VIDYUT- Power generation using renewable source for sustainability

Submitted to University of Mumbai in partial fulfillment
of the requirements of the degree of

Bachelor of Engineering

in

Instrumentation Engineering

by

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Ramrao Adik Institute of Technology

CERTIFICATE

This is to certify that, the Major Project-I entitled

"VIDYUT- POWER GENERATION USING RENEWABLE SOURCES FOR SUSTAINABILITY"

is a bonafide work done by

Ms. Shreya Mani
Ms. Tanaya Mandhare
Mr. Ashutosh Sonar

and is submitted in the partial fulfillment of the requirements for the award of degree of

Bachelor of Engineering
in
Instrumentation Engineering
to the

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Supervisor
Dr. Sharad Jadhav

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Project Co-ordinator	Head of Department	Principal
(Dr. Jayanand Gawande)	**(Dr. Sharad P. Jadhav)**	**(Dr.Mukesh D. Patil)**

Declaration

We declare that this written submission represents our ideas in our own words and where others ideas or words have been included, We have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Date :

Major Project-I Report Approval for B.E

This Major project-I report entitled ***"VIDYUT- Power generation using renewable source for sustainability "*** by ***Ms.Shreya Mani***, ***Ms. Tanaya Mandhare***,and ***Mr.Ashutosh Sonar*** is approved for the degree of ***Bachelor's Degree in Instrumentation Engineering, University of Mumbai***.

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2. ....

Supervisors :
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Date :
Place :

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Date	Signature

Abstract

Sewage waste and sewage waste treatment is one of the most overlooked yet most important aspect with respect to development of a country. With hundreds of people losing their lives everyday due to emission of harmful gases from septic tanks/ sewage waste, this issue is also reported by our hon. Prime Minister Shri Narendra Modi ji in Swachh Bharat Mission, where Government Of India wants youth to come up with digital solutions for Sewage Treatment.In this world of digitization where people are moving towards green economy, and electric vehicles are getting popularised, the major requirement in current times is ELECTRICITY. With conventional methods being burning of coal, which is believed to deplete in few decades, we have to create an alternative. An alternative which is Eco-friendly, cost efficient, easy to install and has high efficiency and usability. As per reports by Oxford University in February 2017 , it is estimated that coal power investors might lose 450-1050 billion dollar as assets would shut down due to environmental reasons. So now its time to utilize the available surplus resources as an alternative so as to overcome this problem, i.e. shortage of raw materials for electricity generation. The current alternative is Sewage waste. Sewage waste is something that is produced every day in huge amounts, precisely 38354 million liters every day in major cities of India. This waste, which is unused and untreated causes many harmful impacts for people as well as environment, reportedly over 347 people lost their lives in last 5 years while cleaning sewers or septic tanks, and the amount of people losing lives due to staying in that environment and accidental deaths is increasing ever since. Sewage waste is proving to be more harmful than the toxic industrial waste and chemicals, resulting in 80 percent of total water pollution globally.This project tries to solve all these problems by using this sewage waste as raw material which is renewable in nature for generating electricity.

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Chapter 1

Introduction

Automation, power consumption, and cost-effectiveness are the most important factors in today's field technology.Energy is the most important parameter for every country, since lives are currently dependent on electricity for every small or larger operation. Every year a total of 1386 billion kWh of energy is produced out of which 5.15 billion kWh is exported and 5.62 billion kWh is imported and own consumption is 1137 billion kWh[1]. For such high usage and production our major source of power generation is burning of coal. Coal not only deposits toxic pollutants in the air resulting in degrading of ecosystem as well as human health. It can cause cancer, damage of nervous system and impacts immunity.It not only pollutes air, but also land and water. It also causes global warming, poisoning of rivers and acid rain. This acid rain has corroded so many beautiful monuments, which are also national heritage sites for India.

Coal mining has caused various harmful effects degrading natural ecosystem,such as problems to forests and irreparable damage to landscapes. it is also resulting in damage to humans, plants and vegetation, animals and environment.Coal power plants reportedly emit upto 60 different hazardous air pollution causing gases and substances, there is yet no solution to completely eradicate these pollutants, as reported by scientists[2].Over 115000 people die every year owing to coal fire power plant pollution. More than 100000 premature deaths are reported, because of asthma and respiratory ailments to coal exposure[3]. Currently, India is producing over 200 gigawatts of power, out of which more than 50 percent is coming from coal.

Sewage waste is something that is produced every day in huge amounts, precisely 38354 million liters every day in major cities of India. Using this surplus unused material as fuel will not only reduce the load on coal, which is currently the primary burning fuel, but will also result in high efficiency, since there will be lot of raw material, and also help in proper utilization and treatment of the sewage waste. There are various alternatives as solar power, nuclear energy and hydro power plants, but these methods are very costly and tedious, reducing its use ability and feasibility. Sewage waste comes as a comparatively cheap, easily available and more feasible option[4].

1.1 Motivation

The major motivation for this project was to make lives easier by using technology by fulfilling these goals:

- Utilizing available sources to create solutions.
- Promoting sustainability by using renewable resources.
- Creating environment friendly product to promote better development of society.
- Utilization of sewage waste which is available in surplus.
- Creating awareness about importance of sewage waste so as to promote safe and proper sewage treatment.
- Generating electricity to promote greener economy and supporting Electrical appliances.
- Implementing automation to reduce load on humans and avoid errors.
- Introducing smart monitoring to have coordination between multiple power plants.
- Avoiding hazardous events by implementing smart automation system, thus saving lives.

1.2 Objective

The primary objectives of this project are as follows:

- To create a system for generating electricity using renewable resources.
- Spreading awareness about importance of sewage waste and sewage treatment.
- Reducing load on pollution causing coal.
- Reducing load on Humans, and ensuring that no waste is wasted.

1.3 Report Organisation

Chapter 2 is the in depth literature survey of the project.**Chapter 3** gives the detailed description of the block diagram.**Chapter 4** gives an introduction to required hardware for this system as well as implementation methodology.**Chapter 5** will deal with the discussion of the result of this project as well as cost analysis.**Chapter 6** gives the conclusion of the project.

Chapter 2

Literature Survey

Various cases of generating electricity using renewable sources were studied before selecting sewage waste as raw material for electricity generation.[8] These case studies used Gobar Gas, Kitchen waste, and other similar wastes and have shown successful results. This lays the foundation of expecting similar (or better) outcomes by using sewage waste, which is more easily available.

2.1 Naravi Village Case Study

Naravi Village is about 50 km away from the M.I.T. campus. It is a small village with 25 families, each of which has three to four cows or buffalo. It is situated in one of the most isolated areas in Karnataka's hinterland. Although the grid supply is present, it is quite inconsistent, with power outages lasting up to 6 to 8 hours during the busiest summer months.[5]Setting up transmission and distribution for this remote town requires more capital. Additionally, the increasing distance from the power plant results in an increase in transmission and distribution losses. On the other hand, decentralised power generation utilising locally produced biogas can successfully provide lights in these remote locations. The system becomes independent as a result. The raw materials are widely accessible.The complete system can be created using local technology, and the fuel is clean and easily accessible in the area.

