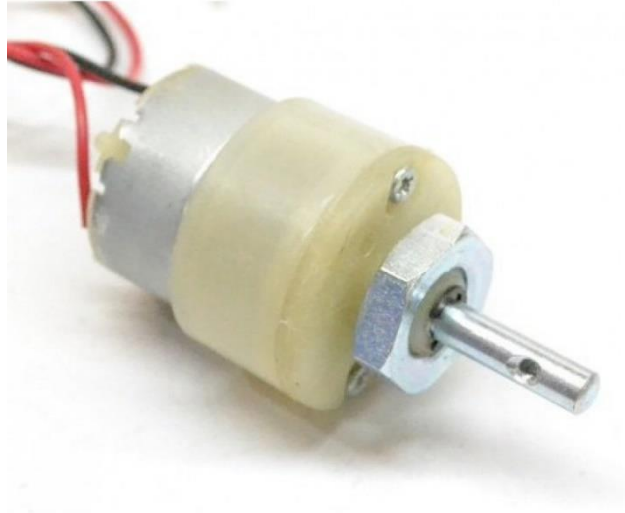


Fig. : 4.12 Gear Motor

4.10.1 Product Details

DC Motor – 300RPM – 12Volts geared motors are generally a simple DC motor with a gearbox attached to it. This can be used in all-terrain robots and variety of robotic applications. These motors have a 3 mm threaded drill hole in the middle of the shaft thus making it simple to connect it to the wheels or any other mechanical assembly.

300 RPM 12V DC geared motors widely use for robotics applications. Very easy to use and available in standard size. Also, you don't have to spend a lot of money to control motors with an Arduino or compatible board. The most popular L298N H-bridge module with onboard voltage regulator motor driver can be used with this motor that has a voltage of between 5 and 35V DC or you can choose the most precise motor driver module from the wide range available in our Motor drivers category as per your specific requirements.

Nut and threads on the shaft to easily connect and internally threaded shaft for easily connecting it to the wheel. DC Geared motors with robust metal gearbox for heavy-duty applications, available in the wide RPM range and ideally suited for robotics and industrial applications. Very easy to use and available in standard size. Nut and threads on the shaft to easily connect and internally threaded shaft for easily connecting it to the wheel.

4.10.2 Specifications

- RPM: 300.
- Operating Voltage: 12V DC
- Gearbox: Attached Plastic (spur) Gearbox
- Shaft diameter: 6mm with internal hole

- Torque: 2 kg-cm
- No-load current = 60 mA(Max)
- Load current = 300 mA(Max).

4.11 Light Dependent Resistor (LDR)

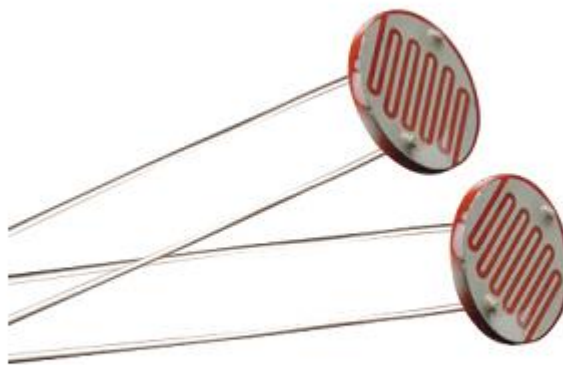


Fig. : 4.13 Light Dependent Resistor (LDR)

4.11.1 Product Details

This is a light dependent sensor used for detecting ambient light. The sensor is available in the size of 3mm and 5mm as per the requirement.

4.12 Rechargeable Battery



Fig. : 4.14 Rechargeable Battery

4.12.1 Product Details

Maintenance-free operation: absorbent glass mat (AGM) technology ensures efficient gas recombination up to 99% and free from electrolyte maintenance, during the expected float service lifespan of JUST batteries, no need to check the specific gravity of the electrolyte or add water

Good discharge ability: tight assembling technology ensures excellent high-rate discharge performance

Long service lifespan: the unique corrosion-resistant grid alloy ensures batteries long service lifespan

Low self-discharge: using high-purity raw materials ensures batteries of less self-discharge rate

Environmental and non-pollution: gas recombination technology ensures the battery high-seal reacting rate, which can prevent the acid fog from spreading out

Safe and reliable: efficient venting system automatically release excess gas when the pressure rises above the normal level and reseals the valves when it returns to the normal rate, which can protect the battery from bursting.