The location of the case study is excellent for the production of electricity utilising biogas energy. It is the ideal model that the Panchayat at the village level can use, allowing all of the village's energy needs—including power, lighting, and cooking—to be satisfied by using cow dung and other human waste products. At a total cost of Rs. 30,000, two floating dome biogas plants with a 15 cubic metre capacity each were set up. Utilizing a combination of diesel and biogas, the generated biogas is used to power a 5-HP diesel engine (2:8).[6]The electricity produced is used specifically for lighting.

This directly results in the saving of diesel. In this instance, a 4.5 KVA alternator (AC generator) that is powered by a 5 HP diesel engine is being employed. Since this unit's output is used for lighting, it runs for 6 hours each day, producing roughly 21.6 Kwh of electricity daily. 16 litres of diesel are saved per day. The kiln/dryer, which bakes areca nuts from a nearby plantation, is powered by the biogas produced at this facility.Kerosene that would have otherwise been utilised is saved as a result. Because biogas is a clean fuel, it doesn't emit any pollutants even when it is burned, helping to keep the ecological balance of rural areas. The biogas facility also produces

BIOMANURE, which is a byproduct that may be sold directly to the locals.

RESULTS AND ANALYSIS OF NARAVI VILLAGE

1. Total Biogas Produced: 15.5 x2=31 cubic meter.
2. Total Biogas Produced: 15.5 x2=31 cubic meter.
3. Total gas production in cubic feet = 31x35.314 = 1094.73 cft.
4. Dung that can be obtained from a single healthy buffalo= 12 Kgs.
5. Biogas generated from each Kg of dung = 1.3 cft. so no. of cattle required = (1059.42/12/1.3) = 67
6. A diesel generating set of 5HP/4.5KVA [6] is run 6 hrs (6:30pm to 12:30am) everyday for lighting using the biogas in conjunction with diesel in the ratio (1:4).
7. The saving in diesel consumption per day is approximately 15 liters.
8. It is used to power 60 bulbs of 60 w each, thus providing 3 bulbs per home.
9. Biogas required for motive power per HP per hour = 15 cubic feet.
10. Biogas required to run the above mentioned engine for 6 hrs everyday = 15x5x6 =450 cubic feet.
11. The remaining biogas (1059.42-450 = 609.42 cubic feet) used to run the kiln/dryer, which in turn is used to bake the raw areca nut.
12. 1 cu. M of biogas can be replaced by 0.620 l of Kerosene (using standard replacement tables).
13. Saving in kerosene per day when biogas is used instead=609.42/35.314x0.620 =10.7l

PAYBACK PERIOD CALCULATIONS FOR NARAVI VILLAGE

1. Cost of generator and related accessories = Rs. 20,000
2. Total cost of set up = Rs 50,000.
3. No. of units of electricity generated by generator set = 4.5x 6 x 0.8 = 21.6 units
4. Saving in the cost of electricity per day @ Rs. 3.5 per day= 21.6x3.5 = Rs. 75.6
5. Saving in the cost of Kerosene per day @ Rs. 5 per liter =10.7x5 = Rs. 53.5
6. Income from bio manure per day from the biogas plant =Rs. 90
7. Cost incurred in diesel consumption per day=4x20=Rs. 80
8. Total payback period days = 50,000/(75.6+53.55+90-80)= 360 days = 1 year approx.

2.2 Shivalli Village Case Study

Shivalli village is located next to M.I.T campus. The campus contains a sewage treatment facility and a well-designed underground sewage infrastructure. The hostels' liquid food wastes are added to the sewer system as well. A a 145 cubic meter fixed dome type biogas plant has been established here. Currently, 95 cubic meters of gas may be effectively and profitably tapped. The key components of this biogas plant are:

- Grit chambers and grease chambers have been installed at each college mess to remove sand, other gritty materials, and oils from sewage.
- An inlet chamber for the sedimentation tank has been included for adequate flow control.
- A pressure booster unit has been installed to regulate pressure and flow of gas at constant points.
- 2 units of 45 cubic meter capacity gas generator system (Digester and fiberglass)

Through an underground sewage system, all of the sewage from the neighbourhood, including the MIT Hostels, goes to the sedimentation tank. This tank's fermented or digested sludge is fed into the biogas plant where it is turned into manure that may be sold to farmers. Aside from enriched manure, it is expected that the night soil sludge, food waste, vegetable cuttings, etc., is enough to produce 3178.26 cubic feet (90 cubic metres) of biogas daily. The gas generated will be enough to fill three to four messes at MIT. If just used for electricity generation, a diesel engine with suitable capacity is predicted to be able to create 22 KVA of power when operating in dual mode.

The projects' advantages include the following:

- The MIT Campus's garbage disposal issue has been resolved.
- The gas produced each day is equivalent to 42kg of LPG (if used just for culinary purposes), or roughly 3.25 cylinders, saving Rs. 890 each day.
- The price of the daily manure production is Rs. 350.
- Considering that the project's cost of Rs. 5.4.lakhs will be recovered in around 2.4 years,it is extremely cost-effective.
- The estate might be landscaped using the water that the Project releases.

RESULTS AND ANALYSIS OF SHIVALLI VILLAGE

1. Amount of Biogas produced : 48x2 = 96 cubic meter.
2. Total gas production = 96x36.42 = 3496.32 cft.
3. Dung that can be obtained from a single healthy buffalo = 15 Kgs.

4. Biogas that can be generated from each Kg of dung = 1.4 cft.. Therefore no. of cattle required = 3496.32/15/1.4 = 166.5 Out of the total gas production of 96 cu. M around 34 cu.M is used for lighting purpose. A diesel generating set with a capacity of 12 HP/10.8 KVA[7] is used for lighting during the 6 hours (6:30 p.m. to 12:30 a.m.) of daily operation (2:8). It is used to power 152 bulbs of 60 w giving each home access to 4 bulbs.

5. Biogas required for motive power per HP per hour = 16cft.

6. Biogas required to run the above mentioned engine for 6hrs everyday= 16x12x6 = 1152 cft.

7. The remaining biogas (3496.32-1152 = 2344.32 cft) used for cooking purpose in the Kitchens of various messes of M.I.T

8. 1 cu. M of biogas can be replaced by 0.513 Kgs of Butane (LPG) (using standard replacement tables) Saving in LPG per day when biogas is used instead = 2344.32 /36.42x0.513 = 33.02 Kgs

PAYBACK PERIOD CALCULATIONS FOR SHIVALLI VILLAGE

1. Cost of Biogas plant setup and the generator related setup = Rs. 6.4 lakhs.

2. No. of units of electricity generated by generator set = 11.2x6.4x0.9 =64.51 units

3. Saving in the cost of electricity per day @ Rs. 3.6 per day = 64.51x3.6 = Rs. 232.24

4. Saving in the cost of LPG per day @ Rs. 280 per 14.2 Kgs = (280/14.2)x25.72= Rs. 507

5. Income from bio manure per day from the biogas plant = Rs. 460

6. Cost incurred in diesel consumption per day = Rs 15x20 = Rs. 300

7. Total payback period days = 640000/ (232.24+507+460- 2300) = 711 days = 1.95 years

2.3 Bajagoli Village Case Study

About 55 kilometres separate the village of Bajagoli from Manipal Institute of Technology. Ideal ice creams ltd. A milk dairy has been built in Mangalore on a 3–4 acre tract of land. On campus, there are about 55 cattle kept. Manufacturing of cattle feed is also set up. A 28 cubic meter biogas plant provides the college with all of its electrical energy.

RESULTS AND ANALYSIS OF BAJAGOLI VILLAGE

1. Total production of Biogas: 28x1=28 cubic meter.
2. Total gas production in cubic meter. = 28x36.42 = 1019.76 cubic feet.
3. Dung that can be obtained from a single healthy buffalo = 15 Kgs.
4. Biogas that can be generated from each Kg of dung = 1.4 cubic feet. Therefore no. of cattle required = (1019.76/15/1.4) = 48.6 app.
5. diesel generating set of 5HP/4.5KVA [7] is run 6 hrs (6:30pm to 12:30am) everyday for lighting using the biogas in conjunction with diesel in the ratio (2:8). It is used to power 151 bulbs of 60 w each, thus providing 3 bulbs per household.
6. Biogas required for motive power per HP per hour = 15 cubic feet.

Chapter 3

Block Diagram and Description

3.1 Proposed Work

- Aims at solving the issue of shortage of raw material, and soon depletion in near future, by involving major automation techniques and replacing coal by renewable resource.
- Firstly the mechanical work of assembling the various parts of project, viz. Digester, Boiler, Turbine and Dynamo is performed to ensure that electricity generation using renewable sources takes place.
- Secondly, the automation process of boiler using sensors, indicators and controllers is performed to make the system more efficient and less prone to hazards.
- Lastly, smart monitoring is performed using the database of, capacity of power plant and availability of load, to further enhance the efficiency of the project.

3.2 Block Diagrams

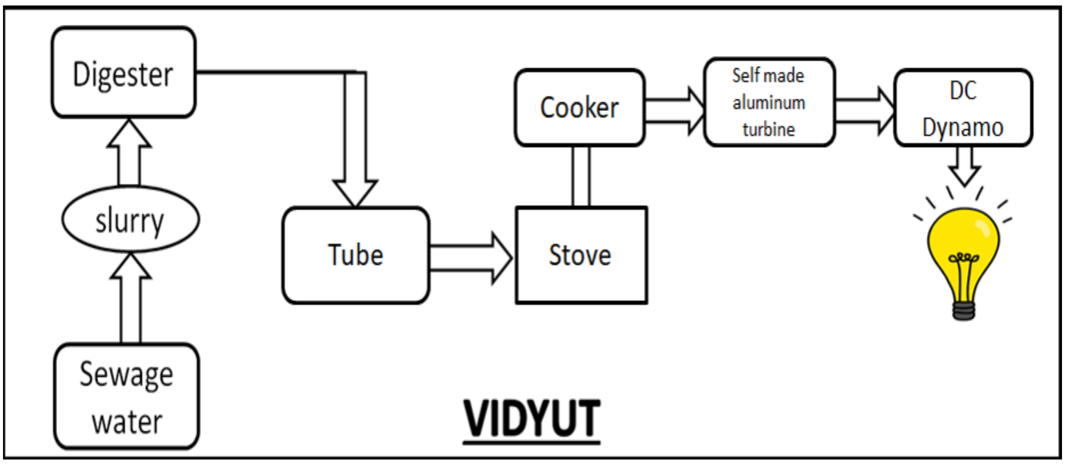

Figure 3.1: Block Diagram of overall system

In the **figure 3.1** there are four major steps. Firstly sewage waste is collected, screened and filtered to create slurry, which is transferred to the digester. This digester stores the slurry in anaerobic conditions for few weeks, which then collects the methane [gas] at the top. This collected gas is used as fuel and is used to provide heat to the boiler [cooker], which produces continuous steam. This steam is used to turn the propellers of the turbine and generate electricity using dynamo.

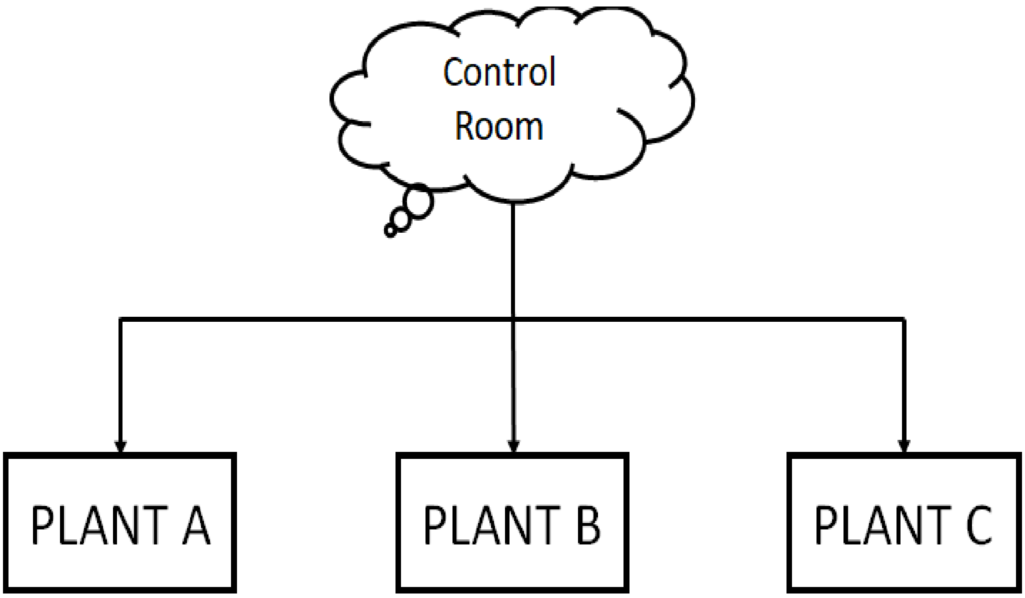

Figure 3.2: Block Diagram of smart monitoring system

In the **figure 3.2** there is a system for smart monitoring of the waste generated. This uses a logical algorithm to keep track of available raw material and demand of the same, so as to have maximum efficiency and least wastage.

In the **figure 3.3**, there are three sensors on the transmitter side, which will be mounted on the boiler. Temperature sensor, Gas sensor and voltage sensors are present which are connected to ATMEGA328 Microcontroller to maintain the temperature as well as prevent gas leakage. The indicator on the boiler is buzzer and LED and a 16 x 2 LCD display. For control action a water pump motor and servo motor are used, these are used to control/moderate the flow rate of liquid in the boiler, thus ensuring that the boiler does not dry or overflow. This transmitter side is connected to a receiver side, which can be present in remote location or control room, via HC 12 Wireless Module. Receiver also uses ATMEGA328 Microcontroller, and has buzzer, LED and 16 x 2 LCD display as indicaters.