4.12.2 Specification

- Nominal voltage: 12V
- Rated capacity (20-hour rate):15Ah
- Sealed type: sealed
- Maintenance type: free
- Container material: ABS
- Dimensions: (L*W*H*TH)mm: 181*77*167*167

4.12.3 Applications

1. Communication systems: switch, microwave stations, mobile base stations, data centres, radio and broadcasting stations
2. Motility field: robots, electric toys, electric tools and portable vacuum cleaners
3. Solar and wind power generation systems
4. Signal systems and emergency lighting systems
5. EPS and UPS systems

4.13 Software used

Arduino IDE



Fig. : 4.15 Arduino IDE

Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programmed (referred to as a microcontroller) and a ready-made software called Arduino IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board.

Key Features

- Arduino boards are able to read analog or digital input signals from different sensors and turn it into an output such as activating a motor, turning LED on/off, connect to the cloud and many other actions.
- You can control your board functions by sending a set of instructions to the microcontroller on the board via Arduino IDE (referred to as uploading software).

- Unlike most previous programmable circuit boards, Arduino does not need an extra piece of hardware (called a programmer) in order to load a new code onto the board. You can simply use a USB cable.
- Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program.
- Finally, Arduino provides a standard form factor that breaks the functions of the micro-controller into a more accessible package.