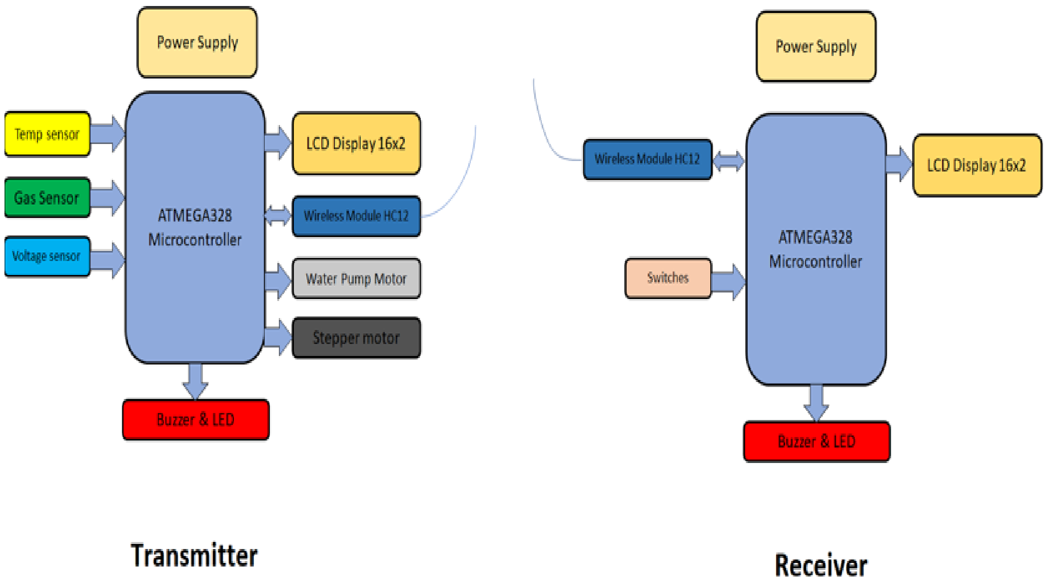

Figure 3.3: Block Diagram of smart automation system for boiler

3.3 Technical Insights

ATMEGA 328

- The high-performance Microchip 8-bit AVR® RISC-based microcontroller includes a serial programmable USART, a byte-oriented Two-Wire serial interface, an SPI serial port, a 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages),1 KB EEPROM, 2 KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes The gadget runs on 1.8 to 5.5 volts. In several projects and autonomous systems that call for a straightforward,inexpensive microcontroller, ATmega328 is frequently employed. The popular Arduino development platform, specifically the Arduino Uno, Arduino Pro Mini, and Arduino Nano versions, may feature this chip the most frequently.

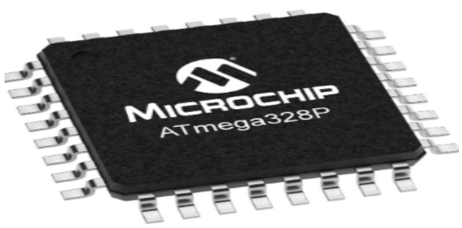

Figure 3.4: ATMEGA 328 [9]

MQ4 GAS SENSOR

The MQ4 methane gas sensor is widely used to find gas leaks in homes and in businesses that deal with methane (CH4) and CNG gas. This gas sensor responds quickly and highly, thus a potentiometer can be used to modify it based on the required sensitivity. The MQ4 methane gas sensor is an analogue voltage-generating MOS (metal oxide semiconductor) type sensor that is used to measure the amount of methane gas in the air at either homes or businesses. The concentration range for sensing in this instance is between 300 pm and 10,000 ppm, which is suitable for leak detection.

The MQ-4 methane gas sensor module has four pins, which are covered in further detail below:-

-

- VCC Pin: The module receives power from this pin, which typically operates at +5V.
- GND Pin: This pin is utilised to link the sensor module to the system's GND terminal.
- The DO (Digital Out) Pin establishes a threshold value using a potentiometer to generate digital output.
- AO (Analog Out): Depending on the gas intensity, this pin produces output analogue voltage that varies from 0 to 5V.

Figure 3.5: MQ4 GAS SENSOR[10]

LCD DISPLAY

This is a list of parallel port examples. The bi-directional feature offered on later ports is not used in this example. As a result, it should operate with the vast majority, if not all, parallel ports. The use of the status port as an input for a 16 character into 2 line LCD module to the parallel port is not shown. Small LCD panels are used in LCD projectors and portable consumer gadgets such as digital cameras, watches, digital clocks, calculators, and cellphones, including smartphones.

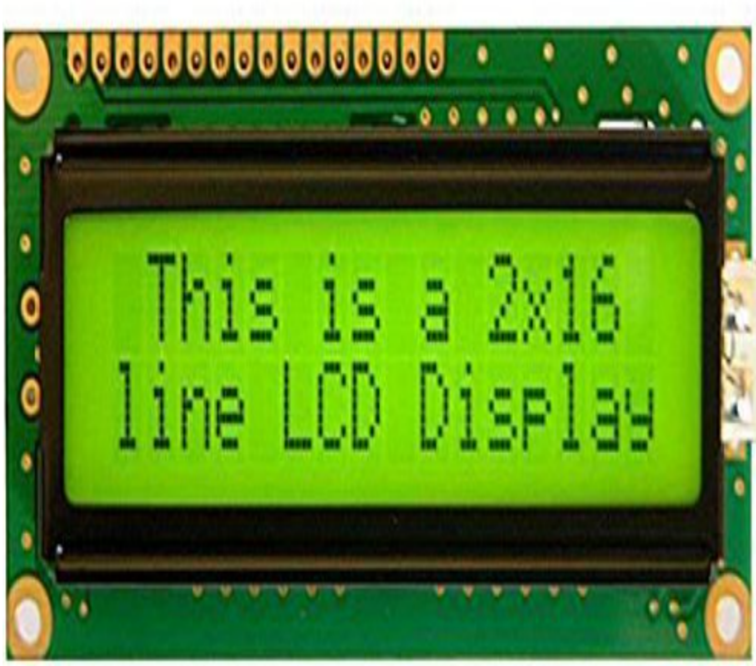

Figure 3.6: LCD Display[11]

12C Module

12C is a packet switched serial bus that is single-ended, synchronous, multi slave, and multi master. For example, multiple chips can be connected to the same bus.The Serial Data Line (SDA) and Serial Clock Line, which are both bidirectional active collector or open drain lines, are both pulled up with resistors in 12C. The 12C LCD is a simple display module that makes showing easier. It can help producers focus on the core of their business by making it easier to produce. With just a few lines of code, users can accomplish complex graphics and text display features using an Arduino library for 12C LCD

DS18B20 TEMPERATURE SENSOR

One sort of temperature sensor is the DS18B20, which provides values of temperature in the 9- to 12-bit range. These numbers display the device's temperature. This sensor can connect with an internal CPU using a one-wire bus protocol, which uses a single data line. In addition, this sensor receives power directly from the data line, eliminating the need for an external power source. The DS18B20 temperature sensor has a variety of uses, including in thermostatic controls, consumer goods, industrial systems, and thermally sensitive systems.