Arduino boards based on ATMEGA328 microcontroller

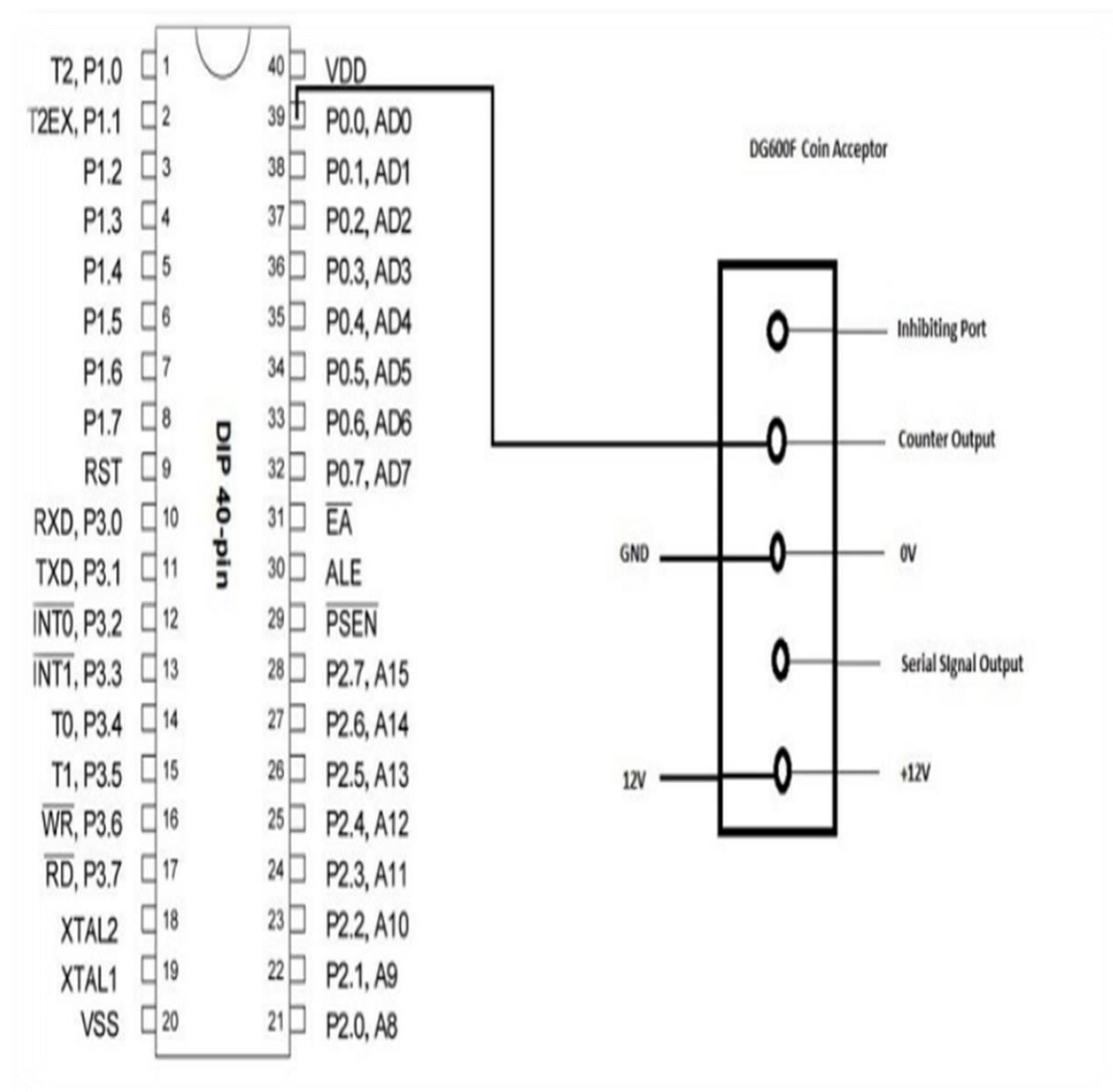
Board Name	Operating Volt	Clock Speed	Digital i/o	Analog Inputs	PWM	UART	Programming Interface
Arduino Uno R3	5V	16MHz	14	6	6	1	USB via ATmega16U2
Arduino Uno R3 SMD	5V	16MHz	14	6	6	1	USB via ATmega16U2
Red Board	5V	16MHz	14	6	6	1	USB via FTDI
Arduino Pro 3.3v/8 MHz	3.3V	8MHz	14	6	6	1	FTDI-Compatible Header
Arduino Pro 5V/16MHz	5V	16MHz	14	6	6	1	FTDI-Compatible Header
Arduino mini 05	5V	16MHz	14	8	6	1	FTDI-Compatible Header
Arduino Pro mini 3.3v/8mhz	3.3V	8MHz	14	8	6	1	FTDI-Compatible Header
Arduino Pro mini 5v/16mhz	5V	16MHz	14	8	6	1	FTDI-Compatible Header
Arduino Ethernet	5V	16MHz	14	6	6	1	FTDI-Compatible Header
Arduino Fio	3.3V	8MHz	14	8	6	1	FTDI-Compatible Header
LilyPad Arduino 328 main board	3.3V	8MHz	14	6	6	1	FTDI-Compatible Header
LilyPad Arduino simple board	3.3V	8MHz	9	4	5	0	FTDI-Compatible Header

Arduino program structure and we will learn more new terminologies used in the Arduino world. The Arduino software is open-source. The source code for the Java

environment is released under the GPL and the C/C++ microcontroller libraries are under the LGPL.

4.14 Interfacing

Interfacing Coin detector to Microcontroller



Chapter 5

RESULTS and DISCUSSION, PERFORMANCE ANALYSIS

The microcontroller is programmed by the Arduino IDE and the language used is 'C'. The coin acceptor when on is always at high and when a valid coin is inserted it turn low for 25ms. So, when coin acceptor turns low the microcontroller detects the signal and commands for passing current to solenoid valve. The microcontroller is kept busy by giving it a counting delay program. Later after certain time the microcontroller output signal to stop passing current to the Solenoid valve.

The solenoid valve has to be programmed to be open for certain time. For 500ml to pass through 0.5mm pipe of the valve is measured in the following 10 trials:

Time trial for dispensing water

Trial	Time taken for dispensing 500ml of water in seconds
1	9.40
2	9.50
3	10.30
4	10.40
5	10.02
6	10.02
7	10.02
8	10
9	10
10	9.30
11	10.20
12	10.20
13	10.04
14	10
15	10
16	10

17	10
18	10
19	10
20	10

The average time taken for 500ml flow of water through the pipe is 10sec.

5.1 Solar Panel Analysis

Consider a solar module having a bellow specification:

- Maximum Power(P_{mp}) = 3WP
- Open Circuit Voltage (V_{oc}) = 11.26V
- Short Circuit Current(I_{sc}) = 0.41A
- Voltage at maximum power(V_{mp}) = 9V
- Current at maximum Power(I_{mp}) = 0.34A
- Irradiance = 1000 W/m²
- Cell temperature = 28 °C

a). During installation, we need to select a suitable place by determining geometrical conditions. Then we need select suitable tilt for the solar panel. The angle should be calculated based on the latitude of the particular location.

Table 1

South facing	15 degrees	
	Voltage	Current
Without shading	9V	0.34A
With Shading	8V	0.14A

Table 2

North facing	15 degrees	
	Voltage	Current
Without shading	6V	0.20A
With Shading	5V	0.1A

India is situated in the Northern Hemisphere (above the equatorial region). So Panels should be facing to south to get maximum output. Table 1 shows that when we face panel to the north getting results less than facing in the south. Thus, comparison table 1 and table 2, Panels should be facing south to get the maximum Sun shine.

b. Climatic Result

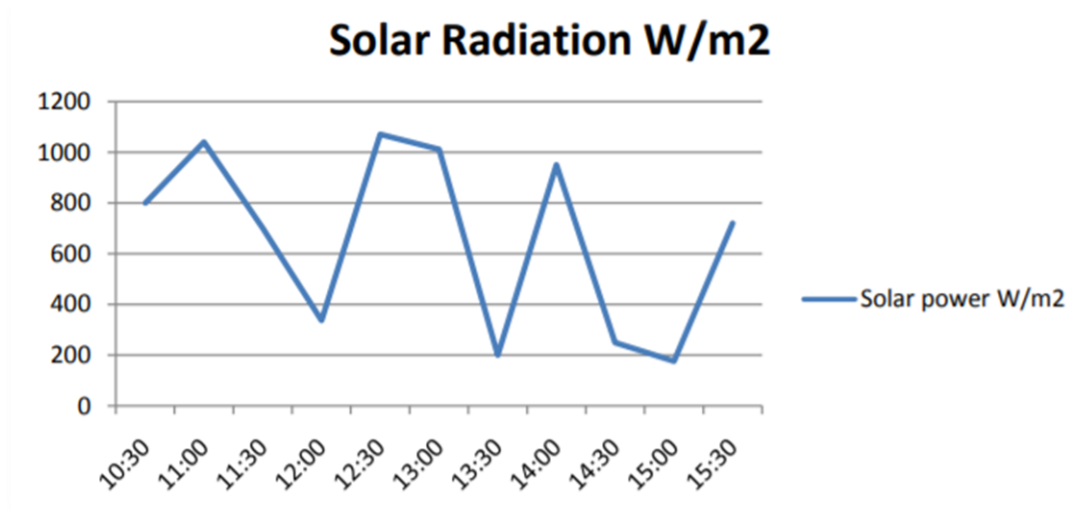
At a particular time, we measure Solar irradiance, Wind Speed, Temperature and Humidity, at the same time noted down the Panel Output readings as Voltage and Current as shown in Table 3.