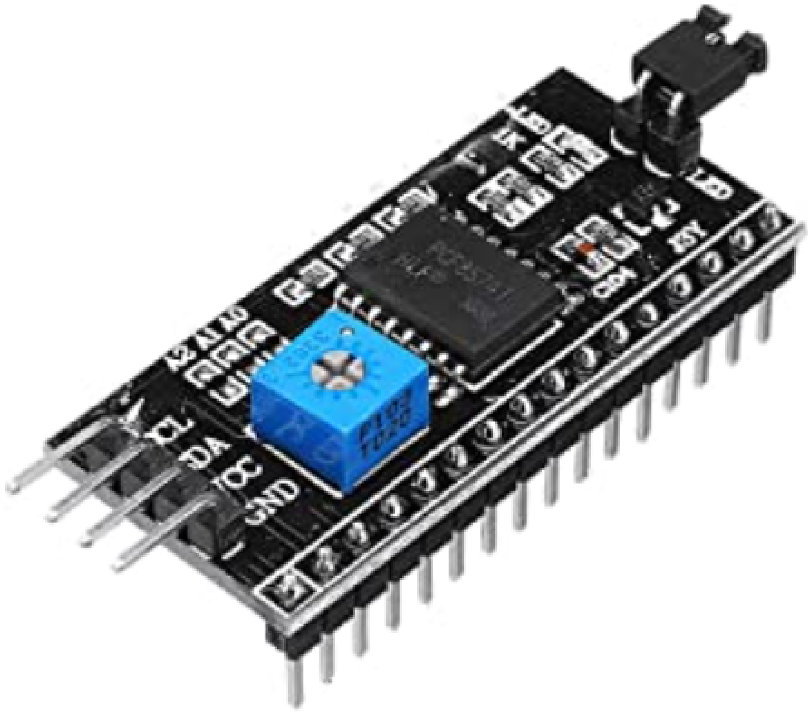

Figure 3.7: 12C Module[12]

Figure 3.8: DS18B20 TEMPERATURE SENSOR[13]

HC12 WIRELESS MODULE

The HC-12 is a 100-channel, half-duplex wireless serial communication module operating in the 433.4–473.0 MHz band with a maximum transmission range of one kilometre. The first part in this project will use the HC-12 to build a wireless connection between two computers, and the last piece will build a straightforward wireless GPS tracker. Half-duplex 20 dBm (100 mW) transmitter and -117 dBm (210-15 W) sensitivity at 5000 bps receiver make up the HC-12. These transceivers are more than capable of giving coverage throughout a standard house and can communicate up to and probably somewhat beyond 1 kilometre in the open when paired with an external antenna.

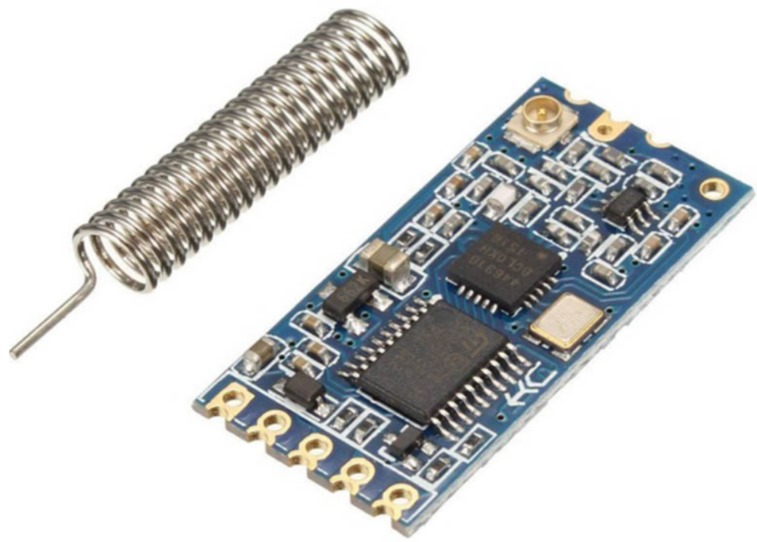

Figure 3.9: HC12 WIRELESS MODULE[14]

STEPPER MOTOR

Power is converted by all motors. Electric motors use electricity to create movement. Electricity is converted into rotation by stepper motors. A stepper motor may be extremely precisely controlled in terms of how quickly and how far it will rotate in addition to converting electrical power into rotation. Stepper motors get their name from the fact that each electrical pulse causes the motor to rotate one step. Stepper motors are managed by a driver, which drives the motor by sending pulses into it. The amount of pulses delivered into the driver's driver equals the number of pulses the motor turns. The frequency of those same pulses will be used to determine how fast the motor will spin. Stepper motors are incredibly simple to manage.

LED

A semiconductor light source is a light-emitting diode. LEDs are rapidly being employed for lighting and as indication lamps in a variety of applications.Forward biasing a led diode causes electrons within the device to recombine with holes, releasing energy as photons.

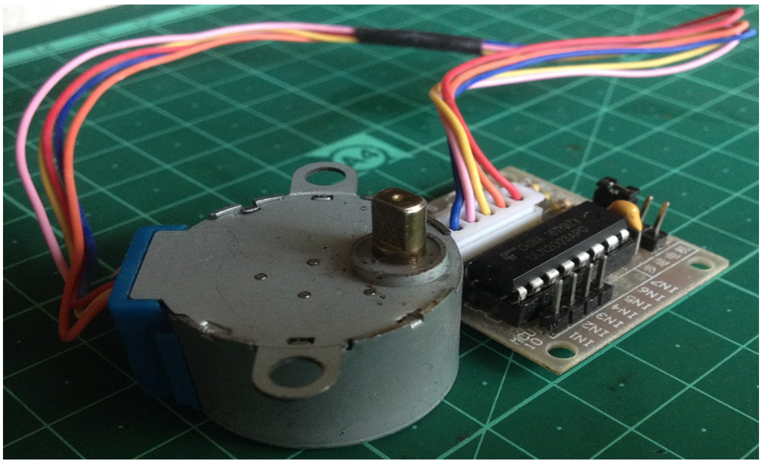

Figure 3.10: STEPPER MOTOR[15]

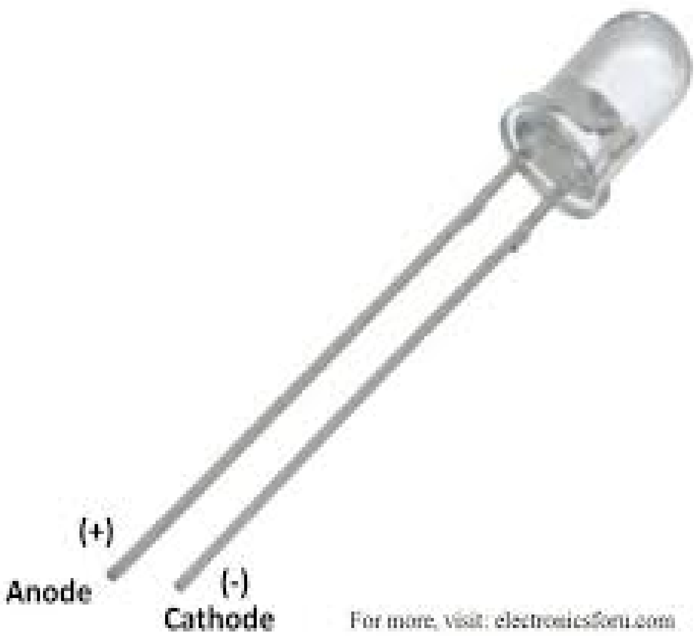

Figure 3.11: LED

Chapter 4

Design and Implementation

4.1 Design Methodology

The final expected outcome is to create a completely automatic, monitored and controlled system, which will generate electricity by using methane collected from sewage waste as fuel. This can be achieved and explained in three steps mentioned below.