Table 3 Climate Data

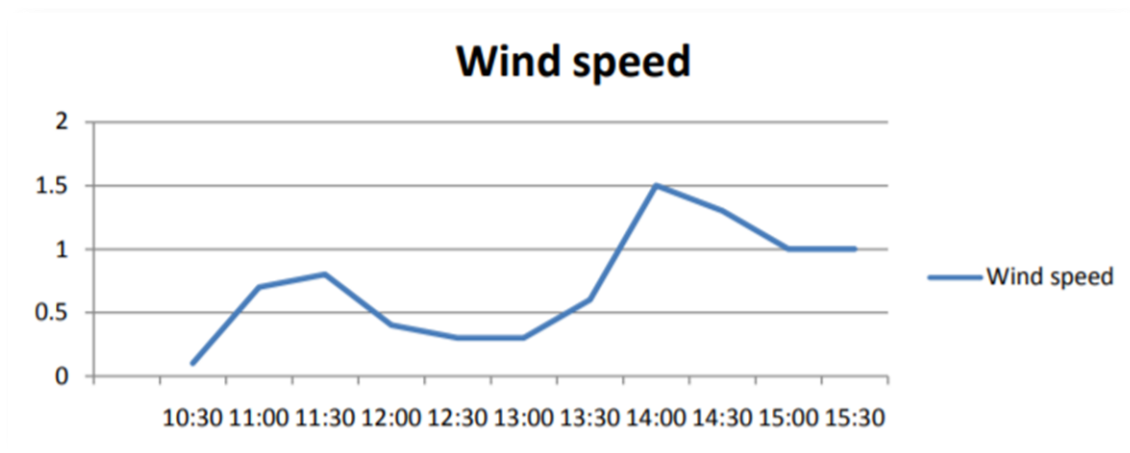
Si no:	Time	Solar Radiation W/m ²	Temperature °C	Humidity %	Wind speed In m/s	Panel output	
						Voltage V	Current A
1	10:30	800	34.0	49	0.1	4	0.07
2	11:00	1040	32.8	52	0.7	6	0.2
3	11:30	700	34.2	60	0.8	5	0.1
4	12:00	336	33.1	46	0.4	4	0.06
5	12:30	1070	33.2	45	0.3	7	0.21
6	13:00	1010	33.6	47	0.3	5	0.1
7	13:30	200	32.6	46	0.6	4	0.06
8	14:00	950	33.3	44	1.5	5	0.25
9	14:30	249	33.4	45	1.3	5	0.2
10	15:00	176	33.8	49	1	4	0.1
11	15:30	720	32.8	44	1	5	0.23