THE FIRST STEP

GENERATION OF ELECTRICITY

This step is the primary stage which deals with the mechanical work. In this stage sewage waste is collected and stored in a digester. Upon being in digester for few weeks, the methane is released and is collected at the top of the digester. This methane is collected and used as fuel to produce heat to the boiler. The boiler [cooker] is used to produce steam. The steam pressure from this boiler is used to turn the propellers of the turbine. Upon rotation, the mechanical energy is converted to electrical energy using dynamo. The electricity that is generated can be used for various purposes.

THE SECOND STEP

SMART AUTOMATION OF THE BOILER

The boiler is the main element of this project, and any deviation from ideal conditions can result in a disaster, so to avoid that complete smart automation and indication is included in Vidyut, so as to avoid any damage to apparatus or property. On the transmitter side, there are three sensors that will be mounted on the boiler. In order to regulate the temperature and stop gas leaks. MQ4 gas sensor, DS18B20 temperature sensor are present and connected to an ATMEGA328 microcontroller. The boiler's indicator consists of a buzzer, LED, and 16 x 2 LCD display. A water pump motor and servo motor are used to control and moderate the flow rate of liquid into the boiler. This prevents the boiler from drying out or overflowing. The HC 12 Wireless Module is used to link this transmitter side to a receiver side, which may be found in a nearby location or control room. Additionally using an ATMEGA328 microcontroller, the receiver side has a buzzer, LED and 16 x 2 LCD display as an indicator.

THE THIRD STEP

SMART MONITORING OF MULTIPLE PLANTS

Upon implementation in multiple locations, viz. Panvel, Kharghar and Vashi, and so on, it can become difficult to keep track of multiple capacity, load and wastage of sewage waste is possible in various locations. To solve this problem Vidyut uses an algorithm which keeps track of surplus waste in the vicinity and gives message to transfer the surplus waste to the nearest plant which is short of waste on that day.

Flowchart for smart monitoring system

The Figure 4.1 indicates the flowchart for the same. It uses the concepts of multi-dimensional matrixes, loops and if else ladders to create the solution. The algorithm is designed in JAVA language. Firstly an 2D array is initialized which stores the data of Capacity and Load every day for all plants. It then calculates the balance, to check if the plant has surplus, sufficient or less load.

Later two single dimensional arrays are created one stores the plants with surplus load and another with plants having less load. These are automatically sorted in order of increasing distance from left to right. It then displays message on the screen indicating loads from which plants are to be transferred to which plant.

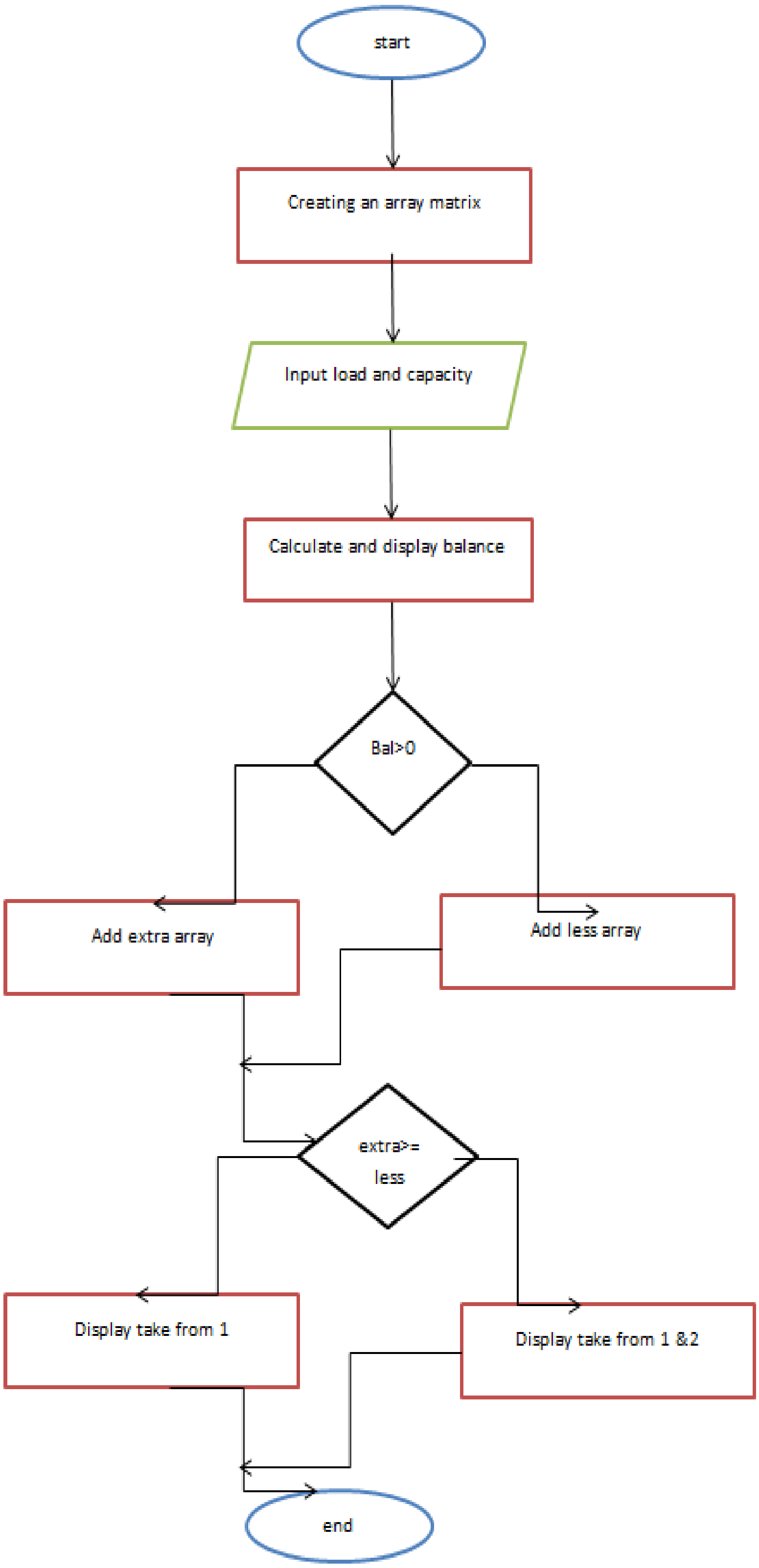

Figure 4.1: Flow chart for smart monitoring system

Chapter 5

Results And Discussion

5.1 Results

The **Figure 5.1** is showing complete block diagram of working system of this project.

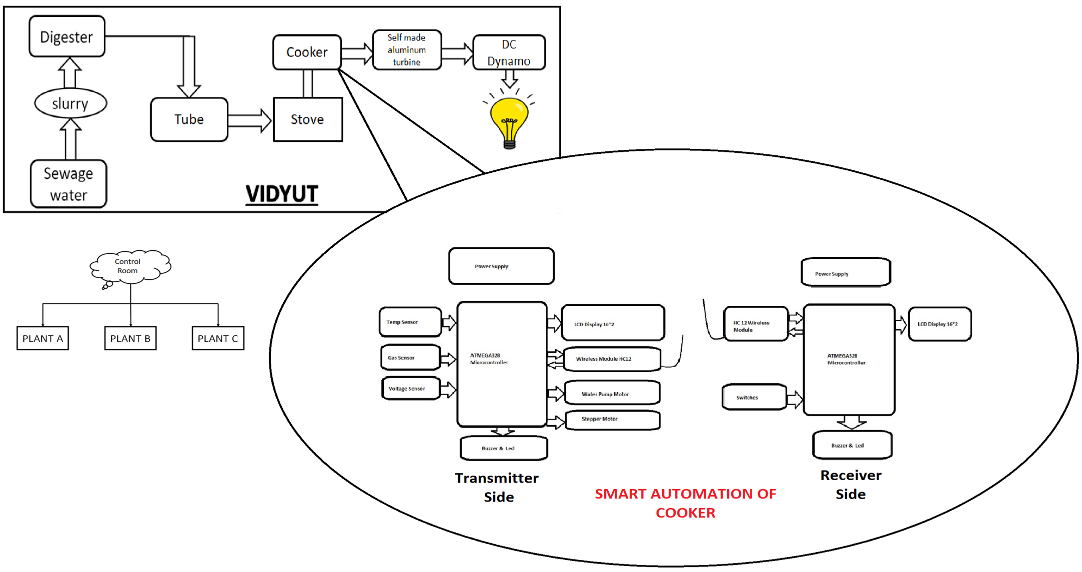

Figure 5.1: Complete block diagram of Working Model

Discussion

The first step in the implementation of this project was to screen and filter the sewage waste so as to remove unnecessary elements like plastic, gravel and so on. This was done to increase the efficiency by removing the items that can do otherwise. Next step was to create the slurry. This was done by adding water to the screened and filtered sewage waste so as to get a consistency which is similar to the consistency obtained by using water and kitchen waste in 1:1 ratio. This slurry was later stored in a digester by maintaining anaerobic conditions. Storing it in dark and anaerobic conditions releases a mixture of gases, this is then collected at top of the digester.

This gas was then analyzed using the 'Biogas Analyzer' and the nature and quantity of all the elements was noted.

Figure 5.2: D.Y. Patil Biogas plant

Figure 5.3: Collection of methane from D.Y. Patil Biogas plant for analysis puprpose

Figure 5.4: Methane from biogas plant stored in tube

Figure 5.5: Analysis of gas from biogas plant and sewage waste under the guidance of of MR. Prashant Jadhav sir

Figure 5.6: Result of gas analysis from biogas plant

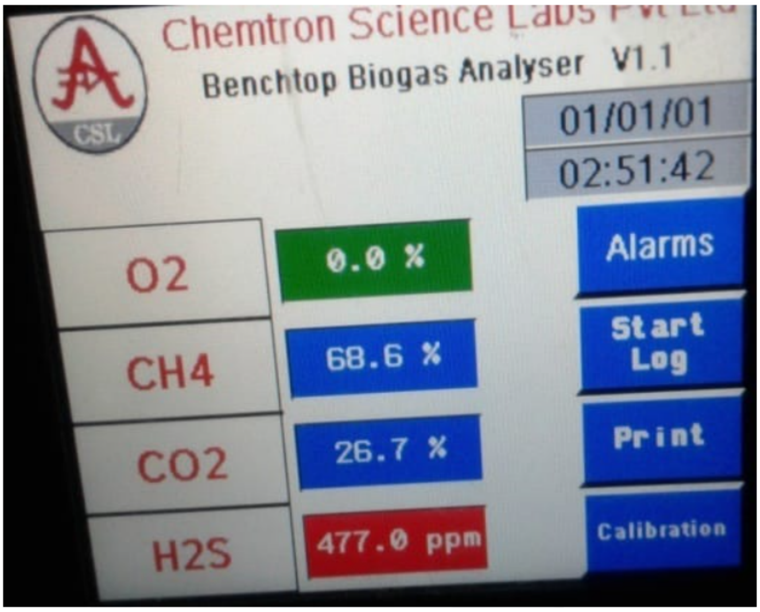

Figure 5.7: Result of gas analysis from sewage waste

The **figure 5.6 and 5.7** shows the concentration of Methane, Carbon dioxide, Oxygen and Hydrogen Sulphide in methane collected from biogas plant as well as methane collected from sewage waste. Biogas plant had around 72.5 percentage of methane while sewage waste gave out around 68 percentage methane. Hydrogen Sulphide which is present in traces was eliminated by passing the gas over metal shavings. This also helps in removing Carbon dioxide. Over 65 percentage presence of methane is a good number and on increasing the quantity of sewage waste, say 100 TPD plant, this 65 percentage can prove to bring a revolution in the electricity generation scenario in India and in world. This methane was then burned using stove and this heat was used to generate steam in the boiler [cooker].The steam from this was used to turn the propellers of the turbine. This conversion of mechanical energy to electric energy was used to generate electricity. A dynamo was used or this purpose.

- A smart automation system proves to be an essential part of the system because it prevents potentially harmful incidents. HC12 wireless module is used in this project for wireless communication between transmitter and receiver side and it performed smoothly. Temperature sensor DS18B20, voltage sensor, and gas sensor MQ4 are employed at the transmitter side as inputs to monitor boiler condition and show data on both sides. Time, water level, and temperature limit are utilised as switches on the receiver side of the system which set some values to the main unit and process all of these set values based on the control action was performed in the event of an emergency

- Lastly, smart monitoring was performed for optimization of the project, and to make it useable in multiple locations at the same time. This was done using an algorithm, designed in java language. It used the concepts of multi-dimensional arrays, if else ladder, loops and similar concepts. Utility library was imported to use the scanner class, so as to make it a user friendly code. The algorithm involves initializing a 2D array of order 3 x 3 (here for Panvel, Kharghar and Vashi plants) which can be further increased to N x 3 order depending on the number of plants. The values of capacity and load and entered manually daily and two single dimensional matrices/arrays are formed. These are used to store the plants which have surplus and less loads in the sequence of increasing distance from left to right. If the first surplus plant has sufficient balance to fulfill the remaining balance of first less plant a message indicating that is prompted. In case if the first plant is unable to supply sewage waste as per needs of plant it tests for next plant up to Nth plant to ensure that the demand is met. Below **Figure 5.8, Figure 5.9, Figure 5.10** shows the code and output of the algorithm