Graphs

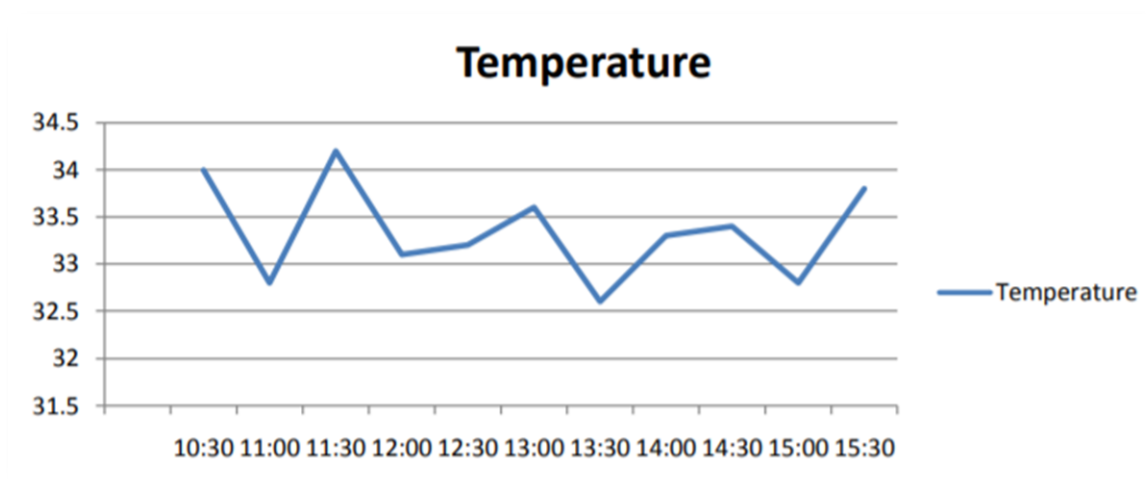
Solar Radiations V/S Time



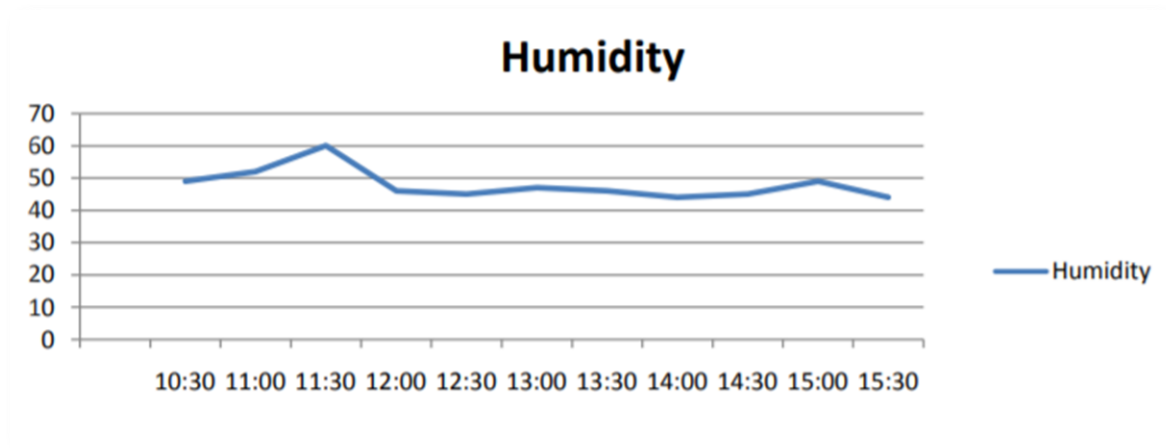
Wind Speed V/S Time



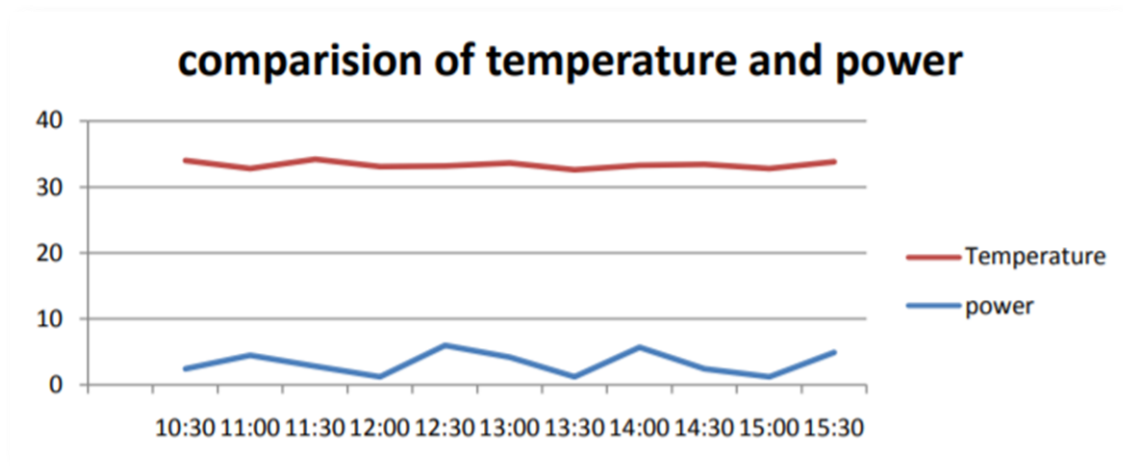
Temperature V/S Time



Humidity V/S Time



Comparison Temperature and Power V/S Time



- Solar powerfully depends upon the irradiation, absorbing surface and sunlight. Absorbing surface and sun should be vertical to each other. Solar cells are sensitive to temperature, increases in temperature decreases the power generating capability shown in fig 8. Mono and Poly crystalline modules are negative temperature coefficient, thus when temperature increases power decreases. Thin film modules are Positive temperature coefficient, thus temperature increases performance also increases. So thin film technology used in high temperature regions.
- Increase in temperature causes slightly increase in current in the solar cells and decreasing in voltage by a greater amount. The result is less power produced as shown in table 3.
- Relative humidity affects the efficiency of Solar panel. Efficiency of Solar panel is high during low relative humidity and also performance is high. Figure 6 shows that humidity varies with time. During Morning and Evening time humidity will be more, thus Performance of the solar panel is minimized. During the peak time, humidity will be less, thus Performance of the panel is maximized. That's why we are getting maximum output during peak time.
- Wind Speed is also considered for performance. At higher Wind speed, the air temperature decreases and output increases, So Wind Speed can help solar

panels perform more efficiently. Thus, during Installation, solar panels should be fixed above the surface level that is 3 or 6 feet, this allows the wind to flow between the solar panels and the roof.

- Finally, to get Maximum Output from the Solar panels we have better climatic conditions. Having an optimum Temperature, more wind speeds, low relative humidity and high solar insolation level.