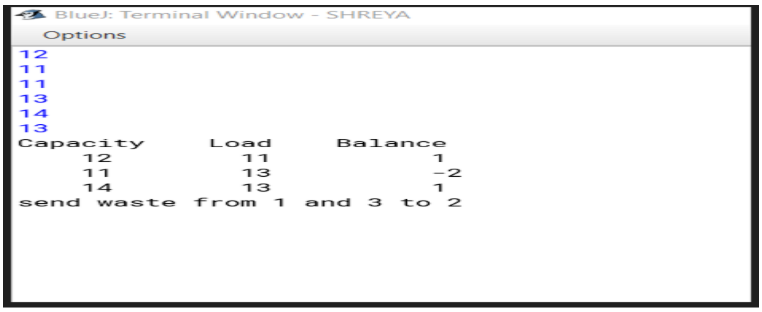

Figure 5.8: OUTPUT of the code

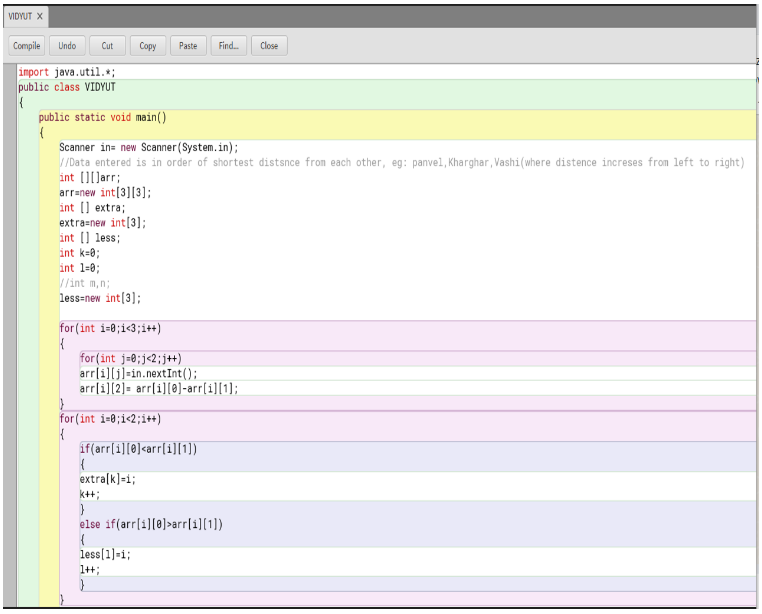

Figure 5.9: First part of the code

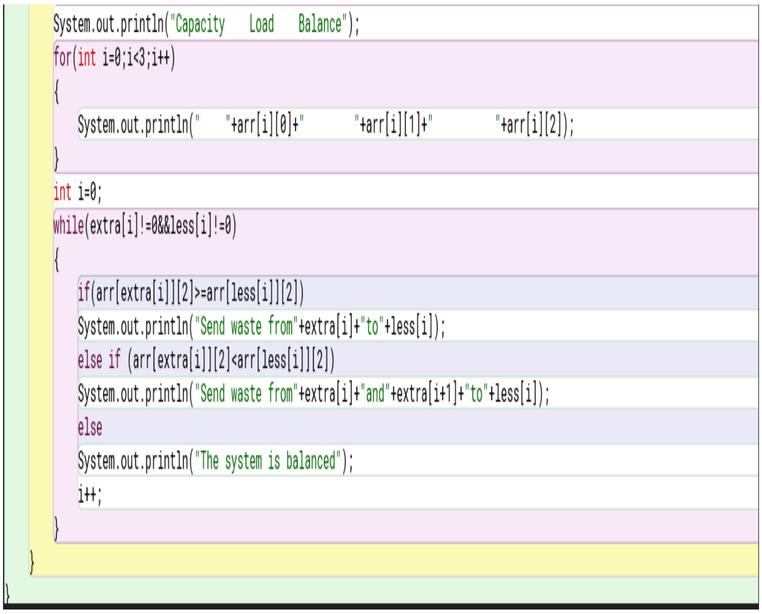

Figure 5.10: Second part of the code

5.2 Cost Analysis

Sr.No.	Components Description	Quantity	Price
1	ATMEGA 328 Microcontroller	2	300
2	MQ4 Gas sensor	1	200
3	LCD Display	1	150
4	Resistor	14	40
5	LED	4	20
6	Buzzer	2	120
7	12C Module	1	90
8	HC12 Wireless Module	1	500
9	Cooker	1	700
10	Generator	1	150
11	Stepper Motor	1	150
12	Water pump Motor driver	1	250
13	DS18B20	1	200
14	Miscellaneous	10	1000
15	Stove	1	500
16	Truck Tube	1	350
17	Total	=	4720

Table 5.1: Cost Estimation Table

Chapter 6

Conclusion

A move toward renewable energy has been prompted by high energy consumption, increased industrialization and automation, as well as environmental damage from the combustion of fossil fuels. A possible renewable energy source that may be utilised in a variety of industries, including transportation, electricity production, heat production, combined heat and power (CHP) systems, and fuel cells, is methane produced from sewage waste. Additionally, improved methane may be used as a transportation fuel in internal combustion engines (ICE) and electricity generation facilities (for electric vehicles). A conceptual analysis of systems for producing electrical power from methane is provided in this project. It is evident that traditional biomass contains significant amounts of contaminants and undesirable components, which reduces the lower heating value (LHV) of biogas. As a result, an evaluation of the effects of biogas plants on the environment is provided. Additionally, the use of biogas energy in combination with other sources, particularly renewable energy sources (such as solar-biogas, geothermal-biogas, wind-biogas, CHP, CCHP, and concentrated photovoltaic-biogas) and the reuse of waste energy for other purposes are investigated. An increase in the use of renewable energy is being pushed by high energy demand, quick industrialization and automation, and environmental damage from burning fossil fuels. A potential renewable energy source, biogas produced from biomass may be utilised in a variety of applications, including fuel cells, combined heat and power (CHP) systems, electricity generation, heat production, and transportation. Additionally, the relationship between the generation of biogas, the purchase of electric power, and the sale of additional biogas is used to measure the economic analysis of systems powered by biogas. As was previously demonstrated, biogas is a significant source of renewable energy. It also aids in waste management and W-to-E (waste to energy) conversion, allowing for the use of large volumes of trash rather than their disposal or landfilling. However, the environment is impacted by how biogas is handled from generation to use. As a result, an evaluation of the environmental effects of biogas facilities is provided.

6.1 Future Scope

This project has possibilities to bring changes in various domains viz.

- As methane has lower calorific value so it can be further treated and converted into ethanol which has comparatively higher calorific value, and this ethanol can be used as fuel.

- Waste water management
- Sewage waste treatment
- Electricity generation
- Sustainability
- Less carbon emission due to coal and so on.

Chapter 7

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