Chapter 6

SUMMARY and CONCLUSION

This research paper introduces a water dispensing machine which operates on coin and it is a solar powered. Various devices like a regulated power supply, coin sensor water pump, solar panels etc., are embodied to design an efficient dispensing system. The system can be programmed for one rupee coin and for certain duration with the help of algorithm and programming in Arduino. The dispenser can be installed on roads (highways), railway stations and other public places to provide water to people at low cost.

The outcome of this project is Solar powered coin based water dispenser system in which power is supply by both solar panels and by main source depend on climate. This product is design to overcome the problem of unhygienic practices and also reduces the load on electric power plant. And the solar power is also eco-friendly.

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SOURCE CODE

/*

LiquidCrystal Library - Hello World

Demonstrates the use a 16x2 LCD display. The LiquidCrystal library works with all LCD displays that are compatible with the Hitachi HD44780 driver. There are many of them out there, and you can usually tell them by the 16-pin interface.

This sketch prints "Hello World!" to the LCD and shows the time.

The circuit:

- * LCD RS pin to digital pin 13
- * LCD Enable pin to digital pin 12
- * LCD D4 pin to digital pin 5
- * LCD D5 pin to digital pin 4
- * LCD D6 pin to digital pin 3
- * LCD D7 pin to digital pin 2
- * LCD R/W pin to ground
- * 10K resistor:
- * ends to +5V and ground
- * wiper to LCD VO pin (pin 3)

Library originally added 18 Apr 2008

by David A. Mellis

library modified 5 Jul 2009

by Limor Fried (<http://www.ladyada.net>)

example added 9 Jul 2009

by Tom Igoe

modified 22 Nov 2010

by Tom Igoe

This example code is in the public domain.

<http://www.arduino.cc/en/Tutorial/LiquidCrystal>

*/

```
#include <LiquidCrystal.h>
#include <EEPROM.h>
// initialize the library with the numbers of the interface pins
LiquidCrystal lcd(13, 12, 11, 10, 9, 8);
// include the library code:
int  outputValue=0,cc,set1,cnt;
long duration, inches, cm;
int sensorValue1;
int sensorValue;
char oc,occ;
char f1,f2,f3,f4;
int o1,o2,o3,o4;
long hl;

void setup() {
  // set up the LCD's number of columns and rows:
  Serial.begin(9600);
  lcd.begin(16, 2);
  lcd.setCursor(0, 1);
  pinMode (2,OUTPUT);//attach pin 5 to GND
  pinMode (3,OUTPUT);//attach pin 5 to GND
  pinMode (7,OUTPUT);//attach pin 5 to GND
```

```

pinMode (6,OUTPUT);//attach pin 5 to GND
pinMode (A1,INPUT_PULLUP);//attach pin 5 to GND
pinMode (A2,INPUT_PULLUP);//attach pin 5 to GND
pinMode (A3,INPUT_PULLUP);//attach pin 5 to GND
pinMode (A4,INPUT_PULLUP);//attach pin 5 to GND

digitalWrite(7,0);
digitalWrite(6,0);

o1=EEPROM.read(10);
o2=EEPROM.read(11);
delay(5000);
}
void loop() {
  // set the cursor to column 0, line 1
  // (note: line 1 is the second row, since counting begins with 0):
  // print the number of seconds since reset:
  lcd.setCursor(0,1);
  lcd.print(digitalRead(A1));
  lcd.print(digitalRead(A2));
  lcd.print(digitalRead(A3));
  lcd.print(digitalRead(A4));
  lcd.print(' ');
  lcd.print(analogRead(A0));

  if(digitalRead(A1)==0)
  {
    if(o1<120)
    o1++;
    EEPROM.write(10,o1);
  }
}

```

```

    delay(1000);
}
if(digitalRead(A2)==0)
{
    if(o1>0)
        o1--;
    EEPROM.write(10,o1);
    delay(1000);
}
if(digitalRead(A3)==0)
{
    if(o2<120)
        o2++;
    EEPROM.write(11,o2);
    delay(1000);
}
if(digitalRead(A4)==0)
{
    if(o2>0)
        o2--;
    EEPROM.write(11,o2);
    delay(1000);
}
lcd.setCursor(0,0);
lcd.print(o1);
lcd.print("  ");
lcd.setCursor(8,0);
lcd.print(o2);
lcd.print("  ");

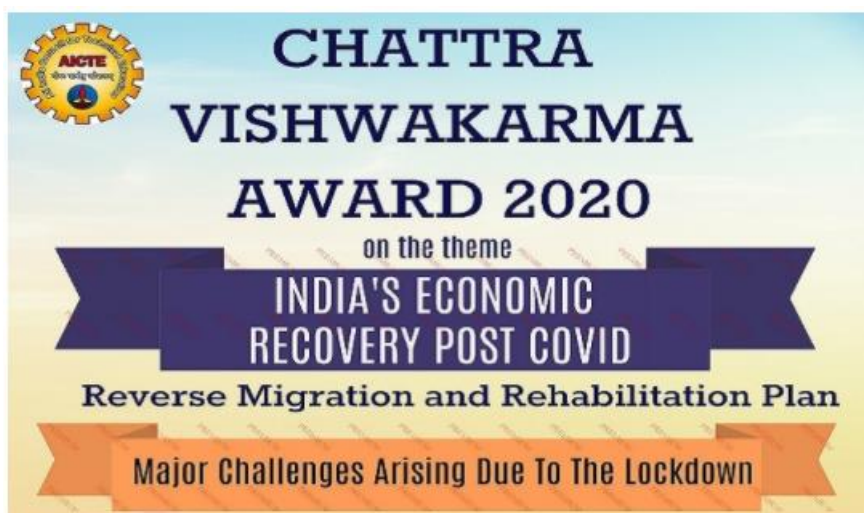
```

```
if(analogRead(A0)>242)
{
  digitalWrite(7,1);
  digitalWrite(6,0);
  delay(o1*1000);
  digitalWrite(7,0);
  digitalWrite(6,1);
  delay(o2*1000);
  digitalWrite(6,0);
}
}
```

PHOTOS

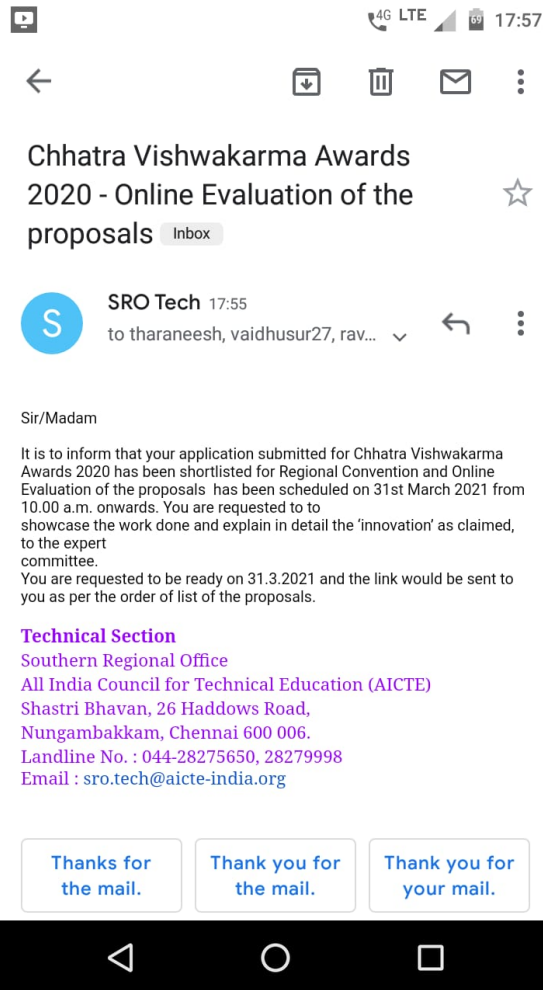


OUR TEAM HAVE APPLIED FOR AICTE CHHATRA VISHVAKARMA AWARD



Application no- VISH202014721

Our Team Shortlisted For Regional Convention



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554	VISH202012980	STATIC LINE 2020	PINEAPPLE LEAF FIBRE NET	PROMOTE VALUE ADDED AGRICULTURAL PROCESSES, PRODUCTS AND HANDICRAFTS	SCAD COLLEGE OF ENGINEERING AND TECHNOLOGY	TAMIL NADU	SOUTHERN

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